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Regulatory Reform – Case Studies on Green Investments

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EXECUTIVE SUMMARY

Competitive markets help maximize the benefits of resource use across society by providing a mechanism to allocate these resources to the highest value user. However, markets can fail to achieve this outcome due to market failures such as public goods, externalities, or increasing returns to scale. These have provided a rationale for government intervention in markets. The case for regulatory intervention, though, rests on the implicit assumption that government failure does not occur, and that if it does occur, then it does not outweigh the costs of the market failure to be remedied. Excessive or poorly designed regulations can negatively affect innovation, lower economic efficiency, and reduce investments resulting in real costs to the economy.

The potential benefits of best practice regulatory reforms, which include enhanced economic growth, better environmental sustainability, strengthening the rule of law, and other societal goals, can be significant. It is also recognized that achievement of the benefits requires effective supporting institutions including high level political commitment to regulatory reform, effective independent regulators and a mechanism to effectively coordinate activities between different levels of government. Many economies and multilateral organizations such as the Organisation for Economic Co-operation and Development (OECD) and APEC have developed best practice regulatory guides. These guides highlight similar key themes. They typically stress the importance of:

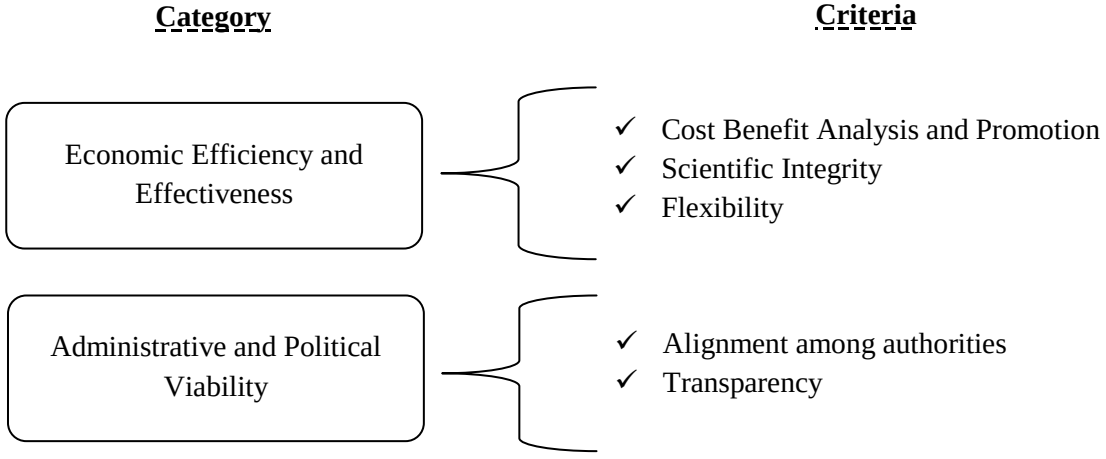
- The need to clearly define the policy problem and the rationale for government intervention.
- Consideration of a range of policy options, including a do-nothing approach.
- Assessing the full range of social costs and benefits of the proposed policy options through a regulatory impact assessment or RIA (i.e. benefit/cost analysis).
- Transparency and public consultation that help governments collect more information and resources, increase compliance and reduce the risk of conflict. These also enhance the quality of rules, strengthen compliance, and reduce enforcement costs for both government and citizens subject to rules.
- Alignment of policies across government agencies and between different levels of government. This will avoid the potential for overlapping and potentially conflicting objectives.
- The need for regulatory review to ensure the on-going efficacy of existing regulations

As part of APEC's efforts to encourage good regulatory practices, this project has developed case studies on the implementation of regulatory policies of selected APEC economies in order to draw lessons on regulatory reform, by analyzing different experiences in formulating and implementing policies to improve energy efficiency (EE) in some sectors and promote certain renewable energy (RE) technologies. The following chart shows which APEC economies and sectors were selected as case studies:

	Energy Efficiency			*Renewable Energy*		
	Case 1	**Case 2**	**Case 3**	**Case 4**	**Case 5**	**Case 6**
	Building (Commercial and Residential)	**Transportation (Public and Private Sector)**	**Household Appliances (including lighting)**	**Conventional Biofuels**	**Geothermal**	**Solar PV**
Australia					✓	✓
Indonesia				✓	✓	
Japan	✓		✓			
Philippines		✓	✓			
Thailand	✓					✓
US		✓		✓		

As can be seen, two case studies were introduced for each selected sector. Since policies and regulatory practices may differ for each APEC economy, these case studies by sector will contribute to the understanding of policies according to each economy's policy direction and economic situation.

The structure of the case studies in this report is similar. They described the size and significance of the sector in the selected APEC economy and identified a series of policies that were implemented by governments to promote investments in the selected sectors and meet policy targets of energy security and environmental sustainability, which are the most common objectives that regulatory reforms seek to accomplish in these sectors. Each case study assessed whether the process to carry out these policies followed certain criteria (good regulatory practices) to facilitate the successful implementation of reforms. These criteria are classified as follows:



Since the focus of this report was to draw lessons on regulatory reform from the case studies, the Executive Summary focuses on the lessons learnt on the implementation of regulatory policies in the selected sectors and APEC economies. These findings may be useful for policymakers, as it highlights what regulatory aspects should be taken into account when formulating and carrying out policies to meet domestic objectives and promote green investments in energy efficiency and renewable energy.

LESSONS LEARNT

Economic Efficiency and Effectiveness

1. There is potential for APEC economies to improve the effectiveness of their renewable energy and energy efficiency policies by drawing on the experiences of each other and following best practices within APEC.

A theme that emerges across the case studies is that many APEC economies could improve policy outcomes by adopting practices already prevailing in other APEC economies. Industrialized economies typically have greater experience in energy efficiency and renewable energy policymaking, and the policies they are currently implementing are often an outcome of a policy evolution process spanning several years. Developing economies can avoid the setbacks and pitfalls inherent in such a process by draw on such experiences and adopting proven best practices.

A good example is provided by the case study on energy efficiency in appliances. Japan adopted the Top Runner program for improving energy efficiency in appliances after trying out energy performance standards for many years. The Top Runner program, by simply taking the existing best performing appliance as the target to be achieved in the next period, simplifies the regulatory process and allows manufacturers flexibility in how they wish to achieve the target. Given that the regulatory process for enacting minimum energy performance standards in the Philippines has suffered from regulatory lags and a lack of flexibility, there is clearly unutilized scope for the Philippines to learn from Japan's experiences in the area.

2. Policy revisions are more frequent in industrialized APEC economies, making the policy process more flexible. The design of individual policies sometimes but not always allows flexibility in achieving policy objectives.

Timely revisions to policies are important in ensuring that policies remain relevant and able to adapt to changing circumstances. In this aspect, industrialized economies in APEC tend to perform better than developing economies, with regular policy revisions more the norm in the former rather than the latter. Both the US and Japan have a history of regularly revising their policies, whereas regulatory lags have been a challenge in economies such as Thailand and the Philippines.

Designing policies so as to enhance the flexibility with which objectives are achieved can play an important role in mitigating the costs of implementing policies and making policies more responsive to changing circumstances. The APEC experience with energy efficiency and renewable energy policies suggests that such flexibility is not always achieved in the regulatory process. This can be illustrated by a comparison of solar PV policies in Australia and Thailand. Australia has increasingly shifted towards technology-neutral policies such as the Renewable Energy Target and carbon pricing, which allow renewable energy and carbon mitigation objectives to be flexibly achieved using the least cost technology option available. Thailand's solar PV polices by contrast are technology-specific and thus not able to shift resources between renewable energy technologies in response to changing market conditions.

3. In general, regulatory policies have been driven by good science in industrialized and developing economies. Nevertheless, policymakers sometimes assign excessive weight on this factor to decide on the formulation of policies.

Scientific integrity is an important factor in designing policies. If regulations are not supported by good science, flaws may appear and make it more difficult to reach the objectives that these regulations are aiming. Many of the case studies show that regulatory policies have been sound from the scientific perspective. For instance, the case studies on energy efficiency in buildings in Japan and Thailand show that the building codes were designed based on scientific analysis, principles and evidence. Similarly, fuel standards in the United States are scientifically sound and have been determined by a process to maximize lifetime economic net benefits from the imposition of standards.

However, in some cases, the existence of technical potential to produce energy from a particular renewable technology or generate energy savings seems to encourage governments to institute wide-ranging policies to promote them, at a great cost to the economy. A clear example is given by the case studies on biofuels. Despite many years of government support to the industry via subsidies, tax credits and grants, among others, it has not been possible to produce an economically-viable biofuel as an alternative to fossil fuels. In addition, the production of biofuels seems not to take into account issues that may contribute to environmental costs such as the emissions caused from the change in land use. The regulatory process could be improved by emphasizing other factors (such as costs and efficiency) together with scientific and technical potential when formulating renewable energy and energy efficiency policies.

4. Cost-Benefit Analysis (CBA) is not the norm in the implementation of policies. Making CBA available to public could be crucial to assist policymakers to remove potential obstacles to reform.

The report found that CBA are not conducted in many occasions and when a CBA is conducted, it is often not accessible to the public. This was corroborated in interviews with some policymakers. Industrialized economies tend to use more cost-benefit tools, such as Regulatory Impact Assessments (RIA), but they do perform little better than developing economies in terms of the utilization of CBA.

The application of CBA for important policy decisions is an important tool that could be used more frequently by governments to allocate scarce resources in the implementation of policies to promote green investments. A well-executed CBA provides a means to reduce instances of regulatory capture by interest groups and raise the transparency of the regulatory process. In the absence of CBA, policies could be implemented at a cost that might not be justified. In addition, CBA can also be carried out *after* policies are implemented as a way to evaluate existing policies and provide directions for future regulatory reform.

A good example on the use of CBA is found in the case study of household appliances in the Philippines. The Government of the Philippines estimated that the cost of implementing the Energy Efficiency Component of the Climate Investment Plan, which promotes the introduction of more energy efficient appliances, was going to be around USD 24 million and the economic benefit of energy savings was going to reach USD 19.8 million per year, which meant that the project was likely to generate net social benefits in less than 2 years.

5. Regulatory policies have been overly focused on energy savings and other policy benefits, rather than cost-based measures.

Ideally, the regulatory process should incorporate both the benefits and the costs of the different policies, and emphasize those that can best achieve policy benefits without incurring too high a cost. Across the APEC economies, there is considerable emphasis on the benefits of policies promoting

energy efficiency and renewable energy. However, the relative costs of alternative policies are often not sufficiently recognized, and in such cases the regulatory process is not sensitive enough to the varying cost-effectiveness of different policies.

The implications for policymaking vary. In some cases, the analysis suggests that the policy benefits can currently only be achieved at a high cost, so that policymakers need to consider whether the policy objective is worth pursuing given the costs involved. For instance, government subsidies for solar PV in Australia and Thailand both achieve carbon emissions mitigation at a very high cost of more than $400 per ton of CO_2 abated. Similarly, the fiscal burden from the support given to biofuels is considerable in both the US and Indonesia.

In other cases, some policies can be identified as being more cost-effective than other policies in achieving similar policy objectives, suggesting that policymakers should promote the set of policies that has been shown to perform better. A good example is provided by fiscal and financial incentive policies in Thailand to promote increased energy efficiency in the buildings sector. A comparison of the financial incentives in place shows that tax incentives generate considerably higher energy saving benefits and leverage a greater amount of private investment, relative to the cost, than the other schemes. This suggests that future policymaking efforts should look at increasing the level of support provided to tax incentives relative to the other financial incentive policies in place.

Administrative and Political Viability

6. Alignment among authorities is more common in industrialized economies. However, both industrialized and developing economies face issues like overlaps in policy design and implementation.

In order to facilitate the implementation of regulatory reforms to promote green investments, alignment among institutions is very important. Reforms are usually comprised by a number of measures that fall under the responsibilities of several institutions. In several occasions, policy implementation did not take place or only occurred at a slow pace due to the lack of proper coordination among authorities. In some cases, the problem arises because there are no institutional mechanisms that support institutional alignment and effective coordination. In other cases, some mechanisms may exist, but different interests among the relevant institutions and no clear leadership accentuate these problems. Cases with better alignment among authorities are those with solid coordination mechanisms (for instance: inter-ministerial committees, such as Japan in the case study on buildings, or councils with mandate to coordinate policies across governments at different levels and institutions, such as Australia in the case study on geothermal energy) or those with a centralized decision-making systems (such as Japan, when deciding on standards and labels for household appliances).

If institutions are not aligned, the cost incurred may be high. This has been the finding for many of the case studies that identified subsidies and other fiscal incentives to encourage the development of renewable energy. For example, the biofuels sector has been receiving support throughout several programs and at several stages of production. Some companies have taken advantage of this situation by tapping into multiple sources of subsidies.

Alignment is not easy and that represents a challenge when governments at many levels are involved (for example, local, state and federal or central governments). In fact, despite the existence of suitable coordination mechanisms, policy overlaps may still happen. For example, the case study of

the solar industry in Australia noted that the Federal Government doubled the rebate available for households for small scale solar PV systems and at the same time, the New South Wales Government introduced a Feed-in-Tariff and offered to buy energy from solar PV systems at a rate that was up to three times the price paid by consumers. This caused a surge in scheme costs and led to the premature cancelation of the rebate program and some Feed-in-Tariff schemes.

7. The effectiveness of the policy architecture depends not just on how individual policies perform, but also on how well they interact with one another. There are benefits to be realized both from coordinating policies that have complementary effects and from avoiding duplication of policies that are close substitutes.

Alignment among policies is critical to the effectiveness of regulatory reforms for green investments. Even well-designed individual policies may not be able to achieve all the potential benefits if the alignment between them is inadequate. The case studies on energy efficiency and renewable energy policies in APEC economies illustrate both examples where policies are well-aligned and examples where there is scope for improving the alignment between different policies.

When policies have complementary effects, there is a case for introducing and implementing them in a coordinated fashion so as to maximize the overall benefits from the set of policies. This is particularly so with standards and labels for appliances and buildings, since labels can provide information on how well manufacturers are complying with standards and thus increase incentives for compliance. Japan's building standards and labels, and the Philippines' appliance standards and labels, provide good examples of coordinated implementation of standards and labels that could be worth replicating in other sectors and economies.

Conversely, when policies are close substitutes of one another, there is a danger of duplication which can increase the costs of implementing the policies without measurably increasing the benefits. An example is the Australian solar PV sector, where the co-existence of carbon pricing and the Renewable Energy Target scheme is likely to increase the cost of achieving Australia's emission reduction target without adding much to the total level of abatement achieved due to the duplication of efforts.

8. Transparency and stakeholder engagement are the norm rather than the exception. Nevertheless, some drawbacks may exist if interest groups are too strong and attempts to conduct reasonable reforms are blocked in the absence of effective leadership of the regulatory process.

In general, laws and regulations are available to public through various means, including online access. Moreover, transparency has also increased at the level of policy formulation. Governments are aware of the need to engage stakeholders in the process to design policies. Meetings with business and consumer associations and other groups are common. Furthermore, some of the case studies show that a formal framework for stakeholder consultations allows interest groups to submit their positions and comment on the draft of proposed regulations.

Stakeholder engagement is very important as it brings legitimacy into any regulatory reform process. Nevertheless, some problems may appear if the objectives of relevant stakeholders differ significantly and/or strong interest groups are opposing the implementation of reasonable reforms. Leadership plays a key role here to establish consensus among the different parties and allow reforms to take place.

In other cases, stakeholders may not be involved in the process, as they may not have the technical capacity and resources to provide inputs in the consultation process. Capacity-building involving the private sector and civil society may be useful to improve the participation of stakeholders in this process.

Some Recommendations for Future Work

The APEC Economic Committee and the Friends of the Chair on Regulatory Reform may consider developing future work on the following matters:

1. To promote the use of Cost-Benefit Analysis and work closely with the APEC Energy Working Group to develop metrics assessing regulatory policies on energy efficiency and renewable energy.

2. To share experiences and discuss the benefits of using ex-post analysis of instituted regulatory policies, in order to get a better understanding of the existing measures/programs and facilitate flexibility by fine-tuning policies and achieve objectives.

3. To strengthen the discussion on formal mechanisms to strengthen stakeholder consultations.

4. To discuss how to foster scientific integrity in developing and implementing regulations.

5. To consider how to enhance harmonization among authorities.

6. To discuss methodologies for ex-ante Regulatory Impact Assessments.

1. Introduction

Rationale for Government Intervention and the Need for Regulatory Reform

Competitive markets help maximize the benefits of resource use across society by providing a mechanism to allocate these resources to the highest value user. But markets can fail to achieve this outcome due to market failures such as public goods, externalities or increasing returns to scale. These have provided a rationale for government intervention in markets. Regulations attempt to alter the allocation of resources that might otherwise not have occurred, to achieve declared welfare objectives.[1] The use of regulations as an instrument of achieving economic and social policy objectives has increased dramatically since the 1940s making regulations ubiquitous.[2]

However, regulatory regimes, if poorly designed, may also be costly. It may negatively affect innovation;[3] it may inadvertently affect market entry, exit, or operation;[4] and can rapidly become obsolete due to the evolution of economic circumstances. Perhaps most fundamentally, the support for regulatory intervention rests on the implicit assumption that government failure does not occur, and that if it does occur, then it does not outweigh the costs of the market failure to be remedied, an assumption that has lost credibility in the past few decades.[5] Stigler[6] in particular brought early attention to the possibility that regulations might not be driven by the need to enhance economic efficiency but rather to meet narrower ends of special interest groups and "captured" regulatory agencies.

The cost of government intervention in markets became more evident after the downturn of the 1970s and led some economies to start rethinking the role of regulation in the market place. This initially focused on eliminating unnecessary regulation or "red tape" (deregulation). The emphasis now has gradually shifted to regulatory reform. Best practice approaches to regulation then evolved into a more systematic approach to regulatory policy. They moved away from one-off reform efforts toward an on-going process of regulatory assessment and review, including through benefit/cost analysis and stakeholder engagement.

Regulatory reform has long been part of APEC's agenda given its mandate to facilitate trade and promote efficient economies. With the decline in tariffs in the APEC region, the emphasis shifted to eliminating the structural and regulatory barriers that constrain cross-border trade and investments. APEC is working toward eliminating these barriers by promoting structural reform, which improves

[1]The Organisation for Economic Co-operation and Development (OECD) (2010) defines a regulation as 'any instrument by which governments, their subsidiary bodies, and supranational bodies (such as the EU or the WTO) set requirements on citizens and businesses that have legal force. The term may thus encompass a wide range of instruments: from primary laws and secondary regulations to implement primary laws, subordinate rules, administrative formalities and decisions that give effect to higher-level regulations (for example, the allocation of permits), and standards.

[2] Jacobs, S., P. Ladegaard (2008). "Regulatory Governance in Developing Economies," Better Regulation for Growth (BRG) Program, Investment Climate Advisory Services, World Bank Group.

[3] Organisation of Economic Cooperation and Development (OECD) (1997), "The OECD Report on Regulatory Reform: Synthesis," OECD, Paris.

[4] APEC (2009), "APEC Economic Policy Report 2009," APEC Economic Committee.

[5] Shleifer, A. (2010), "Efficient Regulation," Working Paper 15651, NBER Working Paper Series.

[6] Stigler. G. J. (1971), "The Theory of Economic Regulation," Bell Journal of Economics and Management Science, 2(1): 3-21.

the quality of institutions, regulations, and governance to support well-functioning markets and reduce the cost of doing business. In 2004, APEC Leaders signaled their commitment to structural reform in APEC when they endorsed an ambitious work program called the Leaders' Agenda to Implement Structural Reform (LAISR). Under this program regulatory reform is one of the five areas for structural reform.[7]

The APEC Economic Committee has been championing the cause for regulatory reform across APEC economies. Regulatory reform, as well as regulatory convergence and cooperation are issues expected to continue being part of the APEC agenda for subsequent years.[8] Efforts in regulatory reform will have a direct incidence in the implementation of initiatives such as the APEC Growth Strategy and the APEC New Strategy on Structural Reform.

The Regulatory Reform – Case Studies on Green Investments paper will develop case studies on the regulatory policies of three APEC-Industrialized (Australia, Japan, and the United States (US)) and three APEC-developing economies (Indonesia, Philippines, and Thailand) with regard to their experiences in formulating and implementing policies to promote certain Renewable Energy (RE) technologies (biofuels, geothermal, solar photovoltaics (PVs)) and improve Energy Efficiency (EE) in some sectors (buildings, household appliances, transportation). Essentially, the overarching theme of the analysis will be to bring to the fore lessons in regulatory policy that can inform the evolution of regulatory practices in other economies.

Assessment Criteria for the Case Studies

The potential benefits of best practice regulatory reforms, which include enhanced economic growth, better environmental sustainability, strengthening the rule of law, and other societal goals, can be significant. It is also recognized that achievement of the benefits requires effective supporting institutions including high level political commitment to regulatory reform, effective independent regulators and a mechanism to effectively coordinate activities between different levels of government.[9] Many economies and multilateral organizations such as the Organisation for Economic Co-operation and Development (OECD) and APEC have developed best practice regulatory guides.[10] These guides highlight similar key themes. They typically stress the importance of:

- The need to clearly define the policy problem and the rationale for government intervention.
- Consideration of a range of policy options, including a do-nothing approach.
- Assessing the full range of social costs and benefits of the proposed policy options through a regulatory impact assessment or RIA (i.e. benefit/cost analysis).

[7] In addition to regulatory reform, competition policy, public sector governance, corporate governance, and strengthening economic and legal infrastructure are areas for structural reform.

[8] APEC (2011), "2011 APEC Ministerial Meeting," Ministerial Statements, Honolulu, Hawaii.

[9] This discussion is based on Meloni (2010) and OECD (2011).

[10] A list of regulatory guides include, from APEC, Good Practice Guide to Regulatory Reform, APEC Economic Policy Report 2009, APEC Economic Policy Report, APEC-OECD Integrated Checklist on Regulatory Reform, The Impacts and Benefits of Structural Reforms in Transport, Energy and Telecommunications Sectors. From OECD, The OECD Report on Regulatory Reform: Synthesis, Draft OECD Recommendation on Regulatory Policy and Governance and World Energy Council, *Energy Efficiency Policies around the World: Review and Evaluation*.

- Transparency and public consultation that help governments collect more information and resources, increase compliance and reduce the risk of conflict.[11] These also enhance the quality of rules, strengthen compliance, and reduce enforcement costs for both government and citizens subject to rules.

- Alignment of policies across government agencies and between different levels of government. This will avoid the potential for overlapping and potentially conflicting objectives.

- The need for regulatory review to ensure the on-going efficacy of existing regulations.

This paper will assess the range of policies adopted by selected APEC economies to promote EE and RE investments (see Table 1.1) to support three broad policy targets: energy efficiency, energy security, and environmental sustainability. The assessment is based on key criteria that determine two fundamental attributes necessary for any successful regulatory intervention: (1) economic efficiency and effectiveness and (2) administrative and political viability. The basic test of economic efficiency is *cost-benefit analysis* which is also the basis of conducting regulatory impact assessments. The criterion of *promotion* (which seeks to ascertain the extent to which a policy has helped increase the uptake of energy efficiency and renewable energy technologies) is subsumed under the criterion of cost-benefit analysis as the uptake will have its cost and benefits that would need to be accounted for. *Scientific integrity* is of course requisite to any attempt at fairly measuring costs and benefits. This criterion will assess if government policies are based on good science. The *flexibility* of administrative regimes to change with altered circumstances or to reform is often critical for continued efficacy of the regime. This criterion will assess if regulatory instruments are flexible enough to automatically respond to the changing environment that stakeholders face or if processes are in place to let governments make adjustments as necessary.

The administrative and political viability of government support programs depends critically on two criteria: *transparency* and *alignment*. The *transparency* criterion measures the extent to which governments have provided an opportunity for stakeholders such as manufacturers, energy suppliers, non-profit organizations and citizens to provide input prior to enacting of regulations. This criterion also assesses if policy details can be easily accessed by the public. Most importantly, transparency makes government failure outcomes less likely, as special interests cannot openly capture regulatory agencies and bias regulatory outcomes. Any government initiative to support and promote investments will require *alignment*. This requires an assessment of whether governments have taken steps to harmonize, simplify and coordinate policies across departments and agencies and between different levels of government.

[11] OECD (2011), "Draft OECD Recommendation on Regulatory Policy and Governance," OECD, Paris.

Table 1.1 ***Case studies to be undertaken***

	Renewable Energy			***Energy Efficiency***		
	Conventional Biofuels	**Geothermal**	**Solar PV**	**Buildings (Commercial and Residential)**	**Transportation (Public and Private Sector)**	**Household Appliances (including lighting)**
APEC-Industrialized Economies						
Australia		×	×			
Japan				×		×
US	×				×	
APEC-Developing Economies						
Indonesia	×	×				
Philippines					×	×
Thailand			×	×		

2. Energy Efficiency Case Studies

Energy efficiency has long been held by its proponents as a "win-win" opportunity to help an economy save money and reduce the negative externalities associated with energy use.[12] The fact that "cheap" options to improve energy efficiency were not being adopted on a large scale led to the notion that there exist market barriers to the uptake of energy-efficient technologies. Whilst such barriers might exist, not all require a policy response. The guiding principle to policy interventions is that these must improve societal welfare. Given this perspective, energy efficiency should not be considered as a goal in itself, but as a means of achieving economically efficient and equitable resource allocation.[13]

APEC governments have invested considerable efforts in the promotion of energy efficiency. The six case studies covered in this section draw from the experiences of four APEC economies (Japan, the Philippines, Thailand, and the US) in enacting energy efficiency policies in three different sectors: buildings, transportation, and appliances (including lighting). For each sector, we analyze, evaluate and compare the policies developed in one industrialized economy and one developing economy. These policies typically include standards and labels together with a range of fiscal and financial incentives. In many of these cases, energy efficiency policies have led or are purported to lead to significant energy saving benefits. However, because there is sparse information available on the costs of complying with the policy, and cost-benefit analysis usually does not play a prominent role in the policy formulation process, it is typically difficult to assess whether these energy efficiency policies have actually led to net social benefits or maximized social welfare.

Standards have formed the centerpiece of energy efficiency policies in most of the APEC economies analyzed, the one exception being the transportation sector in the Philippines for which there are no fuel economy standards as yet. By mandating improvements in energy efficiency, standards can result in significant energy savings: in recent years, for example, energy savings from appliance standards in the Philippines have amounted to a considerable share of its overall energy conservation target. However, the costs of achieving these energy savings need to be considered in order to evaluate whether the energy reductions are economically justifiable. While standards also risk being inflexible, in several cases policymakers have tried to introduce provisions that allow the standards to be met in a flexible manner. Thailand's building energy code, for instance, specifies standards for different components of the buildings, but allows individual buildings the option not to comply with one or more of the individual standards as long as the building as a whole complies. Such provisions enhance the cost-effectiveness of standards and should be given due consideration in APEC economies in which they have not been included.

Regular updates and revisions to policies are helpful in ensuring that policies are up-to-date and therefore effective. However, this has often not been the case in the APEC economies analyzed, with the government taking a particularly long time to revise energy efficiency policies in Thailand and the Philippines. At the same time, the formulation process for energy efficiency policies typically allows stakeholder views to be reflected. Since consulting stakeholders and adjusting policies to reflect their views is time-consuming, there is an implicit tradeoff here between strong stakeholder engagement and rapid revisions to policies that should be recognized by policymakers.

[12] Allcott, H., M. Greenstone (2012), "Is there an energy efficiency gap?" E^3 Working Paper No. 032, Center for Energy and Environmental Economics, University of California, Berkeley.

[13] Jaffe, A., R. Newell, R. Stavins (2004), "The economics of energy efficiency," Encyclopedia of Energy, ed. C. Cleveland, pp. 79–90. Amsterdam: Elsevier.

The energy efficiency case studies are organized as follows. We first look at the buildings sector, analyzing building energy efficiency policies in Japan and Thailand. Transportation fuel economy policies in the US and the Philippines are considered next. We then discuss appliance energy efficiency policies in Japan and the Philippines.

2.1 Buildings

A variety of factors have driven global efforts to improve energy efficiency in buildings. Firstly, energy efficiency investments in buildings are typically cost-effective over their lifetime and have short payback periods. Secondly, given that buildings account for 30% of the world's total energy consumption (Hong et al., 2007), there is a perception that economies that are net fuel importers can improve their energy security by reducing their consumption of energy from the buildings sector. Finally, some of the most cost-effective greenhouse gas abatement options, according to McKinsey's Global GHG Abatement Cost Curve (version 2.1), involve direct energy efficiency improvements in buildings. Enhancing building energy efficiency in new buildings and retrofitting residential heating, ventilation and cooling (HVAC) systems as well as residential insulation can together account for roughly 1.7 $GtCO_2e$ of global abatement potential every year until 2030 (McKinsey & Company, 2010).

Despite the cost-effective nature of energy efficiency improvements in buildings, their uptake has been slow. As the Asia Pacific Energy Research Center (APERC) (2003) points out, energy expenditures often constitute a small proportion of overall expenditures for most households and many small businesses (and are thus of low salience during decision-making), while energy efficiency measures also entail a certain degree of inconvenience as they can disrupt household and commercial activities. As a consequence, short payback periods may not be enough to incentivize energy efficiency improvements in buildings. Given issues such as low salience and risk of disruption, regulations have been used in several economies to drive building energy efficiency.

The most significant among such regulations are building energy codes i.e. energy efficiency requirements in building codes that dictate how new buildings are constructed. While primarily targeted at new buildings, where it is much less costly to integrate energy efficiency improvements, building energy codes can also serve as the efficiency target for refurbishments or other improvements of existing buildings (International Energy Agency, 2008a). By 2003, most APEC economies had already implemented building energy codes, although there were significant differences in coverage (residential vs. commercial buildings) and compliance mechanism (voluntary vs. mandatory codes) (Asia Pacific Energy Research Center, 2003). In addition, a range of other policies have been used to promote energy efficiency improvements in buildings, including building energy performance labeling, financial incentives, energy management and audits, lead-by-example programs (such as government modeling and demonstration projects), information and awareness programs, and research and development (R&D) programs (Asia Pacific Energy Research Center, 2003; Hong et al., 2007).

This section analyzes various regulations aimed at improving energy efficiency in buildings, focusing on the two cases of Japan and Thailand. The chosen case studies provide an ideal platform to study issues relating to regulatory practices in building energy codes (given that there are significant differences in how the two economies have chosen to implement codes) as well as the other types of regulations, most of which have been implemented in at least one of the two economies. For both APEC economies, we describe and evaluate policies enacted in order to boost energy efficiency in buildings. Where appropriate, we also compare how the policies in the respective economies have fared against one another.

2.1.1 Energy Efficiency in Buildings in Japan

Key findings

- Improving energy efficiency in buildings, which account for nearly one-third of Japan's total energy use, will be required if Japan is to achieve its targets of reducing oil dependence, reducing greenhouse gas emissions, and increasing energy efficiency.
- Building energy efficiency policies in Japan consist of an assortment of building energy codes, labeling programs, and a range of financial and fiscal incentives.
- Japan's building energy efficiency policies are comprehensive in their design, flexible and well-aligned, though the extent to which they have cost-effectively met Japan's energy efficiency objectives remains unclear.

Costs, benefits and promotion

- One area that requires attention in Japan is that the design of building energy codes does not take into account the lifetime economic benefits and costs. It is unclear if the design of building energy codes is maximizing societal benefits while minimizing costs.
- Residential and commercial buildings that comply with the building energy codes have reduced their energy consumption by 40% and 75% respectively. However, aggregate energy savings from the codes are constrained by the fact that they are not mandatory either for buildings with a floor area of less than 300 m^2 or for existing buildings of any floor area that have not recently undergone renovation or construction.
- The Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) improves upon earlier labeling programs by providing a clear assessment of a building's energy efficiency performance, but its usage has been limited by the time-consuming nature of the evaluation.
- Financial incentives for energy efficiency improvements in buildings have contributed to the growth of the market for Energy Service Companies (ESCOs) in Japan.

Scientific integrity

- Japan's policies are typically comprehensive in their design and based on scientific analyses and evidence.

Flexibility

- Japan regularly revises its building energy efficiency policies so as to respond to changing circumstances.
- Individual policies adopted by Japan, including the building energy codes, the CASBEE labeling program, and financial and fiscal incentives, allow stakeholders the flexibility to achieve the policy target.

Transparency

- In general, information on various policies is readily available to the public.
- There is some degree of stakeholder engagement in the design of building energy codes. The level of stakeholder engagement in the design of the labeling program CASBEE is good.

Alignment

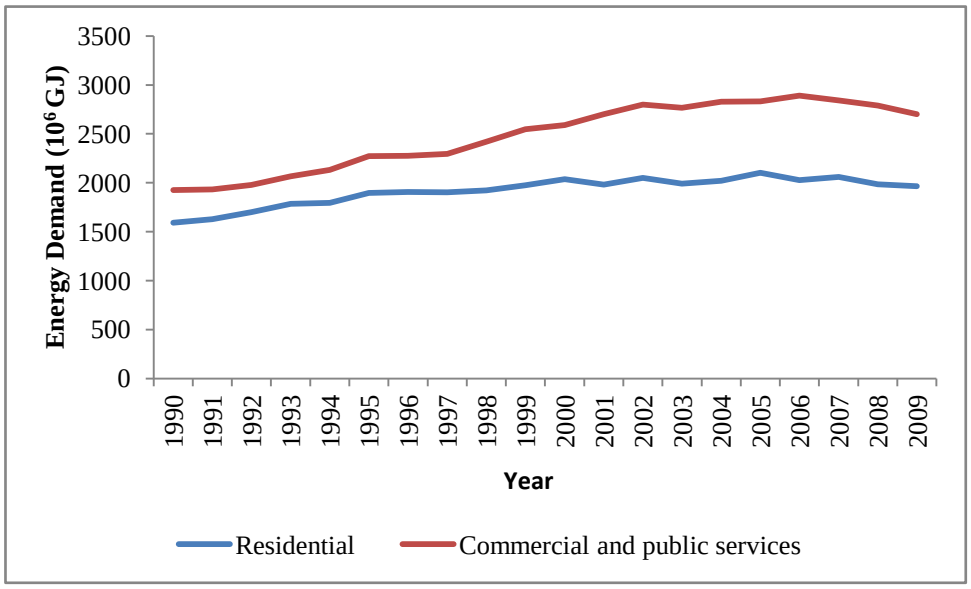
- Japan has taken measures to improve coordination and alignment among authorities, for instance by consolidating several ministries into a single Ministry of Land, Infrastructure and Transport (MLIT) and by relying on an inter-ministerial committee to carry out energy conservation policy changes.
- The different policies are generally well-aligned with one another, with financial incentives typically designed so as to complement building energy codes and labeling schemes.

A. Size and Significance

In 2006, Japan had 12.6 million non-residential buildings, with a total floor space of 0.68 billion square meters, and 32.1 million residential buildings, with a total floor space of 3.4 billion square meters. Single-detached houses account for 85% of the floor space of residential buildings and thus form the major component of Japan's building stock (Evans et al., 2009).

Buildings account for a significant proportion of Japan's energy use. Estimates range from 27.5% (according to estimates for 2004 from the Institute for Energy Economics, Japan (IEEJ)) (Hong et al., 2007) to 33% (according to IEA estimates for the year 2005) (Evans et al., 2009). Moreover, between 1990 and 2005, energy use in the building sector in Japan increased rapidly at a rate of 1.6% annually, in contrast to the industrial (-0.5%) and the transport (0.2%) sectors (Evans et al., 2009). As Figure 2.1.1 shows, energy consumption in both the residential sector and the commercial and public services sector grew swiftly between 1990 and 2005, before declining slightly in more recent years.

Figure 2.1.1 ***Energy consumption in Japan's residential and commercial & public services sectors (1990-2009)***



Source: International Energy Agency, 2011

B. Policy Formulation

(i) History and Background

Improving energy efficiency (EE) forms one of the cornerstones of Japan's energy policy. Japan's Energy Conservation Law, first issued in 1979 and periodically updated (the latest being in 2008), is the foundation of Japan's energy efficiency policy. Energy efficiency policies have been pursued by Japan both to reduce its dependence on energy imports (which account for over 80% of its primary energy) and to reduce its greenhouse gas emissions (GHGs) (Hong et al., 2007). In 2006, the "New National Energy Strategy" was launched, which included energy efficiency and conservation policies to meet a target of 30% energy efficiency improvement (relative to existing levels when the strategy was announced in May 2006) and to reduce oil dependence to below 40% by 2030. On the environmental front, in 2009 the government announced its goal of reducing GHG emissions by 25% by 2020 compared to 1990 levels, while under the revised Basic Energy Plan (June 2010), it has set a target of reducing CO_2 emissions by 30% or more by 2030 compared to 1990 levels (Ministry of Economy, Trade and Industry, Japan, 2010). Environmental objectives provide an additional motivation for pursuing energy conservation policies.

Given that buildings account for a significant and growing proportion of Japan's energy use, the achievement of the aforementioned energy efficiency targets will not be possible unless building energy use reductions are realized. Under the Basic Energy Plan, Japan has adopted targets of a 37% reduction in CO_2 emissions from the commercial sector and a 34% reduction in CO_2 emissions from the residential sector by 2030 (relative to 1990 levels), which will constrain the energy consumption of its commercial and residential buildings respectively (Ministry of Economy, Trade and Industry, Japan, 2010). In addition, the Ministry of Economy, Trade and Industry (METI) has set a variety of targets, for both residential and commercial buildings, aimed at directly reducing energy consumption.

In the commercial sector, the overall consumption of energy increased by about 50% between 1990 and 2008, driven by increases in floor area and a 10% increase in the per floor area energy

intensity. METI has targeted a 3% reduction in the overall energy consumption of the commercial sector by 2020 and a 7% reduction by 2030. The METI also plans to decrease energy intensity in the commercial sector by 10% or more by 2020, and by 15% or more by 2030. At the same time, the METI plans to slow down overall increases in floor area (Ministry of Economy, Trade and Industry, Japan, 2008).

In the residential sector, per household consumption increased by approximately 8% from 1990 to 2008, while the average per-capita energy consumption increased by 30% in the same period. The METI aims to reverse this trend, targeting a 7% reduction in per household consumption by 2020 and a 13% reduction by 2030. The METI has also targeted a 6% reduction in per capita consumption by 2020 and a 14% reduction by 2030 (Ministry of Economy, Trade and Industry, Japan, 2008).

The revised Basic Energy Plan adopted in 2010 sets further energy efficiency targets for the buildings sector. The Plan targets increasing the availability of net zero energy houses by 2020 and realizing net zero energy buildings (both residential and commercial) on average by 2030. Targets for the residential sector also include having high efficiency water heaters in 80–90% of all households by 2030. A further target is to make all lights energy-efficient on a flow basis by 2020 and on a stock basis by 2030. The Ministry of Economy, Trade and Industry (METI) plans to promote measures such as high efficiency hot water supply devices, highly efficient illumination and energy conservation in information technology equipment in order to achieve these targets (Ministry of Economy, Trade and Industry, Japan, 2010).

A distinctive feature of Japan's building sector is the low life span of Japanese homes, only 26 years compared to 44 years in the US and 75 years in the UK (Sunikka-Blank et al., 2011). The low life-span can be attributed to the tradition of wooden houses and the threat of earthquakes and fires. This has negative implications for energy efficiency in buildings – frequent scrapping and construction add to the sector's energy use while the incentive for maintenance is lower (Smith, 2008). It also means a lower incentive to invest in energy efficiency during construction (Evans et al., 2009). Japan's Basic Program for Housing, issued in 2006, aims to address the low life-span by targeting an increase in the life span to 40 years, and in addition aims for 40% of housing to have energy saving measures (Evans et al., 2009).

(ii) Policy Description

MANDATES

Building Energy Codes

Japan's Energy Conservation Law specifies its building standards and codes, which are jointly administered by the Ministry of Economy, Trade and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MILT). Separate energy codes, most recently updated in 1999, specify minimum requirements for the energy performance of commercial buildings and residential buildings or houses, and are adjusted based on the climate zone in which the building is located. The code for commercial buildings, Criteria for Clients on the Rationalization of Energy Use for Buildings (CCRUEB), is a mixture of performance-based and prescriptive energy codes. For houses, the Criteria for Clients on the Rationalization of Energy Use for Houses (CCRUEH) is a mixture of performance-based and prescriptive energy codes with a focus on heating, ventilation, and air-conditioning (HVAC). Houses are also covered by the prescriptive Design and Construction Guidelines on the

Rationalization of Energy Use for Houses, which covers insulation, HVAC, and water heating (Evans et al., 2009).

These building standards, while defined as voluntary, have a number of aspects that are enforceable depending on the floor space of a building. In particular, a specified number of buildings are required to submit a mandatory report on energy conservation measures prior to new construction, extension, alteration, or renovation. Over time, the number of buildings required to submit these reports has increased, as Japan has tried to increase levels of compliance with the standards. Starting from 2003, commercial buildings with a floor space that exceeds 2000 m^2 were required to submit energy conservation measures, and the requirement was extended to residential buildings with a floor space that exceeds 2000 m^2 in 2006 (Hong et al., 2007). After revisions to the Energy Conservation Law that were implemented in 2009, owners of both residential and commercial buildings with an area greater than 300 m^2 are required to submit energy saving plans before construction or renovation (Evans et al., 2009). If the energy use of these buildings is then found to be excessive, improvements are suggested, with 'name-and-shame' penalties as well as a possible sanction of up to US$ 11,000 imposed in case of non-compliance (Sunikka-Blank et al., 2011). In addition, after the 2009 revision, construction companies building more than 150 houses per year are required to improve the energy performance of their buildings (Evans et al., 2009).

Performance standards for housing have a long history in Japan. They were first established in 1980. Table 2.1.1 below shows the evolution of the standards over the years.

Table 2.1.1 ***Changes to building standards since 1980***

Policy	Year	Remarks
Act Concerning the Rational Use of Energy	1980	Establishment of performance standards for housing
Revision to Building Standards	1992	Strengthening of 1980 standards to levels comparable with those of the cold regions of Europe and North America
Revision of Long-Term Energy Policy	2001	Changes include imposing the regulations on buildings smaller than 2000 m^2 and enhancement of the measures for buildings larger than 2000 m^2. There was stricter application of building standards for insulation. Improvements in both evaluation and labeling of energy efficiency were made to facilitate understanding by consumers (International Energy Agency, 2010)[14].
Partial Revision of Building Standards	2003	Owners of specified buildings were required to notify the government of energy saving measures such as measures to prevent heat loss from external walls and windows and measures for effective energy usage of air conditioners and other specified equipment.
Revision of the Energy Conservation Law	2005	Energy conservation measures for the residential and construction sector were strengthened.
Revision of the Energy Conservation Law	2008	Owners of small to medium sized residences and buildings above a certain size to report on energy saving method.

Source: Compiled by the authors from various sources

[14] International Energy Agency (2010), "Comprehensive Review of Japanese Energy Policy," IEA Energy Efficiency Policies and Measures Database. http://www.iea.org/textbase/pm/?mode=cc&id=675&action=detail.

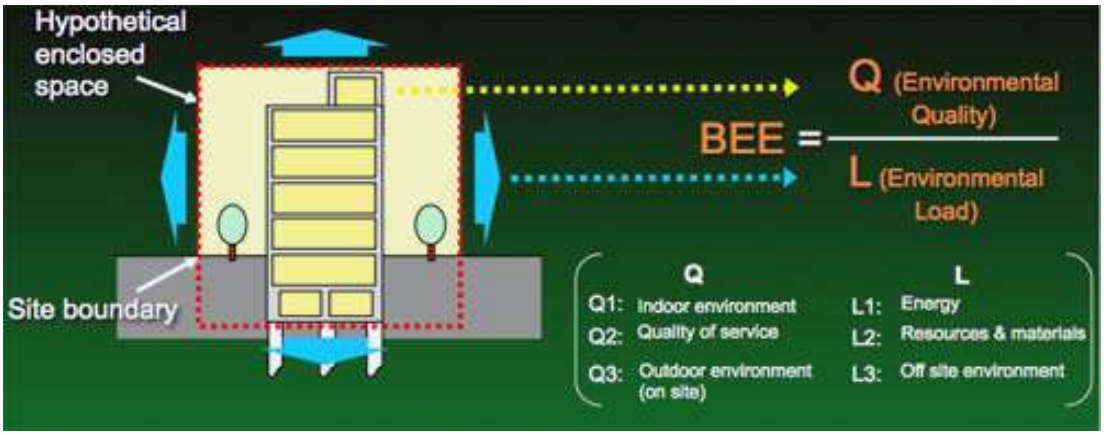
INFORMATION PROGRAMS

Building Labeling

Japan has instituted several rating and labeling programs over the years. These programs help evaluate a building's energy efficiency and sustainability and provide homeowners and buyers with this information. This can cut across incentive mismatches between owners and tenants that might otherwise impede energy efficiency improvements: with energy efficiency information easily available to tenants, owners have a bigger incentive to carry out such improvements in the first place (Evans et al., 2009).

The major labeling program in use in Japan is the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), developed by the Japan Sustainable Building Consortium in 2002 in conjunction with several other Japanese government agencies including the Ministry of Land, Infrastructure, and Transportation (MLIT) (Vare, 2010). CASBEE is an assessment tool that evaluates the Building Environmental Efficiency (BEE) based on both the environmental load of the building (including energy and materials used as well as impact on outside environment) and the environmental quality delivered by the building (including both the indoor and outdoor environments and service quality). A building with a high environmental quality and low environmental load is assigned a higher BEE score, as illustrated in Figure 2.1.2. The scores, or ratios, are labeled as Excellent (S), Very Good (A), Good (B+), Fairly Poor (B-), and Poor (C), in order of decreasing BEE value (Vare, 2010). The use of CASBEE is voluntary, but many local governments have provided incentives for buildings with a high rating on CASBEE, which include subsidies, access to lower interest mortgages, and permission to increase floor-area ratio (Sunikka-Blank et al., 2011).

Figure 2.1.2 ***Description of building energy efficiency (BEE) equation***



Source: Vare, 2010

The historical evolution of labeling programs in Japan provides some perspective on why the CASBEE framework has been adopted. The oldest version of environmental assessment of buildings in Japan involved assessing the performance of building environments, with the aim of improving living amenities or enhancing the level of convenience for residents. The concept of environmental loading was not initiated and incorporated into building environmental assessments until the 1960s, when there was growing concern over air pollution problems, the effects of wind on pedestrians, and other environmental effects. A number of specific methods, such as the GB Tool, were proposed

amidst increased awareness regarding global environmental problems in the 1990's. These assessment methods consider Life Cycle Assessment (LCA), evaluating the lifetime environmental load of a building as well as (in some assessments) the building performance.

However, none of the above assessment tools clearly distinguish between these two basic assessment objects, the building performance and the environmental load of a building, which is what motivated the development of CASBEE (Japan Sustainable Building Consortium, 2005). In contrast to earlier assessment tools, CASBEE clearly defines and distinguishes between the building performance or environmental quality, and the environmental load, as is evident in Figure 2.1.2.

Other labeling programs include the voluntary "Environment and Energy Friendly Building Mark" system initiated in March 1999 for structures other than houses. Operated by the Institute for Building Environment and Energy Conservation (IBEC), it indicates the energy conservation performance level of a building above a certain minimum standard as specified by the building energy codes.[15] Buildings can also be evaluated based on the amount of energy savings achieved due to the implementation of energy saving measures (Institute for Building Environment and Energy Conservation, 1999).[16] In addition, the Housing Quality Assurance Law (2000) includes a voluntary housing performance labeling system designed to protect consumers. While it broadly covers housing performance, it includes a rating for the thermal environment that is based on the building energy codes discussed earlier and is used to assess the building's energy conservation performance, as well as comparisons with other buildings (Evans et al., 2009).

The Environmentally Symbiotic Housing and Urban District Guidelines, issued in 1993, defines "model" housing complexes as those with "low impact" (energy-efficient and low use of natural resources), "high contact" (harmony with surrounding environment), and "health" (a healthy environment with amenities) (Evans et al., 2009). Finally, at the municipal level, the Tokyo Metropolitan Government has implemented a Green Building Labeling program, which ranks buildings according to four key areas: rationalization of energy use, appropriate use of resources, conservation of the natural environment, and abatement of the urban heat island effect (Vare, 2010).

Public Campaign and Awareness Programs

Like labeling programs, public campaign and awareness programs are also aimed at providing information in order to overcome informational and behavioral barriers to building energy efficiency improvements.

In July 2006, an inter-ministry committee coined the concept of "Lo-House," intended to demonstrate options for sustainable housing by measures such as establishing the necessary infrastructure to allow for information sharing and provision on energy-saving housing (Ministry of

[15] The standard is used to evaluate the building's energy performance level, which can be Level 1 (between 5% and 20% more efficient than the energy saving standard) or Level 2 (over 20% more efficient than the energy saving standard).

[16] Level 1 is given to energy saving effects of approximately 5–15% after the energy saving measures while Level 2 is awarded to energy saving effects of more than 15% after the energy saving measures are implemented. Virtual comparisons can be carried out if the energy consumption of the building prior to the implementation of energy saving measures cannot be found.

Land, Infrastructure, and Transportation, 2006).[17] In a November 2007 meeting, the "Inter-Ministerial Liaison Committee for the Promotion of Energy and Resource Conservation Measures" decided to implement "energy conservation contests" for households and draft an operating procedure on energy conservation for the commercial sector (Ministry of Economy, Trade and Industry, Japan, 2007). The government tries to raise public awareness on energy conservation through publicity drives such as the "Energy Conservation Day," campaigns such as the "Energy conservation campaign in summer and winter" (Asia Energy Efficiency and Conservation Collaboration Center, 2010) and various awarding programs on energy conservation, including the "Awarding of Excellent Energy Conservation Factory and Building."

Demonstration programs and projects have also been utilized in Japan. One such program, designed to encourage greater acceptance of fluctuations in comfort level, is the "Cool Biz" program. It is a voluntary demonstration campaign that encourages the setting of air-conditioning to 28 degrees Celsius in the summer. In addition, a number of demonstration projects have been set up to provide examples and models for green buildings. A notable example is Kobunaki Ecovillage in Omihachiman City, where each house fulfills standards for insulation in walls and has features such as natural ventilation, sun shading, and high efficiency appliances (Sunikka-Blank et al., 2011). The government has also implemented environmentally friendly practices in government facilities with the "Government Buildings Green Program" (Ministry of Land, Infrastructure, and Transportation, 2006).

FINANCIAL AND FISCAL INCENTIVES

The Japanese government supports the diffusion of energy efficient buildings by providing financial incentives such as low interest loans and fiscal incentives such as subsidies and tax reductions. Such incentives are used to counter both the negative externalities of high energy consumption as well as capital market barriers to energy efficiency investments. In Japan, moreover, energy efficiency investments are constrained by factors such as the short life spans of buildings, high land prices, and the fact that most of the housing is owned by private owners with little capital to invest, necessitating the use of fiscal and financial incentives to drive such investments (Sunnika-Blank et al., 2011). While these incentives can be designed as stand-alone mechanisms, in Japan fiscal and financial incentives have often been linked with building energy codes or labeling programs, with access to funding prioritized for buildings that comply with the codes or have a high rating under the labeling programs.

Low Interest Loans

The Japan Finance Corporation provides low interest loans of up to 720 million yen (approximately US$ 7.2 million) to support energy efficiency improvements in both existing and new commercial buildings (Asia Energy Efficiency and Conservation Collaboration Center, 2010). There is a low interest loan program to support energy conservation renovation of existing buildings. The loan can be made to building owners to engage Energy Service Companies (ESCOs) to carry out energy efficiency improvement services, or can be made directly to ESCOs themselves. Low interest loans are also available for designing environmentally-friendly new buildings and are provided for

[17] "Lo-House," drawn from the concept of Lifestyles of Health and Sustainability (LOHAS), is intended to be promoted as a concept and image to demonstrate the options for sustainable housing. This will be done by establishing the necessary infrastructure to allow for information sharing and provision on energy-saving housing, developing new methods for evaluation of energy conservation performance in housing, and providing incentives to promote and popularize energy-efficient housing.

specific measures taken in the planning phase, such as energy conservation measures and roof-top greening projects. In 2008, the program was revised to apply only to small and medium-sized enterprises.

Low interest loans are also available for buildings that comply with the building standards (and thus are already energy-efficient). The Japan Housing Finance Agency (JHFA) allows for lower interest rates and preferential loans to be provided for energy efficient residential buildings. In the past (starting from 1996), an extra loan could be provided for houses meeting energy conservation standards, among other requirements such as earthquake resistance performance. Houses had to meet at least the 1980 thermal insulation standard, with an extra loan of US$ 8,550 provided for those meeting the 1992 standards and a further loan of US$ 2,137 provided for houses meeting the 1999 standards (International Energy Agency, 2008b). In 2003, direct loans were discontinued and the JHFA began underwriting a long-term and fixed interest rate loan called "Flat 35," with energy conservation performance as one of the loan evaluation criteria. All houses applying for the loan must meet 1980 thermal insulation standards, and reduced interest rates are provided for those meeting the 1999 standards (Ministry of Economy, Trade and Industry, Japan, 2002).

Low interest loans for non-residential buildings are also available from the Development Bank of Japan, applicable for projects with a floor area of 2000m^2 or more. Applicants must commit to energy conservation efficiency of 20% or higher than the Energy Conservation Standards, utilization of water resources and retention of rain water (Murakami et al., 2007). Similarly, many local governments provide access to lower interest mortgages for buildings with a high rating on Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). For example, in Kawasaki and Sapporo City, a B+ assessment may entitle the building owner to qualify for lower interest mortgages (Sunikka-Blank et al., 2011).

Tax Schemes

The Tax Scheme for Promoting Investment in the Reform of the Energy Demand-Supply Structure is available for businesses acquiring specified energy conservation equipment. It provides special depreciation rate applied for 30% of the acquisition cost, with small scale businesses also provided with a 7% tax deduction of the acquisition cost (Asia Energy Efficiency and Conservation Collaboration Center, 2010). In 2011, the tax scheme was replaced with a new scheme (with the same special depreciation and tax deduction rates on acquisition cost) that targeted highly-efficient equipment and systems used in the residential and commercial sectors, such as highly efficient air conditioning systems, high insulation windows facilities, and light-emitting diodes (International Energy Agency, 2010).[18]

Subsidies

The New Energy and Industrial Technology Development Organization (NEDO) currently provides subsidies for energy efficiency improvements in residential buildings (Energy Conservation Center, Japan, 2011). The subsidy project began in 1999 and set a 2010 target of reducing energy consumption in residential buildings by the equivalent of 3 million liters of crude oil. NEDO subsidies

[18] International Energy Agency (2010), "Financial and Tax Incentives for Industry- Japan," IEA Energy Efficiency Policies and Measures Database. Accessed at http://www.iea.org/textbase/pm/?mode=cc&id=4029&action=detail.

are provided to both newly constructed and existing houses to cover one-third of the expenses incurred in installing energy-efficient appliances, including electric/gas heat pumps, ultra high insulation windows and gas cogeneration systems (International Energy Agency, 2008b). Subsidies are also provided for introducing energy management systems in homes and buildings that enable automatic management of several appliances simultaneously, leading to energy savings and reduced environmental impact (International Energy Agency, 2010).[19] In addition, NEDO subsidies are offered for renovation of residential buildings to meet building standards. To qualify for the subsidies, energy consumption must be reduced by 15% for newly constructed houses and by 25% for renovated houses. Subsidies amounting to a total of US$ 49.8 million have been allocated to home-owners for energy efficient improvements from 1999 to 2006 (International Energy Agency, 2008b).

The Ministry of Land, Infrastructure, and Transport (MLIT) subsidizes one-third of the costs for surveys, planning, and installation of "environmentally symbiotic facilities" (Hong et al., 2007), where compliance with the Environmentally Symbiotic Housing and Urban District Guidelines is a prerequisite for financial support for the construction of these model complexes (Evans et al., 2009).[20] In addition, many local governments provide subsidies for buildings with a high rating on CASBEE e.g. in Osaka, only buildings ranked above 'A' by Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) are eligible to apply for subsidies (Sunikka-Blank et al., 2011).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

Mandates

Although the benefits of the building energy code have yet to be quantified in monetary terms, it is estimated that residential buildings that comply with the energy code consume 40% less energy than non-compliant ones, while commercial buildings that comply consume 75% less energy than those that do not (Ministry of Land, Infrastructure, and Transportation, 2007). Thus, for buildings that do meet the latest standards, there is a significant downward effect on energy consumption and significant benefits in terms of energy savings. Whether the economy-wide energy savings achieved by the energy codes are significant depends on the proportion of buildings (both existing and newly constructed) that meet the standards. However, there is sparse information available on this, making it difficult to estimate the total level of energy savings achieved by the code.

As pointed out earlier, buildings with a floor space greater than 300m^2 are required to submit energy saving plans prior to construction or renovation. Within this set of buildings, compliance rates are mixed. Approximately 85% of the commercial buildings that submitted the mandatory reports in 2005 met the standards, whereas only 36% of new residential buildings complied with the standards in 2006. The difference is partly because residential buildings were first required to submit energy saving plans prior to construction or renovation in 2005, as opposed to 2003 for commercial buildings (Evans et al., 2009). Compliance rates have been on an increasing trend in recent years. The

[19] International Energy Agency (2010), "Home Energy Management System, Building Energy Management System: Japan," IEA Energy Efficiency Policies and Measures Database. Accessed at http://www.iea.org/textbase/pm/?mode=pm&id=684&action=detail.

[20] Please refer to the previous section on building labeling (pg. 14) for more details on the guidelines.

compliance rate for commercial buildings has increased from 34% in 2000 to 85% in 2005 (in large part as a result of the submission of energy savings plan being made mandatory in 2003) while that for residential buildings increased from 13% in 2000 to 36% in 2006 (Hong et al., 2007; Evans et al., 2009).

The actual stock of buildings includes a significant proportion of buildings that are less than 300 m^2 in floor space as well as buildings greater than 300 m^2 that have not recently undergone renovation or construction. Sunikka-Blank et al. (2011) point out that in Japan, where 50% of the stock consists of individual houses and the average floor area of a new dwelling is only 107 m^2, most residential buildings have a floor area less than 300 m^2 and are not required to comply with the building standards. In addition, between 1999 and 2003, 87% of residential buildings did not undergo any renovation (International Energy Agency, 2008b), suggesting that a significant proportion of Japan's building stock at any point in time will not be required to comply with the standards even if they exceed 300 m^2 in floor space. As such the compliance rate for these two classes of buildings, while unknown, is likely to be lower than for buildings that are required to comply with the standards.

As mentioned earlier, Japan has in the past targeted increasing the compliance rate for newly constructed residential and commercial buildings. The number of buildings complying with the building energy code can also be increased by making the energy savings plan submission mandatory for buildings with a floor area of less than 300 m^2, or by making the codes mandatory for existing buildings that have not undergone renovation or construction. Energy savings, however, are only one side of the equation, since energy efficiency measures in buildings also entail costs. If the goal of building energy efficiency policy is to maximize societal welfare, maximizing energy savings may be counter-productive if they are achieved at a very high cost.

Japan's building standards are not determined using life-cycle analysis that would take into account the economic costs and benefits of the standards over their lifetime. This means that regulations do not explicitly aim at ensuring that the standards are set at the optimal level. Ex-post cost-benefit analyses of Japan's building energy codes have not been made available to the authors of the report, at least publicly, though there do exist limited cost estimates. When the building standards for heat insulation were made stricter after the 2001 revision of the Long-Term Energy Policy, energy savings were estimated to be 20% for air-conditioning at a cost of around JPY 1 million (approximately US$ 10,000) per house (Geller et al., 2006; International Energy Agency, 2010).[21] However, it is not clear from this information alone whether the standards were optimally set.

To increase the effectiveness of the codes, therefore, incorporating life-cycle economic analysis into the process for designing building energy codes is recommended, so as to ensure that the process attempts to maximize net benefits. Ex-post analysis of the actual costs and benefits of the codes is also recommended in order to guide future revisions to the code.

In the absence of information on whether the standards were optimally set, it is not clear whether maximizing the number of buildings complying with the standards is necessarily a desirable policy goal. Coverage should be maximized only if the standards are optimally set and the implementation is not too costly.

[21] IEA (2010), "IEA Energy Efficiency Policies and Measures Energy Efficiency Standards for Housing/Building," IEA Energy Efficiency Policies and Measures Database. http://www.iea.org/textbase/pm/?mode=cc&id=675&action=detail.

In considering costs and benefits of policies, it is also worthwhile comparing building energy codes to market-based alternatives such as a carbon/energy tax (or cap-and-trade) that attempt to price the environmental externality of energy use.[22] On the one hand, market-based instruments give building owners the flexibility to decide where to incorporate energy efficiency improvements in the building, which could lead to energy efficiency improvements being achieved at a lower cost. On the other hand, unlike a tax/cap-and-trade, building energy codes also tackle informational and behavioral barriers, such as the low salience of energy efficiency at the point of purchase or rent of a building, and thus could well lead to greater net benefits in terms of energy savings.

Information programs

Labeling programs help evaluate a building's energy efficiency performance and thus provide homeowners and buyers with the information needed to make rational housing decisions. For such programs to be effective, therefore, clarity and simplicity in how the information is presented is essential, otherwise it is likely that consumers will simply ignore the information or process it incorrectly when making decisions. The labeling programs implemented in Japan prior to Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) did not perform well according to this criterion, since they did not clearly distinguish between the building performance (which positively influences the consumer's decision) and the environmental impact (which negatively influences the consumer's decision). CASBEE, by clearly defining and distinguishing between the environmental quality of the building and its environmental load, clarifies and simplifies the assessment of building energy efficiency (Vare, 2010). While the environmental performance result of CASBEE is simple and clear, its detailed criteria limited its use in practice, since the evaluation could take between three to seven days (Sunikka-Blank et al., 2011). It includes both quantitative and qualitative assessments which have to be conducted by an engineer with expertise and knowledge in the area, which further adds to the costs of conducting the assessment.

To address this, the CASBEE Accredited Professional Registration System was established in 2005, and there are now over 10,000 professionals in Japan as of December 2011 (JSBC, 2012). In addition, brief versions of CASBEE are also available in which the assessment process is simplified and takes only around a couple of hours, barring the time required to prepare an Energy Saving Plan (Japan Sustainable Building Consortium, 2012).[23]

The use of CASBEE has been growing, with submissions from more than 6,600 buildings for assessment as of December 2011. 24 local governments, representing 44% of the Japanese population, currently require building owners to report CASBEE assessment results prior to construction (Japan Sustainable Building Consortium, 2012). In addition, many local governments have provided incentives for buildings with a high rating on CASBEE, which include subsidies, access to lower interest mortgages, and permission to increase floor-area ratio (Vare, 2010). From a cost-benefit perspective, such policies would be justified if the benefits from the use of CASBEE – superior availability of information and energy saving benefits – outweigh the costs of performing the evaluation as well as the costs of associated incentives.

Among the other information programs used in Japan, the housing performance labeling system included under the Housing Quality Assurance Law categorizes residential buildings into four

[22] Japan has been considering the introduction of a carbon tax for some time (Watanabe, 2011), though it has recently ruled out introducing a carbon price or a carbon tax in the near future (Shanahan, 2012).

[23] See http://www.ibec.or.jp/CASBEE/english/overviewE.htm

categories, based on whether they comply with the 1999 building standards, 1992 standards, the 1980 standards or none at all, and also provides comparisons to other buildings. The Environment and Energy Friendly Building Mark divides non-residential buildings into two categories based on their performance relative to the building energy standards. Thus, both these labeling programs perform well on criteria of clarity and simplicity. In addition, by providing information on whether buildings meet the building energy codes, they increase the incentive for homeowners to comply with the codes, enhancing the potential benefits of the codes. The 'Cool Biz' program is estimated to have saved 460,000 tons of CO_2 while public awareness of the program was reported to be 96% (Murakami et al., 2007), though it is unclear what the cost was.

Fiscal and Financial Incentives

The New Energy and Industrial Technology Development Organization (NEDO) subsidies for energy efficiency improvements in residential buildings led to energy savings that were close to 135 TJ between 1999 and 2006, at a total cost of US$ 49.8 million (International Energy Agency, 2008b). Thus the NEDO subsidy program achieved savings of around 2.5 TJ of energy for every million US dollars spent on the subsidies. The cost-effectiveness of the NEDO program has increased over the years, from around 2 TJ of energy saved per million US$ in 1999 to more than 3 TJ of energy saved per million US$ in 2006 (International Energy Agency, 2008b).

As mentioned earlier, the NEDO subsidy project targeted achieving energy savings equivalent to 3 million liters of crude oil (=790 TJ) between 1999 and 2010. By 2006, hence, the project had achieved less than 20% of this target. It should also be noted that the energy savings achieved represent a very small proportion of Japan's overall energy consumption from residential buildings; for instance, in 2005, the energy savings from the NEDO subsidies of around 23 TJ (International Energy Agency, 2008b) amounted to approximately 0.001% of Japan's total energy consumption from the residential sector (=2,023,000 TJ) in that year (Asia Energy Efficiency and Conservation Collaboration Center, 2010).

The benefits from financial incentive programs, such as the low interest loans provided by the Japan Finance Corporation and the Japan Housing Finance Agency, include their promotion of green investments, in particular energy efficiency investments carried out by Energy Service Companies (ESCOs). The size of the ESCO market in Japan increased from US$ 10 million in 1998 to US$ 350 million in 2003 (Asia Energy Efficiency and Conservation Collaboration Center, 2010), an increase that can be attributed in part to the rising use of financial incentives during that period (as argued by, for instance, Geller et al., 2006). From 2003 onwards, however, the size of the ESCO market has fluctuated considerably, decreasing to US$ 176 million in 2008 (Asia Energy Efficiency and Conservation Collaboration Center, 2010). This is in part because some restrictions have been imposed on the use of financial incentives since 2003. As mentioned earlier, direct loans for energy efficient houses were discontinued in 2003, while in 2008 the low-interest loans provided by the Japan Finance Corporation were restricted to cover only small and medium-sized enterprises. In the absence of cost-benefit analysis on these financial incentives, however, it is not possible to make a definitive judgment on whether the benefits from the increased size of the ESCO market are justified by the costs of the incentive programs.

(ii) Scientific Integrity

In general, Japan's policies appear to be based on scientific analyses and principles. Policies tend to be detailed and comprehensive in their design and have been formulated taking into account a number of relevant variables.

Scientific evidence and analyses have played a major part in the formulation of the building energy codes. For commercial buildings, energy standards are set for the building envelope as a whole and are also set separately for various specific components of the building envelope, including the heating, ventilation, and air-conditioning (HVAC) system, ventilation, lighting, hot water and lifting equipment. Moreover, these standards are differentiated based on relevant factors such as building type, building size, and climate zone (with standards varying depending on whether the building is located in the ordinary, cold or tropical climate zone). The two energy codes for residential buildings specify maximum allowable heating and cooling loads (for the building as a whole), set standards for insulation, HVAC, and water heating and are differentiated according to the building type and the climate zone (Evans et al., 2009).

A similar conclusion holds for CASBEE. By taking into account both the environmental load of the building and the environmental quality delivered by the building, CASBEE allows for a holistic assessment of a building's sustainability, improving upon evaluation systems used in Europe which only account for the load (Sunikka-Blank et al., 2011). CASBEE's assessment of environmental quality is detailed and takes into consideration a number of relevant variables such as the indoor environment, quality of service and the outdoor environment on site, while its assessment of the environmental load is similarly based on measuring a number of variables such as energy, resources and materials and the off-site environment (Japan Sustainable Building Consortium, 2012). However, a limitation of CASBEE is that biotopes are absent in its assessment, meaning that the assessment does not compensate for green spaces in the building environment (Sunikka-Blank et al., 2011).

(iii) Flexibility

Japan has shown a willingness to revise its policies in response to changing circumstances. The Energy Conservation Act, which forms the foundation for much of Japan's energy efficiency policies, has been revised several times (1983, 1993, 1998, 2002, 2005, and 2008) since it was passed in 1979, so as to better address the changing energy consumption of various sectors in Japan and concerns about global environmental issues (Asia Energy Efficiency and Conservation Collaboration Center, 2010). The earlier focus of the Act was on promoting the efficient use of energy in the manufacturing sector. As energy use in the building sector has increased more rapidly than energy use in the industrial and transport sectors since 1990, building standards have been gradually strengthened and the requirement to submit an energy savings plan was introduced in 2003. In 2008, moreover, the requirement was extended to cover small to medium buildings (between 300 m^2 and 2000 m^2), which were previously exempted.

Regular revisions also underlie the "Basic Program for Housing." This program was issued by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in 2006 and sets targets for the life span of buildings and the number of buildings that have energy saving measures. By regularly analyzing and evaluating the effectiveness of the project using target assessment indicators, the MLIT

intends to reappraise and modify the plan in five years based on the effectiveness of these measures and changes in social conditions (International Energy Agency, 2010).[24]

Since the earliest labeling programs provided no assessment of the environmental load of a building, Japan subsequently adopted labeling methods that considered both the environmental load and the environmental quality (or building performance) of the building. However, in the initial reforms, schemes did not clearly distinguish between these two assessment criteria. This restriction prompted the development of the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) labeling program in which the environmental load and environmental quality of the building are clearly defined and distinguished from each other. Finally, though CASBEE was initially designed only for large-scale buildings, its coverage was subsequently expanded, in 2007, to small-scale detached houses (International Energy Agency, 2008b), responding to the rapid growth in energy use in the buildings sector and the fact that detached houses account for about half of the total housing stock.

As discussed earlier, the building energy codes are as yet mandatory only for a limited proportion of the building stock. Instead, the policy approach towards encouraging compliance with the building energy standards has been through the use of financial incentives and labeling programs that reward energy-efficient buildings. This allows building owners the flexibility to decide whether their buildings should comply with the standards or not depending on whether the energy saving benefits outweigh the costs of implementing energy efficiency measures. Moreover, the building energy codes are differentiated according to factors such as regional and climatic differences, meaning that building codes, by default, are responsive to some dimensions of the varying environment faced by different building owners.

The CASBEE labeling program allows stakeholders some flexibility in their approach towards energy efficiency compliance. CASBEE is composed of four assessment tools corresponding to different stages in the lifecycle of buildings, including CASBEE for Pre-design, CASBEE for New Construction, CASBEE for Existing Building and CASBEE for Renovation. In addition, different versions of CASBEE have been developed that are tailored to specific applications, including CASBEE for Detached Houses, CASBEE for Temporary Construction, CASBEE brief versions, CASBEE local government versions, CASBEE for Heat Island Effect, CASBEE for Urban Development, and CASBEE for Cities.[25] CASBEE local government versions, for instance, allow local governments to set their own guidelines and local criteria, based on assessment standards and different weighting coefficients for certain items.[26] CASBEE for Urban Development and CASBEE for Cities allow assessment of the environmental performance of an entire metropolitan area or a city, not just individual buildings (Japan Sustainable Building Consortium, 2006).

When it comes to fiscal and financial incentives, the multiplicity of policies and regulations in place helps to enhance flexibility and responsiveness of the policy framework to varying circumstances and conditions. For instance, owners of houses that already meet energy conservation

[24] International Energy Agency (2010), "Basic Program for Housing: Energy Efficiency Standards, Japan," IEA Energy Efficiency Policies and Measures Database. http://www.iea.org/textbase/pm/?mode=cc&id=675&action=detail

[25] Please see http://www.ibec.or.jp/CASBEE/english/overviewE.htm

[26] Please refer to "CASBEE for Japanese Local Government" Programs, available at http://www.climate-lg.jp/en/programs/id_003.html

standards can apply for low-interest loans from the Japan Housing Finance Agency (JHFA), whereas owners of houses that do not meet the standards can apply for low-interest loans from the Japan Finance Corporation to support energy conservation renovation of their buildings, or receive grants from the Ministry of Land, Infrastructure, Transport and Tourism (MILT) subsidizing one-third of the costs for surveys, planning, and installation of "environmentally symbiotic facilities" (Hong et al., 2010).

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv)Transparency

Although building energy standards are the joint responsibility of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of Economy, Trade and Industry (METI), the Energy Conservation Center of Japan (ECCJ) is actively involved in the process, providing technical assistance in energy-efficient building construction and operations. The ECCJ is a non-governmental organization established in 1978 with numerous industrial partners (Hong et al., 2007), so the fact that they are involved in the process means there is stakeholder engagement and scope for the views of the owners of commercial buildings to be taken into account in standard-setting. However, owners of residential buildings are not directly represented in the ECCJ, meaning there is limited scope for their views to be accounted for in the standard-setting process.

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) was a joint project between various stakeholders. It was carried out between industry, government and academia with the assistance of the MLIT and is managed by the Japan Sustainable Building Consortium and its affiliated sub-committees (Japan Sustainable Building Consortium, 2006). It also features active involvement from local governments, with 24 local governments currently mandating the use of CASBEE. In that sense, CASBEE is transparent in terms of stakeholder engagement. Information on CASBEE is also easily available to interested stakeholders. Developers, builders, architects and others are enabled to download a program and assess any new building or renovation on their own. Alternatively, they can hire qualified architects to conduct the assessment (Hong et al., 2007). The results of the evaluation are verified by a third party, and then disclosed to the public in a graphic form from a score sheet.[27]

Information about laws, regulations, and financial incentives for energy efficiency investments can be found on the websites of relevant ministries – the Ministry of Economy, Trade, and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) as well as the websites of semi-governmental organizations – the New Energy and Industrial Technology Development Organization (NEDO) and the Energy Conservation Centre, Japan (ECCJ). In addition, the ECCJ is responsible for disseminating information on energy conservation and plays an active role in informing the general public as well as commercial and industrial stakeholders on energy efficiency programs and policies by subsidizing various promotional campaigns and advertising in the media (International Energy Agency, 2008b). This further enhances the transparency of Japan's building energy efficiency policies.

[27] Please refer to "CASBEE for Japanese Local Government" Programs, available at http://www.climate-lg.jp/en/programs/id_003.html

(v) Alignment

The agencies governing laws and policies regarding energy efficiency in buildings include the Ministry of Economy, Trade and Industry (METI), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and the Ministry of Environment. Semi-governmental organizations such as the New Energy and Industrial Technology Development Organization (NEDO) and Energy Conservation Centre, Japan (ECCJ) are responsible for creating awareness regarding energy efficiency, promoting energy efficiency projects, and ensuring compliance to the Energy Conservation Laws. There is thus a distinct difference in the roles and responsibilities of the ministries, on the one hand, and the semi-governmental organizations, on the other, reducing the chances of coordination problems in policymaking.

Alignment among the authorities has been facilitated by the amendment of the Energy Conservation Law which was enforced in December 1983; the changes included the simplification, rationalization, and consolidation of clerical work, to cover 14 ministries and encompass 58 other laws (Asia Energy Efficiency and Conservation Collaboration Center, 2010). Moreover, the establishment of the Ministry of Land, Infrastructure and Transport (MLIT) in 2001, through the consolidation of the former Ministry of Construction, Ministry of Transportation, National Land Agency and the Hokkaido Development Agency (Hong et al., 2007), is also likely to have facilitated coordination and alignment by reducing the number of ministries involved in policymaking.

Many of the policies instituted by Japan are dictated by inter-ministerial committees or involve cooperation among different government arms and other stakeholders, indicating a good level of coordination and alignment in policymaking. In 2007, the "Inter-Ministerial Liaison Committee for the Promotion of Energy and Resource Conservation Measures," consisting of vice-minister level officials, was held to further promote energy conservation efforts and implement, among others, "energy conservation contests" for households and an operating procedure on energy conservation for the commercial sector (as discussed earlier).

Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) is a voluntary program implemented by local governments but encouraged in some central government policy documents like the MLIT Action Plan and the Kyoto Protocol Target Achievement Plan (Sunikka-Blank et al., 2011). Hence, with CASBEE, there appears to be alignment between local governments (which actually implement the program) and the central government (which encourages it). Moreover, the expansion of CASBEE's coverage in 2007 was a joint initiative, with the MLIT overseeing and private, academic and government participants cooperating to bring about the policy change (International Energy Agency, 2008b).

In general, the different policies implemented by Japan to encourage energy efficiency improvements in buildings tend to be well-aligned with each other. The complementary role of fiscal and financial incentives in enhancing the effectiveness of both the building energy codes and labeling schemes (such as CASBEE) has already been highlighted. Similarly, labeling programs such as the housing performance labeling system included under the Housing Quality Assurance Law and the Environment and Energy Friendly Building Mark are directly aligned with the building energy codes as they provide information on the extent to which residential and commercial buildings comply with the codes. The assessment of a building under CASBEE does not indicate whether the building complies with the standards, but a building with a high Building Environmental Efficiency score under the CASBEE scheme is more likely to be compliant with the building energy codes.

2.1.2 Energy Efficiency in Buildings in Thailand

Key findings

- Increased energy efficiency in buildings is expected to form a key component of Thailand's efforts to reduce energy use, with the residential and commercial sectors together accounting for around one-fifth of total energy use.
- Thailand has targeted its building energy conservation efforts on commercial buildings, relying largely on building energy codes and fiscal and financial incentives.
- Thailand's building energy efficiency policies are expected to generate moderate energy savings, though it is unclear whether they can do so in a cost-effective manner. Policymaking is transparent and scientifically grounded, but problems of alignment and policy lags remain.

Costs, benefits and promotion

- Projected energy savings from full implementation of the new building energy code for commercial buildings are moderate, amounting to 1.4% of the total energy demand of the commercial sector in 2016. It is unclear, however, if the costs of the new energy code justify the energy saving benefits.
- Financial incentives are expected to generate energy savings and leverage private investment. However, the extent to which they maximize such benefits while minimizing costs varies. Tax incentives generate the highest energy saving benefits and leverage the greatest amount of private investment relative to the cost when compared with the Energy Efficiency Revolving Fund and the Energy Services Company Fund.

Scientific integrity

- Thailand's policies, in particular the building energy codes, are based on scientific analyses and principles.

Flexibility

- Regular updates are not the norm, as there was a gap of 14 years between the implementation of the original and new versions of the code. However, it is encouraging that lessons from the flaws found in the revision of earlier building codes have been considered in the design of the new building code.
- The new building energy code allows owners increased flexibility in how they wish to improve their building energy efficiency, enhancing the cost-effectiveness of the measures.

Transparency

- The process for the formulation of Thailand's building energy efficiency policies allows stakeholder views to be reflected.

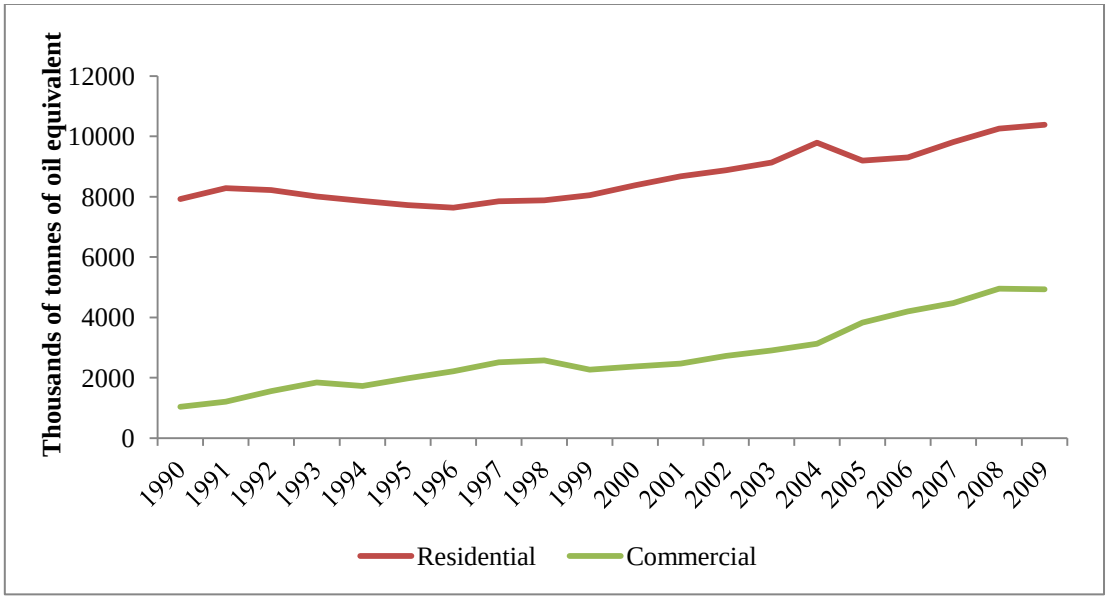
Alignment

- Alignment between the various government agencies has been a challenge and more coordination is needed to improve the effectiveness of the building energy code and energy audits. However, the formation of the Ministry of Energy, as the body overseeing most of the agencies involved, is likely to have assisted in improving alignment among government agencies.

A. Size and Significance

The buildings sector, which essentially consists of the commercial and residential sectors, is a significant user of energy in Thailand. It accounted for 20.2% of Thailand's total energy consumption in 2009. While the energy consumption of the residential sector was more than double that of the commercial sector in 2009 (International Energy Agency, 2011), commercial energy consumption has been growing more rapidly than residential energy consumption in recent years, as Figure 2.1.3 below illustrates. Commercial energy consumption has also been accounting for a rising proportion of Thailand's total energy consumption, from 4.5% in 1999 to 6.5% in 2009, whereas residential energy consumption in 2009 accounted for 13.7% of total energy use as opposed to 16.1% in 1999 (International Energy Agency, 2011).

Figure 2.1.3 ***Historical energy consumption in Thailand's residential and commercial sectors (1990 – 2009)***



Source: International Energy Agency, 2011

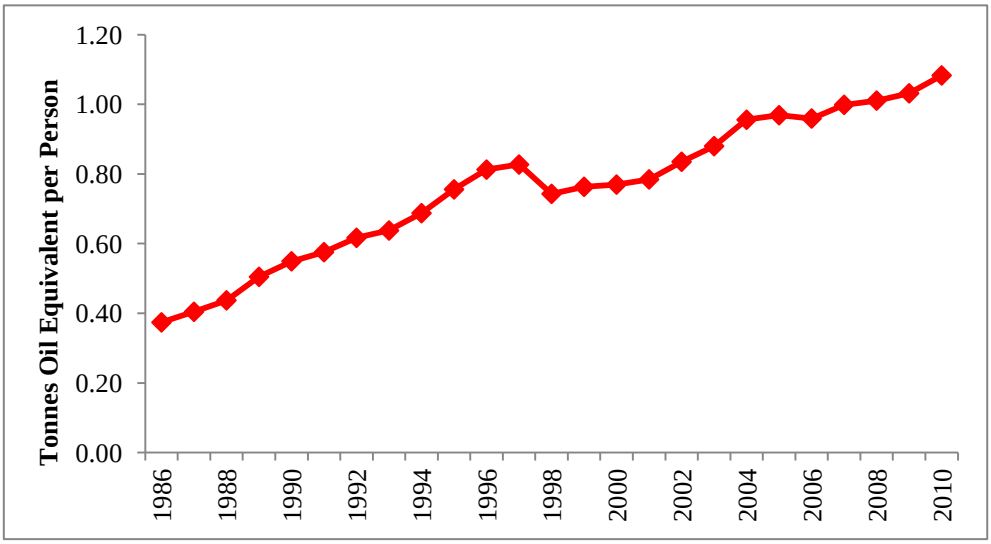
B. Policy Formulation

(i) History and Background

Thailand's energy intensity (final energy consumption per GDP at 1988 prices) has been increasing annually at an average rate of 0.1% while its energy consumption per capita has been increasing rapidly at an average rate of 4.3% annually (see Figure 2.1.4 below) (Energy Policy and Planning Office, 2011). As such, Thailand has laid considerable emphasis on energy efficiency and

conservation policy in order to reduce energy demand, while still ensuring sustainable economic growth and minimal adverse impact in the environment. Thailand's goal of reducing its dependence on energy imports from foreign economies has provided further impetus to its energy efficiency and conservation efforts. Part of Thailand's energy conservation efforts have been targeted at the buildings sector, though till now the focus has largely been on reducing energy consumption from commercial rather than residential buildings.

Figure 2.1.4 ***Historical final energy consumption per capita in Thailand***



Source: Energy Policy and Planning Office, 2011

In 1992, Thailand launched the Energy Conservation Promotion Act (ENCON Act), which is the government legislation that underlies Thailand's energy efficiency and conservation policies and comprises a mixture of mandatory regulations, incentives and penalty measures. The Energy Conservation Program (ENCON Program) and the Energy Conservation Promotion Fund Committee (ENCON Fund Committee) became operational after the Act was enacted. The ENCON Program includes 3 main programs, namely a *Compulsory Program* for "designated facilities" (DFs), which are large commercial buildings and factories, a *Voluntary Program* for small and medium-sized enterprises (SMEs), and a *Complementary Program* for human resource development, public awareness campaign and management and monitoring. It has three phases and covers the periods of 1995–1999, 2000–2004, and 2005–2011 respectively. The ENCON Program Phase 3 was revised in 2008 to include the Energy Efficiency Improvement Sub-Program's target of reducing 10.8% of commercial energy consumption by the year 2011 (Asia Pacific Economic Cooperation, 2010).

Specific policies to improve energy efficiency and conservation in buildings fall under three categories: mandates (in particular, the building energy code), fiscal and financial incentives, and information programs.

(ii) Policy Description

MANDATES

Building Energy Codes

Thailand has a mandatory building energy code (BEC) in place for commercial and government buildings. The Department of Alternative Energy Development and Efficiency (DEDE), the Department of Public Works and Town & Country Planning, the Energy Policy and Planning Office (EPPO) and the Electricity Generating Authority of Thailand (EGAT) are the four government agencies responsible for developing and enforcing the energy-efficiency building codes (Hong et al., 2007). There are two versions of the code that are currently in operation. The first-generation code was introduced in 1995 as part of the ENCON Act (Hong et al., 2007). From December 2001 to March 2004, the DEDE and Danish International Development Assistance (DANIDA) collaborated in developing a new building energy code (Chirarattananon et al., 2010). In 2007, the new code was prepared for submission to the Thai cabinet for endorsement (Hong et al., 2007) and was eventually gazetted in 2009 under the Energy Ministerial Regulation (Prakobchat, 2011).

Since 1995, the first-generation code has been mandatory for both existing and new designated buildings with energy consumption rates above 1.0 MW.[28] In practice, the way designated buildings are defined ensures that most of them have air-conditioned floor areas greater than 10,000 m^2 (Hong et al., 2007). By 2010, it is estimated that more than 1,900 buildings and 3,500 factories have been registered as designated facilities and are required to comply with the code set out in the Energy Conservation Promotion Act (ENCON Act) (Asia Pacific Economic Cooperation, 2010).

The first-generation code specified minimum system performance requirements for the thermal performance of the building envelope as well as the efficiency of the lighting and air-conditioning systems. Existing buildings were given three years to comply with the code. They could achieve this by improving their building shells so that their rate of energy use was 55 watts or less per square meter for heating and cooling. New buildings were required to use no more than 45 watts per square meter. In addition the code specified maximum values for lighting power and minimum coefficient of performances for air-conditioning system (Energy Policy and Planning Office, 2000; Asia Pacific Energy Research Centre, 2003). Energy audits were required for existing designated buildings, and those did not meet the code requirements were required to undergo retrofit changes to comply with the standards set in the code (Hong et al., 2007). The penalties for non-compliance can be categorized into two types: 1) the surcharge for the electricity utilization and the suspension of financial support, and 2) a fine or imprisonment. The code also requires each Designated Facility (DF) to assign one qualified "Person Responsible for Energy" (PRE)[29] as an energy manager and to report "Target and Plan" for implementation of energy conservation measures every three years, in addition to complying

[28] Under the ENCON Act, the Royal Decree on Designated Building, B.E. 2538 was issued to define "Designated Facilities or Buildings" for energy conservation purposes. DFs are building and factories with an installed electrical demand more than 1.0 MW or an annual commercial energy consumption (electricity and steam) of more than 20 TJ.

[29] With the revision of ECP Act in 2007, stringent requirement necessitates each DF with an electrical demand from 3000 kW onwards to appoint two PREs who are responsible for energy auditing the facilities and reporting the results to Department of Alternative Energy Development and Efficiency (DEDE).

with other duties[30] defined in the Energy Conservation Promotion Act (ENCON Act) (Energy Policy and Planning Office, 2000).

By contrast, the new building energy code is meant to target only new and retrofitted commercial buildings that have a total floor area of at least 2,000 m^2 (United Nations Environment Program, 2011). Buildings are now categorized into three types: office and school; department store, hypermarket, and miscellaneous; and hotel, hospital, condominium and hostel, with the standards differentiated based on the building type. The standards embodied in the original code were updated in the new code using a life cycle costing principle, meaning that the life cycle costs associated with alternative standard levels were evaluated and compared in coming up with the final set of standards (Chirarattananon et al., 2010).

Like the original code, the new code continues to adopt system performance requirements for building envelopes, lighting, and air-conditioning. However, buildings that fail on the "system performance-based compliance" because their performance for one or more of the components does not meet the standard, can still be assessed to be energy-efficient if they satisfy the new "whole building compliance" criterion. This criterion is assessed by ensuring that the annual energy consumption of the proposed building is less than that of a reference building (Chirarattananon et al., 2010).[31] In addition, the new code sets minimum efficiency requirements for boilers and water heaters and encourages the use of renewable energy by allowing both the use of solar energy via "daylighting" and the generation of electricity from solar PV systems to count towards the "whole building compliance" (Chirarattananon et al., 2010; Rakkwamsuk, 2010). Along with the new code, Thailand government has written a handbook to assist building professionals in building design and a computer program in code compliance.

Building Energy Audits and Retrofits

The ENCON Act (as described above) requires existing designated buildings to undergo energy audits and retrofitting to improve their energy conservation performance (Hong et al., 2007). After the 2007 revision to the ENCON Act, the energy audit requirement was strengthened and designated buildings are now required to carry out an annual energy audit and report the results to the Department of Energy Development and Efficiency. The audit costs are financed by ENCON Fund. By 2001, roughly 1,600 commercial buildings had received energy efficiency audits (United Nations Environment Program, 2011), which is estimated to have increased to more than 1,900 commercial buildings by 2010 (Asia Pacific Economic Cooperation, 2010). It was found that designated buildings that received retrofits did so primarily for their lighting systems (Hong et al., 2007).

Energy audits for commercial buildings also form part of the US$ 189 million Demand Side Management (DSM) Program, and the Demand-Side Management Office (DMSO), which is in charge of the DSM program, offers energy audits for building lighting, cooling envelope, and load management systems. This program is coordinated with the energy audits required under the compulsory program of the ENCON Act. By 2000, 433 building owners applied to participate and the

[30] The duties stipulated by the Act include assigning one person as an "Energy Manager", keeping records on monthly energy consumption data, submitting information of energy consumption, production and conservation to government agency, setting up energy conservation targets and plans and monitoring the achievement in implementing the targets and plans.

[31] Reference building is hypothetically designed to have identical dimension, shape and functional areas as the proposed building and to comply with the requirements in "system performance-based compliance."

Demand Side Management Office (DSMO) had conducted 252 energy efficiency audits, though only 34 projects were approved (Hong et al., 2007).

In addition, Thailand has implemented a Government Buildings Audit and Retrofit Program, financed by the ENCON Fund, encouraging all government offices to carry out an energy audit and a subsequent retrofit program for their buildings (United Nations Environment Program, 2011). Public buildings are an attractive target for energy efficiency improvements due to the possibility of a direct implementation of energy efficiency measures by the government and a short payback period which in turn implies a high rate of return on public expenditure (Asia Pacific Energy Research Center, 2003). Between 1997 and 2001, DEDE conducted energy audits and carried out retrofitting on 600 government buildings (Asia Pacific Energy Research Center, 2003).

INFORMATION PROGRAMS

The Department of Alternative Energy Development and Efficiency (DEDE) established a labeling program for Thai buildings in 2007, aimed at promoting energy-saving buildings (both residential and non-residential) in Thailand (United Nations Environment Program, 2011). The labeling program is voluntary and awards different scores for different levels of energy and environmental performance. The program has three levels of labels – Bronze, Silver and Gold – which are given for various residential and non-residential buildings after assessing their energy and environmental performances. The DEDE provides technical advice and recommendations for energy efficiency improvements to participants in the labeling program free of charge, to provide an incentive for the buildings sector to participate in the scheme (Asia Pacific Economic Cooperation, 2010).

Thai public buildings have also become living laboratories for state-of-the-art energy efficiency demonstrations. The Energy Demonstration Center and the Electricity Generating Authority of Thailand (EGAT) Headquarters Buildings are good examples on the matter (Asia Pacific Economic Cooperation, 2010). Other voluntary and non-regulatory initiatives include Thai Energy Efficient Building Award, Green Building Program, and regional energy efficiency activities. Starting from 2006, the Ministry of Energy has provided awards for different categories of energy-efficient buildings in Thailand. Thailand also has actively participated in the development of regional energy benchmarking of buildings and award programs for energy efficient buildings in ASEAN region (Hong et al., 2007).

FISCAL AND FINANCIAL INCENTIVES

The Thai government has also developed a number of financing mechanisms to reduce energy consumption in the buildings sector. Under the Energy Conservation Promotion Act (ECP Act), four financing mechanisms were established, namely an Energy Conservation Promotion Fund, an Energy Efficiency Revolving Fund, an Energy Service Company Fund, and tax incentives.

Energy Conservation Promotion (ENCON) Fund

The Energy Conservation Promotion (ENCON) Fund revenues are derived from a tax of THB 0.04 per liter collected from domestically sold petroleum products.[32] The tax provided an initial Oil Fund of THB 1.5 billion (US$ 50 million) (Wangskarn, 1997) and provides annual inflows of

[32] The petroleum products include gasoline, diesel, kerosene and fuel oil. LPG is exempted (Asia Pacific Energy Research Centre, 2003).

approximately THB 2 billion (US$ 70 million).[33] By 2005, the Fund had accumulated around THB 14 billion (US$ 470 million) in 2005 (Hong et al., 2007). The ENCON Fund has been utilized for carrying out energy efficiency improvements in 10 building projects and 56 factory projects as well as for supporting other energy conservation activities, including RE projects, energy-related research and development, human resource development, public awareness campaign and Energy Conservation Program management and monitoring. The ENCON Fund also provides funding for other energy efficiency financing mechanisms such as the Energy Efficiency Revolving Fund and the Energy Service Companies (ESCO) Fund.

Energy Efficiency Revolving Fund (EERF)

In late 2002, the DEDE introduced a loan program to stimulate energy efficiency investments in designated facilities. The Energy Efficiency Revolving Loan Fund gives commercial banks capital at no cost (zero interest rate), enabling the banks to then provide loan opportunities for energy efficiency and renewable energy projects at a maximum interest rate of 4%. The banks manage all aspects of the loans and report on the status of individual projects regularly. The DEDE is responsible for ensuring that the energy savings are genuine, the targeted numbers are achieved, the lending and repayment are met, the performances are evaluated and the energy savings are measured. The Energy Conservation Promotion (ENCON) Fund provided an amount of THB 2 billion (US$ 70 million) to Phase 1 (2003), Phase 2 (2006) and Phase 3 (2007) of the Revolving Fund.

In 2010, the Fund was in its third phase with a maximum loan of THB 50 million (US$ 1.70 million) available per project and a maximum repayment period of 7 years. The loan funded 43 projects in the building sector out of 239 projects in commercial and industrial facilities (Asia Pacific Economic Cooperation, 2010). Between 2002 and 2008, 11 public and commercial banks extended US$ 150 million in loans from the Revolving Fund in support of 250 projects with total investment of around US$ 500 million (Asawutmangkul, 2010).

Energy Service Company (ESCO) Fund

Energy Service Companies (ESCOs) play a role in narrowing the energy efficiency gap in the building sector by helping building owners and operators implement EE measures and manage their energy use. In Thailand, ESCOs provides a range of energy management services including energy auditing, energy efficiency measures consultation, project development, project commissioning, financing and performance guarantees (Vechakij, 2010). [34] In 2008, the DEDE established the ESCO Fund as a source of venture capital to stimulate joint investments between public sectors and private investors in energy efficiency and renewable energy projects, through various channels – venture capital, equity investment, equipment leasing, carbon market, technical assistance and credit guarantee facility.

The Fund serves as a pilot initiative to provide capital up to 50% of total equity and hence address the issue of lack of equity capital for SMEs. The initial amount allocated from the Energy Conservation Promotion (ENCON) Fund to the ESCO Fund was THB 500 million (US$ 16.7 million). The maximum loan size is US$ 1.25 million per ESCO and the maximum repayment period is 5 years. The DEDE appointed the Energy Conservation Foundation of Thailand (ECFT) and Energy

[33] This is based on an assumed exchange rate of 1 USD = 30 baht.

[34] ESCOs offer risk management service by guaranteeing savings when incurring losses while sharing the benefits with the clients when generating profits.

for Environment Foundation (E for E) as ESCO Fund Managers. The two entities received THB 250 million (US$ 8.3 million) each to evaluate proposals of energy efficiency and renewable energy projects from investors. By 2010, the Fund had already provided US$ 8.8 million as supporting investment in 17 ESCO projects, including a solar firm, cogeneration power plants, biomass power plants, gasification projects, heat recovery system and energy management system (Asawutmangkul, 2010; Asia Pacific Energy Research Center, 2010).

Tax Incentives

The DEDE has introduced tax incentives to induce investments in energy efficient equipment or machinery. Three methods of corporate tax deduction have been put in place, namely *Cost-based*, *Performance-based* and *Board of Investment-based* (*BOI-based)*. The *Cost-based* method allows 25% credit on income tax of investment costs in energy efficiency projects. In 2008, 94 *Cost-based* projects were implemented (Asawutmangkul, 2010). The *Performance-based* method supported 200 projects by allowing an income tax deduction of 30% from project's actual energy savings value, but not exceeding THB 2 million (US$ 70,000). Thailand's *BOI-based* method has also provided incentives for businesses to undertake EE investments through exemptions of import duties and corporate taxes for a maximum of eight years. In the 1st phase of the scheme, from 2006 to 2007, 193 projects were approved resulting in a total investment of THB 4836 million (US$ 160 million); while in Phase 2 (2008-09), as of August 2008, there were 127 participating projects (Asia Pacific Energy Research Centre, 2010).

Research and Development (R&D) Assistance

While Thailand does not have any policies specifically targeting research and development for building sector energy efficiency, the government has continuously supported R&D to develop and demonstrate new energy efficient technologies as well as to improve and disseminate existing energy efficient technologies. R&D promotions which were a part of Energy Conservation Program received financial support from the Energy Conservation Promotion (ENCON) Fund. The Fund provided a total of THB 525 million (US$ 17.5 million) in grants for 59 R&D projects (Asia Pacific Energy Research Center, 2003). Some examples of R&D projects funded include development of wall materials to reduce cooling loads in buildings, testing of fuel-saving equipment for vehicles, reduction of energy consumption on shrimp farms, energy efficient home designs and a handbook on efficiency characteristics of building materials. In addition, the government has also allocated research funds of THB 50 million (US$ 1.7 million) per year for academic and research institutions and of THB 5 million (US$ 170,000) per year for postgraduate and Ph.D. students to promote the study of energy efficiency and conservation (Asia Pacific Energy Research Center, 2010).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

There is evidence that social costs and benefits are taken into account in the regulatory process for the formulation of several of Thailand's building energy efficiency policies. As mentioned earlier, during the design of the new building energy code, an economic life cycle costing principle was used to determine the minimum energy performance requirement of each system in buildings (Chirarattananon et al., 2007). The life cycle costing principle dictates that the total cost throughout

the life of a building should be the basis for the choice of building construction materials, systems and equipment. For any particular system, the lifetime costs arising from different performance levels are evaluated and compared while determining the minimum energy performance requirement for that system. The measurement of life cycle costs incorporates both the energy saving benefits of higher levels of energy efficiency as well as the possibly higher upfront costs. Thus, the building energy codes have a basis in economic cost-benefit analysis.

The same also holds true for many of the funding mechanisms as well. An Energy Efficiency Market Assessment study was conducted in 2001 to estimate the economic potential for energy efficiency projects in industries and buildings (Energy Futures Australia Pty Ltd & DMG Thailand, 2005). Only after the study was finalized did the DEDE decide on an initial allocation of THB 2 billion (US$ 70 million) from the Energy Conservation Promotion Fund to the Revolving Fund. Subsequently, in 2003, the Energy Efficiency Revolving Fund commenced and the Energy Conservation Committee[35] gave approval for a pilot program (Phase 1) which would last for three years. In this case, the amount of funding to be allocated was determined based on analysis of the economic potential for the energy efficiency projects that were to be covered by the funding. In addition, before an energy efficiency project can receive funding from the Revolving Fund, the loan applicant will have to perform a detailed feasibility study in order estimate the likely energy savings from the project and determine whether the likely repayment commitments can be met, while the bank issuing the loan performs its own financial analysis of the project (Energy Futures Australia Pty Ltd & DMG Thailand, 2005). This process is likely to ensure that economic costs and benefits are taken into account when deciding whether to allocate funds from the Revolving Fund to an energy efficiency project.

The evidence is less clear on whether Thailand's building energy efficiency policies, once implemented, maximize benefits and minimize costs. While quantitative studies on the costs and benefits from Thailand's first-generation building energy code have not yet been conducted, qualitative evidence suggests that the code did not always maximize benefits while minimizing costs. The code placed a lot of emphasis on retrofitting existing buildings to improve their energy efficiency (Chirarattananon et al., 2007), whereas the more cost-effective way to achieve energy savings is to implement energy efficiency measures before the building is constructed. By contrast, the new building energy code is targeted at either new buildings (where energy efficiency can be incorporated directly into the design of the building) or at buildings that are going to be retrofitted in any case (so that the marginal cost of implementing energy efficiency measures is comparatively low). A further reason why focusing on new buildings makes more sense from a cost-benefit perspective is the relatively low life-span of Thai buildings. For instance, buildings in Bangkok typically last between 30-40 years.[36] In addition, the standards set out in the original code were often misconstrued by industry participants as target levels for energy efficiency performance, rather than as minimum requirements which could be exceeded if necessary. This was a sub-optimal outcome since improving energy efficiency beyond the minimum standards would typically lead to net benefits (Chirarattananon et al., 2007).

[35] Energy Conservation (ENCON) Committee chaired by Deputy Prime Minister includes members from various government agencies i.e. Ministry of Science and Technology, Ministry of Industry, Office of the Economic and Social Development Board, Thailand Industrial Standard Institute, Comptroller General's Department, DEDEM and Department of Public Works, Town and Country Planning.

[36] Personal Communication (19 Jan 2012), Prof Surapong Chirarattananon, Asian Institute of Technology, Thailand.

A study was conducted to assess the potential energy saving benefits from the mandatory implementation of the new building energy code (Chirarattananon et al., 2010). The assessment was conducted by developing three building models corresponding to three possible cases of buildings i.e. the "base" case (buildings that do not carry out energy efficiency improvements), the "code" case (buildings that exactly comply with the standards set in the new code), and the "economic" case (buildings in which building components reach higher performance levels and lower life cycle costs than in the "code" case). The model assumes that compliance with the new building energy code begins in the year 2010.

The study estimated that the initial energy savings from the new building energy code were likely to be small, amounting to only 0.13% of the total energy demand of the commercial sector in 2010. However, energy savings are expected to rise over the years, as more and more buildings "over-comply" with the standards and the proportion of new and existing buildings that correspond to the "economic" case increase. The energy savings expected in 2016 amount to 1.4% of the total energy demand of the commercial sector and 10% of the total energy demand of large commercial buildings, while the energy savings expected in 2021 amount to 2.6% of the total energy demand of the commercial sector and 20% of the total energy demand of large commercial buildings. The *cumulative* energy savings from the new code amount to 3.3% by 2016 (as a percentage of the total energy demand of the commercial sector in that year) and 26.7% by 2021.

In addition, the Asia Business Council (Hong et al., 2007) has projected that the new building energy code will produce an additional 8–9% of energy savings when compared to the original code. The aforementioned analyses only consider the benefits of the new building energy code and refrain from considering the costs of implementing it. It remains unclear, therefore, whether the standards set in the building energy code are optimally set.

According to the Asia Business Council (Hong et al., 2007), 60% of existing buildings complied with the envelope requirements, 75% complied with the lighting requirements while close to 50% complied with the air conditioning requirements. The level of compliance is thus only moderately high. More significantly, coverage of the code is limited. Although the residential sector accounts for around 14% of total energy use compared to just 7% by the commercial sector, only commercial buildings are covered at all by the code. Within the commercial sector, only large buildings (existing buildings with energy consumption rates above 1.0 MW and new or retrofitted buildings with floor areas above 2,000 m^2) have to abide by one of the codes.

Building energy audits and retrofits complement the first-generation building energy code and increase the energy saving benefits from them, since audits allow identification of the buildings that comply or do not comply with the standards and retrofitting allows non-compliant buildings to improve their energy conservation performance. However, as already discussed, it is not clear whether the energy auditing and retrofitting approach is the most cost-effective way to constrain the energy consumption of the commercial sector. Energy audits and retrofitting for designated facilities under the Demand-Side Management (DSM) Program have had a limited impact. By 2000, although 433 building owners applied to participate in the program and the Demand Side Management Office (DSMO) had conducted 252 energy efficiency audits, only 34 projects were approved (Chirarattananon et al., 2007).

Financial incentives are expected to generate energy savings over their lifetime, though the extent to which they do so varies from fund to fund. For Energy Conservation Promotion Fund, a total of

THB 11.7 billion (US$ 390 million) was spent during the fiscal year period of 1995-2001 to provide financial support to energy conservation programs that were expected to return a saving of THB 12.2 billion (US$ 410 million) over their lifetimes (refer to Table 2.1.2). While this seems to indicate a positive rate of return on the energy efficiency investment, the energy savings accrue slowly over time whereas the costs are incurred initially (note from Table 2.1.2 that the savings per year have been outweighed by the average disbursement per year). Depending on the discount rate, therefore, net monetary benefits from the program may not necessarily be positive. On the other hand, the monetary calculation of energy saving benefits could underestimate the social benefits from such energy savings if the positive externalities from reduced energy use (e.g. environmental and energy security benefits) are substantial.

Table 2.1.2 ***Energy Conservation Promotion (ENCON) Fund budgets and savings potential***

	Compulsory	Voluntary	Other	Total
ENCON Fund Budgets				
Average per year (million US$)	15.5	14.9	18.3	48.6
Total disbursement (million US$)	124	119	165	389
Electricity Savings Potential (million kWh)				
Savings per year (million kWh)	129	51		181
Savings over project life (million kWh)	1,938	771		2,709
Avoided capacity (MW)	48	15		63
Fuel Savings Potential				
Savings per year (million liters crude)		48		48
Savings over project life (million liters crude)		666		666
Monetary Savings				
Savings per year (million US$)	8.7	18.4		27.1
Savings over project life (million US$)	130	277		407
Avoided investment (million US$)	73	22		95

Source: Asia Pacific Energy Research Center, 2003
Note: All figures In US$ are converted from THB using an exchange rate of 1 US$ = 30 THB.

Table 2.1.3 summarizes the costs and benefits from the other three financial mechanisms in operation, namely the Energy Efficiency Revolving Fund (EERF), the Energy Service Company (ESCO) Fund, and the tax incentives. Tax incentives provide the highest benefit (in terms of energy savings) relative to the initial cost, and have also leveraged the greatest total investment relative to the initial cost.[37]

[37] In addition to the studies summarized in Table 2.1.3, an Asia Pacific Economic Cooperation case study (Energy Futures Australia Pty Ltd & DMG Thailand, 2005) found that each dollar of lending from the Energy Efficiency Revolving Fund (EERF) resulted in more than US$ 10 in lifetime financial energy savings and leveraged around US$ 0.60 in private sector lending.

Table 2.1.3 ***Financial incentives for buildings in Thailand***

	EE Revolving Fund	ESCO Fund	Tax Incentive
Description	Low interest loan	Co-investment fund between public and private sectors	Income tax reduction
Number of EE and RE projects	250	17	327
Total investment	US$ 500 million	US$ 125 million	US$ 189 million
Benefit per annum (energy savings)	US$ 120 million	US$ 14 million	US$ 75 million
Cost (initial allocation from ENCON Fund or tax revenue reduction)	US$ 150 million	US$ 15 million	US$ 6.2 million
Benefit per annum / Cost	0.80	0.93	12.10
Investment / Cost	3.33	8.33	30.48

Source: Asawutmangkul (2010), Sinsukprasert (2009)

The Department of Alternative Energy Development and Efficiency (DEDE) and the banks share the responsibility of promoting the Energy Efficiency Revolving Fund (EERF) and educating the public with the prospect of the Fund. The DEDE runs seminars for participating banks, which in turn proactively promote the Fund to their customers.

(ii) Scientific Integrity

A positive feature of Thailand's policies is that they are generally based on scientific analyses and principles. For the building energy code, the key variable used to gauge the energy performance of the building envelope is the Overall Thermal Transfer Value (OTTV), which measures the size of the average heat gain across building envelope of a commercial building as sensed by the cooling coil of the building's air-conditioning system. The OTTV formulation is generated by using computer code to simulate annual cooling load of a generic building; the data is then utilized for OTTV formulation regression. Background justification for the methodology is provided by Chirarattananon & Taveekun (2004), and Chirarattananon et al. (2010) point out that this formulation provides "an accurate measure of the thermal performance of the envelope of a building." The methodology is also conceptually identical to that used in the Singapore code and the Hong Kong code. In addition, the performance for lighting and the air-conditioning system are measured by the Lighting Power Density (LPD) and Coefficient of Performance (COP) respectively.

The original building energy code had some shortcomings from a scientific perspective, since many of the system requirements that it specified were based on old technologies and had become outdated, while there was no differentiation into categories for different building types (Chirarattananon et al., 2010). However, the development of the new code takes into account updated technologies used in new equipment, while the standards set in the new code are differentiated according to the building type.

The process for determining whether an energy efficiency project can receive funding from the Energy Efficiency Revolving Fund also takes into account scientific evidence and analyses. The

feasibility study carried out by the applicant requires an assessment of whether the proposed energy efficiency measures are technically feasible as well as the likely energy savings from the project, while some banks carry out their own technical analysis of the proposed measures (Energy Futures Australia Pty Ltd & DMG Thailand, 2005).

(iii) Flexibility

The Thai government decided to revise the first version of the building energy code due to its limited success in conserving energy in commercial buildings. Some limitations in the earlier code included the absence of any economic justification for the system performance requirement, excessive emphasis on retrofitting existing buildings, and outdated standard values. The new building energy code was designed so as to account for these problems, i.e. by targeting new commercial buildings only. The process by which flaws in the original code were identified and a new building energy code was formulated indicates that Thailand's building energy efficiency policy process is responsive to changing circumstances. However, although the development of the new code began as early as December 2001, the new code was finalized and gazetted only in 2009. The lengthy process for updating the building energy code means that flexibility in the policymaking process is constrained. An APEC Peer Review on Energy Efficiency in Thailand suggested that the commercial building energy code should be updated every 3 years, whereas in the case of Thailand there was a gap of 14 years between the implementation of the original and new versions of the code.[38]

The new building energy code allows building owners greater flexibility in their choice of improving their building energy efficiency, compared to the original version. In the original code, a proposed building design would be accepted if it passed one or more of the three system performance-based requirements, i.e. building envelope, lighting, and air-conditioning. Revision of the code has introduced a new degree of flexibility, by allowing building designs which do not pass the three system performance-based requirements, to continue to be eligible for assessment under the whole building energy compliance option. The added flexibility of the new code is also likely to mean that energy savings under the new code will be achieved in a more cost-effective manner. If it is costly for building owner to satisfy the minimum requirements for one of the systems (e.g. air-conditioning), the new code gives the owner the option to "over-comply" in one of the other systems and thus achieve the same level of energy savings for the building as a whole at a lower cost.

The policy process for grants and other financial mechanism has been moderately flexible and responsive. For instance, when the Revolving Fund commenced in 2003, only owners of designated facilities were eligible to apply for funding for their energy efficiency projects. As such, the take-up of loans was slow in the first 18 months during which the Fund operated. This led to an extension of the eligibility criterion to include any commercial building and industrial facility, i.e., small and medium enterprises (SMEs) and third parties such as energy service companies (ESCOs). The main objective of the eligibility extension was to expand the Fund's target area and hence expedite the take up rate of loans. Since the eligibility criterion was extended in 2005, the take up has increased, but most banks are still reluctant to make loans to third parties due to lack of collateral. Still further adjustments to policy (for instance, provision of low-interest loans for energy efficiency improvements via channels other than through commercial banks) might be necessary to increase the take up rate.

[38] Asia Pacific Economic Cooperation (APEC) (2010), "Peer Review on Energy Efficiency in Thailand."

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

In planning new policies, public hearings with relevant stakeholders are considered standard protocol for the responsible government agencies.[39] Stakeholders include specialists, academics, suppliers and users (public) and about three to four hearings are held. Before the policies/laws are imposed, they are announced one year in advance to allow for an adjustment period. Following the implementation of policies, the DEDE monitors and evaluates the policies. The Department obtains feedback by conducting focus group sessions. This allows for the fine-tuning of policies every three to five years if needed. This process is likely to enhance transparency and stakeholder engagement.

In particular, the development of the building energy code in Thailand can be said to be transparent with respect to involvement of relevant stakeholders in the standard-setting process. Similar to Japan, the development and implementation of the standards is the responsibility of government authorities. However, the process features involvement from stakeholders. In the development of the building energy code, after alternative building systems with different performance levels were developed and life cycle costs were evaluated, the results were then used in a series of consultations with expert groups to determine the value of minimum performance requirement for each system i.e. building envelope, lighting system, air-conditioning system, absorption chillers, hot water system, and renewable energy (Chirarattananon et al., 2010). It has been noted that an effective collaboration between government agencies and academic institutions has contributed to the development and refinement of codes and standards in the Thai building sector (Hong et al., 2007). In addition, a manual that contains the requirements of the building energy code was published and more than a thousand copies were distributed to building professionals, enhancing availability of information on the code.

The process via which the financial mechanisms are designed also allows stakeholder views to be reflected. For instance, the DEDE's allocation of an initial budget of US$ 50 million (THB 2 billion) from the ENCON Fund to the Energy Efficiency Revolving Fund (EERF) was decided only after several discussions with Thai commercial banks, and the process for determining the policy took into account stakeholder views in a number of ways. The DEDE collected information about the value of loans which the banks were expected to make before issuing a credit line of US$ 2.5 to 10 million (THB 100 to 400 million) to each of participating banks over Phase 1 (2003 – 2006) of the program. It also proposed a fixed maximum interest rate to help the banks to cover management fees and loan risks while still ensuring attractive loans to project proponents. As a result, the banks provide loans to proponents of EE projects at the maximum interest rate of 4% per annum. In 2002, the DEDE and participating banks negotiated a contract to reach a mutual agreement for requirements and conditions of loans. The contract took 12 months to negotiate and prescribed that the banks will be allowed to terminate a default contract and replace it with another commercial loan.

(v) Alignment

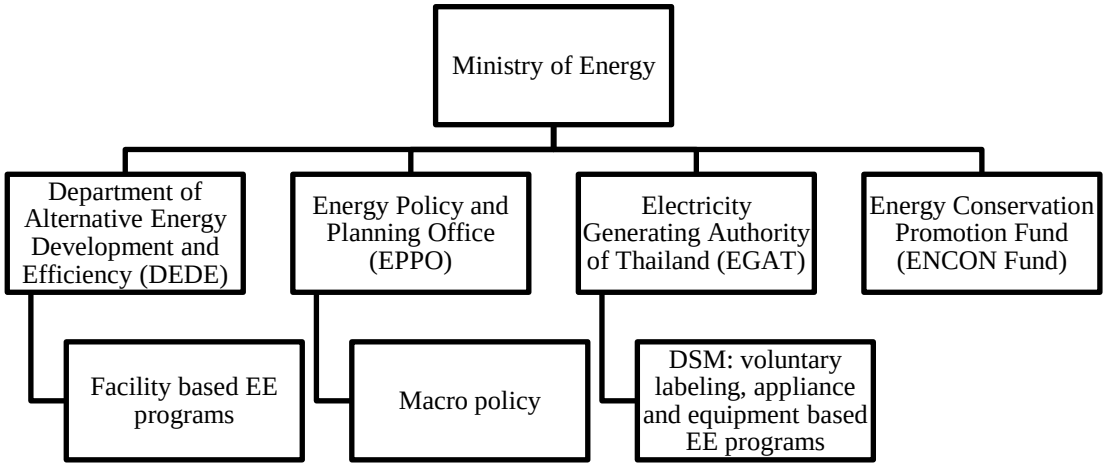
Energy policy in Thailand is decentralized, with multiple government agencies involved. Alignment between the various agencies can be a challenge, even though most of these agencies are

[39] This information was gleaned from interviews conducted with officials from the Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, Thailand (19 Jan 2012).

under the Ministry of Energy, which was formed in 2002 to assist alignment and coordination among them.

The building energy code is the main energy efficiency policy for the Thai building sector, and is also the policy for which the greatest number of government agencies is involved. The jurisdiction of each of the agencies involved is distinguished from one another. The Energy Policy and Planning Office (EPPO) is responsible for formulating overall energy policy, the Department of Alternative Energy Development and Efficiency (DEDE) formulates and determines building energy code requirements, and the Department of Public Works and Town & Country Planning (under the Ministry of Interior) administers and enforces the building energy codes. However, adequate coordination between the different agencies has often been lacking.[40]

Figure 2.1.5 ***Thai government agencies responsible for energy efficiency activities***



Source: Energy Futures Australia Pty Ltd, DMG Thailand, 2005

Alignment problems have limited the effectiveness of the energy audits conducted by the Demand Side Management Office (DSMO), which is an office within the Electricity Generating Authority of Thailand (EGAT), a state-owned electricity generating company (Hong et al., 2007). As noted earlier, although the DSMO carried out 252 preliminary energy efficiency audits, only 34 projects were approved. Since the energy audits are conducted only for designated facilities that do not meet the building energy code set by the DEDE, the successful implementation of energy audits requires collaboration between the DEDE and the DSMO. Chirarattananon et al. (2007) and the Asia Business Council (Hong et al., 2007) have both suggested that lack of effective collaboration and coordination between the DEDE and the DSMO is a significant reason why the energy audit program has not yet had a significant impact.

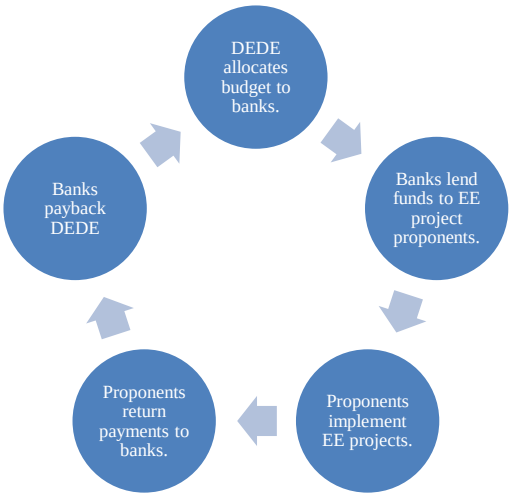
For other key policies, there is usually just a single authority involved, minimizing potential problems of a lack of coordination. The Energy Efficiency Revolving Fund (EERF), the Energy Service Company (ESCO) Fund and tax incentives are managed by the DEDE, while the Energy Conservation Promotion (ENCON) Fund is managed by its own Fund Committee.

Thai commercial banks are responsible for most aspects of the lending process for the various funds. The lending process for the Energy Efficiency Revolving Fund (EERF) comprises of several

[40] This information was gleaned from interviews conducted with academics from the Asian Institute of Technology, Thailand.

stages: the DEDE allocates budget to banks, the banks give loans to project proponents, the proponents implement energy efficiency project, the proponents return payment to the banks, and finally the banks pay back the DEDE (see Figure 2.1.6). The decision to appoint the banks in processing the loans has helped expedite investments in EE projects.

Figure 2.1.6 ***Energy Efficiency Revolving Fund***



Source: Energy Futures Australia Pty Ltd, DMG Thailand, 2005

Unlike Japan, in Thailand there is no direct link between building energy codes and financing mechanisms in the sense that provision of subsidies or loans is typically not contingent on the building meeting the standards. However, the various funds support energy efficiency projects, some of which go towards improving building energy efficiency, thus making it easier for buildings to meet the standards. Thus, the building energy codes and financial mechanisms are still aligned with each other, if in a different and more indirect way than in Japan.

The voluntary labeling program for buildings is, similarly, not aligned with the building energy code. The labels given by the labeling program for different levels of energy performance do not indicate (for large commercial buildings) the extent to which they comply with the building energy code. It should be noted that the labeling program is targeted at a much wider class of buildings than the building energy code, so the lack of alignment is unlikely to be a major drawback.

The Energy Efficiency Revolving Fund was established to overcome specific (largely informational and institutional) barriers to the implementation of energy efficiency measures. The barriers which hindered the progress of energy efficiency efforts included lack of awareness of energy efficiency improvement opportunities, the low priority given to energy costs in management decision-making due to limited access to capital, and excessive bureaucracy and paperwork associated with energy auditing and reporting. To overcome these barriers, the Revolving Fund was established to involve the Thai financial sector in providing low interest loans for energy efficiency improvements and renewable energy development. Thus, the Revolving Fund helps to complement measures such as energy auditing as well as policies such as building energy codes which are meant to encourage energy efficiency improvements in buildings and which become more effective if the barriers discussed above are removed.

2.1.3 Concluding Remarks

Japan and Thailand have utilized a similar mix of building energy efficiency policies that includes building energy codes, information programs, and fiscal and financial incentives. Information programs, in particular labeling programs, have been used to a greater extent in Japan. The policies in Japan target energy efficiency improvements in both commercial and residential buildings, whereas Thailand's policies are mostly targeted at large commercial buildings. In contrast to Japan, aggregate energy savings from Thailand's building policies are likely to be constrained by the fact that residential buildings are so far not included in most of the policies aiming to improve energy efficiency.

The formulation of building energy codes in Thailand takes into account economic cost-benefit analysis, with the choice of the standards based on an evaluation of expected lifetime costs. Such a procedure is more likely to ensure that the standards end up achieving an outcome that is socially optimal, and it is recommended that ex-ante economic cost-benefit analysis is incorporated into the formulation process for building energy codes in Japan as well. Ex-post analysis of the actual costs and benefits of the different policies is recommended for both economies in order to evaluate whether the policies are leading to socially optimal outcomes and to guide future revisions.

Japan has regularly revised its building policies in response to changing circumstances, for instance by strengthening energy standards for commercial and residential buildings in response to the rapid growth in energy use in the buildings sector since 1990. By contrast, regular revisions have not been a feature of Thailand's policies, with a gap of 14 years between the implementation of the original and new versions of the building energy code. Policymakers in Thailand should ensure that regular updates to its building energy efficiency policies are carried out to enhance their effectiveness and to ensure that policies are not outdated.

However, it is encouraging that Thailand's new building energy code allows building owners increased flexibility in how they wish to meet the targets. Even if a building does not satisfy the minimum requirements for a particular component (e.g. air-conditioning, lighting or building envelope), it can still comply with the code by ensuring that its overall energy consumption satisfies the standards. This is likely to enhance the cost-effectiveness of the standards and is an option that should be considered by Japanese policymakers in the implementation of their building energy codes.

Alignment between the various government agencies has been more of a challenge in Thailand than in Japan, even though Thailand has improved alignment by setting up a Ministry of Energy in 2002. Japan has implemented a series of measures to improve alignment, including consolidation of a number of government agencies into the Ministry of Land, Infrastructure and Transport (MLIT), simplification and consolidation of clerical work, and utilization of inter-ministerial committees to carry out changes to its energy conservation policy. In attempting to address issues of inter-agency alignment and coordination, Thailand should consider drawing from Japan's experience in the area.

Overall, Japan's building energy efficiency policies are comprehensive in their design, flexible and well-aligned. Thailand's policies are transparent and scientifically grounded and are expected to generate moderate energy savings, though problems of alignment and policy lags remain. In both economies, however, the extent to which the policies have cost-effectively met their respective energy efficiency objectives remains unclear.

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2.2 Transportation

The transportation sector is a significant consumer of energy worldwide. According to the International Energy Agency (IEA), transportation accounted for approximately 19% of global final energy consumption in 2007. Their forecasts for demand at the sectoral level suggest that 97% of the increase in world primary oil use between 2007 and 2030 will come from this sector (Kojima and Ryan, 2010). All transport modes are projected to show substantial increases in activity and fuel use in the future. Even in those regions where transportation energy efficiency policy initiatives have been in force for several decades, the growth in energy demand is expected to be substantial. For instance, in Europe, road transport will continue to dominate overall transport energy and oil use, accounting for nearly 80% of oil demand in 2050 (Mantzos and Capros, 2006).

Policymakers have sought to mitigate the accompanying energy security and greenhouse gas emission risks of oil-dominated road transportation. This has usually meant instituting policies that have centered on reducing the fuel used in this sector, essentially improving energy efficiency. Of late, technological change has brought alternative fuel vehicles, such as natural gas vehicles or those that run on biofuels, and electric drive vehicles into the limelight. Shale gas finds in the US and the possibilities of large reserves across the globe have raised the probability of natural gas-powered vehicles becoming a larger part of the vehicle mix. Increasing the proportion of biofuels in transportation is similarly purported to offset the need for imported crude oil. Electric vehicles offer the possibility of highly efficient motility.

However, each of the technological solutions has its own drawback. Electric vehicles offer limited range and require significant investment in the development of charging infrastructure. Most importantly, the vehicles are sold at a substantial premium to conventional internal combustion engine vehicles. These factors limit their suitability as a policy option. And though natural gas vehicles are competitively priced and often have lower operating costs than their petroleum fuelled counterparts, the construction of the requisite fuelling infrastructure is an expensive proposition. Biofuels offer their own set of issues, the fundamental being doubts as to the environmental friendliness of the fuel and the inability to scale up operations.

As of now, given the current state of technology and the projections of evolution of the same over the next few decades, the only feasible option for policymakers seems to be that of reducing energy use in the transportation sector via the institution of smart energy efficiency policies. These will also help economies achieve their environmental objectives. For instance, the International Energy Agency notes that policies that help to improve vehicle fuel economy are one of the most cost effective measures for achieving an overall CO_2 reduction target of 50% below 2005 levels by 2050 across the transport sector (Kojima and Ryan, 2010).

In this section, the transportation policies of the US and the Philippines will be critically examined. The objective will be to ascertain the genesis of each economy's transportation policy, to examine the efficacy of the instituted regulations, and to determine whether policy objectives were met. The differences in the approaches towards transportation policy of the US and the Philippines will also be considered.

2.2.1 Transportation in the US

Key Findings

- The main impetus for improving fuel economy in the US is energy security, with reduction of oil imports a national policy goal. Additional benefits of improving fuel economy include improved air quality, reduced carbon emissions and fuel savings for vehicle drivers.

- The key fuel economy policies are mandatory standards and labels, fiscal incentives and Research and Development (R&D) funding. These are used to improve the efficiency of conventional technologies such as diesel and gasoline engines, as well as to promote alternative fuel vehicles.

- Most fuel economy programs are expected to yield net economic benefits, whereas electrification of road transport has proven to be expensive. Policies are scientifically sound and determined by a transparent formulation process, but issues of alignment can arise and the strength of lobby groups can sometimes be problematic.

Costs, benefits and promotion

- Most of the various fuel economy programs that are currently in operation or will be implemented in the future are expected to yield incremental economic benefits that are greater than the incremental costs, though the magnitude of the net benefits depends on the discount rate adopted.

- There is considerable emphasis on the electrification of road transport, with various tax incentives for electric vehicles offered on top of existing incentives for alternative fuel vehicles up to the end of 2011. However, the high cost of electric vehicles has impeded their take-up and many of these tax incentives were not renewed when they expired on 31st December 2011.

Scientific integrity

- Fuel economy standards in the US are scientifically sound and are determined by a process that explicitly seeks to maximize lifetime economic net benefits from the imposition of the standards. Fuel economy labels have also been designed by taking into account the factors that influence consumers when purchasing vehicles, so as to maximize their potential effectiveness.

Flexibility

- Fuel economy policies are updated every five years, taking into account stakeholder feedback and changing technology. However the institutional structure does not allow for rapid adjustments to the standards, in response to changing circumstances, other than at the end of every five-year period.

- Fuel economy standards give manufacturers flexibility in how they choose to meet the standards.

Transparency

- Transparency is widespread as stakeholder engagement is central to the regulatory process for designing fuel economy standards. However, strong lobbying by car manufacturers partially contributed to the stagnation of fuel economy standards for cars.

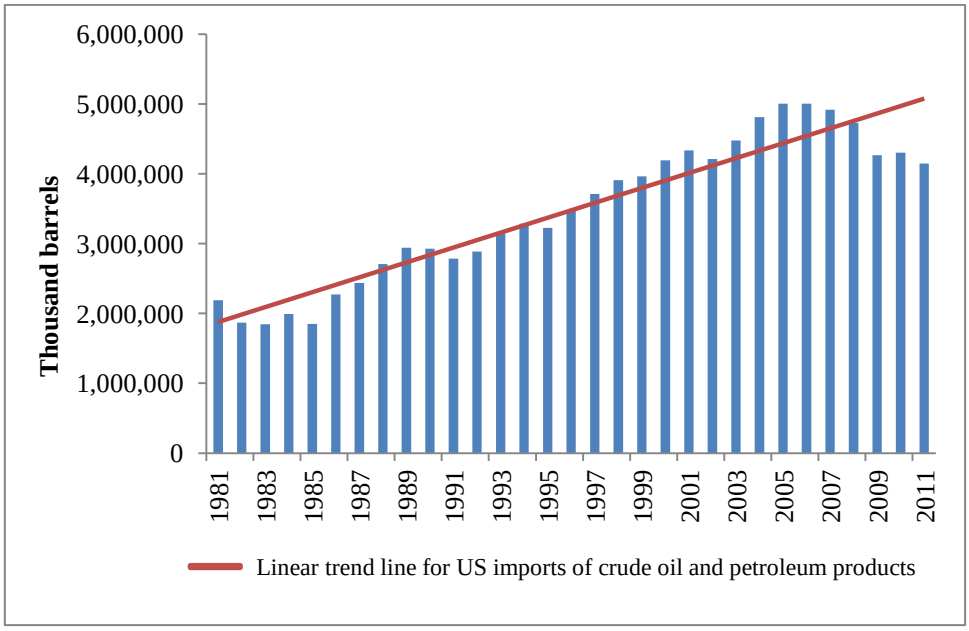
Alignment

- There have been improvements in coordination and alignment both among the authorities at the federal level and between the federal and the state governments in the management of fuel economy standards. However, in the absence of an institution to coordinate the different regulatory agencies whose policies affect the transportation sector, issues of alignment can arise.

A. Size and Significance

The transportation sector accounts for a significant proportion of energy consumption in the United States (US). In 2010, it accounted for 28.1% of energy consumption in the US (US Department of Energy, 2011a). Energy consumption in the transportation sector is largely in the form of liquid petroleum products; oil's share in transportation energy consumption stood at approximately 71% in 2010 (National Highway Traffic Safety Administration, 2012). A large part of the liquid fuels demand is increasingly met by imported energy. Figure 2.2.1 below shows the upward trend in crude oil and petroleum product imports from the late 1981 to 2011. As of 2010, net petroleum imports accounted for 57% of US domestic petroleum consumption (National Highway Traffic Safety Administration, 2012). This growing dependence has played an important role in US energy policy, particularly in the transportation sector.

Figure 2.2.1 ***US imports of crude oil and petroleum products***



Source: US Energy Information Administration (2012)

B. Policy Formulation

(i) History and background

Ever since the twin oil prices shocks of the 1970s, energy security has been the cornerstone of US energy policy. Policymakers have often considered energy dependence or energy independence as a measure of energy security. Energy dependence, which is the ratio of energy imports to total energy consumption, is viewed as a measure of the vulnerability of an economy to disruptions in energy markets.[41] The greater the dependence, the worse off is an economy purported to be. Several US presidents have reiterated the policy direction of energy independence in some form or the other since President Richard Nixon was in office in the early 1970s. Table 2.2.1 shows the long-standing impact that the idea of energy independence has provided to US energy policy.

Table 2.2.1 ***US's long-standing policy of energy independence***

President	Term in office	Energy policy goal	Plan
Richard Nixon	1969 - 1974	Energy independence by 1980	• Decrease industrial use of petroleum • Ration home heating oil and airplane fuel • Reduce red tape for nuclear power plant construction.
Gerald Ford	1974 - 1977	Energy independence by 1985	• More domestic oil drilling • Tariffs on imported oil • An end to price controls • Fast-tracked, coal-fired power plants • Tax credits for nuclear power plants • Increased home and vehicle efficiency • Development of synthetic fuels • Establishment of a strategic petroleum reserve
Jimmy Carter	1977 - 1981	Cut U.S. oil imports in half by 1985	• Conservation programs • Expanded use of coal and solar power • Development of synthetic fuels • Creation of the Energy Department
George H. W. Bush	1989 - 1993	Cut oil imports by one-third by 2010	• Fast-tracked pipeline construction • Incentives for natural gas use, new investments in energy research and development
George W. Bush	2001 - 2009	Cut 75 percent of oil imports from the Middle East by 2025	• Open more federal lands to oil and gas exploration • Expand subsidies for biofuels production • Fund research into hydrogen fuel cells, coal gasification, and other technologies
Barack Obama	2009 - date	Cut oil imports by one-third by 2025	• Stimulus spending on renewable-energy research • Tax credits for home energy efficiency

[41] Conversely, energy independence is defined as the ratio of domestically produced energy to total energy consumption. The greater the independence, the better off the economy.

			• A cap-and-trade system for reducing carbon emissions and making renewable energy cost-competitive • Expansion of offshore oil and gas drilling.

Source: Adapted from Homans, 2012

Scholars have questioned the desirability of energy independence as a national policy goal for the past three decades. For instance, an inquiry into the relationship between US oil imports and energy security by Crane et al (2009) of RAND Corporation noted that the gap between US production and consumption was substantial and that efforts at eliminating it would entail extraordinarily costly changes to patterns of consumption and production of fuels. Their analysis also revealed that even if there were sharp reductions in US oil imports, the price of oil in the United States would still be determined by global, not national, shifts in supply and demand. Hence, a large, extended reduction in the global supply of oil would trigger a sharp rise in the price of oil and lead to a sharp fall in economic output in the United States, no matter how much or how little oil the United States imports. Nevertheless, reducing energy dependence remains central to energy policy in the US.[42]

As such, given the fact that a large portion of transportation energy demand is met by imported energy, US transportation policy has focused on reducing import dependence. In 2011, President Barack Obama set a national goal of reducing oil imports by a third by 2025 (see Table 2.2.1) while increasing the production of hybrid, electric, and other clean transport alternatives. In particular, the US seems to be placing considerable emphasis on the promotion of electric vehicle technology.[43] In 2008, President Obama announced his goal of putting one million plug-in hybrid vehicles on the road by 2015 (The White House, 2011). Although Electric Vehicles technology dominates alternative fuel programs, there are also programs for fuel cell, natural gas vehicles,[44] and biofuel technology. In addition to the improvement of energy security, the National Highway Traffic Safety Administration has also publicized the other benefits of alternative fuel vehicles such as reduced carbon emissions and improved air quality. This is line with the observation that in recent years, environmental imperatives such as reducing greenhouse gas emissions have grown in importance in the design of transportation energy policy (Gallagher et al., 2007).

(ii) Policy Description

We consider four broad categories of policies in this section: mandates, fiscal incentives, financial incentives, and information programs.

[42] See for instance Fialka (2006) for the opinions of energy experts across several disciplines on the fallacy of the policy directive of increasing energy independence by using "domestic" but costly alternatives.

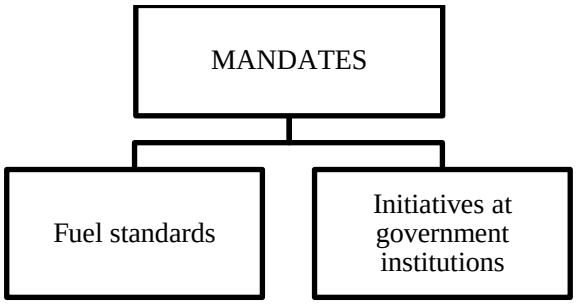
[43] The recent glut in natural gas in the US on account of the shale gas phenomenon has raised expectations of increased use of relatively clean natural gas in the US's electricity generation mix. By shifting transportation from liquid fuels to electricity via the use of electric vehicles, the expectation is that the US's energy security and climate change objectives will be met simultaneously.

[44] The perceived glut of natural gas could also drive the development of natural gas vehicles (NGVs). However, the difference in driving characteristics of these vehicles, such as acceleration, might reduce their popularity amongst consumers with strong preferences for vehicle performance. Furthermore, there are high costs associated with setting up refueling infrastructure for gas-powered vehicles.

MANDATES

There are two broad categories of mandates considered in this section: fuel standards and initiatives at government institutions (see Figure 2.2.2 below).

Figure 2.2.2 ***Broad categories of mandates***



Fuel standards

During the 1970s, the growing contribution of crude oil in the primary energy mix and the fact that an increasing proportion of the demand for crude oil was being met by imports led the US government to impose fuel economy standards.[45] The Energy Policy and Conservation Act (EPCA) in 1975 provided the issuance of corporate average fuel economy (CAFE) standards of 18 mpg [46] in 1978 for passenger automobiles (National Highway Traffic Safety Administration, 2012b). Manufacturers who failed to comply with CAFE standards are subject to a civil fine of US$ 55 per car per mpg (Cato Institute, 2002). This was followed by the enactment of the Gas Guzzler Tax in 1978 on passenger cars below 22.5 mpg (Environmental Protection Agency, 2011a). Manufacturers were fined anywhere from US$ 1,000 to US$ 7,700 for each car, depending on the extent of deviation from the standard.

With moderating energy prices following the 1970s, standards for passenger cars stagnated at 27.5 mpg from 1989 to 2010. The oil price spike in 2008 made energy issues prominent once again leading to fuel standards being raised to 30.2 mpg in 2011. These will further be raised to 37.8 mpg by 2016. Standards for light trucks[47] were introduced in 1979. These standards began at 17.2 mpg and rose gradually to 24.1 mpg in 2011. They are slated to be 28.8 mpg by 2016. Figure 2.2.3 below shows historical and future fuel economy standards for passenger cars and light trucks.

In 2007, the Energy Independence and Security Act targeted an increase of combined corporate average fuel economy standards to 35.0 mpg by 2020. In 2011, automakers agreed to a proposal by the White House to double the fuel economy of the vehicles they sell to a fleet wide average of 54.5 mpg by 2025 (Bloomberg, 2011).[48] The National Highway Traffic Safety Administration has proposed raising the corporate average fuel economy standards to 56.0 mpg for passenger cars and to 40.3 mpg for light trucks by 2025, bringing the combined fuel economy for both vehicle fleets to 49.6 mpg (see Figure 2.2.3).

[45] Aside from energy security considerations, the fuel economy standards were believed to help alleviate economic impacts such as the downward pressure on the US dollar and an increase in vulnerability to macroeconomic shocks.

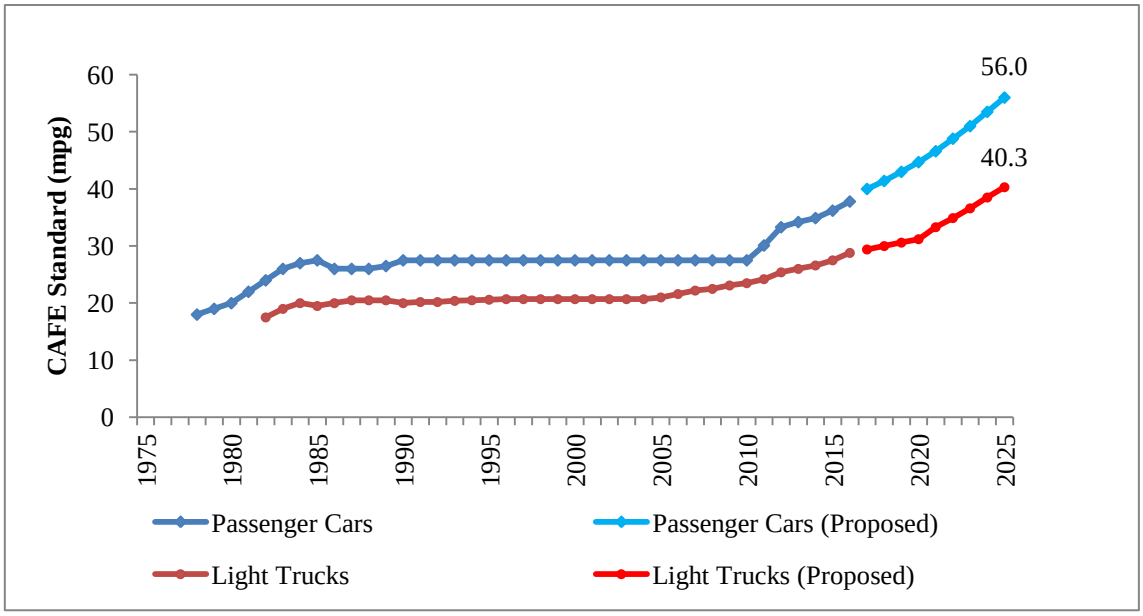
[46] Miles per gallon

[47] Light duty trucks include smaller (1/2 ton) pickup trucks, sport utility vehicles, minivans and similar vehicles with a gross vehicle rating of less than 8,500 pounds

[48] Automakers representing 90% of vehicles sold in the US agreed to the proposal.

In 2008, new Environment Protection Agency (EPA) testing procedures were added to reflect real world fuel economy more accurately (Environment Protection Agency, 2006).[49] From 2011, corporate average fuel economy standards were adjusted to reflect varying targets based on the vehicle size or "footprint."[50] Setting different standards for vehicles of different sizes solved the problem caused by previous standards which created the incentive for the production of smaller trucks and exposed drivers to greater safety risks.[51]

Figure 2.2.3 ***Historical and future proposed CAFE standards, 1978-2025***



Source: National Highway Traffic Safety Administration (2011)

The corporate average fuel economy (CAFE) law provides special treatment of vehicle fuel economy calculations for dedicated alternative fuel vehicles and dual-fueled vehicles,[52] giving them higher fuel economy ratings. For dedicated alternative fuel vehicles, the fuel economy is divided by a factor of 0.15 while for dual-fueled vehicles, the fuel economy is found by taking the average of the fuel economy of the gasoline or diesel engine with the fuel economy of the alternative engine as previously above (National Highway Traffic Safety Administration, 2004).

[49] From 2011, manufacturers will need to perform additional cold temperature, air conditioning and/or high speed/rapid acceleration driving tests for vehicles most sensitive to these conditions. The Environment Protection Agency's new fuel economy estimates will also reflect other road conditions that influence fuel economy such as road grade, wind, tyre pressure, load and the effects of different fuel properties. From 2008 to 2011, new calculation methods were used to capture these driving conditions, giving manufacturers time to plan for this additional testing and still provide consumers with reliable estimates of fuel economy.

[50] Footprint is determined by multiplying the vehicle's wheelbase by the vehicle's average track width.

[51] Earlier standards which were applied to vehicles of all sizes caused manufacturers to produce small light trucks with high fuel economy to offset the low fuel economy of large light trucks. Historically, the safest vehicles have been heavy and large while vehicles with highest fatal-crash rates have been light and small. Both, the crash rate as well as fatality rate per crash are higher for small and light vehicles. In addition, the diversion of car makers' efforts to improve fuel economy deprived consumers of other desired attributes such as greater acceleration, greater capacity, and reliability.

[52] Dual-fuel vehicles are motor vehicles capable of operating on alternative fuels and gasoline or diesel fuel.

Greenhouse gas (GHG) and fuel economy standards for model year (MY) [53] 2014 medium- and heavy-duty trucks [54] will be introduced. GHG emission standards range from 66-120g CO_2/ton-mile while final fuel consumption standards range from 6.5-11.8 gal/1,000 ton-mile. Greenhouse gas emission standards will also be introduced for passenger cars and light trucks beginning MY 2017 (Environment Protection Agency, 2012a). Box 2.2.1 below describes the key agencies involved in improving US fuel economy.

Box 2.2.1 ***Key agencies in improving land transport fuel economy***

Key Agencies

There are two key agencies involved in setting fuel economy standards and developing fuel economy labels

- The National Highway Traffic Safety Administration (NHTSA) administers the CAFE program, setting fuel economy standards for cars and light trucks sold in the US under the Energy Policy and Conservation Act (EPCE), as amended by the Energy Independence and Security Act (EISA).
- The US Environmental Protection Agency (EPA) manages the collection of fuel economy and related emissions data. This data is used in various federal programs such as in designing Fuel Economy and Environment Labels and setting EPA greenhouse gas emissions standards under the Clean Air Act.

Both agencies, upon the President's request in 2010, are working together to develop a national program that will produce a new generation of clean vehicles which responds to the economy's critical need to reduce oil consumption and address climate change.

Source: National Highway Traffic Safety Administration, 2012

Initiatives at Government Institutions

Unlike fuel standards, initiatives at government institutions directly affect only a small proportion of the vehicle fleet, since most vehicles are privately owned. Their direct impact on aggregate energy consumption from transportation is therefore likely to be limited. However, such initiatives can potentially have spillover effects if they trigger fuel economy improvements in the rest of the economy. For examples, regulations mandating alternative fuel vehicles for publicly owned fleets create a market for alternative fuel vehicles, which can then become available to private owners as well.

Federal Agencies and Departments

[53] In the US, automobile model year sales traditionally begin with the fourth quarter of the preceding year. So model year refers to the "sales" model year; for example, vehicles sold during the period from October 1 to December 30 of the following year are considered one model year.

[54] The heavy duty fleet incorporates all on-road vehicles rated at a gross vehicle weight at or above 8,500 pounds and the engines that power them. Trailers are exempted.

The Energy Policy Act of 1992 encouraged the use of alternative fuels [55] through both regulatory and voluntary activities and approaches. It required certain federal fleets to have alternative fuel vehicles (AFVs) as 75% of acquisitions from 2000 and beyond. Executive Order 13423 issued in January 2007 required federal agencies with 20 vehicles or more in their fleet to decrease petroleum consumption by 2% per year relative to their 2005 baselines through to 2015. Agencies were also required to increase their alternative fuel use by 10% year on year.

In October 2009, Executive Order 13514 required federal agencies to develop, implement, and annually update a Strategic Sustainability Performance Plan. Agencies had to measure, reduce, and report their greenhouse gas emissions with an overall goal of a 28% reduction in greenhouse gas emissions by 2020 from the 2008 baseline. These reductions could be achieved through the use of alternative fuel vehicles or through fleet optimization efforts. In May 2011, the Federal government announced the purchase of 100% alternative fuel vehicles by 2015[56] as well as a drive for agencies to reduce petroleum consumption by 30% by 2020 (The White House, 2011). With effect from January 2011, the Department of Defense was required to exhibit a preference for motor vehicles using electric or hybrid propulsion systems, including plug-in hybrid systems. Tactical vehicles designed for use in combat were exempt from this rule (US Code, 2011).

State Government and Alternative Fuel Provider Fleets[57]

The Energy Policy Act of 1992 also required the state government and alternative fuel provider covered fleets to acquire alternative fuel vehicles. The Act required 75% of covered state fleets' annual light duty, non-excluded vehicle acquisitions to be alternative fuel vehicles and 90% of covered alternative fuel providers' light duty vehicle acquisitions to be alternative fuel vehicles. Fleets are considered "covered fleets" if they own, operate, lease or otherwise control 50 or more non-excluded light duty vehicles and of those, at least 20 are used primarily within a single Metropolitan Statistical Area/Consolidated Metropolitan Statistical Area and are capable of being centrally fueled.

In March 2007, the Department of Energy announced "Alternative Compliance," which allowed fleets to meet the Energy Policy Act of 1992 requirements by reducing their petroleum consumption as an alternative to acquiring alternative fuel vehicles (which came to be known as "Standard Compliance"). Interested fleets have to obtain a waiver from the Department of Energy by proving that they will achieve petroleum reductions equivalent to that achieved by having alternative fuel vehicles running on alternative fuels 100% of the time (Alternative Fuels Data Center, 2011).

[55] Alternative fuels are defined under the Energy Policy Act of 1992 as pure methanol, ethanol, and other alcohols; blends of 85% or more of alcohol with gasoline; natural gas and liquid fuels domestically produced from natural gas; liquefied petroleum gas (propane); coal-derived liquid fuels; hydrogen; electricity; pure biodiesel; fuels, other than alcohol, derived from biological materials.

[56] In conjunction with the press release, the General Service Administration announced its initial purchase of more than 100 electric vehicles to be leased to 20 agencies. The General Service Administration manages federal fleets and buildings and hence will also coordinate on the installation of the necessary infrastructure.

[57] An alternative fuel provider is any entity whose principal business involves alternative fuels, persons whose principal business involved generating, transmitting, importing, or selling at wholesale or retail electricity and persons producing and/or importing an average of 50,000 barrels per day or more of petroleum
See http://www1.eere.energy.gov/vehiclesandfuels/epact/alt_fuel_provider.html

FINANCIAL INCENTIVES

Research and Development (R&D)

The Department of Energy supports research and development of alternative fuel systems. In 2007, the Advanced Research Projects Agency-Energy (ARPA-E) was established within the Department of Energy. In 2009, the ARPA-E received US$ 400 million of funding to support projects that will develop transformational technologies that reduce the nation's dependence on foreign energy imports, reduce the US's energy related emissions, improve energy efficiency across all sectors of the economy, and ensure that the US maintains its leadership in developing and deploying advanced energy technologies. Areas of focus include vehicle technologies, biomass energy, and energy storage (Advanced Research Projects Agency-Energy, 2012).

The latest example of the Department of Energy's support for research and development is the US$7 million award for research into reducing the costs of electric vehicle charging (US Department of Energy, 2011b). This came just months after US Energy Secretary Steven Chu announced that more than US$ 175 million would be spent over the next three to five years to accelerate the development and deployment of advanced vehicle technologies. The funding will support 40 projects in 15 states to research better fuels and lubricants, lighter weight materials, longer lasting and cheaper electric vehicle batteries and components and more efficient engine technologies (US Department of Energy, 2011c). A separate US$ 7 million was appropriated for independent cost analyses to support research into the development of fuel cells and hydrogen storage systems.

The Vehicle Technologies Program supports the Department of Energy and the Office of Energy Efficiency and Renewable Energy in strengthening US energy security, environmental quality, and economic vitality through public-private partnerships (Energy Efficiency and Renewable Energy, 2010a). The Department of Energy partners with industry to identify and select appropriate R&D objectives to achieve its and its partner's strategic goals. Projects are conducted through various mechanisms such as cooperative agreements, university grants, subcontracts, and research funded at the Department of Energy's national laboratories. Key areas of research include hybrid electric systems, advanced combustion engines, advanced materials, and fuels technology.

The Vehicle Technologies Program also undertakes research partnerships with industry and academia to develop and validate technologies. This ensures that the nation's best resources are applied to R&D activities and maximum technology transfer takes place, and allows industry resources to leverage government resources. The two main partnership programs are US DRIVE (Driving Research and Innovation for Vehicle efficiency and Energy sustainability) and the 21st Century Truck Partnership. The former seeks to accelerate the development of advanced technologies that are not yet market competitive and the latter is aimed at developing technologies for trucks and buses that can safely and cost effectively move larger volumes of freight and greater number of passengers.

FISCAL INCENTIVES

Tax Incentives

In order to bring about increased fuel efficiency, the federal government offers tax credits to incentivize consumers to switch to alternative fuels. Alternative fuels used in a manner deemed by the

Internal Revenue Service (IRS) as nontaxable are exempt from federal fuel taxes.[58] Tax credits were available for alternative fuel infrastructure through 31st December 2011; [59] tax credits for hydrogen fuelling equipment placed into service after 31st December 2005 were available for up to 30% of the cost, not exceeding US$ 200,000. Tax credits were also available for fueling equipment for natural gas, liquefied petroleum gas, electricity, E85[60] or biodiesel installed through to 31st December 2011, up to 30% of the cost, not exceeding US$ 30,000. Consumers who purchase qualified residential fueling equipment may receive a tax credit of up to US $1,000.

With regard to fuel cell vehicles in particular, tax credits of up to US$ 4,000 are available for the purchase of qualified light duty fuel cell vehicles. Tax credits are also available for medium and heavy duty fuel cell vehicles, with the credit amount dependent on vehicle weight. The credits expire on 31st December 2014. A tax credit of US$ 0.50 per gallon is available for liquefied hydrogen that is sold or used as a fuel by registered entities to operate a motor vehicle. As such, tax exempt entities such as state and local governments that dispense qualified fuel from an on-site fueling station also qualify for the incentive. This credit expires on 30th September 2014. A tax credit of US$ 0.50 per gallon is available for the sale or use of liquefied hydrogen used by registered alternative fuel blenders to produce a mixture containing a taxable fuel. This credit expires on 30th September 2014.

Additional tax credits are available specifically for new plug-in electric vehicles. The Energy Improvement and Extension Act of 2008, followed by the American Clean Energy and Security Act of 2009, granted tax credits for new qualified plug-in electric vehicles, ranging from US$ 2,500 to US$ 7,500.[61] Tax credits of up to US$ 18,000 were available for the purchase of qualified heavy duty hybrid electric vehicles with a gross rating of over 8,500 pounds. This expired on 31st December 2009. Converted plug-ins were also eligible for tax credits of up to 10% of the conversion cost (not exceeding US$ 4,000) through 31st December 2011. Additionally, tax credits of up to 10% of the cost of qualified low speed electric vehicles, electric motorcycles and three-wheeled electric vehicles (not exceeding US$ 2,500) were available through to 31st December 2011. The latter two incentives lapsed at the end of 2011, while the US$ 7,500 tax credit for new electric vehicles was continued as the Obama administration felt that it built a market for electric vehicles, which helps create jobs (Washington Post, 2012). Additional incentives are available at the state level, ranging from monetary incentives of up to US$ 7,500 and non-monetary incentives such as carpool lane access.

Incentives are also available for technologies that provide higher efficiencies and lower emissions. For instance, qualified on-board idling reduction devices [62] and advanced insulation are exempt from the 12% federal excise tax imposed on the retail sale of heavy duty highway trucks and

[58] Common nontaxable uses are: on a farm for farming purposes, in certain intercity and local buses, in a school bus, exclusive use by a nonprofit educational organization and exclusive use by a state, political subdivision of a state, or the District of Columbia.

[59] The tax breaks for alternative fuel infrastructure were not renewed and lapsed on 31st December 2011.

[60] E85 refers to fuel consisting 85% ethanol and 15% gasoline

[61] The tax credit starts from a base sum of a sum of US$ 2,500 with an addition of US $ 417 for each kWh of battery capacity over 5 kWh. This credit is capped at US$ 5,000

[62] Such types of equipment are meant to reduce the idling of a motor vehicle at a rest stop or other locations where they are temporarily parked or remain idle (Advanced Fuels Data Center) 2011.

trailers. States are allowed to exempt low emission and energy efficient vehicles from High Occupancy Vehicle (HOV) [63] lane requirements.

INFORMATION PROGRAMS

Fuel Economy Labeling

Fuel Economy labeling was introduced in the US in the mid-1970s, with every new car and light-duty truck being required to have a fuel economy label (Environment Protection Agency, 2011b). From model year 2013 onwards, redesigned labels will provide information on vehicles' fuel economy, energy use, fuel costs, and environmental impacts. They will also be required for all new vehicles including plug-in hybrids and electric cars.

Tire Fuel Efficiency Labeling

The Energy Independence and Security Act (EISA) of 2007 required that the National Highway Traffic Safety Administration develop a national tire fuel efficiency consumer information program to educate consumers about the effects of tires on automobile fuel efficiency, safety, and durability.[64] When the program is fully established, the information will be provided to consumers online and in the form of a label at the point of sale for replacement tires (National Highway Traffic Safety Administration, 2010). This is important as the rolling resistance of tires in the replacement market could be higher than those offered on new cars, and in the absence of information on the greater fuel efficiency of low rolling resistance tires, consumers have little incentive to purchase them as replacement tires due to their high cost and limited market availability.

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

Effect of standards on fuel economy levels

As seen in Figure 2.2.4, fuel economy levels rose from 1979 to 1985 and then stagnated. Thereafter, there was a gradual decline in fuel efficiency standards. This decline was a function of the fall in real gasoline prices in the 1980s. A study by the National Academy of Sciences (NAS) found that the corporate average fuel efficiency standards arrested what could have been a precipitous decline in fuel economy levels in the 1980s. Standards were found to push manufacturers in the direction of technology improvement (Board on Energy and Environmental Systems, 2002). In 1985, light duty vehicles had improved enough to meet corporate average fuel efficiency standards and from then on, car makers concentrated on improving performance and other attributes. Fuel economy remained essentially unchanged while vehicles became on average 20% heavier, with 25% faster acceleration from 0-60 mph (miles per hour).

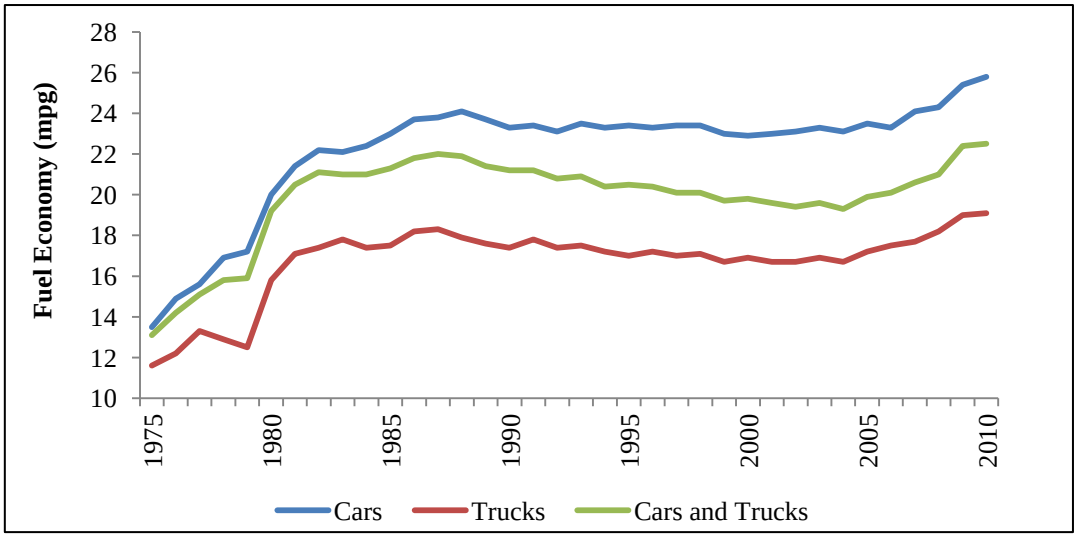
[63] High Occupancy Vehicle (HOV) lanes are added to existing facilities and only vehicles carrying 2-3 persons are allowed to travel on these lanes. The central concept for HOV lanes is to move more people rather than to move more cars.

[64] The rolling resistance, wet traction and tread wear life are measured as metrics of fuel efficiency, safety and durability respectively.

Corporate average fuel efficiency standards for passenger cars remained constant between 1989 and 2010, only being raised in 2011. This did not coincide with the trend in actual fuel economy levels, which began to rise in 2007. A more plausible conclusion is that the trend in fuel economy levels was influenced by the price of oil, which moderated in the 1990s and began a steep upward increase in 2007. This could mean that standards in the past 20 years were unable to influence behavior. The World Resources Institute estimates that revisions to the standards, namely raising car mileage to 42.0 mpg in 2025 and increasing light truck mileage to 32.0 mpg by 2025, would save the US about 3 million barrels of oil per day and reduce oil consumption by nearly 25% (World Resources Institute, 2008). As mentioned previously, the National Highway Traffic Safety Administration has proposed raising corporate average fuel efficiency standards to 56.0 mpg for passenger cars and to 40.3 mpg for light trucks by 2025, which would potentially generate a greater amount of fuel savings.

Aside from high oil prices, there were several other arguments to reverse the stagnation of standards and to raise them in 2011. The study by the National Academy of Sciences found that technologies to reduce fuel consumption significantly already existed and were in use in European and Japanese markets. It was also found that gasoline prices at that time did not take into account the impacts of fuel consumption such as greenhouse gas emissions and world oil market conditions (Board on Energy and Environmental Systems, 2002).

Figure 2.2.4 ***Adjusted fuel economy values (1975-2010)***[65]



Source: Environmental Protection Agency, 2010a

The Board on Energy and Environmental Systems has estimated that the corporate average fuel efficiency standards avoided the consumption of 2.8 million barrels of gasoline, or 14% of US consumption in 2001 (Board on Energy and Environmental Systems, 2002). Such benefits, however, are also accompanied by a variety of costs. Regulatory costs are one such cost. For instance, in financial year 2010, the National Highway Traffic Safety Administration spent $8.9 million administering the corporate average fuel efficiency standards (Department of Transport, 2011).

[65] The US EPA adjusts reported fuel economy values by taking into account conditions that occur on the road that affect fuel economy which do not occur during laboratory testing such as cold temperature, aggressive driving and excessive use of power hungry accessories.

Furthermore, consumers face higher prices when the costs of producing more efficient vehicles are passed on to them by automobile manufacturers.

Table 2.2.2 below shows the estimated costs and benefits of fuel economy standards in the US since standards were raised in 2011. The costs and benefits were calculated over the lifetime of vehicles manufactured in the model years (MY) for which the programs were in effect.

Table 2.2.2 ***Estimated costs and benefits of national fuel economy programs over the lifetime of the vehicles manufactured in their respective model years***

Program	Estimated Energy Savings	Estimated Environmental Savings	Estimated Benefits	Estimated Costs
Standards for light trucks, MYs 2008-2011	5.4 to 7.8 billion gallons of fuel	52 to 73 million metric tons (mmt) of CO_2 emissions	Incremental benefits estimated at US$ 8.1 billion	Incremental program costs estimated at US$ 6.7 billion from 2008-2011. Incremental cost per vehicle to rise $188 on average between MYs 2007-2011
Standards for passenger cars and light trucks, MY 2011	887 million gallons of fuel	8.3 mmt of CO_2 emissions	Between US$ 1 to US$ 2.3 billion in societal benefits[66]	Between US$ 0.8 million to US$ 2.2 billion[67] for owners of MY 2011 passenger cars and light trucks
Standards for passenger cars and light trucks, MYs 2012-2016	61.0 billion gallons of fuel	654.7 mmt of CO_2 emissions	US$ 52 billion to US$ 183 billion[68], most of which comes from reductions in fuel consumption and valuing fuel savings at future pretax prices.	Program costs estimated at US$ 52 billion.[69] Average vehicle prices were expected to rise on average. This ranges from US$ 434 per vehicle in MY 2012 to US$ 926 per vehicle in MY 2016.
Standards for trucks, MYs 2014-2018	530 million barrels of oil	270 mmt of GHG emissions	Fuel savings ranged from US$ 34 billion to US$ 50 billion, with benefits ranging from US$ 6.7 billion to US$ 7.3 billion.[70] Truck operators were expected to be able to be able to pay for the technology upgrades in less than a year and realize net fuel savings of US$ 73,000 over the lifetime of the truck. The US EPA estimates that improvements in air quality due to reductions in particulate matter and ozone will realize an additional US$ 1.3 billion to US$ 4.2 billion in societal benefits in 2030.	Program costs were estimated to be US$ 8.1billion
Proposed standards for passenger cars and light trucks, MYs 2017-2025	Four billion barrels of oil billion over the lifetimes of vehicles sold.	2 billion metric tons of GHG emissions	US$ 424 billion to US$ 522 billion.[71] Benefits to consumers come in the form of fuel savings ranging from US$ 5,200 to US$ 6,600, depending on the discount rate.	Programs costs range from US$ 168 billion to US$ 178 billion.[72] Vehicles prices to increase by US$ 2,000 but owners will enjoy fuel savings of US$ 5,200 to US$ 6,600 on average over the lifetime of the vehicle.

Source: National Highway Traffic Safety Administration, 2012

[66] These are at 7% and 3% discount rates respectively.
[67] These are at 7% and 3% discount rates respectively.
[68] These are at 7% and 3% discount rates respectively.
[69] The costs were the same at 3% and 7% discount rates.
[70] These are at 7% and 3% discount rates respectively.
[71] These are at 7% and 3% discount rates respectively.
[72] These are at 7% and 3% discount rates respectively.

As Table 2.2.2 illustrates, the National Highway Traffic Safety Administration reports that its fuel economy standards are, in general, expected to result in incremental benefits over their lifetime that exceed the incremental costs (whether the assumed discount rate is 3% or 7%, although incremental benefits are considerably larger with the lower discount rate). The difference between benefits and costs is expected to be greatest for fuel economy standards implemented over the period 2017-2025 for passenger cars and light trucks. The question that remains, of course, is whether these estimated benefits and costs will actually accrue in the future, which would also determine whether the standards are being set at the socially optimal level.

Critics of the standards argue that the program increases car buyers' costs. They estimate that the proposed model years 2017-2025 standards will raise vehicle prices by up to $5,000, causing an average buyer's monthly payments to go up by US$ 60 or US$ 70 (New York Times, 2012). This provides a disincentive for consumers from buying new cars, thus keeping old and less fuel efficient cars on the roads. Critics have also argued that domestic firms are more constrained by the standards than foreign firms. They instead propose raising taxes on gasoline to internalize externalities such as air pollution and traffic congestion (Cato Institute, 2002). According to modeling from Harvard's Kennedy School of Government (Morrow et al., 2010), setting high fuel efficiency standards could reduce carbon emissions from the transportation sector more than paying people to buy alternative vehicles would and cost the government much less. However, they found that a higher tax on gasoline would be much more effective and generate a socially efficient outcome.

More importantly, the true drawback of fuel economy standards, such as the CAFE standards, is that they do not encourage a potentially crucial element to reducing fuel use: driving less. In fact, ironically, increased fuel economy standards could have a perverse and unwelcome effect; better fuel economy will increase the fixed cost of driving (i.e. vehicle prices) but will actually reduce driving's marginal cost (i.e. fuel expenditures). To a degree, more fuel efficient cars will actually cause people to increase the number of kilometers they drive potentially offsetting the gains from improved fuel efficiency of their vehicles. This is commonly referred to as the "rebound effect" in the literature.[73]

The International Energy Agency (IEA) (2008a) has studied testing procedures for different fuel economy standards and compared the advantages and disadvantages of classifying vehicles by weight against classification by size. It was found that size-based standards are consumer-friendly since people would be more interested in comparing the fuel efficiency of vehicles with similar size than comparing the fuel efficiency of different vehicles (such as a sports car with a van) with similar weights. This approach is technology neutral and thus allows manufacturers to determine which measures to undertake in order to increase fuel efficiency of the vehicle. However, unlike weight, size is only indirectly proportionate to the energy required. This presents a possible loophole for the US system where two differently shaped vehicles could have different footprints but could have similar weights and aero dynamic drag, and therefore be subject to different standards while having similar fuel efficiencies.

Consumer preferences may change and cause an increase in the number of vehicles manufactured outside the range originally considered (which are therefore exempt from the standards). For example, there has been a gradual switch from passenger automobiles to light trucks and sport utility vehicles. As such, because the standard for light trucks has historically been less stringent than that for passenger cars, there was a decrease in overall average fuel efficiency in the mid-1990s. This

[73] For a description of what the rebound effect entails, see Saunders, Harry (1992), "The Khazzom-Brookes Postulate and Neoclassical Growth," Energy Journal 13: 131–148.

"leakage" problem was corrected when the program was reformed in 2006 to extend its scope (IEA, 2008a). In general, standards with greater coverage of vehicle types tend to lead to greater fuel savings but increase the administrative cost of testing vehicles and the cost of compliance.

Labeling

The fuel economy label in the US provides comprehensive information but it did not manage to arrest the slide in overall fuel economy mentioned earlier. This could either mean that labeling alone is inadequate in increasing fuel economy, or that the label was not designed well enough. The International Energy Agency (IEA) recommends the use of labeling accompanied by standards of an appropriate type and stringency to yield results as these work together to influence consumer choice. Labels should contain information such as the expected fuel efficiency range for most drivers, estimated annual fuel cost and a performance comparison with similar vehicles. Furthermore, it should show the relative performance of the vehicle relation to the standards that are in place (International Energy Agency, 2008a). In the absence of any data, it is not possible to obtain a dollar amount on the costs and benefits of such a program.

Incentives

While the US has rolled out several incentives to support plug-in electric vehicles, it recently allowed two of them to lapse at the end of 2011. Electric vehicles are expensive, so the incentives were criticized as being subsidies to the rich. While the government has argued that the tax credits help to stimulate the market for electric vehicles, hence leading to job creation, it is becoming increasingly apparent that electric vehicles are not ready for the mass market at the moment. Electric vehicle sales in 2011 fell short of expectations, with the Chevrolet Volt coming in below its 10,000 units forecast. In addition, safety concerns were raised when crash tests resulted in the battery bursting into flames (Washington Post, 2012). Sales of the Nissan Leaf worldwide also failed to meet its forecast of 20,000 units; however, this was also due in part to supply disruptions brought about by the Japanese earthquake and tsunami (Financial Times, 2012).

On the whole, it may be more cost-effective to focus on improving the fuel economy of conventional vehicles running on gasoline and diesel than to support alternative fuels which are still not cost competitive. The IEA's 2008 Energy Technology Perspectives projects that the fuel economy of new light-duty vehicles could be improved by 50% by 2030 using cost effective technologies, including but not limited to hybridization (International Energy Agency, 2008b).

Financial incentives targeted at improving fuel economy levels have not always been effective, though. One policy which attracted much controversy was the Car Allowance Rebate System, more popularly known as "Cash for Clunkers". Over the course of 2 months, nearly 700,000 new cars were bought using a subsidy of US$ 4,500, costing the government US$ 3 billion. The effect of this was to raise overall fuel efficiency by 0.65 mpg (Department of Transport, 2010). Proponents of the program hailed it as a success since it boosted the car manufacturing industry while at the same time increasing overall fuel economy, enhancing energy security, and protecting the environment. Critics however, argued that the subsidy did not add to net national wealth since it merely transferred money to one taxpayer's pocket from someone else's, in effect paying the taxpayer to destroy a perfectly serviceable asset in return for something he/she might have bought anyway. In addition, it was found that the program boosted US vehicle sales by just 360,000 in July and August of 2009 and provided no stimulus thereafter. Other estimates showed that about 45% of cash-for-clunker vouchers went to consumers who would have bought new cars anyway, meaning that the policy was rather inefficient.

(ii) Scientific Integrity

Setting fuel economy standards

Fuel economy standards are set based on analysis of currently available technologies. Feedback from manufacturers is also taken in account when deciding which technologies will be feasible (National Highway Traffic Safety Administration). In order to analyze the incremental costs to manufacturers and consumers brought about by fuel economy standards, the National Highway Traffic Safety Administration uses results produced by the CAFE Compliance and Effects Model, also referred to as the Volpe model.[74] The model considers as inputs the technologies along with their cost and energy savings potential. It then estimates the cost of compliance to a particular standard. In addition to this, the National Highway Traffic Safety Administration also studies other potential impacts of raising fuel economy standards. This includes the impact of higher prices on sales and employment, the rebound effect, and benefits from reducing emissions. Discount rates of 3% and 7% are applied to find the net present value of net costs and benefits of raising CAFE standards.[75]

As such, fuel economy standards in the US are scientifically sound, taking into consideration expected technological improvements over time, and are determined by a process that explicitly seeks to maximize the lifetime economic benefits (and minimize the costs) that can accrue from the standards.

Fuel economy labels

In order to revamp fuel economy labels to ensure that consumers have the most accurate, meaningful and useful information available to them, the US Environmental Protection Agency engaged PRR[76] to work with them in the design and implementation of several information protocols. This involved a literature review, focus groups, a national online survey of new vehicle buyers and engaging an expert to understand the factors that influence consumers when purchasing vehicles. The literature review found that the most important purchase factors were reliability, safety, price, and fuel economy (Environmental Protection Agency, 2010b). The findings of the study shaped the design of the new fuel economy labels, illustrating that the regulatory process aims to design the labels so as to maximize their potential effectiveness.

(iii) Flexibility

The National Highway Traffic Safety Administration updates the fuel economy standards every five years. The National Highway Traffic Safety Administration uses the five year period to elicit feedback on its existing program. This information is used as an input into subsequent programs. This institutional structure allows for limited flexibility, since it does not allow for adjustments to changing circumstances except at the end of every five-year period.

[74] This is a software developed by the Department of Transport's Volpe National Transportation Systems Center specifically for NHTSA's CAFE rulings

[75] 3% is considered to be the social rate of time preference, used when discounting future benefits and costs of regulations that primarily affect vehicle purchases while 7% is reflective of real economy wide opportunity cost of capital.

[76] PRR is a consulting firm that works in the fields of research, marketing, media and community relations, graphics design, and public policy.

The standards program, however, gives manufacturers the flexibility to decide how to meet the standards. The CAFE standards are imposed not on individual vehicles, but on a manufacturer's vehicle fleet as a whole. The manufacturer meets the standards as long as the average fuel economy of all vehicles it sells in a given year meet or exceed minimum fuel economy standards; this gives manufacturers the flexibility to decide on which vehicles to concentrate energy efficiency improvements. All of these features are meant to facilitate compliance from manufacturers, and in addition enable fuel economy improvements to be achieved at a lower overall cost.

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

Feedback and compliance from car manufacturers are vital in both the design and implementation stages of policy administration. The views of car manufacturers are taken into account in the process of policy making. In fact, the stagnation of CAFE standards was partially attributed to car companies lobbying successfully against higher CAFE requirements (World Resources Institute, 2008). This suggests that there exists a potential for regulatory capture when lobbies are too strong.

More recently, the National Highway Traffic Safety Administration formally requested comments from manufacturers and the general public on its proposal to reform the automobile fuel economy standards program in 2003 (National Highway Traffic Safety Administration, 2012). It also accepts comments from the public on its proposed rules for 60 days from the date the proposals are published. In addition, public hearings are held for the pros and cons of the program to be debated before the regulation is passed.

The National Highway Traffic Safety Administration and US Environmental Protection Agency have jointly proposed fuel economy standards for model years 2017- 2025. They have noted the long time frame in setting standards for model years 2022-25 and thus will undertake a comprehensive mid-term evaluation. Up-to-date information will be compiled for through a collaborative, robust and transparent process, including public notice and comment (National Highway Traffic Safety Administration, 2012). Thus, stakeholder engagement continues to be integral to the process of designing the CAFE standards, although the risk of regulatory capture by strong lobbies is not mitigated.

(v) Alignment

CAFE standards are implemented jointly by the National Highway Traffic Safety Administration, which sets the standards, and the Environmental Protection Agency, which implements the associated labeling program and tests vehicle efficiency (National Renewable Energy Laboratory, 2009). The clear delineation of roles between the two agencies means there is less likelihood of potential mismatches in coordination and alignment between the regulators.

Historically, the federal government has had jurisdiction over setting fuel economy standards, but in June 2009 the state of California was granted a waiver to allow it to establish a separate and higher fuel efficiency standard. Thereafter, thirteen other states and Washington D.C. followed suit. However, soon after that the federal standards were updated so that they remained in alignment with the California standards. There is also growing alignment of fuel economy standards at the state level, with many states forming regional collaborations (such as the Western Climate Initiative) to address climate change issues and in doing so, aligning their fuel economy standards with each other. Fuel

economy labeling is implemented solely by the federal government, which reduces the chances of policymaking conflict among different government levels.

As mentioned previously, President Obama has requested for the National Highway Traffic Safety Administration and US Environmental Protection Agency to collaborate on building a national program that will produce a new generation of clean vehicles. This has resulted in joint efforts by both agencies to launch its first fuel efficiency and GHG programs for model years 2012-2016, as well as a second program proposed for model years 2017 – 2025, which appears to reflect a move towards increased alignment and coordination among the two authorities. However, in the absence of an institutional mechanism to facilitate the change, it is unclear whether this desirable practice will continue.

2.2.2 Transportation in the Philippines

Key Findings

- Similar to the US, the drive to increase fuel economy in the Philippines is motivated by energy security concerns.
- There is a drive towards alternative fuels as these not only reduce oil consumption but are also considered to be less polluting in nature. Retrofitting of existing vehicles to run on alternative fuels helps to renew the fleet, which provides an additional boost to improving efficiency. The government has made available over US$ 24 million in soft loans for drivers to convert their engines to natural gas vehicles.
- There are no standards or labeling programs in the Philippines, as insufficient data make it cumbersome for such programs to be implemented. In addition, fuel economy is not a consideration for consumers when they are in the process of purchasing a vehicle.
- The drive towards the use of alternative fuels has been of mixed effectiveness. The use of biofuels in vehicles is likely to lead to significant energy savings and emission reductions at a relatively moderate cost, whereas the use of natural gas vehicles is initially highly expensive and relatively ineffective at reducing either energy use or greenhouse gas emissions. Policymaking is characterized by robust stakeholder engagement, but problems of conflicting objectives of different stakeholders and lack of alignment can arise.

Costs, benefits and promotion

- The use of biofuels in vehicles is likely to lead to significant energy savings and emission reductions at a relatively moderate cost.
- Natural gas vehicles are relatively ineffective in reducing energy use or greenhouse gas emissions, while they are initially highly expensive due to the large capital investment required in developing pipelines and fueling infrastructure and the high costs of compressed natural gas buses.

Scientific integrity

- The scientific basis for switching to compressed natural gas, under the government's Alternative Fuels Program, is questionable from an energy efficiency basis, as compressed natural gas buses have been found to be generally less fuel efficient that diesel buses.

Flexibility

- Most policies do not impose mandatory requirements, giving manufacturers and owners the flexibility to decide whether and how to improve the fuel economy levels of their vehicles.

Transparency

- The involvement of stakeholders is perceived as important whilst drafting regulatory policy.

However, consultations with several stakeholders have on occasion faced drawbacks arising from conflicting objectives of different stakeholders, which may seem difficult to overcome.

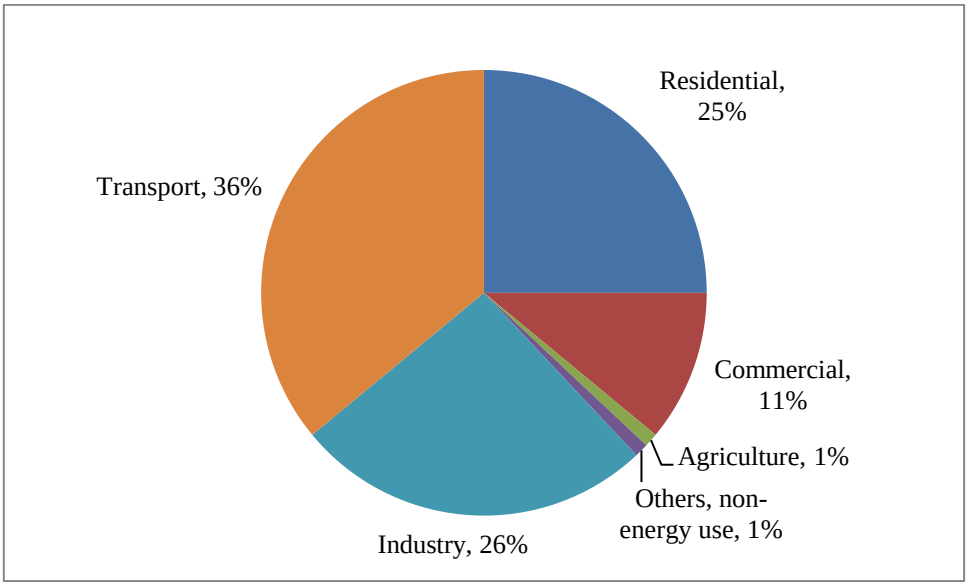
Alignment

- There are several government organizations with different mandates that are directly or indirectly involved in setting regulations that could affect the transport sector. Given that there is no formal institution to ensure that these organizations coordinate on their policies, issues of alignment can arise.

A. Size and Significance

As of 2010, the Philippines had an energy demand of approximately 24.74 million tons of oil equivalent (Mtoe). The Philippine Department of Energy estimates that the next two decades will see a growth rate of total energy demand of at least 3.5 to 3.6% per annum. The transportation sector was the biggest contributor to energy demand (amounting to approximately 9 million tons of oil equivalent in 2010). Figure 2.2.5 gives the sectoral shares of final energy demand. It shows that the transport sector's share in final energy demand is approximately 36%. Crucially, energy demand from the transportation sector is expected to grow at a rate of 3.8% per annum up until 2030 (Philippines Department of Energy, 2012).

Figure 2.2.5 ***Sectoral demand shares in the Philippines (2010)***

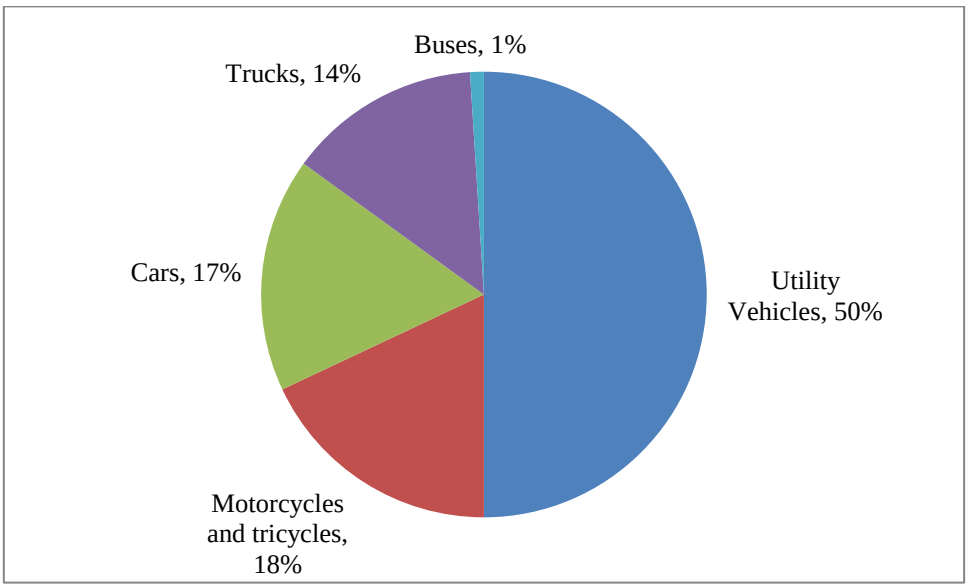


Source: Philippine Department of Energy, 2010

Imported oil comprises over 90% of national oil consumption in the Philippines. The transport sector has been one of the major and fastest growing consumers of oil. In 2003, the transport sector accounted for 46% of total oil consumption of the Philippines, a figure that is rapidly increasing at an annual growth rate of 4.9% (Food and Agriculture Organization of the United Nations, 2009). Of the different vehicle types, public utility vehicles (which include vans and other light duty vehicles) have historically been the largest consumers of fuel. Figure 2.2.6 below shows the fuel consumption of

vehicles by type in 1996. Fuel consumption of public utility vehicles accounted for approximately half of the fuel consumption of the transportation sector. Interestingly, two-wheeler and three-wheeler (motorcycle and tricycle) fuel consumption demand rivaled that of cars in 1998. To date, motorcycles and tricycles still contribute significantly to road transport.[77]

Figure 2.2.6 ***Fuel consumption of vehicles by type in 1996***



Source: Philippines Department of Energy, 2010

B. Policy Formulation

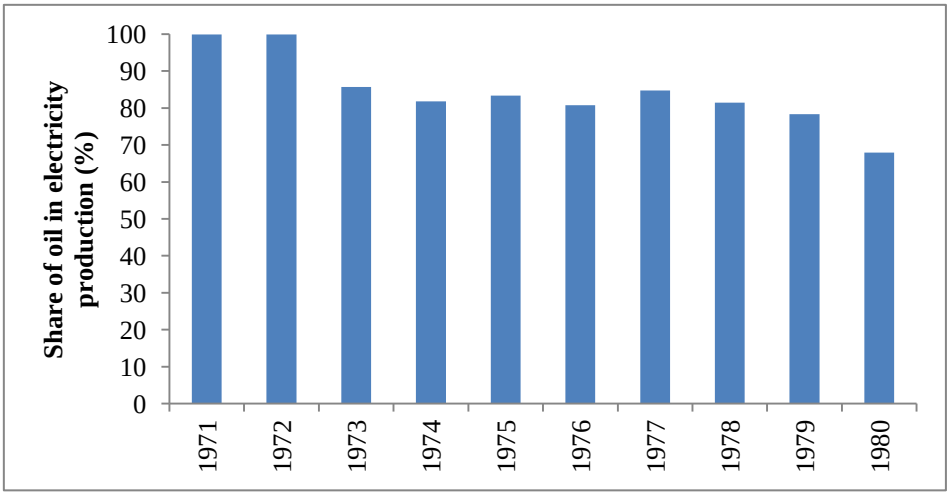
(i) History and Background

The oil shocks of the 1970s set the tone for energy policy in the Philippines. At that time, the Philippines was highly dependent on crude oil not just in the transportation sector but also in the electricity sector. Figure 2.2.7 below shows the share of oil in electricity production in the 1970s.[78] Even at the end of 1970s, oil's share in electricity production was greater than 60%. Energy conservation became the policy objective with strict energy conservation policies such as scheduled rotating brownouts implemented to reduce energy demand.

[77] This is based on interviews with officials from the Philippines Department of Energy (16 April 2012).

[78] Over the years, this share has dropped gradually. From 2005 onwards, oil's share in electricity production has been approximately 10% (Global Energy and CO_2 Data, Enerdata (2012)).

Figure 2.2.7 ***Share of oil in electricity production (1970 – 1980)***



Source: Global Energy and CO2 Data, Enerdata, 2012

The energy shocks of the 1970s resulted in the passage of several energy conservation laws by the Batasan Pambansa (BP) or National Assembly of the Philippines. These largely came in the form of Letters of Instructions (LOIs) and Presidential Decrees (PDs). These emphasized the promotion of energy efficiency and conservation and the raising of public awareness of the same. The primary policy focus was the improvement of energy security of the Philippines. Over time, the policy directive has evolved to include goals of developing indigenous resources, reducing local pollution, maintaining reasonable energy prices, and improving the sustainability of the energy system.

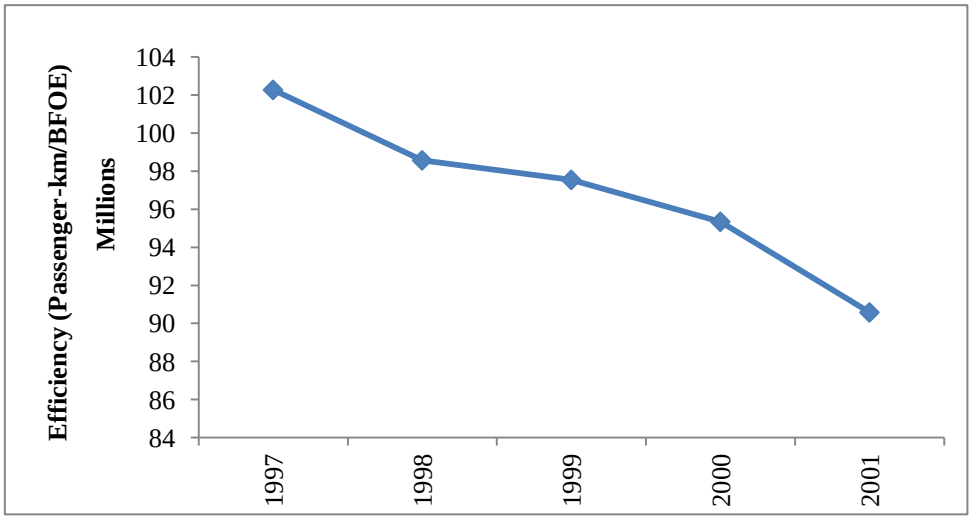
In 2007, the National Energy Efficiency and Conservation Program (NEECP) was implemented as a 7 year program, part of President Arroyo's goal to achieve 60% energy self-sufficiency by 2010. Aside from transport, the program includes measures that cover the government, industrial, residential, commercial, and agricultural sectors. Subsequently, the Renewable Energy Act of 2008 (also known as the Republic Act 9513) was passed which gave impetus to the development of the economy's renewable energy resource.

With regard to the transportation sector, it seems plausible that the increase in oil consumption from the sector is partly due to a fall in transport efficiency.[79] Figure 2.2.8 shows the passenger transport efficiencies for road transport. From 1997 to 2001, passenger transport efficiency fell over 10%, from 102,276 passenger-km/energy Bfoe (barrels of fuel oil equivalent) to 90,581 passenger-km/Bfoe. From 1990 to 2005, energy intensity of transport doubled from 0.013 koe/$95peso (0.52

[79] No formal study has been carried out to study why road transport efficiency has fallen, but it could be partly to the increase in the population of public utility vehicles and motorcycles/tricycles which rose by 19.7% and 40.6%. respectively from 1997 to 2001. Assuming a full passenger load, buses and cars are more fuel efficient than motorcycles and tricycles, while buses are more fuel efficient than public utility vehicles, due to their larger carrying capacities. Furthermore, from 1997-2001, the total vehicle population rose 16.6%. This could have contributed to increased road congestion, thus lowering fuel efficiency. The increased life of vehicles also means that older, more inefficient vehicles are being retired from the market at a slower rate, further contributing to falling transport efficiency.

koe/US$) to 0.026 koe/$95peso (1.04 koe/US$) (Bayot et al, 2006).[80] This shows that transport efficiency has been falling. This has contributed to the rise in the absolute amount of fuel consumed.

Figure 2.2.8 ***Road transport efficiency (1997-2001)***



Source: Bayot, et al, 2006

(ii) Policy Description

MANDATES

The Philippines has been quite active in setting economy-wide energy efficiency targets including energy efficiency targets for its transportation sector. As per the 2009–30 Philippine Energy Plan (PEP), the government set a target reduction of 10% of final energy demand for the commercial, residential, industrial, transport, and agricultural sectors (Institute of Energy Economics, Japan, 2010). The Department of Transportation and Communication (DOTC) has 5 fundamental strategies to promote fuel efficiency in the land transport sector (Philippines Department of Energy, 20008), namely:

- Increase vehicle efficiency through the modernization of the public transport fleet and the enforcement of vehicle standards.
- Switch to alternative fuels such as liquefied petroleum gas (LPG), compressed natural gas (CNG), and electric vehicles.
- Switch to energy efficient transport modes including high occupancy mass transport system, railways, a rapid bus system, and non-motorized transport.
- Decrease travel distance and travel time through traffic decongestion measures and the clearing of roadways of obstructions.
- Increase vehicle load factor by promoting bigger capacity vehicles.

With regard to the biofuels sector, the national biofuels regulator under the Department of Energy aims to maximize biofuels contribution for fuel transport. The Department of Energy has mandated a minimum of 10% blend of ethanol into gasoline and a 2% blend of biodiesel in petroleum diesel distributed and sold in the Philippines. The development of biofuels policies in the Philippines takes

[80] Koe refers to thousands of barrels of oil equivalent; $95peso refers to 1995 prices at purchasing power parity. We assume that 1 US$ = 40 pesos.

into consideration alternative feedstocks,[81] logistics, fuel compatibility, and price (a high price is not sustainable due to the dependence of public transport on diesel).[82]

Standards

Unlike the US, fuel economy standards have not had a place in the Philippines road transportation policy toolkit. However, standards governing the use of alternative fuels have been implemented. As part of the Natural Gas Vehicle Program for Public Transport, 48 sets of International Standards Organization (ISO) standards were adopted as the Philippines National Standards in June 2003. These covered CNG fuel system components, rules covering the quality of natural gas, and analytical methods to determine the composition of natural gas. Other standards covered code of practice for CNG compressor refueling stations regarding on-site storage and location of equipment (Philippines Department of Energy, 2005a).

In 2006, the Department of Energy implemented standards to regulate the different components of an autogas program.[83] Similar to that for CNG, these standards are not fuel economy standards for vehicles running on autogas but standards for specific equipment, installation of systems, and code of practice (Philippines DOE, 2005a).[84] In addition, 11 sets of Philippine National Standards were implemented in 2008 for electric vehicles (Philippines Department of Energy, 2010).

Initiatives at Government Agencies

The Government Energy Management Program (GEMP) was put in place in 2004 specifically to improve the conservation of fuel used in government vehicles and improve the energy efficiency of government building electricity use. This Program came into effect as per Presidential issuances such as Administrative Orders Nos. 103, 110,126, and 183. It directs government agencies to reduce their fuel and electricity consumption by at least 10%. Strategies to reduce energy usage include changing behavior to use fuel more efficiently as well as using CME[85] blended diesel fuel, the observance of austerity measures, and the use of energy efficient lighting (Philippines Department of Energy, 2005b). The Department of Energy executes this Program, which involves the monitoring of fuel and electricity consumption of all government departments, bureaus, government-owned and controlled corporations, and academic institutions.

FISCAL INCENTIVES

Fuel Subsidies

Fuel subsidies lower the salience of the cost of fuel prices and discourage drivers from switching to alternative fuels which are operationally cheaper and can be more efficient (Interlaboratory Working Group, 2000). Hence, fuel subsidies negatively impact transportation fuel efficiency.

[81] The feedstock used in the production of biofuels in the Philippines is coconut oil. The price of the same is quite high when compared to the fossil fuel alternatives

[82] This is based on interviews with officials from the Philippines Department of Energy (16 April 2012).

[83] Autogas is the common name for liquefied petroleum gas (LPG) when it is used as a fuel in internal combustion engines in vehicles. It is a mixture of propane and butane.

[84] Philippines DOE, Autogas, Philippines

[85] CME refers to coco-methyl ester, a biodiesel derived from coconut oil

The Philippines has done away with fuel subsidies for the most part. However, although the subsidy of fuel prices was ended in 1998 due to the "Downstream Oil Industry Deregulation Act of 1998,"[86] the government still steps in to provide funding for fuel discounts. In January 2011, soaring oil prices resulted in the price of petroleum rising by more than 20 times. This prompted President Benigno Aquino III to approve a 500 million peso[87] fuel subsidy to public utility jeepneys and tricycles (Inquirer, 2011).

President Benigno Aquino III approved an executive order granting fuel subsidies to public utility vehicles, a move seen to cushion the effects of the continuing oil price increases resulting from political and civil unrest in Middle Eastern economies. The subsidy was to be allotted to jeepney and tricycle drivers through "fuel assistance smart cards," which will be issued by the Land Bank of the Philippines (LBP). Good for a period of one month, the cards would allow jeepney and tricycle drivers to enjoy discounts of anywhere from 2 to 3 peso per liter of fuel (US$ 0.05-0.07 per liter).[88] However, the subsidy could only be enjoyed by those who had valid franchises from the Land Transportation Franchising and Regulatory Board (LTFRB). Funds for the subsidy were to be sourced from government savings and were not to cover buses given that a bus fare hike was recently approved. In November 2011, the government confirmed that they were willing to extend the subsidies as the prices of gasoline and diesel had not fallen (Sunstar, 2011).

Legislative Support for Alternative Fuel Vehicles

In October 2011, Senator Ralph Recto proposed "An Act providing incentives for the manufacture, assembly, conversion, and importation of electric, hybrid and other alternative fuel vehicles." The proposed act consisted of fiscal and non-fiscal incentives to the importation and manufacture of electric, hybrid, and other vehicles. Fiscal measures include exempting manufacturers from payment of excise taxes and duties and from payment of value added tax for the purchase and importation of materials for nine years. Owners of alternative fuel vehicles would be exempt from paying the motor vehicle user's charge upon registration of their vehicles. Non-fiscal measures include free parking, priority in registration and issuance of license plates, priority in franchise applications for public utility vehicles and exemption from the Unified Vehicular Volume Reduction Program (UVVRP)[89] (Institute For Climate And Sustainable Cities, 2011). In 2011, Energy Secretary Rene Almendras publicly endorsed the use of electric vehicles and pushed for giving tax incentives for the importation of electric powered vehicles (Malaya, 2010). As of January 2012, there was no news on whether these proposed Acts and incentives were passed.

Demand Side Management

In addition to the usage of technological means to reduce energy use, the Philippines has plans to use vehicle demand management policies to curb the demand for vehicles. The Unified Vehicular

[86] The Downstream Oil Industry Deregulation Act of 1998 allows oil companies the freedom to set prices based on an unregulated, competitive market structure.

[87] This would approximate to a subsidy of US$ 12.5 million at current market exchange rates of 1 US$ = 40 pesos.

[88] Assumed exchange rate of 1 US$ = 40 pesos.

[89] The Unified Vehicular Volume Reduction Program is designed to reduce the amount of vehicular traffic in Metro Manila. Since 1995, motor vehicles whose license plate ends in a particular number are barred from using the main streets of Metro Manila on certain days from 7am to 7pm. For instance, license plates ending with numbers 1 and 2 are banned on Mondays. The rule does not apply on Saturdays, Sundays and official public holidays. See http://www.mmda.gov.ph/MMDAMC/MMDAMC03-11.html

Volume Reduction Program (UVVRP) mentioned earlier was carried out to reduce congestion and effectively improve vehicular efficiency. However, elected officials are reluctant to further these initiatives by implementing tougher polices, such as congestion pricing and vehicle taxes based on fuel standards, due to public opposition (World Bank, 2010).

Improving public and non-motorized transport

Given the efficiency of public transportation and the railways, the Philippines is looking to promote public and non-motorized transport in some of its major cities. The Metro Manila Development Authority is planning investments that would enhance bus routes, result in new terminals, improve existing bus stops, and regulate short-running of buses to meet hourly demand. Approximately 50 km of Bus Rapid Transit (BRT) lines have been planned, starting with a 15 km corridor in Cebu by 2013. There is also on-going construction as well as plans to extend light rail transit lines in Manila. In 2011, an additional 11.7 km of light rail transit lines were announced, together with an impending phase-out of taxis after 10 years, utility vehicle expresses after 15 years and 10 years for multi-cabs.[90] Non-motorized transport is promoted by providing segregated cycle paths in cities. Sidewalks are also being cleared and improved to facilitate pedestrian traffic (Vergel, et al, 2005).

FINANCIAL INCENTIVES

Alternative Fuel Programs

The Philippines has several initiatives to rationalize the use of fossil fuels. In September 2011, the Philippine Department of Energy announced plans to accelerate its alternative fuel sources program, the Fueling Sustainable Transport Program (FSTP), which will convert oil-fuelled vehicles to run on electricity, CNG, or LPG (Manila Bulletin, 2011). The program not only serves to modernize the transport system of the economy but also to standardize the type of fleets serving the public. The government is implementing an "Alternative Fuels Program" which taps into the economy's domestic resources as viable sources of energy. It comprises four major subprograms, namely the Biodiesel Program, Bioethanol Program, Natural Gas Vehicle Program for Public Transport and Autogas Program. Other technologies being advocated are hybrid, fuel cell, hydrogen, and electric vehicles.

In 2004, President Arroyo signed an Executive Order No. 397 to promote low engine displacement and hybrid vehicles by reducing the rates of import duty on completely-knocked-down parts and components for such vehicles. This was followed by Executive Order No. 488 in 2006 which reduced the import duty of components, parts and accessories for the assembly of hybrid, electric, flexible fuel, and CNG motor vehicles (Official Gazette, 2006).

The use of the four-stroke engine for motorcycles and tricycles is also being encouraged together with the entry of electric-powered motorcycles or electric bikes to facilitate the elimination of two-stroke motorcycles (Clean Air Initiative, 2010). In 2008, the government launched a billion (peso) soft loan program to help owners of jeepneys, buses and taxis to convert their diesel or gasoline fed engines into ones that would run on alternative fuels (Clean Air Initiative, 2010). The then-President

[90] Utility vehicle expresses and multi-cabs are taxicabs of the Philippines. Similar to jeepneys, they are classified under utility vehicles but vary in seating capacity and ceiling height. See http://www.easts.info/on-line/proceedings_05/90.pdf

Gloria Arroyo announced a goal of 10,000 vehicles that would use cheaper and cleaner alternative fuels. The Philippines Department of Energy expects to reduce the number of gasoline and diesel fed transport vehicles by 30% by 2020.

The Natural Gas Vehicle Program for Public Transport (NGVPPT) was launched in 2002 with various incentives to promote investment from the private sector. The program offers tax holidays, zero rate of duties, accelerated administrative processing, financial assistance from governmental financial institutions (GFIs) and manpower development and capacity building to promote conversion for public transport vehicles to run on natural gas. Executive Order No. 396 was signed in 2004 which reduced the import duties on natural gas motor vehicles to 0% (Clean Air Initiative, 2010). Targets have been set for 600 CNG buses and 3 daughter stations (DS) by 2015 and 2000 CNG buses and 12 daughter stations by 2020.[91]

Plans have also been made to retrofit public jeepneys to use auto-LPG (for subsequent conversion to run on CNG) (Philippines Department of Energy, 2010). Philippines aims to have 300 jeepneys retrofitted by 2015 and 800 by 2020. Other targets include 19,500 auto-LPG taxis by 2015 and 20,500 by 2020 (World LPGas Association, 2009). As of 2007, there were a total of 4,275 autogas vehicles/taxis in the Philippines (Philippines Department Of Energy, 2005a). A study on the economic viability, environmental soundness, health impact and social acceptability on jeepneys converting from diesel to LPG is also underway (PhilSTAR.com, 2011).

In 2011, the National Electric Vehicle Strategy (NEVS) was announced. The NEVS is a partnership between the government and the Asian Development Bank (ADB) intended to reduce the carbon footprint of road transport in the Philippines. The program began with a trial in the city Mandaluyong City in Metro Manila involving 20 electric tricycles in May 2011 (Mindanao Examiner, 2011). Positive results of the trial led to the DOE to announce in January 2012 its plans to tap P100 million from the Clean Technology fund to finance the deployment of 20,000 electric tricycles over the next two years[92] (Inquirer, 2012). Targets have also been set for electric vehicles: 20,000 electric tricycles by 2015 and 24,000 by 2020.

INFORMATION PROGRAMS

Road Transport Patrol Program

In 1998, the Committee on Fuel Conservation and Efficiency in Road Transport launched the Road Transport Patrol Program (Philippines Department of Energy, 2005c). It targets a 10% reduction in fuel consumption[93] and provides consumers with information on the efficient use of fuel through proper vehicle maintenance, efficient driving and values formation among drivers through seminars,

[91] Daughter stations are installed at locations where a CNG fill station is needed but there is no natural gas pipeline. Natural gas is brought to the daughter station by mobile storage.

[92] There are presently about 3.5 million tricycles in the Philippines [CNN (2011). Driving ambitions for electric vehicles in Philippines. Accessed at http://edition.cnn.com/2010/WORLD/asiapcf/12/07/electric.vehicles.philippines/index.html]. The ADB itself has committed Peso500 million (approximately USD12.5 million at an exchange rate of 1 US$ = 40 pesos) to supporting the electric tricycle project.

[93] The campaign was launched through Executive Order No. 472 which originally targeted a 5% reduction in fuel consumption.

workshops and use of the tri-media.[94] There are several programs that aim at reducing the use of vehicles so as to reduce fuel consumption and the concomitant carbon emissions such as car less day, carpooling, park and wait, park and ride, park and walk, and park and pick.

The car less day is meant to encourage people to leave their cars at home one day a week. Carpooling in the Philippines requires that three or more individuals travelling to the same destination arrive at an arrangement whereby they utilize just one car. The park and wait or anti-idling campaign, which was launched in 2004, encourages motorists to turn off their engines when parking. The park and ride campaign, which was also launched in 2004, promotes the use of parking spaces where vehicle owners can leave their vehicles and then use public transportation to get to their final destination. Similarly, the park and walk campaign encourages vehicle owners to park their vehicles and walk to their final destination. The park and pick campaign encourages taxis to pick up customers at designated points so as to reduce congestion.

Fuel Economy Run

To raise awareness amongst the general public regarding judicious use of fuel in transport, the Philippines Department of Energy introduced the Fuel Economy Run program since 2002. This program has been conducted for different types of vehicles and emphasizes the importance of vehicle maintenance and driving habits to achieve better fuel economy ratings. This event has gained support and participation from several vehicle manufacturers and transport organizations. The winners of the Fuel Economy Run are awarded cash prices and other giveaways. In addition, the winners have their names and fuel economy ratings published in national newspapers with wide circulation.

Electric tricycle design contest

To raise awareness and encourage local participation, an electric tricycle design contest was launched as part of the program. The Department of Energy envisions that the promotion of electric tricycles will eventually translate to the development of local expertise in designing and maintaining small electric cars (Official Gazette, 2012). However, there are no immediate plans for mass commercialization of electric cars. The government plans to demonstrate their use by testing them.

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

Standards

It is worth noting that using fuel efficiency standards is what political scientists and economists call a "second-best" solution. There is a long history of debate on whether "command and control" regulations (like raising CAFE standards) are a good way to bring about desired changes in behavior. The other or "first-best" option is the use of price signals—which in the case of transportation would be increased fuel taxes—to influence consumer behavior. The use of price signals to bring about a change is contentious and can be politically challenging to enforce. The Philippines is no different

[94] "Tri-media" is a commonly used term in the Philippines which refers to the three forms of traditional media: print (newspapers), radio, and television.

from any other economy is this respect.[95] However, the Philippines has avoided implementing even the second-best solution preferring to rely on voluntary standards. The International Energy Agency (IEA) recommends setting standards in the place of voluntary programs as the latter have generally fallen short of their targets in most economies where they have been employed. As such, there is a general trend away from the use of voluntary programs worldwide.

However, there are a number of reasons as to why standards have not yet been implemented in the Philippines.[96] It is not feasible to implement standards at the moment due to insufficient data. While the Fuel Economy Run program has been generating data to aid the setting of standards in the future, no formal testing cycle has been adopted (United Nations Environment Program, 2011). Another barrier to setting standards is the fear of the car industry moving to other economies. There is also the perception that it will be difficult to influence manufacturers for whose cars are assembled within the Philippines but whose car components, including the engine, are manufactured elsewhere (Clean Air Initiative, 2010). Furthermore, there are issues of equity that regulators in the Philippines have to contend with. The use of mandatory fuel standards might see lower-cost but inefficient vehicles exit the market. In an economy where alternative modes of transport are scarce, this might impose a penalty on less well-off individuals especially if the two- and three-wheelers are brought under the purview of the fuel standards.

Initiatives at Government Agencies

The Government Energy Management Program (GEMP), a continuing program of the Philippine Department of Energy, requires that the spot checks or unannounced energy audits are conducted on various government agencies. A grading system is in force that determines the extent of the compliance of the Agencies with the Administrative Orders. The Agencies' ratings are posted publically with an intent to "name and shame" those whose energy reduction efforts fall below designated thresholds. For those Agencies who manage to reduce their energy consumption, monetary incentives are provided. From September 2005 to July 2011, the Department of Energy reported savings of 1.5 billion pesos[97] on electricity and fuel (Philippines Department of Energy, 2012). The amount of energy saved was equivalent to 0.22 million barrels of fuel oil equivalent (MMBFOE) in 2009 and 2010. The cost of achieving these savings is not been made available. Hence, the cost-effectiveness of the program cannot be evaluated.

Alternative Fuels Program

The Alternative Fuels Program has led to 18,731 registered taxis running on LPG in the Philippines with 560 electric vehicles operating in major cities as of March 2011. However, jeepney operators are finding it difficult to convert their vehicles to run on LPG as compared to taxis due to the high cost. It costs about P250,000[98] to convert a jeepney, over 10 times the price for a taxi which

[95] In fact, politicians try to gain the support of their electorate by trying to reduce the final cost of energy. For instance, recently, the opposition party member Mitos Magsaysay appealed for the reduction of Value Added Tax (VAT) on petroleum products (accessed at http://www.tempo.com.ph/2012/reduce-fuel-tax-govt-urged/#.T53dPDLa-So).

[96] It should be noted that the Energy Efficiency and Conservation Action Plan (2010 – 2030) looks to begin the setting of standards and labeling for passenger cars and light duty vehicles by 2015.

[97] This amounts to approximately US$ 37.5 million at current market exchange rates of 1 US$ = 40 pesos.

[98] This amounts to approximately US$ 6,250 at current market exchange rates of 1 US$ = 40 pesos.

lies between P20,000 to P30,000.[99] Conversions for taxis are much simpler, consisting of add-ons onto the existing engine, while for jeepneys, the process is more complicated and involves replacing the whole engine and then attaching a LPG kit. As such, the Clean Air Initiatives for Asian Cities Center has recommended the implementation of financial mechanisms such as micro-financing to support drivers and operators to convert their vehicles to run on LPG (PhilSTAR.com, 2011). However, such a recommendation would only be justified if the net benefits of the Autogas Program (under the Alternative Fuels Program) were shown to exceed its net costs.

Table 2.2.3 below summarizes the World Bank's evaluation of the expected benefits (both in terms of fuel savings and emissions reduction) and costs of various programs under the Alternative Fuels Programs. Without quantifying the benefits of energy savings (including energy security benefits) and the benefits of emission reduction in dollar terms, it is not possible to make a definitive judgment as to whether the Alternative Fuels Program has led to net welfare benefits. However, it is possible to compare between different alternative fuels on the basis of costs and benefits.

The results indicate that the use of biofuels in vehicles is likely to lead to significant energy savings and emission reductions, at a relatively moderate cost. The study finds that costs are negative if co-benefits such as health effects are taken into account. In contrast, natural gas vehicles are relatively ineffective in reducing energy use or GHG emissions, while they are also highly expensive due to the large capital investment required in developing pipelines and fueling infrastructure, and the high costs of CNG buses (World Bank, 2010). In the case of the Philippines, switching fuels to LPG (under the Autogas program) is also a relatively inefficient policy tool, achieving no energy savings and minimal reductions in GHG emissions. Energy security motivations for the switch to gas are not compelling either. The Philippines is not a major gas producer, with gas production of 3.6 billion cubic metres (bcm) in 2011 (as opposed to 75.6 bcm in Indonesia, 37.0 bcm in Thailand and 8.5 bcm in Vietnam) (BP, 2012) and there are uncertainties regarding the size of its gas reserves (World Bank, 2010).

Table 2.2.3 ***Evaluation of alternative fuels scenario***

Scenarios	Energy Use Impact, Fuel Saved/year in MTOE	Emission Impact, GHG Reduced/year in $MtCO_2$	Indicative Cost of GHG Reduction, US$ per tCO_2
Biodiesel			
S1: PEP 2008 (20% CME by 2030)	1.1	3.4	30.8
S2: 20% CME by 2020	1.8	3.5	-9.8 (with co-benefits)
Bioethanol			
S1: PEP 2008 (E85 by 2030)	1.4	5.2	
S2: E85 by 2025	4.7	11.3	
Natural Gas			
S1: PEP 2008 (5,000 CNG buses by 2026)	0.02	0.06	442
S2: 10% of all buses and trucks by 2020, 25% by 2025, and 50% by 2030	1.8 (2020-2030)	1.6 (2020-2030)	No estimate for cost with co-benefits
Auto Gas			
S1: 100% conversion of gasoline-fed taxis by 2015	0	0.04	9.7

[99] This amounts to approximately US$ 500 to USD 750 at current market exchange rates of 1 US$ = 40 pesos.

S2: 25% conversion of gasoline-fed private cars by 2020, 50% by 2030	0	1.0	–

Source: World Bank, 2010

Of greater pertinence to the alternative fuels program is that it may be, in the case of the Philippines, more cost effective to focus on improving the fuel economy of conventional vehicles rather than supporting alternative fuels which are still not cost competitive. The International Energy Agency projects that the fuel economy of new light-duty vehicles could be improved by 50% by 2030 using cost effective technologies, including but not limited to hybridization (International Energy Agency, 2008a). The welfare effects of such a policy direction, which should plausibly be higher than the alternative fuels program on account of lower switching costs,[100] need to be further explored in the Philippine context.

Information programs

Car buyers in the Philippines are not familiar with the features of vehicles with respect of fuel economy. More importantly, it has been found that fuel economy is not a consideration for consumers in the decision making process (United Nations Centre for Regional Development, 2010). This suggests that the Road Transport Patrol Program has not yet been effective in providing consumers with information on fuel efficiency or in creating awareness among drivers. More promotion work is necessary. It also highlights the need for information and labeling programs to be implemented on a wider scale in the Philippines, in order to increase the salience of fuel economy in the decision-making process for the purchase of vehicles. Nevertheless, the Philippine Department of Energy estimates that information and education campaigns, which include the transport sector, resulted in energy savings of 3.47 and 3.45 million barrels of fuel oil equivalent in 2009 and 2010 respectively (Department of Energy, The Philippines, 2012). As the costs of achieving these savings have not been reported, it is not possible to ascertain the relative efficacy of this program.

(ii) Scientific Integrity

Among the Department of Transportation and Communication (DOTC)'s 5 fundamental strategies to promote fuel efficiency in the land transport sector, one is to switch to alternative fuels such as LPG, CNG and electric-powered vehicles. The government's Alternative Fuels Program has sought to implement this by encouraging the use of alternative fuels such as bioethanol, biodiesel, LPG and CNG. However, the scientific basis for switching to CNG as a way to enhance fuel efficiency is questionable. In fact, CNG buses are generally between 15% and 40% *less* fuel efficient than diesel buses (World Bank, 2010).

Data from the on-going Fuel Economy Run will be used for the future setting of fuel economy standards. However, no formal testing regarding fuel efficiency has been adopted to date.

[100] Switching costs in the context of alternative fuels refers not only to the costs that individuals face in purchasing an alternative fuel vehicles but also to the costs of putting in the requisite infrastructure for refueling and vehicle maintenance. For instance, the large-scale uptake of electric vehicles requires that charging infrastructure is built. This investment is considerable and needs to be considered when planning for any such large-scale transition.

(iii) Flexibility

The Philippines does not have fuel economy standards for its vehicles; the key mandates aimed at improving fuel economy are the biofuel requirements for gasoline and petroleum diesel. Instead, policies to increase fuel economy have largely focused on the use of fiscal and financial incentives and information programs to incentivize both a switch towards alternative fuel vehicles and improvements in fuel economy in conventional vehicles. The fact that most of these policies do not impose mandatory requirements implies that vehicle manufacturers and owners have the flexibility to decide whether and how to improve the fuel economy levels of their vehicles. In particular, because incentives are in place for a variety of alternative fuels, including biofuels, LPG, CNG, hybrid and electric vehicles, manufacturers and owners have the option of deciding which fuel to use, as opposed to being forced to adopt a particular alternative fuel. This is especially pertinent in the Philippine context: given the diversity of vehicle types in use in the Philippines, it could make economic sense for different types of vehicles to adopt different means towards achieving increased fuel economy levels.

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

The official website of the Philippine Department of Energy gives an overview of the policies that are in place. Details are not available on the website but can be found from online presentations and papers.

The involvement of stakeholders is perceived as important whilst drafting regulatory policy. The views of the stakeholders are elicited via public consultation. In addition, the details of proposed policies are set forth in the form of white papers or consultation papers. The feedback received is taken into consideration whilst drafting the proposed regulations.[101] For instance, the Department of Energy's National Biofuels Program (2007–2012) regularly reassesses standards for fuel blends. Before introducing new blends, the Technical Committee of Petroleum Products and Additives (TCPPA) meets stakeholders, which includes academic institutions, car manufacturers, oil companies, farmers, and citizens, to consult with them on emissions impact, vehicle compatibility, and the availability of fuel supply.

However, the process of consulting several stakeholders has experienced its own drawbacks.[102] Consider for instance the case of the Energy Conservation Bill which will be tabled during the State of the Nation Address by President Benigno Aquino III on the second week of July 2012. The Department of Energy along with the Development Academy of the Philippines is still in the process of finalizing draft of the 17-page Bill. The opinion of stakeholders (citizens, non-governmental organizations, members from House of Representatives, and electric power companies) was sought via public consultation. However, it was felt that the public consultation process, wherein several stakeholders are consulted simultaneously, was ineffective. This is because the vested interests of different stakeholders led to proposals that did not align with the objectives of the Bill. Furthermore, given that several stakeholders were consulted simultaneously, time constraints made discussions of the details of the provisions of the Bill difficult. Nevertheless, the inputs from the stakeholders were

[101] This information was gleaned from the interviews that we conducted with members of the Philippines Department of Energy.

[102] This information was gleaned from the interviews that we conducted with members of the Philippines Department of Energy.

given due consideration and some of the suggestions will be incorporated into the final draft of the Bill.

(v) Alignment

In the Philippines, several government agencies are involved when it comes to policies concerning energy efficiency at the economy-wide level. The Department of Energy, which was created under the Republic Act 7638, has the mandate to coordinate and supervise all government plans relevant to the energy efficiency and conservation. The Department of Energy has oversight over the five government-owned or controlled corporations, such as the Philippines National Oil Company. In addition, the Department of Energy has three institutional partners to assist it in its energy efficiency and conservation programs, namely: the Philippine Council for Industry and Energy Research and Development, the Bureau of Product Standards, and the Department of Environment and Natural Resources. The Department of Transportation and Communications, whose mandate is the promotion, development and regulation of a dependable and coordinated network of transportation and communications systems, is not under the purview of the Department of Energy. Similarly, the Department of Finance, which covers vehicle tariffs, taxes, and fuel subsidies, is an independent government agency.

So issues of alignment between the various authorities can arise. For instance, the objectives of the Department of Transportation and Communications and the Department of Energy might be at odds with each other given their respective mandates. This issue has been noted by the Philippine authorities and there have been efforts to get the government agencies efforts aligned. An example of this is the Executive Order 472 that led to the creation of the Committee on Fuel Conservation and Efficiency in Road Transport (CFCERT). This Committee was chaired by the Undersecretaries of the Department of Energy and the Department of Transportation and Communications. In addition, 12 government agency and six private sector representatives were part of the Committee. The principal objective of the Committee was the promotion of energy efficiency in the transport sector via awareness campaigns.

Despite efforts at coordination such as this, it is uncertain whether there is a clear decision maker when it comes to fuel economy policies, given that several government agencies have a stake in energy efficiency policies in the transport sector. As such, the potential for fragmented decision making exists, and there is no guarantee that the different departments will be aligned with one another. Individual decisions by each department might then end up not being cost effective when viewed as a whole. It would thus be more efficient if there was a single agency in charge of energy efficiency with sufficient clout to influence the other departments (Reddy, 1991), or if a better inter-institutional coordination mechanism existed with one of the agencies leading the process with the support of the main authorities.

2.2.3 Concluding Remarks

Energy security is the principal driver of policy efforts to improve energy efficiency of transportation in both the US and the Philippines. The positive environmental externalities of reduced fuel use have also been gaining importance in the past few years. Efforts to improve fuel efficiency in the vehicular stock have taken the form of mandatory standards and labels, fiscal incentives, research and development (R&D) funding, and incentives for alternative fuel vehicles in the US, whereas most programs in the Philippines are voluntary in nature.

Given that fuel economy ranks quite low on the list of attributes when buying a vehicle in the Philippines, well-designed fuel economy labeling programs and informational campaigns are essential to raising the salience of this issue. The US has used fuel economy labels for a while and studies have been and are being conducted on the behavioral impacts of these labels on consumer buying behavior. It will be instructive for policymakers in the Philippines to understand these issues such that they make an informed choice when instituting such programs in the future.

Fuel economy standards in the US have been contentious. Proponents argue that these are essential to steer the market towards more energy efficient vehicles whereas opponents point to the increased private cost of vehicles that fuel efficiency standards entail. Furthermore, standards tend to reduce consumer choice as less efficient and in some cases cheaper vehicles forced out of circulation. Issues of the rebound effect wherein the fuel savings from energy efficiency are not as large as expected have been reported in the literature.

While both schools of thought proffer compelling arguments, policymakers should rely on cost benefit analysis to make their decision. Issues like the energy security costs of fuel imports or environmental benefits of reduced fossil fuel consumption are quantifiable. It is possible, as has been done by several researchers, to evaluate the net benefits of any fuel efficiency program. The Philippines can learn from the US experience in carefully ascertaining the true value to introducing fuel standards. Price signals can offer the least cost solution to the issues of energy security and environmental objectives and as such should be preferred to standards.

Standards reduce the flexibility to respond to changing market conditions resulting in welfare losses. The process of setting standards has also seen the influence of strong industry lobby groups in the US, where fuel economy standards were allowed to stagnate between 1989 and 2010, and the Philippines, where efficiency standards or even fuel economy labeling are being resisted by certain groups. The relative weight of industry lobby groups compared with other stakeholders can result in outcomes that are lopsided, lowering societal welfare. Raising the transparency of the policymaking process is a means of reducing this negative outcome.

Both the US and the Philippines have been pushing for the development of alternative fuel vehicles such as natural gas or biofuel vehicles. It should be noted that scaling up these technologies requires substantial investment as far as the setting up of refueling infrastructure is concerned. In the case of electric vehicles, the vehicles come at a significant premium to conventional internal combustion engines vehicles and the requisite electric vehicle charging infrastructure is expensive. Given this and the fact that the energy efficiency and environmental efficacy of conventional internal combustion engines is rapidly improving, the US and the Philippines can look to reevaluate their transportation policies and the emphasis on alternative technologies as the means to achieving their twin goals of energy security and environmental stewardship.

In summary, the effectiveness of policies in both economies has been relatively mixed. Most fuel economy programs in the US are expected to yield net economic benefits, whereas electrification of road transport has proven to be expensive. In the Philippines, the use of biofuels in vehicles is likely to lead to significant energy savings and emission reductions at a relatively moderate cost, whereas the use of natural gas vehicles is initially highly expensive and relatively ineffective at reducing either energy use or greenhouse gas emissions. Policies in the US are scientifically sound and determined by a transparent formulation process, but issues of alignment can arise and the strength of lobby groups can sometimes be problematic. Policymaking in the Philippines is also characterized by robust stakeholder engagement, but problems of conflicting objectives of different stakeholders and lack of alignment can arise.

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2.3 Household Appliances

In this section, we examine the policies enacted by Japan and Philippines to enhance the energy efficiency of appliances. For each economy, we describe and review the various regulations enacted in order to boost appliance energy efficiency. We also compare how the regulations in Japan and Philippines fare against each other.

Globally, improving the energy efficiency of appliances and equipment is now recognized as one of the most effective ways of reducing energy consumption as well as cutting down on greenhouse gas (GHG) emissions. Energy savings from energy efficiency improvements can be particularly dramatic for appliances. The Lawrence Berkeley National Laboratory estimates that energy efficient standards and labeling (EES&L) programs aimed at improving the energy efficiency of equipment (including both appliances and lighting) can potentially lead to savings of 3,860 TWh of electricity and 1,041 TWh of fuel per year by 2030 (McNeil et al., 2008) – to put that in context, the world's total electricity generation in 2010 was 21,325 TWh (BP, 2011). Notably, the mitigation potential from EES&L programs is the greatest in Asia and North America (McNeil et al., 2008), underscoring the potential that exists for improving the energy efficiency of appliances in APEC economies.

Energy efficiency improvements in appliances in industrialized economies in the past 30 years have been driven primarily by efficiency standards, labeling, and incentive schemes (Geller, 2005), suggesting that government policies and regulations will be central to any concerted improvements in the energy efficiency of appliances in the future. In the past two decades, there has been a proliferation of EES&L programs around the world, rising from only 12 in 1990 (largely concentrated in industrialized economies) to more than 60 in 2005 (including many in developing economies) (McNeil et al., 2008). Almost all of the member economies of the International Energy Agency have minimum energy performance standards (MEPS) and associated labeling programs for appliances, and all of them have policies in place to increase energy efficiency in lighting (International Energy Agency, 2009). Given this context, it is important for APEC economies to critically assess their own policies relating to appliance energy efficiency. This section contributes to that discourse by looking at policies aimed at appliance energy efficiency in both a developing economy (Philippines) and an industrialized economy (Japan) within APEC.

It should be noted that "appliances," in the context of this section, is taken to include lighting equipment in addition to appliances such as refrigerators and air-conditioners. This may be different to some treatments of energy efficiency in which lighting is considered separately from appliances, but our approach is conceptually simpler since the policies used to improve lighting energy efficiency tend to be quite similar to those used to improve energy efficiency in other appliances and equipment. A second point is that while we treat energy efficiency of appliances and that of buildings separately, the two are interlinked in the sense that building energy codes (that specify energy efficiency standards for buildings) typically set energy efficiency requirements for appliances and equipment used for heating, ventilation, and air conditioning (HVAC) as well as for lighting equipment. Thus, in practice, how energy-efficient these appliances are will be determined not just by the policies considered in this section (that specifically target appliances), but also by the economy's policies targeting energy efficiency in buildings.

2.3.1 Energy Efficiency in Household Appliances in Japan

Key findings

- Appliances (including lighting) account for 41% of Japan's household energy use. Thus, achieving its target of a 30% improvement in its energy efficiency by 2030 will require Japan to increase appliance energy efficiency.
- Japan's policy approach to increasing appliance energy efficiency combines appliance standards (i.e. the Top Runner program), a number of labeling programs, and fiscal and financial incentives.
- Japan's appliance energy efficiency policies are estimated to have led to significant energy savings, though it is unclear whether these were achieved in a cost-effective manner. Policymaking is flexible and transparent and the various authorities involved are well-aligned with each other.

Costs, benefits and promotion

- In general, the formulation of standards does not seem to consider life-cycle analysis of economic costs and benefits, so that there is no guarantee that the standards will result in societal net benefits.
- Estimated cumulative energy savings from the Top Runner program by 2010 are in the range of 110-150 TWh by 2010, or between 16-25% of Japan's energy conservation target of approximately 610 TWh by 2010. However, the costs of achieving these energy savings may be significant.
- The Top Runner program transforms the entire market and thus encourages R&D and green investments for all products in the market, including those that are already energy-efficient. However, the Top Runner program encourages incremental rather than innovative changes and R&D.
- The potential benefits from labeling and information programs is likely to be somewhat limited by their lack of alignment with standards, their comparatively limited coverage and the fact that they are not universally mandatory.

Scientific integrity

- There is evidence that the formulation of the Top Runner standards takes into account scientific evidence and analyses. However, the performance of the most energy-efficient product, which is used to formulate the standards, may not always be a suitable proxy for the energy performance level that is technically and economically feasible.

Flexibility

- Japan has revised and adjusted its appliance standards over time, developing the Top Runner program in response to the flaws of earlier appliance standards.

- The Top Runner standards are based on current energy efficiency levels and expected technological progress, meaning they automatically respond to changing market circumstances. There is, however, limited discretion on the policymaker's part to adjust the standards.

- The Top Runner program imposes standards on a weighted average of each manufacturer's products and thus allows manufacturers the flexibility to choose the products on which to focus their energy efficiency efforts, enhancing the cost-effectiveness of the standards.

Transparency

- Representatives from industries, consumer groups, and trade unions are involved in the decision-making at every level of the hierarchical decision-making structure for the formulation of the Top Runner standards and associated labels

- In general, information on various policies are readily available to the public.

Alignment

- The decision-making structure for standards and labeling programs is hierarchical and centralized, facilitating alignment and coordination among authorities.

- Regulations are not always well-aligned with one another, with labels typically not introduced in conjunction with standards and label programs often being voluntary, lessening their effectiveness at complementing the Top Runner program.

A. Size and Significance

Appliances account for a significant proportion of Japan's energy use, with 41% of household energy use in Japan accounted for by lighting and appliances (Sunikka-Blank et al., 2011). The proportion of energy used in appliances has been growing in recent years. While the energy consumption of Japan's industrial sector has remained steady since 1990 and its final energy consumption is expected to level off by 2030 (Hong et al., 2007), energy use by the commercial and residential sectors has jumped in the corresponding period. Between 1990 and 2005, final energy consumption increased from 45 Mtoe to 62 Mtoe in the commercial sector, and from 38 Mtoe to 55 Mtoe in the residential sector. Nearly half of Japan's commercial energy consumption is for heating and cooling, with appliances and heating forming the next major energy load. Growth in residential energy use, on the other hand, has been driven largely by increasing penetration of appliances (International Energy Agency, 2008).

B. Policy Formulation

(i) History and Background

Improving energy efficiency forms one of the cornerstones of Japan's energy policy. Initially, energy efficiency policies were motivated by the desire to reduce the economy's dependence on energy imports – Japan relies on imports for over 80% of its primary energy supply and 99.7% of its petroleum (Hong et al., 2007). The oil crises of the 1970s adversely affected Japan's economy prompting the enactment of the Energy Conservation Law in 1979. It is this law that forms the basis

of many of Japan's future energy efficiency and conservation policies (Ministry of Economy, Trade and Industry, Japan, 2010a).

More recently, other factors have combined to provide further impetus to energy efficiency policies. After the Kyoto Protocol was issued in 1997, environmental concerns (particularly the issue of greenhouse gas emissions) began to assume greater importance in Japan's energy policy-making. In the 1998 review of Japan's Long-Term Energy Supply and Demand Outlook, which is meant to guide Japan's energy supply and demand through to 2030, environmental concerns were accorded a higher priority than before. The review identified a need for greater energy conservation, among others. In light of this review, the Ministry of Trade and Industry's (METI) 2000 review of Japan's energy policy included a strong emphasis on energy conservation measures in the industrial, residential/commercial, and transport sectors. After the Kyoto Protocol came into force in 2005, Japan established a new National Energy Strategy with the two key "pillars" are to improve Japan's energy security and to reduce its CO_2 emissions. Energy efficiency was once again identified as one of the key measures to achieve these objectives (Hong et al., 2007).

In the long-term, Japan has set a target of improving the efficiency of its energy consumption by at least 30% by 2030 (International Energy Agency, 2008). In the near-term, it set a goal of reducing its energy consumption by approximately 2.2 EJ/year (exajoules per year) by 2010.[103] To put this into context, this targeted reduction equals about 14% of total energy consumption in 2001, and is slightly greater than the amount of energy consumed every year by the nation's households (Geller et al., 2006).

Achieving its energy conservation targets will require Japan to restrict the growth in energy use of the commercial and residential sector. This in turn will require a concerted effort to improve the energy efficiency of appliances, whether it is air-conditioners and other heating and cooling equipment, electrical appliances, or lighting equipment. A recent study suggests that Japan's energy efficiency and conservation efforts could lead to potential energy savings of 57 Mtoe in the year 2030, an 11.3% reduction from Japan's Business-as-usual (BAU) consumption in that year. The key contributor, in gross terms, is the "Others" sector (which includes both the commercial and residential sectors) with 22.5 Mtoe of energy savings (Kimura, 2011).

(ii) Policy Description

MANDATES

Standards for appliances and lighting

Japan's approach towards enacting standards for appliances and lighting has undergone significant changes over the years, and it is instructive to look at the drivers of change. After the Energy Conservation Law was enacted in 1979, Japan introduced energy performance standards for refrigerators and room air-conditioners in 1983, which were later upgraded in the early to mid-1990s. Specific penalties for non-compliance were introduced in 1993 (Geller et al., 2006) and in 1994, the coverage of the standards was significantly expanded, with central air-conditioners, fluorescent lamps, televisions, copying machines, computers and magnetic disk units now included. Refrigerators, though, were not included – the manufacturers were already occupied with eliminating

[103] Using a conversion factor of 1 kWh = 3,600 kJ, 2.2 EJ is equivalent to 610 TWh.

chlorofluorocarbons (CFCs) and were temporarily given some leeway when it came to energy efficiency improvements (Nakagami et al., 1997).

The distinctive feature of Japan's earlier standards is that they were not minimum energy performance standards of the kind widely used elsewhere in the world (including the Philippines), which dictate minimum energy efficiency requirements that every product must meet. Instead, the standards applied to the shipment-weighted average efficiency level of each manufacturer – individual products were allowed to fall short of the standard provided that this was compensated for by greater efficiency levels (relative to the standards) in other appliances produced or imported by the manufacturer. The standards were set by the Ministry of International Trade and Industry (MITI), relying on proposals made by an Advisory Committee tasked with studying and developing the standards (Nakagami et al., 1997).

The earlier standards met only with modest success. Although the average efficiency level of refrigerators increased by 15% between 1979 and 1997 (Geller et al., 2006), energy efficiency in air-conditioners only increased by 6% on average by 1990 (Nakagami et al., 1997).[104] Even though the program was expanded in 1994, the required improvements in energy efficiency were very small and typically achievable either with existing technology or with only minor technological progress (Nakagami et al., 1997).

In 1998, therefore, after the revision of the Energy Conservation Law, the earlier system of performance standards was overhauled and replaced by the Top Runner program (Ministry of Economy, Trade and Industry, Japan, 2010a). Under the Top Runner program, the minimum standard that all manufacturers must meet by the end of the target period is determined by the most energy efficient product in the market at the beginning of the target period (i.e. at the time that the standard is set). The minimum standard is therefore based on market data, but also takes into account the technological potential for efficiency improvement in the future i.e. if there is a high potential for energy efficient improvements in the future due to technological change, irrespective of whether the standards are imposed, the standard of energy efficiency set will be higher than the energy efficiency of the current Top Runner.

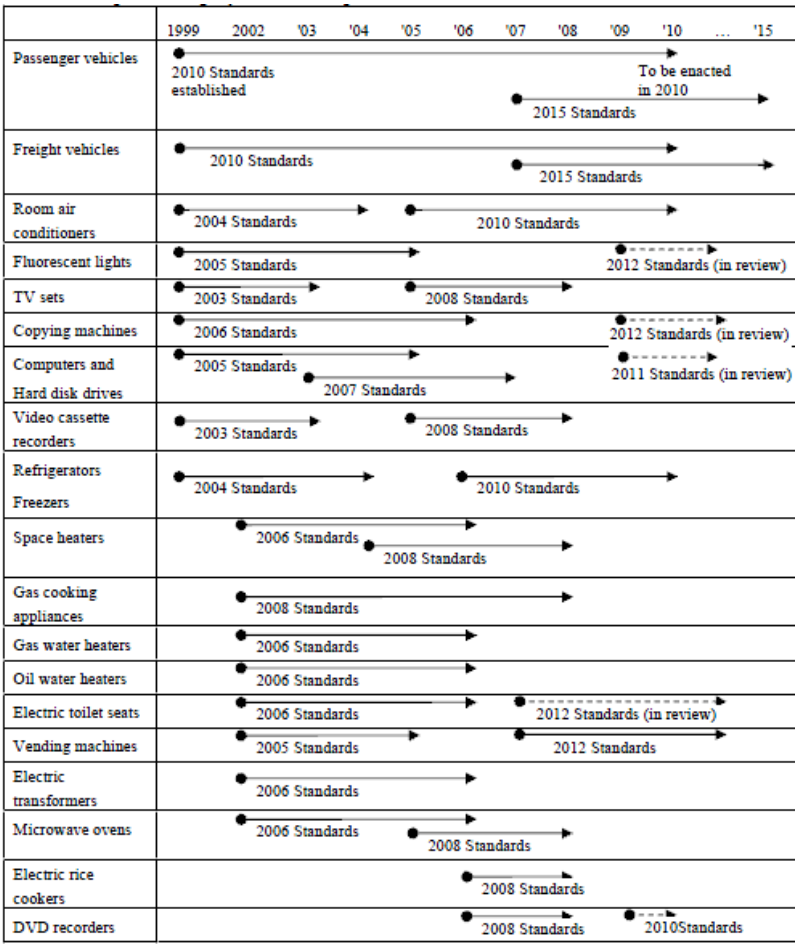
In addition, the Top Runner program does not impose a uniform standard on all products within a specified category. Instead, the exact standard imposed on a particular product depends on various parameters such as size, weight, and technology type, all of which can affect the energy efficiency of a product irrespective of the manufacturer's efforts to improve efficiency. Finally, similar to the earlier standards, the Top Runner standard does not apply to every product produced by the manufacturer. The manufacturer instead has to ensure that the weighted average of all the products it sells in a particular category in a particular year (e.g. all of its refrigerators sold in 2007) achieves the Top Runner standards (Kimura, 2010).

The targets are mandatory, though penalties for noncompliance are based on an unusual "name and shame" approach. If a manufacturer does not comply with the standard, The Ministry of Economy, Trade and Industry first issues a recommendation to the producer to improve the energy efficiency of its products. If the producer continues not to comply, the Ministry makes the recommendation public and finally orders the manufacturer to comply with the recommendations

[104] Although refrigerators were eventually not included in the standards program of the early 1990s, energy efficiency improvements in refrigerators had already taken place since manufacturers had expected standards to be enacted for refrigerators as well (Nakagami et al., 1997).

(Kimura, 2010). The "name and shame" approach is also utilized by Japan in enforcing its building energy codes, as we saw in the Japan Buildings Case Study.

Figure 2.3.1 ***Scope and target year of the Top Runner Standards***



Source: Kimura, 2010.

Initially the Top Runner program applied to 13 products, most of which were appliances and lighting equipment: gasoline passenger cars, diesel passenger cars, gasoline and diesel trucks, air-conditioners, heat pumps, fluorescent lamps, refrigerators, TVs, computers, VCRs, magnetic disc drives, and copying units (Geller et al., 2006). By 2001, vending machines and electric toilet seats had been incorporated into the Top Runner program (Ministry of Economy, Trade and Industry, Japan, 2010a). All of these products were required to achieve energy efficiency improvements, according to the benchmark set by the Top Runner product, within a target year that lay between 2003 and 2007 (varying depending on the product category). Coverage has been expanded even further for the next target period – the Top Runner program currently comprises 23 product categories (see Figure 2.3.1). Product categories are included in the Top Runner program if they satisfy three basic criteria: 1) the machinery and equipment is used in large quantities in Japan, 2) the machinery and equipment consumes considerable amounts of energy while in use, and 3) the machinery and equipment requires considerable effort to improve its energy consumption efficiency (Ministry of Economy, Trade and Industry, Japan, 2010a).

INFORMATION PROGRAMS

Appliance Labeling

Unlike Philippines and many other economies, where appliance standards and labeling programs were introduced and developed concurrently, labels and standards have evolved at different rates in Japan. While standards have been around since 1983, energy efficiency labels are a relatively recent addition to Japan's policy approach towards raising energy efficiency in appliances.

The most important among the labeling programs is the Energy Saving Labeling Program that was launched in 1998, around the same time that the Top Runner program was introduced. Under this scheme, labels come in two colors – green if the product has already met the Top Runner standard, and red if it hasn't. Since 2002, the label also displays the performance of the product relative to the Top Runner (Geller et al., 2006), so that consumers can find out from the label not just whether the product has met the standard, but also the extent to which it has done so.

Currently, the label shows four items – the performance relative to the Top Runner program, energy saving standard achievement rate, energy consumption efficiency, and the target fiscal year. Participation in the scheme is voluntary for manufacturers of the products covered (Ministry of Economy, Trade and Industry, Japan, 2010a). However, according to Article 20 of the Energy Conservation Law, all producers of the products targeted under the Top Runner program are required to provide information on the energy efficiency of their products (Swedish Environmental Protection Agency, 2005). Thus, manufacturers have to display the information. They can only choose how to provide the information, whether by participating in the Energy Saving Labeling Program or in some other way.

While the Top Runner program initially covered 13 product categories, only 5 of these were initially covered under the Energy Saving Labeling Program – air-conditioners, refrigerators, freezers, televisions and fluorescent lights (Geller et al., 2006; Ministry of Economy, Trade and Industry, Japan, 2010a). The range of products covered by the labeling program has increased considerably since then, with 16 product categories covered as of July 2010 (see Table 2.3.1 below). In addition to the original five, the coverage now includes space heaters, gas cooking appliances, gas water heaters, oil water heaters, electric toilet seats, computers, magnetic disk units, transformers, microwave ovens, jar rice cookers, and DVD recorders (Ministry of Economy, Trade and Industry, Japan, 2010a). However, the extent of coverage is still by some degree lower than that achieved by the Top Runner program, which currently covers a total of 23 product categories.

In addition to requiring manufacturers to provide information, Japan has, since 2006 (when the revised Energy Conservation Law came into effect), required retailers to provide information on the energy efficiency of the products they sell, the rationale being "the importance of retailers' role as an interface to customers" (Ministry of Economy, Trade and Industry, Japan, 2010a). Under the Label Display Program for Retailers, retailers are required to use the Uniform Energy-Saving Label when displaying air-conditioners, electric refrigerators (freezers) and TV sets (the products with wide variation in energy-saving performance) in their shops; the label includes the multistage rating (that uses one to five stars to represent the relative position of the product in the market with respect to energy-saving performance), the expected electricity bill as well as the information displayed on the Energy-Saving Label.

For eight other products covered by the Energy-Saving Labeling Scheme, retailers are required to display the expected annual electricity bill (or expected annual fuel usage for gas/oil equipment) together with the Energy-Saving Label. Finally, under the Energy Efficient Product Retailer Assessment Program, retail outlets that provide information on energy efficiency and conservation of their products or actively promote energy-efficient appliances are selected as "Outlets that Excel at Promoting Energy-Efficient Products" and the results are publicly announced through newspapers, magazines, etc. (Ministry of Economy, Trade and Industry, Japan, 2010a).

Table 2.3.1 ***Product categories covered by Energy Saving Labeling Program and Label Display Program***

Target Products Covered by the Labeling Program			
Top Runner target machinery and equipment	Energy-Saving Labeling Program	Expected annual electricity bill	Uniform Energy-Saving Label
Air conditioners	●	●	●
TV sets	●	●	●
Electric refrigerators	●	●	●
Electric freezers	●	●	
Electric rice cookers	●	●	
Microwave ovens	●	●	
Lighting equipment	●	●	●
Electric toilet seats	●	●	●
DVD recorders	●	●	
VCRs		●	
Space heaters	●		
Gas cooking appliances	●	● (Fuel usage)	
Gas water heaters	●	● (Fuel usage)	
Oil water heaters	●	● (Fuel usage)	
Computers	●		
Magnetic disk units	●		
Transformers	●		
Copying machines			
Vending machines			
Passenger Vehicles			
Freight Vehicles			
Routers*	▲		
Switching units*	▲		

Products covered by label display program for retailers: * Routers and Switching units are scheduled for addition within 2010.

Source: (Ministry of Economy, Trade and Industry, Japan, 2010a)

Separately, office equipments in Japan are also covered by the international Energy Star program. Personal computers, displays, printers, facsimile, and copying machines that meet the Energy Star standards can affix the Energy Star logo (Geller et al, 2006). The Energy Conservation Centre, Japan, administers this program on behalf of the METI (ENERGY STAR, n.d., *International Partners*).

FISCAL AND FINANCIAL INCENTIVES

Most of the fiscal and financial incentives used by Japan to encourage energy conservation in buildings are likely to simultaneously encourage efficiency improvements in appliances, given that energy efficiency in buildings is linked to the energy efficiency of its appliances. A detailed discussion of these incentives can be found in the Japan Buildings Case Study.

Japan has implemented some incentive schemes that are specifically targeted at appliances. From May 2009 to March 2011, the Japanese government developed the Eco-Point system, as part of a stimulus package in response to the financial crisis of 2008. Essentially, the system rewards consumers with "eco-points" for purchases of digital terrestrial broadcasting (DTB) televisions, air conditioners, and refrigerators that are energy-efficient and have eco-labels indicating four stars or more. These eco-points can then be redeemed for gifts cards, prepaid cards, or other goods and services including LED bulbs (Ministry of the Environment, Japan et al., 2011). Points could be earned for between 5% and 10% of the total product price, up to US$ 410 (Vare, 2010). The budget for the program was 693 billion yen (approximately US$ 6.9 billion) (Ministry of the Environment, Japan et al., 2011). In addition, the Japan Electro-Heat Centre, Toshi-gas Shinko Center, the Conference of LP Gas Associated Organizations, and Petroleum Association of Japan all provide subsidies in support of projects that introduce high efficiency water heaters (Asia Energy Efficiency and Conservation Collaboration Center, 2010).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits, and Promotion

The Top Runner program does not include an economic life-cycle analysis that goes into the formulation of the standards. This is in part because, by design, the policymakers do not have the discretion to set the standards, since the standards set depend on the energy-efficiency performance of existing products and certain exogenous parameters such as the expected rate of technological progress. While the Top Runner program guarantees an increase in the energy efficiency of the targeted appliances up to the level of the current Top Runner product, there is no guarantee that socially optimal outcomes will necessarily be achieved, as standards may be too lax or too stringent (International Energy Agency, 2003) and may result in product prices that are too high (Kimura, 2010).

Even though the policymakers do not retain a great deal of control over the standards that are ultimately set, the fact that ex-ante life-cycle analysis of the standards is typically not carried out by the competent authority (METI) is potentially undesirable. The full economic implications of the program remain unknown when a given set of standards is adopted (International Energy Agency, 2003). Even if the standards themselves cannot respond to such information, other policies could be adjusted or formulated in response to ex-ante analysis of the impact of the Top Runner program. For example, if prices are expected to increase to high levels due to the standards, suitable mitigation measures could then be adopted by the government.

Whether the Top Runner program helped to maximize benefits and minimize costs can be assessed by looking at a combination of different criteria:

1) Coverage and compliance

A wide range of appliances were covered by the Top Runner program at its very inception, and coverage has only increased in recent years, with 23 product categories now included. These include most of the appliances and equipment that are major users of energy use, such as air-conditioners, refrigerators, electronic appliances and lighting equipment (where there are standards for CFLs, electronic, and magnetic ballasts as well as a variety of different fluorescent lamps – see Ministry of

Economy, Trade and Industry, Japan, 2010a). As a result, as much as two-thirds of residential energy use is thought to be covered under the Top Runner scheme (Nordqvist, 2006).

2) Energy efficiency targets

Another way of assessing the program is to quantify the extent to which the energy efficiency targets set for individual products have been achieved, thus far. How different product categories fared for the first assessment period (with target periods between 2003 and 2007) can be seen in Table 2.3.2 below.

As Table 2.3.2 shows, all of the products in the Top Runner program, on average, exceeded their energy efficiency targets. Some of them did so by a considerable margin, in particular copying machines and refrigerators which exceeded their targets by an order of 2 (approximately). For refrigerators, computers, copying machines, air-conditioners, VCRs and magnetic disk units, efficiency gains of more than 50% were achieved over the target period. Moreover, as indicated by the fact that no manufacturer has so far been advertised as noncompliant (Kimura, 2010), compliance rates are high, indicating that energy efficiency improvements were achieved not just by a few manufacturers but by the market as a whole.

Table 2.3.2 ***Energy efficiency improvements- actual vs. Top Runner target***

Product category	Energy efficiency improvement (result)	Energy efficiency improvement (initial expectation)
TV receivers (TV sets using CRTs)	25.7% (FY 1997 → FY 2003)	16.4%
VCRs	73.6% (FY 1997 → FY 2003)	58.7%
Air conditioners * (Room air conditioners)	67.8% (FY 1997 → 2004 freezing year)	66.1%
Electric refrigerators	55.2% (FY 1998 → FY 2004)	30.5%
Electric freezers	29.6% (FY 1998 → FY 2004)	22.9%
Gasoline passenger vehicles *	22.8% (FY 1995 → FY 2005)	22.8% (FY 1995 → FY 2010)
Diesel freight vehicles *	21.7% (FY 1995 → FY 2005)	6.5%
Vending machines	37.3% (FY 2000 → FY 2005)	33.9%
Fluorescent light equipment *	35.7% (FY 1997 → FY 2005)	16.6%
Copying machines	72.5% (FY 1997 → FY 2006)	30.8%
Computers *	80.8% (FY 2001 → FY 2007)	69.2%
Magnetic disk units *	85.7% (FY 2001 → FY 2007)	71.4%
Electric toilet seats	14.6% (FY 2000 → FY 2006)	10.0%

Source: Ministry of Economy, Trade and Industry, Japan, 2010a

Note: For the product categories marked with *, energy efficiency standard values are defined by the energy consumption efficiency (e.g. km/l), while the standard value for categories without * are defined by the energy consumption (e.g. kWh/year).

It is not immediately apparent whether the energy efficiency gains in Table 2.3.2 are as a result of the Top Runner program. Kimura (2010) argues, using the examples of room air-conditioners and passenger vehicles, that the Top Runner program most likely had a significant positive impact on the energy efficiency of the products covered. With room air-conditioners, for instance, energy efficiency improvements had stagnated in the early to mid-1990s, but energy efficiency began to grow rapidly

after the Top Runner program was introduced in 1998, all the way until 2006 (even after the first target year of 2004 had passed, indicating the continuing effectiveness of the Top Runner standards for air-conditioners).

3) Energy savings

There is sparse literature on the subject of the energy savings actually achieved by the Top Runner program. There are, however, a number of estimates of the net energy savings *anticipated* from the Top Runner program. In general, they suggest that the Top Runner program can be expected to produce significant energy savings, consistent with the rise in energy efficiency highlighted earlier.

The International Energy Agency (2002) estimated energy savings from the Top Runner program to reach 0.35 EJ (= 97 TWh) by 2010. This is approximately 16% of Japan's target of reducing its energy consumption by 2.2 EJ (= 610 TWh) by 2010 or 17.5% of Japan's total annual household energy consumption of approximately 2 EJ (= 555 TWh) (Geller et al., 2006). Nordqvist (2006) estimated that energy savings from the Top Runner program by 2010 could be even more significant, reaching roughly 0.4–0.55 EJ (= 110–150 TWh) by 2010 (with 0.2 EJ [= 56 TWh] of savings from the residential sector and 0.2-0.35 EJ [= 56-97 TWh] of savings from the commercial sector). The Top Runner program alone, therefore, was anticipated to contribute between 16–25% of Japan's energy conservation target of approximately 2.2 EJ (= 610 TWh) by 2010. A definitive conclusion on how much the Top Runner program actually contributed to energy savings (as opposed to the expected energy savings) is, however, yet to be reached.

4) Costs and benefits

There is no guarantee, from a welfare-maximizing perspective, that the Top Runner standards will be set at the optimal level; the standards might be either too stringent or too lax. The argument could be made that since the compliance rates are high and efficiency improvements have on average significantly exceeded, the targets set by the Top Runner program are too lax. However, comparing energy efficiency standards across Japan, Europe, and the US (for those products where comparison is possible), a 2003 study by the Energy Conservation Center, Japan found that Top Runner standards set in Japan compare favorably, when it comes to stringency of targets, to standards set in the US and Europe, with the energy efficiency of Japanese refrigerators and air-conditioners the highest among the 3 (cited in Swedish Environmental Protection Agency, 2005).

It is even possible that the targets are too stringent for some appliances, leading to the promotion of appliances that are energy-efficient but not cost-effective. Kimura (2010), for instance, estimated payback periods for energy efficient air-conditioners sold in the winter of 2006 in Japan and found that many of the efficient models require more than 10–15 years for payback, which implies a payback period greater than the lifetime of a typical air-conditioner. This would suggest that in many cases, the consumer's gains in terms of lower energy costs are outweighed by the higher price of the efficient air-conditioner, yet such models remain in the market since more cost-effective air-conditioners are 'weeded' out by the Top Runner program.

As there is no guarantee that the Top Runner program will lead to a socially optimal outcome, the fact that ex-post analysis of the full economic implications of past standards is typically not carried out is unfortunate, since it forgoes the opportunity to properly evaluate whether the Top Runner framework should be in place and how it can be improved in order to maximize net social benefits.

5) Incentive for R&D and green investments

By pushing manufacturers of a variety of appliances and equipment to invest in greater energy efficiency of their products, the Top Runner product can be said to have encouraged R&D and green investments in Japan. The high compliance rate of manufacturers suggests that the Top Runner program has achieved greater energy efficiency in a 'positive' way by encouraging greater green investments by manufacturers, rather than in a 'negative' way by driving out manufacturers who fail to meet the standard.

A purported favorable aspect of the Top Runner program over minimum energy performance standards for appliances, is that it transforms the entire market (since by definition, all the appliances in the market will have to achieve some level of energy efficiency gains) and thus universally encourages R&D and green investments. With minimum standards, by contrast, the standard set may lie well below that of the most energy-efficient product, meaning that is the standards provide little incentive for producers that already exceed the standard to carry out further green investments or R&D into energy efficiency.

However, the Top Runner program encourages incremental rather than innovative change, since the ambition of the standard set is limited by the energy efficiency of appliances already on the market. The unique structure of the Top Runner program also creates possibilities for collusion, with manufacturers potentially colluding either tacitly or overtly to restrain energy efficiency improvements so as to receive more lax targets in the future (International Energy Agency, 2003).

There are possible disincentives for green investment and R&D by manufacturers of products that are already very energy-efficient and at or near the Top Runner level, since if they achieve further energy efficiency gains, their new levels of energy efficiency will simply be used as the benchmark for the succeeding period. On the other hand, the Top Runner program might also encourage such manufacturers to increase the energy efficiency of their products even further so as to increase the stringency of the Top Runner targets in the following period and thus drive out competitors.

Labeling and information programs are comparatively recent and there is a lack of quantitative estimates of their impact on societal welfare. In general, such programs work best when they complement mandatory standards. The Top Runner program ensures that manufacturers work to improve energy efficiency, but labels can augment that effect even further by increasing consumer demand for energy-efficient appliances. Energy Saving Labels, since their introduction, have been effective in providing consumers, retailers as well as manufacturers with a simple benchmark for evaluating appliance energy efficiency, thus potentially boosting manufacturers' incentives to comply with the standards (Swedish Environmental Protection Agency, 2005).

On the other hand, it is probable that the gains from such labeling programs could be even higher. As already pointed out, their coverage is incomplete, with many Top Runner programs not yet covered. Moreover, their voluntary nature impedes their potential effectiveness. Admittedly it is still mandatory for manufacturers to indicate their products' energy efficiency level, but a key benefit of Japan's labeling programs, such as the Energy Saving Labeling Program and the Label Display Program for Retailers, is that they give consumers information such as *relative* energy efficiency and expected electricity bill that might well be a better guide to decision-making than simply the energy efficiency level. The voluntary nature of these schemes means that if a manufacturer decides not to use these labels and display only the energy efficiency level of its products, the benefits of greater information provision will be significantly diminished. Increasing the coverage of the labeling

programs and making them mandatory would, however, also lead to higher costs incurred by manufacturers and retailers in complying with the labeling requirements, and hence would be justified only if the additional benefits outweighed these costs.

The Eco-Point system has contributed to significantly increased sales of the three types of energy-efficient as well as increased purchases of energy-efficient LED bulbs (which is one of the items eco-points could be exchanged for). The market penetration of energy-efficient home appliances has also increased considerably since the program was enacted. The Eco-Point system is likely to have saved significant amounts of energy, as the associated reductions in CO_2 emissions have been estimated at 2.7 million tons per year (Ministry of the Environment et al., 2011). However it is unclear whether the energy savings and environmental benefits, as well as other benefits such as the stimulus effect on the macro-economy, are justified at the program cost of US$6.9 billion. In addition, DTB TVs are large and use up more energy (even if the energy is used more efficiently), and it is not clear whether replacing inefficient smaller TVs with more efficient but larger DTB TVs actually led to major energy savings (Vare, 2010).

Some of the ways the existing measures can be improved are:

1) For both the Top Runner program and the various labeling schemes, ex-ante analysis of the potential economic and environmental impacts should be carried out in order to better ground the policies as contributing to maximizing welfare, while ex-post analysis of costs and benefits is needed to improve evaluation of past policies. This is particularly critical for the Top Runner program, where there exist particular risks for a sub-optimal outcome by having too stringent standards that lead to energy efficiency improvements that are not cost-effective (as might be the case for air-conditioners).

2) The Top Runner program should also be modified so as to reward energy efficiency improvements from manufacturers that are close to the efficiency level of the Top Runner. One possible way to do so is to reward the Top Runner at the beginning of each target period.

(ii) Scientific integrity

There is evidence that the formulation of the Top Runner standards takes into account scientific evidence and analysis. The standards are differentiated across various products based on a number of relevant parameters that affect the appliance energy efficiency, such as size, weight and technology (Kimura, 2010). Differentiation is also carried out by dividing products into separate categories where possible, with the targets for individual categories distinct from one another (e.g. DVD recorders are categorized as “HDD” or “VCR”) (Ministry of Economy, Trade and Industry, Japan, 2010a). This ensures that the target for a given product is one that is applicable to that product and technically feasible. In addition, the standards are updated on a regular basis, meaning they are unlikely to be out-of-date at any given point in time.

One potential disadvantage of the Top Runner standards, from a scientific standpoint, is that they are based on the energy performance level of the most energy-efficient product that already exists in the market, rather than the highest energy performance level that is technically and economically feasible, but may not yet have been realized by any product in the market. The regulatory process for the formulation of the standards does, however, take into account expected technological progress. If there exists significant technological potential for improvements in energy efficiency for a given product, the target is adjusted accordingly and made more stringent (Ministry of Economy, Trade and Industry, Japan, 2010a), though it is unclear how exactly the adjustment is made.

(iii) Flexibility

Japan has demonstrated a willingness to revise and adjust its appliance standards program over time. The relative lack of effectiveness of its earlier standards led Japan to expand the program in 1994. When the standards continued to have only a moderate effect on the energy efficiency of appliances in Japan, they were completely overhauled in 1998 and replaced with the Top Runner program. The Top Runner methodology for determining the standards was both developed and implemented in a relatively short time, demonstrating flexibility in policymaking.

One of the key strengths of the Top Runner program is its built-in flexibility. By imposing standards on a weighted average of the manufacturer's products, the program gives manufacturers the flexibility to decide how to achieve the energy efficiency target, and if necessary respond to changing circumstances by increasing their energy efficiency efforts in some products and reducing them in other products. Moreover, the fact that the Top Runner program sets differentiated targets for different producers depending on a number of exogenous parameters increases the extent to which the program is flexible.

The Top Runner program is also responsive when it comes to updating of the standards. Because future standards under the program are based on current energy efficiency levels and current projections of technological progress, any standards set take into account the actual market scenario faced by manufacturers, meaning that the Top Runner standards are responsive to changing circumstances. In addition, the process for setting standards is flexible enough that consultative deliberations for determining future standards can be re-opened even before the target year (Nordqvist, 2006).

Against all this, however, is the fact that the Top Runner program risks being inflexible from the policymakers' perspective. Given that the procedure for determining standards is clearly defined as a function of a limited set of variables (such as energy efficiency of current appliances, technological progress etc), there is limited discretion on the policymaker's part to adjust the standards in response to a change in some variable other than the ones explicitly taken into account in the setting of the standards.

The voluntary nature of the Energy Saving Labeling Program means that it is inherently flexible for manufacturers. They can, for instance, choose to eschew the Energy Saving Label altogether if they can come up with an alternative way of displaying their energy efficiency. However, retailers who are covered by the mandatory Label Display Program for Retailers face a relatively inflexible obligation which may be difficult to fulfill if, for instance, the manufacturer does not provide the retailer with complete energy efficiency information on its products.

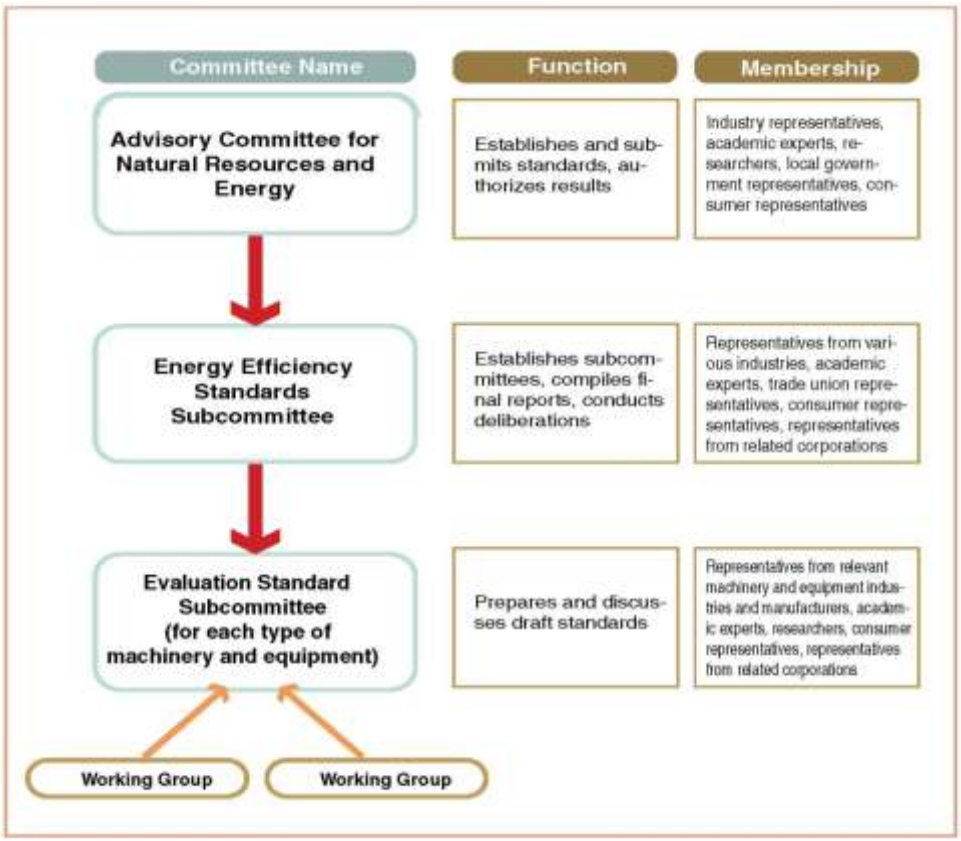
ADMINISTRATIVE AND POLITICAL VIABILITY

(iv)Transparency

The administrative process by which energy efficiency standards are established under the Top Runner program is depicted in Figure 2.3.2. The Ministry of Economy, Trade and Industry (METI) is the government authority ultimately in charge of determining standards (Kimura, 2010). The Advisory Committee for Natural Resources and Energy is an advisory body to the METI and deliberates on Japan's energy conservation policies. The Energy Efficiency Standards Subcommittee, within the Advisory Committee, deliberates on appliance standards, based on draft standards

developed by Evaluation Standard Subcommittees, each of which is devoted to a specific product category. The same hierarchical structure also functions to deliberate on energy efficiency labeling, whether for manufacturers under the Energy Saving Labeling Program or for retailers under the Label Display Program for Retailers (Ministry of Economy, Trade and Industry, Japan, 2010a).

Figure 2.3.2 ***Process for establishing Top Runner standards and associated labels***



Source: Ministry of Economy, Trade and Industry, Japan (2010a)

There is scope for stakeholders' views to be reflected in the final Top Runner standards. The Ministry of Economy, Trade and Industry, Japan (2010a) points out how the regulatory process sometimes yields difficult deliberations regarding whether a particular type of equipment should be included under the Top Runner program. Even for products that are already in the Top Runner program, factors other than the energy efficiency of the Top Runner product – such as the differentiated parameters and the definitions and delineations of the various product groups – also impact on the final set of standards adopted and, since they are not necessarily fixed or predetermined, may be adjusted to reflect stakeholder views. For labels, similarly, the authorities retain discretion over which products are to be included, meaning there is scope for stakeholders to have a say in the final list of products that are to be brought under the labeling program(s). A major indicator of stakeholder engagement is the fact that stakeholders (in particular, industry) have been accepting of the Top Runner program and have been active in cooperating with the authorities as well as in deliberating on the standards (Nordqvist, 2006).

Detailed information on the Top Runner program and the associated labeling & information programs (i.e. the Energy Saving Labeling Program, Label Display Program for Retailers and the Energy Efficient Product Retailer Assessment Program) is available in METI's publication "Top

Runner Program: Developing the World's best Energy-Efficient Program," which is available online at the METI website.[105] This publication, which is updated regularly to take into account changes in policies, contains an overview of the rationale for standards and labels, how they are designed, and how they work. In addition, the publication provides detailed information on the Top Runner standards for each of the products covered by the scheme, and includes pictorial representations of what the Energy Saving Label and the Uniform Energy-Saving Label look like so as to facilitate consumer recognition of the labels. Basic information on the Energy Star program is available from the Energy Star website,[106] while the Energy Conservation Center, Japan (ECCJ) maintains a website which details the manufacturers and their respective products that are registered under the Energy Star program.[107]

In addition, the ECCJ is responsible for disseminating information on energy conservation and plays an active role in informing the general public as well as commercial and industrial stakeholders on energy efficiency programs and policies, by subsidizing various promotional campaigns and advertising in the media (International Energy Agency, 2008). Thus the role played by the ECCJ further enhances the transparency of Japan's appliance energy efficiency policies.

(v) Alignment

As Figure 2.3.2 above illustrates, the decision-making process for standards and labels, while reflecting viewpoints from a variety of different stakeholders, is also highly centralized, with only one government ministry in charge (i.e. the METI), and has a clear hierarchical structure. Such a structure, by its very nature, facilitates alignment and coordination among authorities. Alignment is further boosted by the fact there is a clearly defined process for determining standards, with pre-established guidelines dictating much of the process (these guidelines can be found in Ministry of Economy, Trade and Industry, Japan, 2010b). One indicator suggesting that government authorities in charge of designing policies are well-aligned is the fact that the decision-making process for establishing standards tends to be relatively quick, usually taking about a year or two (Kimura, 2010). Indeed, this is one of the key reasons, according to the Ministry of Economy, Trade and Industry, Japan (2010b), behind the switch from its earlier system of energy efficiency standards to the current Top Runner system. By simplifying the process of establishing standards (since stakeholders can no longer explicitly bargain on what exactly the standard should be), greater alignment has arguably been achieved.

Evidence that regulations are aligned among each other is less conclusive. Unlike the Philippines, where standard-setting and labeling have often proceeded hand-in-hand, the same has not always been true in Japan. As noted earlier, standards in Japan were introduced in advance of labels, while labels do not cover all the products that are subject to standards under the Top Runner program. Moreover, the Energy Saving Labeling scheme, under which manufacturers have to indicate whether their products are satisfying the Top Runner standard and the extent to which they are doing so, is voluntary. Manufacturers are obligated (under the Energy Conservation Law) only to report the energy efficiency of their products, but that risks leaving the consumers uninformed about the product's relative performance under the Top Runner program. This lack of alignment could limit the potential gains from the Top Runner program. It is true that the Label Display Program obligates

[105] The publication can be found here: http://www.enecho.meti.go.jp/policy/saveenergy/toprunner2011.03en-1103.pdf.
[106] See http://www.energystar.gov
[107] See http://www.energystar.jp/index_esu.html

retailers to display information on, among others, the performance of the product with respect to the Top Runner, but its coverage of products is even more limited than that of the Energy Saving Labeling Scheme.

2.3.2 Energy Efficiency in Household Appliances in the Philippines

Key findings

- Increasing the energy efficiency of appliances (including lighting) in the Philippines could reduce cumulative energy consumption between 2010 and 2030 by as much as 150.3 TWh, which forms roughly 45% of Philippines' goal of achieving total energy savings of 10% by 2030.
- The Philippines' policy approach to increasing appliance energy efficiency combines mandates (including minimum energy performance standards for appliances, and lighting retrofits), information programs, and fiscal and financial incentives (including distribution of compact fluorescent lamps (CFLs), and a hire-purchase scheme for purchases of energy-efficient appliances).
- The Philippines' appliance standards and labels have led to significant energy savings in recent years at an unknown cost, while recently introduced policies under the Philippine Energy Efficiency Program and the Clean Investment Plan are expected to lead to net social benefits. The effectiveness of the policymaking process can be constrained by irregular policy updates, lack of flexibility, and lack of alignment among authorities.

Costs, benefits and promotion

- Appliance standards and labels led to energy savings of 7 TWh in 2009 and 9.1 TWh in 2010, which accounted for around 11% of the Philippine's energy conservation target. However the costs of achieving these savings are unknown. The formulation of standards could be improved if economic cost-benefit analysis is conducted.
- The National Residential Lighting Program, the Retrofit of Government Office Buildings and the Public Lighting Retrofit Program were expected to lead to net social benefits of $106 million over a 5-year period. Actual net social benefits are likely to be lower due to the delay in the distribution of CFLs under the National Residential Lighting Program.
- The Energy Efficiency Component of the Clean Investment Plan is expected to lead to net social benefits, with the present value of the energy saving benefits expected to outweigh the initial costs in less than 2 years.
- Only a few Energy Service Companies (ESCOs) operate in the Philippines. Policies aimed at improving energy efficiency in appliances have not been effective at incentivizing ESCOs. A number of barriers have impeded the development, including limited access to funds, lack of flagship projects, lack of technical evaluation and lack of awareness of end-users and business managers.

Scientific integrity

- While minimum energy performance standards in the Philippines are based on scientific evidence and analysis, they are not updated on a regular basis and the testing capacity is limited since there is only one accredited facility to check whether or not products comply with standards.

Flexibility

- Lags in policymaking and the rigidity of mandatory minimum energy performance standards constrain flexibility in the efforts to build proper energy efficiency policies.

Transparency

- Most of the Philippines' policies reflect a strong degree of stakeholder engagement in the formulation process, with manufacturers directly involved in the setting of standards and in projects such as the Efficient Lighting Initiative.
- Information on appliance standards and the labeling program is not easily available and occasionally outdated. Information on other policies relating to appliances is generally readily accessible.

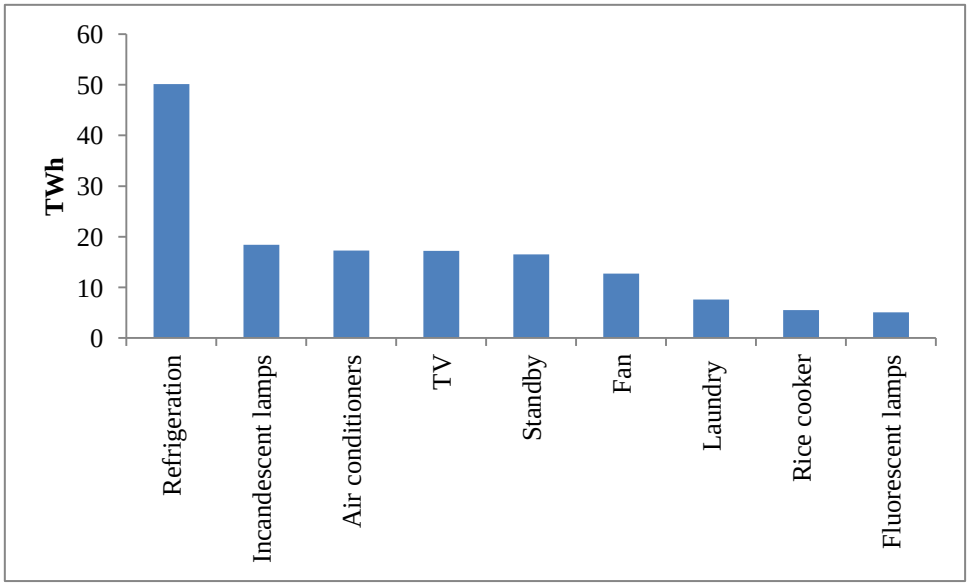
Alignment

- Alignment between the various authorities involved has been a challenge in certain cases. For example, coordination problems have contributed to delays in the distribution of CFLs under the National Residential Lighting Program as well as the cancellation of the plan to create a super ESCO.
- The Philippines' policies are generally well-aligned with each other, with labels implemented so as to complement appliance standards and the various incentive schemes designed so as to increase the effectiveness of standards and labels.
- Fiscal and financial incentives are also well-aligned with the standards and labeling program in the sense that they help to address market failure, capital market barriers, and information barriers.

A. Size and Significance

The potential for energy savings from appliances in the Philippines is considerable – a recent study estimated that between 2010 and 2030, the cumulative energy savings from implementing minimum energy performance standards and labels in Philippines could amount to as much as 150.3 TWh (APEC, Energy Working Group 2010). Figure 2.3.3 below illustrates the breakdown of such savings among different types of appliances.

Figure 2.3.3 ***Estimated cumulative energy savings potential, 2010 – 2030 (TWh)***



Source: APEC Energy Working Group, 2010

By far the greatest potential for energy savings lies in refrigeration at 50.1 TWh (one-third of the total energy savings potential of 150.3 TWh in appliances). Other appliances with significant potential for energy savings include incandescent lamps, air-conditioners, televisions and fans. It should be noted, however, that although by 2030 refrigeration will account for the greatest potential energy savings, improving the energy efficiency of lighting (in particular by replacing incandescent lamps) will lead to the largest energy savings (potentially) in the near-term (APEC Energy Working Group, 2010).

B. Policy Formulation

(i) History and Background

The Philippines is a net importer of energy, with 57% of its primary energy met from domestic sources (Rein and Cruz, 2011). This state of affairs has motivated the Philippine government to adopt a long-term goal of energy independence – a goal that underlies much of Philippine's energy policy discourse and has driven its efforts towards increasing energy efficiency and conservation. After frequent power shortages in the 1980s, the Philippine government committed to promoting energy conservation and this was recognized in the National Energy Plans set by the Department of Energy (Egan, 1999). Given the significant potential for energy savings from appliances, tackling energy efficiency in appliances forms a crucial element of the Philippines' efforts to achieve these energy conservation targets.

Recent iterations of the Philippine Energy Plan have included concrete targets for energy efficiency and conservation. The Mid-Term Philippine Energy Plan (2005a) included the National Energy Efficiency and Conservation Program (NEECP), with a target of 10% energy savings on total annual demand of all economic sectors by 2014. This amounts to total energy savings of 229 Million Barrels of Fuel Oil Equivalent (MMBFOE) (= 146 TWh) in the 2005-2014 period (Department of Energy, Philippines, 2005a). The Long-Term Philippine Energy Plan (2009) sets a similar target of 10% energy savings on total annual demand of all economic sectors by 2030 (Department of Energy,

2009). This amounts to total energy savings of around 524 MMBFOE (=334 TWh) in the 2009-2030 period (Suryadi, 2011). In addition to setting the energy saving targets, the National Energy Efficiency and Conservation Program also includes appliance standards and appliance labels, two of the major policy tools utilized by the Philippines in order to enhance energy efficiency in appliances.

In addition to the Philippine Energy Plan and the National Energy Efficiency and Conservation Program, the other major policy framework that forms the basis of the Philippine's energy efficiency policies in the appliance sector is the Philippine Energy Efficiency Project (PEEP). The Philippine Energy Efficiency Project started in February 2010 and is being led by the Department of Energy, with financial assistance from the Asian Development Bank (ADB). The project is the successor to the Philippine Efficient Lighting Market Transformation Program (PELMATP), which operated from 2005 to 2009 and was aimed at removing the barriers to the widespread use of energy efficient lighting systems (Department of Energy, 2005b; Verdote, 2009). Along with energy shortage problems and the problem of greenhouse gas emissions that form the rationale for much of the remainder of Philippine energy policy as well, three factors have been crucial in motivating the PEEP:

a) In the Philippines, the peak demand for electricity is in the evening and driven by lighting. Widespread use of inefficient lighting not only increases total electricity demand, but it also tends to increase peak demand and thus raises the cost of electricity, since peak demand has to be met by generating electricity using expensive diesel/fuel oil.
b) Despite the attractive opportunities that exist for energy service companies (ESCOs) to invest in energy-efficiency projects, there are few operating ESCOs in the Philippines.[108]
c) Replacement of fluorescent lamps with more energy-efficient compact fluorescent lamps (CFLs) carries with it the risk of mercury pollution from the disposal of the older lamps.

The PEEP consists of an assortment of policies and regulations aimed at addressing these issues, out of which three are relevant to the improvement of energy efficiency in appliances. The Efficient Lighting Initiative promotes energy efficient lighting technology, the Efficiency Initiative in Buildings and Industries aims to revitalize the market for Energy Service Companies (ESCOs) in the Philippines (among other objectives), while Communication and Social Mobilization aims to provide information and create awareness (Asian Development Bank, 2009).

The Philippines is currently considering the establishment of an Energy Efficiency and Conservation Bill that is to serve as the legal policy framework for its energy efficiency policies (Department of Energy, 2012). The Department of Energy is currently in the process of finalizing the Bill and incorporating stakeholder view that were obtained through a process of public consultation, and will submit the Bill in July 2012.[109]

[108] The ESCO market in the Philippines is discussed in more detail in the regulatory review section.

[109] Based on interviews with staff from the Energy Efficiency and Conservation Division, Energy Utilization Management Bureau, Department of Energy, The Philippines (16 April 2012).

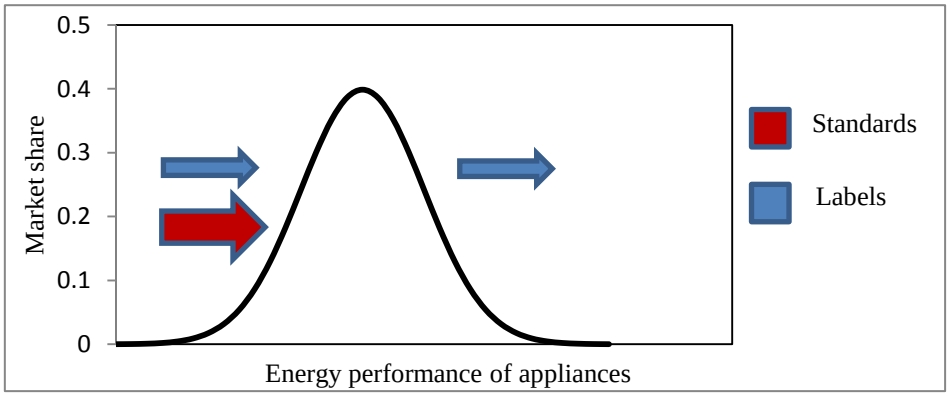
(ii) Policy Description

MANDATES

Appliance Standards

Appliance standards and labels are complementary policies that transform the energy efficiency of appliances in the market in quite distinct ways. Appliance standards "push" the market – they aim to improve the energy efficiency of new appliances by imposing minimum standards that serve to eliminate the least efficient appliances from the market. Appliance labels provide consumers with information on the energy efficiency of the products and thus serve to both "push" and "pull" the market (Egan, 1999); however, unlike standards, they may be not be able to fundamentally transform the market since inefficient products still remain in the market and it is possible that consumers' selection criteria may exclude considerations of energy efficiency (World Energy Council, 2008). This is schematically illustrated in Figure 2.3.4 below.

Figure 2.3.4 ***Standards and labels – "pull" and "push" factors***



Source: Authors' representation

Mandatory minimum energy performance standards were first introduced in the Philippines in 1993, covering only room air-conditioners (window type) at the time (Egan, 1999; CLASP, 2011). Subsequently, coverage was expanded to include split-type air-conditioners (2002), magnetic fluorescent lamp ballasts (2002), CFLs (2002), electronic ballasts (2010) and double-capped fluorescent lamps (2010) (APEC Energy Working Group, 2010; Xue et al., 2010; Harrington and Damnics, 2004; CLASP, 2011). Currently under consideration for inclusion into the minimum energy performance standards program are televisions and washing machines (CLASP, 2011) as well as refrigerators (Campanano, 2012). Standards are determined by the Department of Energy, while the Lighting and Appliance Testing Laboratory carries out energy efficiency testing on products to determine whether they satisfy the standards. Currently the laboratory has facilities for testing air-conditioners, small refrigerators and CFLs (Asian Development Bank, 2009).

Retrofitting of lighting

The Philippines has implemented a number of policies mandating the retrofit of lighting so as to promote energy efficiency in lighting. As part of the Philippine Efficient Lighting Market Transformation Program, Administrative Order No. 183 (the Palit-Ilaw Program) was issued in 2007 mandating the use of energy efficient lighting in government buildings (Asia Pacific Energy Research Centre, 2010). The Palit-Ilaw Program was also aimed at meeting a target of a 10% reduction in the

energy consumption of government buildings that had been mandated by previous Administrative Orders.

Complementing the Palit-Ilaw Program is the Retrofit of Government Office Buildings program, which is a component of the Efficient Lighting Initiative under the Philippine Energy Efficiency Project (PEEP). With a US$3 million budget, this policy aims to retrofit 35 government office buildings in Manila by replacing older-style fluorescent lamps, incandescent lamps and inefficient magnetic ballasts with the energy-efficient alternatives of new fluorescent lamps, CFLs and electronic ballasts respectively (Asian Development Bank, 2009). The program has since been revised and the target now is to retrofit 100 government office buildings throughout the Philippines (Anunciacion, 2012).

The Philippine Energy Efficiency Project also includes the US$1.5 million Public Lighting Retrofit Program, which aims to achieve energy efficiency in public lighting by replacing incandescent bulbs with efficient CFLs, mercury vapor lamps with high-pressure sodium lamps, and incandescent lamps used in traffic lights with LEDs (Asian Development Bank, 2009). The scope of the project has recently been expanded, with the Philippines planning to carry out retrofitting of traffic lights as well (Anunciacion, 2012).

Energy Efficiency Testing

As part of the Efficient Lighting Initiative of the Philippine Energy Efficiency Project, the government plans to upgrade the Lighting and Appliance Testing Laboratory so as to enable it to test televisions, washing machines, large refrigerators, freezers, and a range of other products, in addition to the three products (air-conditioners, small refrigerators and CFLs) that it is already capable of testing (Asian Development Bank, 2009). The government also plans to buy calorimeter equipment for the air-conditioning unit of the laboratory.[110] The budget for upgrading the laboratory is US$2.5 million (Asian Development Bank, 2009).

INFORMATION PROGRAMS

Appliance Labels

Appliance labels, which like appliance standards are also mandatory, cover a much more comprehensive list of appliances and equipment. Currently, the appliances that are required to display energy efficiency labels include window air-conditioners (1994), split air-conditioners (2002), refrigerators (2000) and freezers (2000) as well as 5 different lighting types- magnetic ballasts (2002), CFLs (2002), single-capped and double-capped fluorescent lamps (2010) and electronic ballasts (2010) (CLASP, 2011; Xue et al., 2010; Pacudan, 2001; Hernandez, 2001). These labels display indicators of the energy efficiency performance of the appliance that is specific to the product in question. For instance, the air-conditioner energy label illustrates the energy efficiency ratio, while the label for CFLs displays indicators such as the light output, power consumption, efficacy and average life (Campanano, 2012).

The Philippines is currently considering the inclusion of televisions, washing machines, industrial fans and lamps (high-intensity discharge) into the labeling scheme (Campanano, 2012; CLASP, 2011;

[110] Based on interviews with staff from the Energy Efficiency and Conservation Division, Energy Utilization Management Bureau, Department of Energy, The Philippines (16 April 2012).

Xue et al., 2010), while a new design for the air-conditioner energy label is under consideration as well (Campanano, 2012).

Efficient Lighting Initiative

The Efficient Lighting Initiative (ELI)[111] was implemented between 1999 and 2003 by the International Finance Corporation (IFC), supported by US$15 million of investment from the Global Environment Facility or GEF (International Finance Corporation, 2005). The initiative consisted of two components. The "green leaf" logo was a voluntary labeling scheme that encouraged lighting manufacturers to increase the energy efficiency of their products. In addition, the IFC also catalyzed regulatory change by building coalitions of regulators, manufacturers, utilities, and environmental and consumer groups in order to promote energy-efficient lighting. As such, the Efficient Lighting Initiative laid the groundwork not only for lighting standards and labels that started operating from 2002, but also for other programs directed at lighting.

Philippine Efficient Lighting Market Transformation Project

The Philippine Efficient Lighting Market Transformation Project (PELMATP) was led by the Department of Energy with support from the Global Environment Facility (GEF) as well as the United National Development Programme (UNDP). The objective of this project, which operated from 2005 to 2009, was to remove the barriers to widespread use of energy efficient lighting systems (Department of Energy, 2005b; Verdote, 2009). The project primarily operated through capacity building, information provision, and policies enhancing consumer awareness, though it did include mandates such as the Palit-Ilaw program. The project consisted of five components: Energy Efficient Lighting (EEL) policy, Standards and Guidelines Enhancement Program, EEL Application Consumer Awareness Program, EEL Initiatives Financing Assistance Program, and EEL System Waste Management Program- the latter is meant to address the problem of mercury waste from the disposal of lights (Asia Pacific Energy Research Centre, 2010). Some of the key achievements of the PELMATP included setting up Guidelines on Energy Conserving Design in Buildings (to ensure the adoption of energy efficient lighting in building design) and Guidelines on Roadway Lighting, setting up a Waste Management Guidebook, Guidelines and Info-Roster, and finally the issuance of Administrative Order No. 183 that mandates the use of energy efficient lighting in government buildings.

Communication and Social Mobilization

The Communication and Social Mobilization component of the Philippine Energy Efficiency Project aims to organize activities grouped into two streams: 1) communication for efficient lighting and 2) promotion of energy efficiency in everyday life. The objective of these activities is to promote and communicate information about each of the other policies implemented under the Philippine Energy Efficiency Project, such as the Retrofit of Government Office Buildings or the Public Lighting Retrofit Program (Asian Development Bank, 2009).

[111] Despite the confusing nomenclature, this policy is distinct from the Efficient Lighting Initiative that is part of the Philippine Energy Efficiency Project and was implemented much later in 2010.

FISCAL AND FINANCIAL INCENTIVES

National Residential Lighting Program

This program, which is one of the components of the Efficient Lighting Initiative under the Philippine Energy Efficiency Project, aims to distribute 13 million CFLs to households free of charge, in order to replace inefficient incandescent bulbs that are widely used, with many households having at least two incandescent 40-watt bulbs. The incandescent bulbs will be collected and used to claim carbon credits for the program. In addition, for households in off-grid areas, the program will provide light emitting diode (LED) lights to replace kerosene, candles, and other non-electric lighting alternatives that are currently used. The US$ 18 million program was launched in 2009 and planned to be completed by end-October 2011, though as of April 2012 the distribution had not yet been completed (Anunciacion, 2012).

Super Energy Services Company (ESCO)

The Efficiency Initiative in Buildings and Industries (under the Philippine Energy Efficiency Project) aimed to set up a Super ESCO as a subsidiary of the Philippine National Oil Company (PNOC). With a budget of US$ 8 million, the Super ESCO would target the revitalization of the ESCO market in the Philippines, both by developing public sector energy efficiency projects on its own and by supporting the development of other ESCOs that can then target energy efficiency projects in the private sector. The support to private sector ESCOs would consist primarily of financial support in the form of low-interest loans, with a revolving fund created so that loan repayments from ESCO projects supported in the past can be channeled towards funding new ESCO projects. It was also envisaged that the Super ESCO would provide technical advisory support to other ESCOs in the form of training materials, best practices, accreditation, etc. (Asian Development Bank, 2009). However, the Super ESCO project was formally cancelled in April 2011 due to a decision taken by the PNOC not to implement the project (Anunciacion, 2012), and there are as yet no indications that any other projects to set up a Super ESCO will be launched in the near future.

Energy Efficiency Component of Clean Investment Plan

In October 2011, an Energy Efficiency Component was added to the Philippine's Clean Investment Plan (CIP) under the Clean Technology Fund (CTF) (CTF Trust Fund Committee, 2011). This program was motivated by the existence of market failure in the market for energy efficient appliances in the Philippines, e.g. "efficient" light emitting diode (LED) and liquid crystal display (LCD) televisions (TVs) sold in the Philippines are less efficient than elsewhere in the world, while old and inefficient cathode ray tube (CRT) TVs are imported from abroad and dumped in the domestic market at "throwaway" prices. The Philippine government has identified lack of awareness about energy-efficient appliances and the high upfront costs of such appliances as the key factors behind the market failure. The program aims redress this market failure and accelerate the introduction of more energy efficient appliances, including LED and LCD TVs, computer monitors, fans, air-conditioners, and refrigerators etc. This will be done primarily through a hire-purchase scheme, whereby the project will purchase about 200,000 efficient air-conditioners, 150,000 refrigerators, 350,000 fans, and 100,000 televisions (with the prices reduced through bulk procurement) and consumers will be able to pay for the appliances over a 36-month hire-purchase scheme. In addition, a revolving energy efficiency trust fund will be established and consumer awareness will be raised (CTF Trust Fund Committee, 2011).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

The Philippine regulatory process for determining standards and labels does not ensure that the policies instituted maximize net social benefits. While the Philippine government has occasionally carried out ex-ante analysis of the possible impact of its standards and labeling program (Hernandez, 2001), such analysis has only looked at the potential benefits (in terms of expected energy savings) without also examining the costs. The analysis carried out by Hernandez (2001) took the existing standards as given, rather than comparing the lifetime economic impacts under different standard levels and then picking the optimum one (as recommended, for instance, by Egan et al., 1997).

Whether appliance standards and labels have actually maximized benefits and minimized costs has to be assessed based on ex-post analysis of their impact. The following criteria could be looked at in order to assess the benefits of the standards and labeling program:

Coverage and compliance

For standards and labels, the greater the breadth of products covered, the greater are the energy saving benefits. Coverage of the labeling program is fairly comprehensive, with refrigerators, air-conditioners and a variety of lighting equipment already included; given that there are plans to include TVs, washing machines and industrial fans as well, each of the appliances identified in Figure 2.3.3 above as a major source of energy savings until 2030 is either already covered or will soon be covered by the labeling scheme. The same is not true, however, for the minimum energy performance standards program, since the list of products currently covered by standards does not include refrigerators. Given that potential energy savings from improving energy efficiency in refrigerators (and freezers) dwarf the potential energy savings from improving the efficiency of any of the other appliances, the exclusion of refrigerators is likely to have restricted the energy savings from appliance standards. However, the Philippines is currently developing minimum energy performance standards for small and medium-sized refrigerators (with a size of up to 12 cubic feet) (Campanano, 2012).

Within each product category, the higher the level of compliance, the greater are the energy savings. For residential air-conditioners, there was a 93% level of compliance with the energy label requirement for the year 2000 (Hernandez, 2001). Prior to the imposition of minimum energy performance standards for room air-conditioners in 1993, only 50% of the small units, and none of the large units in the market, met the standard. All the inefficient models were weeded out after the first target year, indicating that targets were stringent (Egan, 1999). In addition, the standards for air-conditioners were gradually ratcheted upwards and made even more stringent with time, with the standards for small air-conditioners updated twice by 2001, and the standards for large air-conditioners updated thrice by 2002 (Hernandez, 2001). However, in the last decade or so, the process of updating standards has stagnated, with the standards currently in place for air-conditioners last updated in 2002 (Campanano, 2012; Gatdula, 2011). Thus, it is likely that the current air-conditioner standards are outdated.

Energy savings

In the first year after the minimum energy performance standards for room air-conditioners were introduced, the standards alone led to energy savings of over 17 GWh (Egan, 1999). By 1999, the annual energy savings from having both standards and labels on room air-conditioners had increased to as much as 224 GWh, jumping the following year to 283 GWh. Although no standards are in place for refrigerators, the introduction of labels for refrigerators and freezers soon led to energy savings of 44GWh in 2000.

Actual energy savings from the standards and labeling program (combining all appliances) increased to 616 GWh in 2005, though this was lower than projections made by the Bureau of Product Standards (in 2001) that energy savings from appliance standards and labels would reach 1 TWh by 2004 (Hernandez, 2001). However, the energy savings nearly doubled in 2006 to 1.28 TWh, with 704 GWh of the savings coming from the introduction of CFLs (Asia Pacific Energy Research Center, 2010).

In recent years, the energy savings from the appliance standards and the labeling program have increased considerably. In 2009 the energy savings were 7 TWh, increasing even further to 9.1 TWh in 2010 (Campanano, 2012). To put these numbers in context, the energy savings from the appliance standards and the labeling program in 2009 and 2010 alone account for around 11% of the Philippine's energy conservation target of reducing energy use by 146 TWh between 2005 and 2014. The energy savings from appliance standards and labeling in 2009 and 2010 were also much higher than earlier projections that put expected energy savings at 4.27 TWh in 2010 and 5.15 TWh in 2014 (Asia Pacific Energy Research Center, 2010).

There have been significant energy saving benefits, especially in recent years, from the appliance standards and the labeling program. To assess whether the level of coverage of the two programs is optimal and whether the standards have been optimally set, however, would require accounting for the full social benefits and costs of the programs. Discussion of costs is largely missing from the literature on the standards and the labeling program, while positive externalities potentially associated with the energy savings (such as environmental or energy security benefits) have not yet been measured. In the absence of such information, it is not possible to reach a definite conclusion on whether appliance standards and labels have achieved or maximized net social benefits.

Similarly, the earlier discussion on criteria such as coverage, compliance, and stringency of standards needs to be qualified as well. While increased coverage, greater compliance rates and more stringent standard levels will lead to greater energy saving benefits, it is not necessarily true that they will always lead to *net* social benefits, for example, if the implementation cost offsets the benefits.

The ADB carried out an ex-ante analysis of the expected impact of three of the policies under the Philippine Energy Efficiency Project, namely the Public Lighting Retrofit Program, the Retrofit of Government Office Buildings and the National Residential Lighting Program (which involves the distribution of 13 million CFLs as well as an unspecified number of LED lights). In terms of energy savings, the largest expected savings are from the National Distribution Lighting Program, with the ADB expecting the program to achieve energy savings of 534 GWh annually. The expected reduction in CO_2 emissions is 300,000 tonnes annually from reduced power generation.

Combining the expected benefits of the three programs with the investment cost involved (US$ 18 million for the National Residential Lighting Program, US$ 3 million for the Retrofit of Government

Office Buildings and US$ 1.5 million for the Public Lighting Retrofit Program), the ADB found that over a 5 year period, the expected net present value of the three programs, calculated by taking into account the investment cost and the benefits from reduced power generation, was positive at US$ 106 million. This is likely to underestimate the expected net social benefit, which would also factor in the environmental benefits of reduced power generation (e.g. reduced CO_2 emissions).

While the Philippine Energy Efficiency Project is still ongoing, the Energy Utilization Management Bureau of the Department of Energy has carried out an ex-post analysis of the impact that these programs have had so far (Anunciacion, 2012). The retrofit of public lighting has already been completed, while the retrofitting of traffic lights is yet to begin. The retrofit of government buildings has progressed more slowly, with only 7 out of a planned 100 buildings retrofitted so far. As mentioned before, the National Residential Lighting Program is behind schedule, with 4.46 million CFLs distributed so far, while the collection and disposal of incandescent lamps has not yet begun (Anunciacion, 2012). Since the distribution of CFLs accounted for the largest portion of the energy savings in the ADB's analysis of the expected impact of the three aforementioned programs, the delay in the distribution implies that the energy saving benefits from the three programs will accrue more slowly over time than expected, so that the actual net present value of the programs over 5 years is likely to be lower than the US$ 106 million projected by the ADB.

The Government of Philippines has estimated that the cost of implementing the Energy Efficiency Component of the Climate Investment Plan (involving the hire-purchase scheme for energy-efficient appliances) will be US$ 24 million (in initial investment costs), while the estimated energy savings are 250 GWh annually and the estimated greenhouse gas reductions are 125,000 tonnes of CO_2 annually (CTF Trust Fund Committee, 2011). Using the same methodology utilized by the ADB in assessing the three programs under the Philippine Energy Efficiency Project (Asian Development Bank, 2009), the economic benefit of the energy savings due to reduced generation costs amounts to US$ 19.8 million annually.[112] Thus, the project is likely to lead to net social benefits, since the expected benefits from the energy savings alone will outweigh the investment cost (in present value terms) in less than 2 years.

In assessing the Philippine's policies on appliance energy efficiency, it is also important to evaluate whether they have contributed to green investments, in particular the market for Energy Service Companies (ESCOs). While policies such as energy standards and labels have led to green investment in the form of energy efficiency improvements in individual appliances, ESCOs can improve energy efficiency at the system level and thus potentially achieve more fundamental improvements in energy efficiency. However, though the Philippines is in theory one of the most attractive places in the region for ESCO investments, since its high electricity tariffs provide a stronger incentive for energy-efficiency projects, only a few ESCOs currently operate in the economy. A number of barriers have impeded the development of the ESCO, including limited access to funds, lack of flagship projects, lack of technical evaluation capacity in commercial banks, and lack of awareness of end-users and business managers regarding energy efficiency investments (Asian Development Bank, 2009).

Measures that could help to improve the existing situation are:

[112] The ADB multiplied the average electricity price in the Philippines (US$ 0.0792/kWh) with the energy savings to calculate the economic value of those energy savings. We adopt the same method (and the same electricity price) here.

1) For standards and labels, ex-ante analysis of the potential economic and environmental impacts should be carried out in order to better ensure that the policies are contributing to maximizing benefits while minimizing costs, while ex-post analysis should look not just at the energy saving benefits but the costs and any positive externality benefits as well.

2) In addition to tackling appliance efficiency at the individual level, greater efforts should be put into re-energizing the ESCO market in order to drive energy efficiency at the systemic level.

(ii) Scientific integrity

The minimum standards that have been set for the various appliances are differentiated based on scientific analysis that takes a number of relevant variables into account. Standards for air-conditioners are differentiated based on their cooling capacity, while standards for the compact fluorescent lamps (CFLs) as well as the various types of linear fluorescent lamps are differentiated based on the input power of the lamp and the correlated color temperature (Campanano, 2012).

However, the fact that appliance standards are not updated on a regular basis (e.g. for air-conditioners) means that they are not responsive to technological change and may well be outdated for lengthy periods of time. Moreover, there does not appear to be a strong emphasis on scientific analysis in the regulatory process for the setting of standards. While this is elaborated upon in a later section, the standard-setting process in the Philippines is characterized by strong public-private cooperation with active participation from manufacturers. As such, the process tends to be consensus-based and regulators are unlikely to force manufacturers to comply with tough standards, even if compliance with such standards is technically and scientifically feasible.

Performance testing of appliances, to verify that they comply with standards and that their labels accurately display, is a key element in ensuring the scientific integrity of the standards and labeling program. However, manufacturers have to wait almost one year before their products can get tested and they are allowed to sell the appliances on the market. The lack of accredited testing facilities is one reason for the delay, with the Philippines currently only having a single laboratory, the Lighting and Appliance Testing Laboratory, to carry out energy efficiency testing (GEOSPHERE, 2011). Another reason is a lack of technical manpower.[113] In addition, the Lighting and Appliance Testing Laboratory currently only has facilities for testing air-conditioners, small refrigerators and CFLs. Though the government plans to upgrade the laboratory as one of the initiatives under the Philippine Energy Efficiency Project (as highlighted earlier), new testing facilities were yet to be installed as of December 2011 (Anunciacion, 2012).

(iii) Flexibility

The Philippine energy efficiency policy framework has been experiencing policy lags and inertia. This is exemplified by the fact that appliance standards are sparingly updated, with air-conditioner standards not having been updated for over a decade. Thus, standards are unlikely to be responsive to changing circumstances. There is evidence of policy lag in the Philippine Energy Efficiency Project as well, with the National Residential Lighting Program well behind schedule in its distribution of CFLs. Policy lags appear to exist at a broader level as well. The Philippines is currently planning to establish an Energy Efficiency and Conservation Bill, but a similar bill was proposed as early as 1993 and waited for four years for approval from the Senate (Egan, 1999), without eventually being passed. The

[113] Based on interviews with staff from the Energy Efficiency and Conservation Division, Energy Utilization Management Bureau, Department of Energy, The Philippines (16 April 2012).

existence of policy lags means that the Philippine's appliance energy efficiency policies are unlikely to be flexible in adapting and responding to changing circumstances.

Mandatory minimum energy performance standards (MEPS) in the Philippines have elements of inflexibility embedded in them – manufacturers are obligated to meet the MEPS for each product, these standards are uniformly imposed on all manufacturers of that product, and once the standards are set for a particular year, there is little precedent for re-negotiating the assigned standards. Allowing manufacturers to meet an average standard over a basket of products (as is done in Japan) rather than a minimum standard for every product would allow energy savings to be achieved at a potentially lower cost. However, such inflexibility may have advantages too, since in the long-run it can lead to a more complete transformation of the market towards energy-efficient appliances by removing all inefficient products.

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

A distinctive feature of the Philippine standards and labeling program is the extent to which manufacturer groups are involved in their design. At the very outset, the Philippine Appliance Industry Association (PAIA) was involved in the decision-making process that goes towards establishing and revising standards.[114] The PAIA is one of the four agencies that directly participate in the design of standards, together with the Department of Energy (which ultimately determines the standards), the Bureau of Product Standards (which administers and enforces the standards) and the Lighting and Appliance Testing Laboratory (which carries out energy efficiency testing on the products) (Egan, 1999; International Copper Association, 2010; Pacudan, 2001; Campanano, 2012). Other industry associations, such as the Philippines Lighting Industry Association, are also engaged in the process (Hernandez, 2001). As a result, the process for establishing standards and labels reflects the views of manufacturers, who are one of the key stakeholders in the entire process. This has led to desirable outcomes such as increased trust and goodwill between the regulators and the manufacturers, as well as the PAIA communicating the advantages of the standards and labeling program to its members, thus reducing potential opposition to the programs (Egan, 1999). The close co-operation between government and industry may well be one factor that has allowed Philippines to implement its standards and labels largely on a mandatory basis. However, stakeholders other than manufacturers, such as consumers, trade unions and retailers, are not relatively well represented and do not have a direct say in how the standards are enacted, meaning their views may not necessarily be taken into account.

Historically, many of the Philippine's other energy efficiency policies relating to appliances have been transparent in taking stakeholder views into account: as already highlighted, the Efficient Lighting Initiative between 1999 and 2003 was unique in that it involved building up coalitions of regulators, manufacturers and utilities as well as environmental and consumer groups in order to promote energy-efficient lighting. By contrast, the more recent Philippine Energy Efficiency Project appears to have a more centralized structure with the Department of Energy and the Asian Development Bank (which provides the bulk of the funding) making major decisions and stakeholder groups such as consumers and manufacturers not directly involved in the process.

[114] The organization was previously known as the Association of Home Appliance Manufacturers (AHAM).

The regulatory process for the design of the Energy Efficiency and Conservation Bill has also been characterized by a significant level of stakeholder engagement. The Department of Energy has sought views from a wide range of stakeholders that included citizens, non-governmental organizations, members from the House of Representatives and electric power companies and is currently incorporating stakeholder views while finalizing the Bill.[115]

As already discussed, the Department of Energy is in charge of the standards and labeling (S&L) program in operation in the Philippines. Its website contains a good overview of Philippines' overall energy policy framework, including a document containing highlights of the Philippine Energy Plan as well as websites describing the National Energy Efficiency and Conservation Program (NEECP).[116] However, general discussion of the appliance standards and the labeling program – why they were formulated, evidence of historical success, evolution of the programs over the years and broad targets for the programs – tends to be lacking or outdated.[117]

The DOE website does contains detailed and specific lists of refrigerators, air-conditioners, ballasts and CFLs that are certified under the labeling and/or standards scheme, with information on the energy efficiency performance of each model. In addition, the website contains "Consumer Talk" articles on labels for CFLs, air-conditioners and refrigerators explaining in layman terms what the information on the labels represents and how it should guide consumer purchases of appliances. However, when it comes to products that are covered under minimum performance standards, the lists of certified models do not indicate what the standard levels are, nor are the exact standards publicized anywhere else on the website of the Department of Energy. This makes it difficult for the public to find out the relative performance of a product relative to the minimum performance standard.

Information on the Philippine's other energy efficiency policies relating to appliances is generally readily accessible on either the website of the Department of Energy or the website of one of its partner organizations.[118]

(v) Alignment

With 3 government agencies and one manufacturer association involved in the design of appliance standards and labels, alignment among the various authorities has often been a challenge. Each authority has, in theory, a distinct and clearly delineated role. The Department of Energy determines the standards and administers the program, the Bureau of Product Standards enforces and administers the standards, the Lighting and Appliance Testing Laboratory (which is under the authority of the Department of Energy) carries out energy efficiency testing on the products and the Philippine Appliance Industry Association is part of the technical committee (Pacudan, 2001). In practice, though, the line separating out the responsibilities of the different agencies is not always

[115] Based on interviews with staff from the Energy Efficiency and Conservation Division, Energy Utilization Management Bureau, Department of Energy, The Philippines (16 April 2012).

[116] The Department of Energy website is http://www.doe.gov.ph/. Highlights of the Philippine Energy Plan can be found here: http://www.doe.gov.ph/PEP/. The National Energy Efficiency and Conservation Program (NEECP) is described here: http://www.doe.gov.ph/EE/EE&C%20Plans%20and%20Programs.htm and here: http://www.doe.gov.ph/neecp/aboutus.htm.

[117] See http://www.doe.gov.ph/efficiency/standards.htm.

[118] See http://www.doe.gov.ph/efficiency/eli.htm for information on the Efficient Lighting Initiative, http://www.doe.gov.ph/pelmatp/ for information on the Philippine Efficient Lighting Market Transformation Project and http://peep.doe.gov.ph/ for information on the Philippine Energy Efficiency Project and its various component policies.

clear.[119] A further issue is that there is no central authority in charge of the programs,[120] as the Lighting and Appliance Testing Laboratory is under the Department of Energy while the Bureau of Product Standards is under the Department of Trade and Industry. However, the Department of Energy and the Bureau of Product Standards do coordinate with each other in the monitoring process (Harrington and Damnics, 2004). The Philippines is also currently considering handing over the responsibility of implementing the appliance standards entirely to the Department of Energy,[121] a move which would likely ease alignment problems.

When it comes to the Philippine Energy Efficiency Plan and the Department of Energy do have a shared vision on the goals and objectives of the Plan; however the extent to which they are able to coordinate and harmonize policies with respect to each other remains unclear. The distribution of CFLs, for instance, was delayed in Central Visayas due to what appears be a lack of coordination between the agencies (Baquero, 2011). During the CFL distribution, it was found that the Department of Energy lacked a waste facility for the disposal of incandescent bulbs and the risk of mercury pollution meant that the CFL distribution had to be delayed. Lack of alignment is also likely to have been a factor behind the shelving of the plan to create a super ESCO. While the Philippine Energy Efficiency Project drafted by the Department of Energy and the Asian Development Bank envisaged the establishment of a super ESCO as a subsidiary of the Philippine National Oil Company (PNOC) (Asian Development Bank, 2009), the Philippine National Oil Company – Renewables Corporation was unwilling to take on energy efficiency projects that did not have a renewable energy component to them.[122]

Alignment can also refer to how well alternative policies complement each other. Standards and labels appear to be very well-aligned with one another. Given the complementary role they play in enhancing energy efficiency, they are likely to be most effective when implemented in conjunction with each other. This has indeed been the case in the Philippines – whenever a product has been brought under the minimum energy performance standards scheme, it has also been brought under the labeling scheme, either at the same time or in advance. This has likely contributed to the considerable energy savings from standards and labels in recent years.

Fiscal and financial incentives are also well-aligned with the standards and labeling program in the sense that they help to address market failure, capital market barriers, and informational barriers that could otherwise prevent standards and labels from being most effective. The newly added Energy Efficiency Component of Philippine's Clean Investment Plan, for instance, proposes to use innovative financing schemes (such as hire-purchase) to increase the demand for energy-efficient appliances. If these are successful, standards and labeling programs will likely become more effective at reducing energy use, since the increases in energy efficiency of appliances brought about by the standards and labeling program will have a larger impact on gross energy use the greater the demand for more energy-efficient appliances is.

[119] Based on interviews with staff from the Energy Efficiency and Conservation Division, Energy Utilization Management Bureau, Department of Energy, The Philippines (16 April 2012).
[120] Ibid.
[121] Ibid.
[122] Based on interviews with staff from the Energy Efficiency and Conservation Division, Energy Utilization Management Bureau, Department of Energy, The Philippines (16 April 2012).

2.3.3 Concluding Remarks

The most distinctive difference between Japan and the Philippines is in how they implement appliance standards, with Philippines adopting minimum energy performance standards (MEPS) and Japan adopting the Top Runner method. The Philippine policy approach is also characterized by a focus on improving energy efficiency in lighting.

To some extent, these differences are a function of the stage of development of the respective economies. In a relatively less advanced economy such as the Philippines, it makes sense to target highly inefficient appliances (e.g. incandescent lamps in Philippines) where the potential for energy savings is the greatest. This provides a rationale for using MEPS (which has the greatest impact on inefficient appliances that lie below the standard) and policies specifically directed at lighting. In a relatively more advanced economy such as Japan, where the most inefficient appliances have already been eliminated, the Top Runner approach may be more suitable by encouraging improvements in energy efficiencies for both inefficient and efficient appliances.

The Top Runner process has the advantage of simplifying and shortening the regulatory process leading up to the enactment of the standards (Ministry of Economy, Trade and Industry, Japan, 2010a). In particular, it is difficult for manufacturers to argue against the targets since they are based on the existing best performers (Nordqvist, 2006). A further advantage of the Top Runner standards from a flexibility perspective is that manufacturers are free to choose which appliances to focus their energy efficiency efforts on, as long as they ensure that the weighted average of all their products meets the standard.

By contrast, the regulatory process leading to the enactment of minimum energy performance standards in the Philippines can be drawn-out, and current standards have, in many cases, not been updated for over a decade. Moreover, minimum standards are relatively inflexible for manufacturers. The Philippines should consider adopting a more flexible and responsive policy approach, drawing from Japan's experience with the Top Runner program. For instance, the Philippines could modify its appliance standards so that they apply not to individual products, but to weighted averages of each manufacturer's products.

In both Japan and the Philippines, appliance standards are not determined using economic cost-benefit analysis, though in the Philippines ex-ante cost-benefit analysis has accompanied the introduction of policies such as the National Residential Lighting Program. To ensure a socially optimal outcome, ex-ante economic cost-benefit analysis should be carried out when formulating the standards in both economies.

The role of public-private partnerships (PPP) is a distinctive feature of policymaking relating to appliance energy efficiency in both Japan and Philippines. In both economies, manufacturer groups are very actively involved in policymaking and in particular in the setting of standards. While this has eased the process of implementation of the standards and their political acceptability, it has sometimes provided the opportunity to determine standards based largely on a process of negotiation rather than on economic analysis of projected outcomes that might be more likely to result in a socially optimal set of standards.

Finally, there is a stark contrast between the private market for energy efficiency in the two economies i.e. the market for Energy Service Companies or ESCOs. Japan has a robust ESCO market, with the size of the market reaching US$ 176 million in 2008 (Asia Energy Efficiency and

Conservation Collaboration Center, 2010), whereas the ESCO market in the Philippines is relatively stagnant. The difference is partly attributable to policy reasons. As discussed in the Buildings Case Study, fiscal and financial incentives have contributed significantly to the growth of the ESCO market in Japan. Incentive programs in the Philippines, by contrast, have typically not been aimed at incentivizing ESCOs, though inherent barriers such as limited access to funds, lack of technical evaluation and lack of awareness of end-users and business managers are also major reasons impeding the development of the ESCO market.

Overall, Japan's appliance energy efficiency policies are estimated to have led to significant energy savings, though it is unclear whether these were achieved in a cost-effective manner. The Philippines' appliance standards and labels have led to significant energy savings in recent years at an unknown cost, while recently introduced policies under the Philippine Energy Efficiency Program and the Clean Investment Plan are expected to lead to net social benefits. Policymaking in Japan is flexible and transparent and the various authorities involved are well-aligned with each other. By contrast, the effectiveness of the policymaking process in the Philippines can be constrained by irregular policy updates, lack of flexibility, and lack of alignment among authorities.

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3. Renewable Energy Case Studies

In this section we will consider the biofuels, geothermal, and solar policies of a select group of APEC economies, which have extended and/or plan to extend substantial resources to the promotion of these technologies as desirable substitutes for conventional fossil fuels. The imperatives of energy security and the oil crisis of the 1970s drove major attempts to boost novel energy technologies. Of late, increasing concerns about global climate change have made the emission mitigation potential of renewable energy technologies a declared core benefit as well.

Biofuels in the US and Indonesia have garnered support largely on account of their purported energy security benefits. The environmental benefits of biofuels, which were once considered a positive externality from their use, are now under question. Biofuels are proving to be an expensive greenhouse gas emissions abatement strategy. Key US policies in support of the biofuels industry include mandates, tax incentives, import tariff, and loans and grants, while Indonesia has introduced biofuel targets and subsidies. The fiscal burden of supporting biofuels has been increasing rapidly in the US. It is unclear whether Indonesia's biofuel subsidies and targets are calibrated to reflect the contribution of the biofuel industry toward social objectives such as energy security or emissions reductions. Transparency in US regulatory policy at the policy formulation stage appears to be lacking. Furthermore, the institution of subsidies/tax credits for ethanol appears to have been influenced by lobby groups. While Indonesia has made progress in promoting transparency in the development of regulations, further effort is needed to involve stakeholders and to quantify the true cost of support for the biofuel industry. Indonesia needs to work on the cohesiveness of its policymaking among central government agencies and local governments.

Projections of Australia's geothermal resource are quite large; however, the potential to support commercially viable power plants has not yet been proven. In contrast, Indonesia has a mature geothermal industry with commercially viable geothermal capacity. Australia's geothermal industry faces resource uncertainty, cost, and financing difficulties, whereas the Indonesia's electricity pricing structure acts as the principal impediment to the expansion of the geothermal industry. Indonesian geothermal policies are based largely on inflexible targets and prices that are constrained in responding to changing market conditions. This rigidity could be costly for Indonesia if enforced. Furthermore, as in the case of biofuels, policy cohesiveness is an area of concern in Indonesia given that a formal coordination mechanism amongst the central and local government agencies is not present. In contrast, Australia has introduced measures to promote alignment across policies.

The solar insolation resource in Australia and Thailand is considerable. This high technical potential in both economies notwithstanding, the large drops in solar photovoltaic (PV) module prices in the last few years is still not sufficient in making solar PV competitive with other renewables and fossil fuel technologies in the two economies. Solar PV continues to remain an expensive means of abating greenhouse gas emissions in both economies. Given that Australia uses subsidies and grant programs to promote solar PV installations, the ability to respond to changing market conditions is diminished, unlike Thailand's Feed-in-Tariff program and renewable energy targets that are reasonably flexible. Australia has introduced and generally implemented measures to promote alignment, transparency, and stakeholder engagement across a range of solar PV policies, but in some cases there is duplication of support measures.

The renewable energy case studies are organized as follows. We begin by looking at conventional biofuels in the US and Indonesia. Geothermal policies in Australia and Indonesia are considered next. Finally we discuss solar PV policies in Australia and Thailand.

3.1 Conventional Biofuels

The IEA (2011) classifies biofuels as conventional or advanced according to their stage of technical maturity. Conventional (or first generation) biofuels are produced using technically mature processes that have been proven on a commercial scale. These biofuels include sugar and starch based ethanol, oil crop based biodiesel and straight vegetable oil, as well as biogas derived from anaerobic digestion. The main types of feedstock used to produce conventional biofuels are sugar cane and sugar beet, starch bearing grains like corn and wheat, oil crops like rape (canola), soybean and oil palm and in some cases animal fats and used cooking oils.

Advanced biofuels are produced using technologies that are still in the R&D, pilot or demonstration phase. These are commonly referred to as second or third generation biofuel technologies. This category includes hydrotreated vegetable oil (HVO), which is based on animal fat and plant oil, as well as biofuels based on lignocellulosic biomass such as cellulosic ethanol, biomass to liquids (BtL)-diesel and biosynthetic gas. It also includes novel technologies that are mainly in the R&D or pilot phases such as algae based biofuels and the conversion of sugar into diesel type biofuels using biological or chemical catalysts. This paper will focus on conventional biofuels as they are more widely used across both the US and Indonesia.

Biofuels can be used as an energy source for transport, heating, electricity, and cooking. In the transport sector biofuels are typically blended with gasoline or diesel fuel. Conventional vehicles can accommodate a blend of around 5-15% biofuel but a higher percentage of bioethanol can be used in modified ‘flex fuel’ vehicles (Brown et al., 2011). This paper will focus on the use of conventional biofuels in the transport sector in the US and Indonesia.

3.1.1 Conventional Biofuels in the US

Key findings

- The main impetus for the support extended to biofuels in the US is energy security. The 1973 oil crisis led to subsidies for the sector, while rising oil prices at the turn of the 21st century have prompted further support to reduce US dependence on foreign oil imports. Government agencies have also considered biofuels as a means of helping the US achieve its climate change and energy goals and providing a new source of income for rural America.

- Key policies in support of the biofuels industry include mandates, tax incentives, an import tariff, and loans and grants.

- The analysis of US regulatory practices for the biofuels sector leads to the conclusion that the support that the biofuels sector has received appears to be unsustainable and disproportionate to the purported benefits, such as improved energy security and CO_2 emissions reductions. Furthermore, the industry has the potential to put upward pressure on food prices and infrastructure.

Costs, benefits and promotion

- The fiscal burden from excise tax credits to biofuels producers and blenders has been increasing very rapidly, costing US$ 3 billion in 2006, US$ 3.2 billion in 2008, and US$ 6.1 billion in 2009. Furthermore, if the renewable fuel standards (RFS) targets are met, the federal budget losses are projected to increase from around US$ 6.7 billion in 2010 to a range of US$ 19 billion to US$ 27 billion in 2022.

- Biofuels are an expensive means of abating CO_2 emissions in the US context. Abatement costs per ton of CO_2e of greenhouse gas emissions borne by tax payers are approximately US$ 750 for ethanol and US$ 300 for biodiesel.

Scientific integrity

- There are concerns that not all factors were adequately taken into account in earlier studies when measuring costs and benefits of biofuels, especially with regard to land-use change emissions which can raise doubts on the scientific support of the initial mandates.

Flexibility

- The Renewable Fuel Standard allows for yearly revisions, but recent downward revisions have created investment uncertainty and raised questions over the credibility of the mandate.

- Given agricultural stakeholder positions, the ability to substantially change or discontinue the program is compromised affecting the flexibility of the programs.

Transparency

- The regulatory process is transparent from the point of view of availability of information and stakeholder consultations on the various regulations. However, transparency in the policy formulation stage is limited by political economy considerations, in particular the strength of the influence of lobby groups in the policy formulation process.

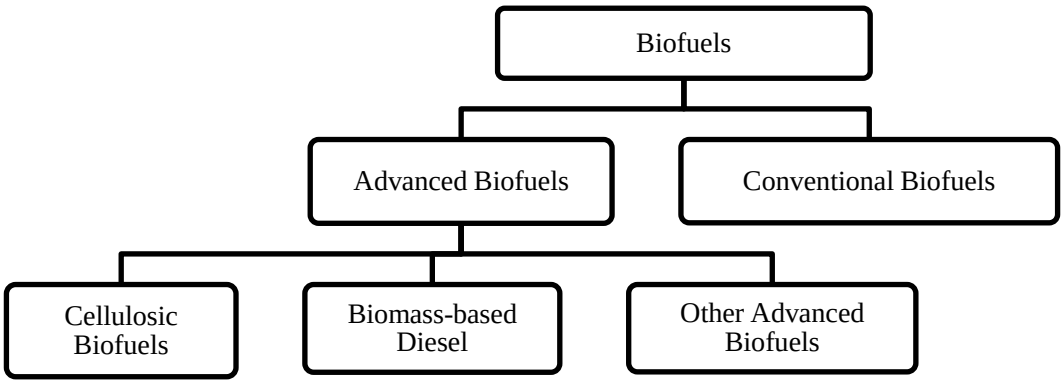
Alignment

- Policy coherence is far from optimal. Several government programs have been created to support virtually every stage of production and consumption relating to ethanol and biodiesel. In many locations, producers have been able to tap into multiple sources of subsidies. Overlapping programs may also carry a high cost for little benefit in terms of energy infrastructure.

A. Size and Significance

In the US, biofuels mostly refer to the liquid biofuels for use in transportation. The most common types of biofuels currently produced and consumed in the United States are fuel ethanol derived from corn grain and biodiesel derived from soybean (Box 3.1.1 depicts the broad classification of biofuels). Fuel ethanol dominates the industry. From 1980, ethanol production has seen a 75-fold increase from 175 million gallons in 1980 to 13,230 million gallons in 2010 at a compound annual growth rate (CAGR) of 24% (see Figure 3.1.1 below). The industry has seen a particularly strong uptake since 2005 with additions in the range of 1 to 2 million gallons per annum. It was also in 2005 that the US surpassed Brazil as the world's largest producer of fuel ethanol (World Bank, 2008).

Box 3.1.1 ***Categories of biofuels***



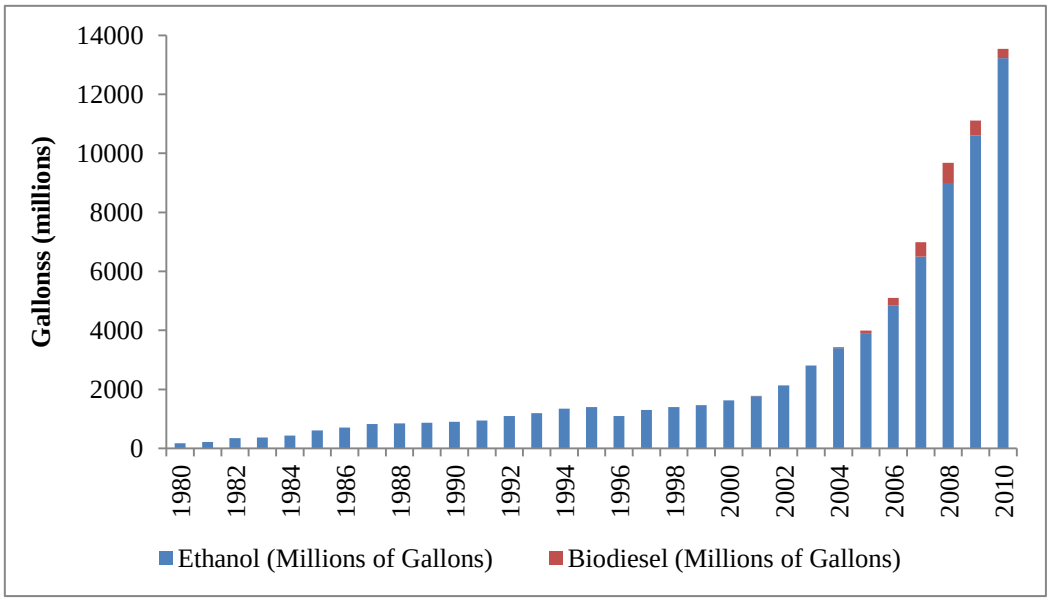
- **Conventional biofuels** in the U.S. comprise of ethanol derived from corn starch. Conventional biofuel produced from facilities that commenced construction after December 19, 2007 would have to achieve a life-cycle greenhouse gas (GHG) threshold of at least a 20% reduction in emissions from the baseline to qualify as a renewable fuel under the Renewable Fuel Standards 2.
- **Advanced biofuels** are defined as renewable fuels, other than ethanol derived from corn starch. These include ethanol derived from cellulose, hemi-cellulose, or lignin, sugar or starch (other than corn starch), waste material (including crop residue, other vegetative waste material, animal waste, food waste and yard waste); biomass-based diesel; biogas (including landfill gas and sewage waste treatment gas); butanol or other alcohols produced through the conversion of organic matter from renewable biomass and other fuel

derived from cellulosic biomass. In the U.S., these fuels must achieve a life-cycle GHG threshold of at least 50% reduction in emissions compared to the baseline petroleum-based gasoline and diesel[123] to qualify as a renewable fuel under the Renewable Fuel Standards 2.

- **Cellulosic biofuels** are renewable fuels derived from any cellulose, hemi-cellulose, or lignin from renewable biomass. This group must achieve a life-cycle GHG threshold of at least 60%.
- **Biomass-based diesel** is biodiesel derived from vegetable oils or animal fats and cellulosic diesel. Examples are biodiesel derived from soybean or algae. The life-cycle GHG threshold for this category is 50%.

Biodiesel, on the other hand, lags significantly behind both in terms of market entry and volume. It is commercially available in most oilseed-producing states. As of 2005, it was more expensive than fossil diesel. Ethanol is blended into gasoline and biodiesel into petroleum diesel. According to the Renewable Fuels Association (2011), over 90% of US gasoline is now blended with ethanol.

Figure 3.1.1 ***Status of biofuels in the US 1980–2010***



Source: Renewable Fuels Association (RFA), Industry Statistics. Available at: http://www.ethanolrfa.org/pages/statistics; EIA (2010), "Annual Energy Review 2009." Available at ftp://ftp.eia.doe.gov/multifuel/038409.pdf

The increase in the production and consumption of biofuels in the US since the turn of the century has come about in part through the increased policy support that the sector has received at both the federal and local levels in the US (Horelik, 2008). In particular, the sales of biofuel/petrol fuel blends that have a low proportion of biofuels in the mix have received encouragement. This is because consumers are unable to distinguish between the performance of a low blend-fuelled vehicle and a pure petrol-fuelled vehicle (GAO, 2007).

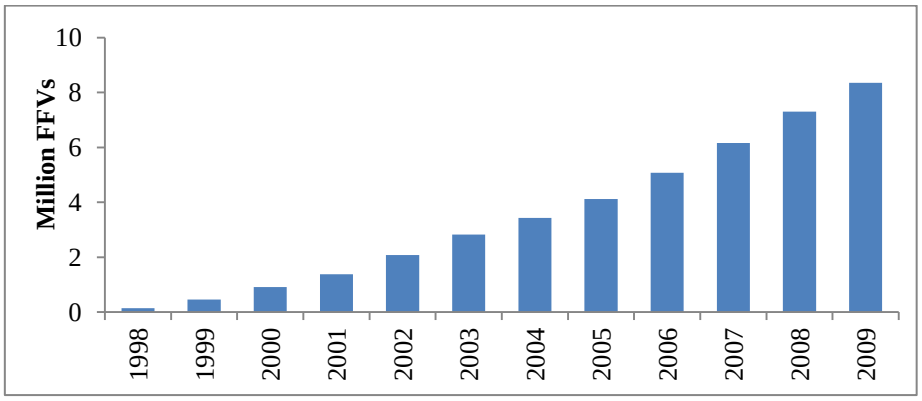
Flexible fuel vehicles (FFVs) are those that are designed to handle a wide range of biofuel/gasoline blends. The number of flexible fuel vehicles has also been increasing at a modest pace. Figure 3.1.2 below shows the increase in the number of E85 [124] FFVS from 1998 to 2009 giving

[123] Baseline life-cycle greenhouse gas emission is the average life-cycle greenhouse gas emissions as determined by the Administrator, in this case the US Environmental Protection Agency, for gasoline or diesel (whichever is being displaced by the renewable fuel) sold or distributed as transportation fuel in 2005.

[124] E85 refers to a fuel blend that consists of 85% ethanol and 15% petrol.

a CAGR of 15.5%. The general scarcity of E85 fuel and E85 refueling stations, and low awareness amongst consumers were believed to have contributed to the E85 vehicles being used primarily in localities where the E85s were mandated by law (International Trade Administration, 2007).

Figure 3.1.2 ***E85 FFVs in use in the US***



Source: Alternative Fuels Data Center (AFDC)[125]

The majority of the ethanol and biofuel fueling stations are geographically located near the corn and soybean production centers. This has resulted in a high concentration of fueling stations in the US Midwest. The dispersion for both ethanol and biodiesel infrastructure displays this concentration. For instance, as of September 2011, of the 2,442 stations offering E85, nearly half of the fuelling stations were located in only six states: Minnesota (14.7%), Illinois (8.9%), Iowa (6.5%), Indiana (6.3%), Wisconsin (5.7%), and Michigan (4.8%) (AFDC). Similarly for biodiesel, of the 627 fueling stations, six states accounted for half of the fueling stations: North Carolina (22.4%), Tennessee (7.1%), California (6.1%), South Carolina (4.8), Washington (4.8%), and Oregon (4.2%) (AFDC). These refueling stations comprise less than 1% of the US's motor vehicle fueling stations.

B. Policy Formulation

(i) History and Background

The US has a long history of supporting the biofuels industry. The policies enacted in the past two decades are outlined in Table 3.1.1 below. The regulations that directly affect the biofuels industry can be broadly classified into mandates (minimum consumption volumes); fiscal incentives (tax credits, subsidies and import tariffs); and financial incentives (loans, loan guarantees and grants).

In addition to Federal-level policies, the US has many varying state-level policies on consumption mandates and fiscal and financial incentives which make it difficult to determine the overall level of mandates and subsidies in the economy. However, comparing the magnitudes of the federal and state level initiatives, the economic and welfare impacts of the Federal-level programs far outweigh state-level policies.

Biofuels are more expensive relative to traditional fossil fuels. Bioethanol and biodiesel are currently not competitive with gasoline or diesel prices, except in some markets (notably Brazil) where production costs are low (Brown et al., 2011). These costs are largely driven by the cost of the

[125] Please see http://www.afdc.energy.gov/afdc/data/index.html

feedstock which typically make up between 45% and 70% of total production costs (Brown et al., 2011).

Biofuels have been promoted in the US by the various government administrations since Nixon as a means of reducing dependence on foreign oil, providing a new source of income for rural America, and contributing to the economy's climate change goals (Worldwatch Institute, 2009). The notion that increased biofuels production would enhance energy security has been around since the 1970s. In the aftermath of the oil shocks of the 1970s,[126] the US looked to biofuels as one of the means of ensuring security of supply especially in the transportation sector. Energy security and the crisis environment of the oil price shocks were at the root of some of the major attempts to boost the newer energy technologies. Efforts to encourage commercial developments of new energy technologies in the US, the biggest spender on R&D by far, became a key policy focus with President Nixon's "Project Independence," which was continued under President Ford and Carter.

It was especially during the Carter Administration that policy efforts for alternative energy technologies became heavily funded and gained much publicity. The earliest federal mandates in the US for ethanol arose then.[127] Since then, US experiments in commercializing renewable energy since 1973 include synfuels,[128] nuclear fusion,[129] "new generation vehicles" with ultra-low emissions and fuel efficiencies higher than current fleet averages by a factor of over three,[130] and advanced

[126] The 1970s witnessed two large spikes in the price of crude oil. The first spike occurred in 1973 following the Arab oil embargo. This resulted in a quadrupling of the price to nearly US$12 per barrel in 1974. The second spike occurred in 1979 in the wake of the Iranian Revolution. In the year that followed, the price of crude oil rose by approximately 2.6 times to US$39.50 per barrel (Barsky and Kilian, 2004).

[127] Since the late 1970s, U.S. policymakers at both the federal and state levels have enacted a variety of incentives, regulations, and programs to encourage the production and use of agriculture-based energy (Caperhart, 2009). The earliest regulation was introduced through the Energy Tax Act of 1978 (IEA, 2010). The Act constitutes a programme of tax credits for household and businesses purchasing alternative energy equipment including solar wind and geothermal. The bill also created an excise tax exemption of US$ 0.04 per gallon of blended gasoline for alcohol fuels (ethanol and methanol), which was equivalent to the full value of the excise tax at that time. The ethanol excise tax exemption was extended in 1980. The credit was set to expire in 1984 but has been extended several times since at different levels of exemptions.

[128] Synthetic fuels or synfuels refer to unconventional liquid fuels that can be used as petroleum or crude oil substitutes. Synfuels are created by chemical reactions, usually Fischer-Tropsch process, from base resources such as coal, natural gas, oil shale or biomass feedstock (EIA, 2006).

[129] Nuclear fusion is the process by which two or more atomic nuclei join or "fuse" to form a single heavier nucleus (WNA, 2012). This is usually accompanied by the release or absorption of large quantities of energy. With current technology, the reaction most readily feasible is between the nuclei of the two heavy forms (isotopes) of hydrogen – deuterium (D) and tritium (T). Each D-T fusion event releases 17.6 MeV (2.8 x 10-12 joule, compared with 200 MeV for U-235 fission) (WNA, 2012). At present, two main experimental approaches are being studied: magnetic confinement and inertial confinement. The first method uses strong magnetic fields to contain the hot plasma. The second involves compressing a small pellet containing fusion fuel to extremely high densities using strong lasers or particle beams (WNA, 2012).

[130] President Clinton's Clean Car Initiative of 1993 was renamed "Partnership for a New Generation of Vehicles" (PNGV) when the government announced a joint effort with the big three US auto companies GM, Ford and Chrysler. The PNGV Challenge was to build a car with up to 80 miles per gallon at the level of performance, utility and cost of ownership that today's consumers demand (DOE, 2012). Researchers for the Partnership for a New Generation of Vehicles (PNGV) have identified a number of ways to reach 80 mpg including reducing the vehicle weight, increasing engine efficiency, combining gasoline engines and electric motors in hybrid vehicles, implementing regenerative breaking, and switching to high efficiency fuel cell power plants.

conversion of waste or abundant cellulosic materials into biofuels.[131] Thus, a wide variety of policy actions, including taxes on conventional fuels, tax incentives for alternative fuels, financial assistance programs, money for research, and regulations were initiated to encourage conservation and investment in alternative fuels infrastructure (Horelik, 2008).

The 1980s witnessed a massive collapse in crude oil prices.[132] With biofuels positioned as a substitute to fossil-fuels, this fall in crude oil prices reduced the economic attractiveness of biofuels. Nevertheless, in the decades that followed, the industry continued to receive support under various federal and local initiatives. Tax incentives were the most prevalent, supporting various types of biofuels at different rates. Domestic production was protected by imposing an ad-valorem tariff on imported biofuels and an offsetting tariff on imported ethanol. A national consumption mandate was decreed to firm up investor confidence and boost biofuels demand. Various loans and guarantees for biofuels production, supporting infrastructure and research were also made available to support the industry uptake. However, despite these incentives, biofuels did not contribute significantly to the US's energy mix, remaining at less than 1% of energy consumption for transportation in the 1990s and 2000s (Horelik, 2008).

The run up in crude oil prices in the past decade has again brought biofuels back in favor amongst US policymakers. More recently, President Obama's recent State of the Union addresses present renewable energy goals in terms of US economic competitiveness and industrial policy, in addition to stated climate change concerns.[133]

[131] 3rd-generation biofuel is basically advanced algae-based biodiesel while 4th-generation biofuels are created using petroleum-like hydro-processing or advanced biochemistry (Greentechmedia, 2010).

[132] After 1980, reduced demand and overproduction produced a glut on the world market, causing a six-year-long decline in oil prices culminating in a 46 percent price drop in 1986 (Koepp, 1986).

[133] See, for instance, Ellerman (2012).

Table 3.1.1 ***Biofuel policies in the US***

Administering Agency	Program	Description	Expiry date
Mandates			
Environmental Protection Agency	Renewable Fuel Standard	Mandated use of renewable fuel in gasoline: 4.0 billion gallons in 2006, increasing to 36 billion gallons in 2022, out of which 21 billion gallons must be advanced biofuel	None
Tax incentives			
Internal Revenue Service	Volumetric Ethanol Excise Tax Credit	Gasoline suppliers who blend ethanol with gasoline are eligible for a tax credit of 45 cents per gallon of ethanol	End of 2011
	Small Ethanol Producer Credit	An ethanol producer with less than 60 million gallons per year in production capacity may claim a credit of 10 cents per gallon on the first 15 million gallons produced in a year	End of 2011
	Biodiesel Tax Credit	Producers of biodiesel or diesel/biodiesel blends may claim a tax credit of $1.00 per gallon of biodiesel	End of 2011
	Small Agri-Biodiesel Producer Credit	An agri-biodiesel (produced from virgin agricultural products) producer with less than 60 million gallons per year in production capacity may claim a credit of 10 cents per gallon on the first 15 million gallons produced in a year	End of 2011
	Renewable Diesel Tax Credit	Producers of renewable diesel (similar to biodiesel, but produced through a different process) may claim a tax credit of $1.00 per gallon of renewable diesel	End of 2011
	Credit for Production of Cellulosic Biofuel	Producers of cellulosic biofuel may claim a tax credit of $1.01 per gallon. For cellulosic ethanol producers, the value of the production tax credit is reduced by the value of the volumetric ethanol excise tax credit and the small ethanol producer credit—the credit is currently valued at 46 cents per gallon. The credit applies to fuel produced after December 31, 2008.	End of 2012
	Special Depreciation Allowance for Cellulosic Biofuel Plant Property	Plants producing cellulosic biofuels may take a 50% depreciation allowance in the first year of operation, subject to certain restrictions	End of 2012
	Alternative Fueling Station Credit	A credit of up to $30,000 is available for the installation of alternative fuel infrastructure, including E85 (85% ethanol and 15% gasoline) pumps	End of 2011
U.S. Customs and Border Protection	Import Duty for Fuel Ethanol	All imported ethanol is subject to a 2.5% ad valorem tariff; fuel ethanol is also subject to a most-favored nation added duty of 54 cents per gallon (with some exceptions)	End of 2011
Financial Incentives			
Department of Agriculture	Biorefinery Assistance	Loan guarantees and grants for the construction and retrofitting of biorefineries to produce advanced biofuels	End of 2012
	Repowering Assistance	Grants to biorefineries that use renewable biomass to reduce or eliminate fossil fuel use	End of 2012

	Biorefinery Program for Advanced Biofuels	Provides payments to producers to support and expand production of advanced biofuels	End of 2012
	Feedstock Flexibility Program for Producers of Biofuels (Sugar)	Authorizes the use of CCC funds to purchase surplus sugar, to be resold as a biomass feedstock to produce bioenergy	None
	Biomass Crop Assistance Program (BCAP)	Provides financial assistance for biomass crop establishment costs and annual payments for biomass production; also provides payments to assist with costs for biomass collection, harvest, storage, and transportation	End of 2012
Department of Energy	Rural Energy for America Program (REAP)	Loan guarantees and grants for a wide range of rural energy projects, including biofuels.	End of 2012
	Biomass Research and Development	Grants for biomass research, development, and demonstration projects	End of 2015
	Biorefinery Project Grants	Funds cooperative R&D on biomass for fuels, power, chemicals, and other products	None
	Loan Guarantees for Ethanol and Commercial Byproducts from Various Feedstocks	Several programs of loan guarantees to construct facilities that produce ethanol and other commercial products from cellulosic material, municipal solid waste, and/or sugarcane	Varies
	Department of Energy Loan Guarantee Program	Loan guarantees for energy projects that reduce air pollutant and greenhouse gas emissions, including biofuels projects	None
	Cellulosic Ethanol Reserve Auction	Authorizes DOE to provide per-gallon payments to cellulosic biofuel producers	August 8, 2015
Department of Transportation	Flexible Fuel Vehicle Production Incentive	Automakers subject to Corporate Average Fuel Economy (CAFE) standards may accrue credits under that program for the production and sale of alternative fuel vehicles, including ethanol/gasoline flexible fuel vehicles (FFVs)	After model year 2019

Source: Yacobucci, 2011

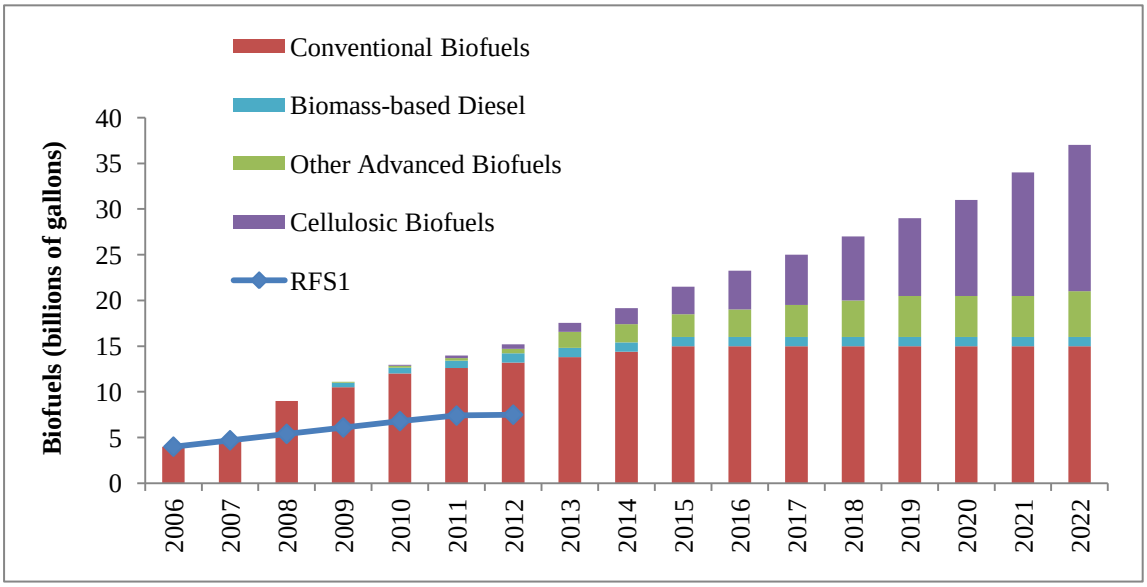
(ii) Policy Description

MANDATES

Renewable Fuel Standard

The original Renewable Fuel Standard (RFS), or RFS1, was established under the Energy Policy Act (EPAct) of 2005. It was the first mandate at the federal level to regulate the use of renewable transportation fuels in the United States. Under the RFS1, a minimum amount of 4.0 billion gallons of biofuels is targeted in 2006 and scheduled to increase to 7.5 billion gallons by 2012. The Energy Independence and Security Act (EISA) of 2007 expanded the RFS1 to encompass a more rigorous standard based on a finer categorization of renewable fuels. This is commonly referred to as the RFS2. Box 3.1.1 above summarizes the categories of biofuels covered under RFS1 and RFS2.

Figure 3.1.3 ***Mandated targets for categories of biofuels under the Renewable Fuel Standard – Energy Independence and Security Act of 2007***



Source: The Energy Policy Act of 2005, §1501; the Energy Independence and Security Act, §202

Note: Volumes of total renewable fuels, total advanced biofuels, cellulosic biofuels, and biomass-based diesel are binding requirements by RFS2. Volume of conventional biofuels is derived by subtracting the total renewable fuels mandate by the total advanced biofuels mandate.

Under the RFS2, the minimum standard volume contributed by all renewable fuels has been revised upwards substantially, almost doubling for every year mandated under the RFS1 and increasing progressively for every year afterwards (see Figure 3.1.3). Starting with a base of 9 billion gallons in 2008, the targets for 2015 and 2022 were set at 20.5 billion gallons and 36 billion gallons respectively, implying a CAGR of 10%. The RFS2 also specifies the minimum volume of total renewable fuels that has to be met by advanced biofuels, and under advanced biofuels, the minimum volume that has to be met by biomass-based diesel and cellulosic biofuels. This effectively puts a cap

on the growth of conventional biofuels, underpinning the gradual shift away from corn-based biofuels which has enjoyed rapid expansion and has led to the food-fuel debate.[134]

In order to ensure that the required volumes are met each year, the Energy Protection Agency determines the ratio of biofuels to be used in total transportation fuels. This annual blending percentage obligation is set for the total biofuels as well as each category, and is applicable to all companies that blend gasoline or diesel for transportation. This is referred to as the Renewable Volume Obligation (RVO). To track the volume of biofuels, each gallon qualified under the mandated criteria is issued a unique Renewable Identification Number (RIN). At the end of the year, companies must prove that they have enough RINs to satisfy the RVO.

FISCAL INCENTIVES

Tax Credits

The United States has been providing fiscal support for biofuel production over the last 30 years. The very first tax incentive dated back to 1978 under the Energy Tax Act of 1978, which exempted biofuel producers from the gasoline excise tax of US$ 0.04 per gallon.

In 2004, tax exemption was superseded by several incentives that came in effect under the American Jobs Creation Act of 2004. Under the Act, the federal government granted a Volumetric Ethanol Excise Tax Credit (VEETC) of US$0.51 per gallon of ethanol to gasoline blenders, which was reduced to US$ 0.45 per gallon effective from 1 January 2009 (OECD, 2011b). A Biodiesel Tax Credit (BTC) was also granted to biodiesel blenders, at US$ 1.00 per gallon for biodiesel produced from virgin agricultural products such as soybean or animal fats, and US$ 0.50 per gallon for biodiesel produced from previously used agricultural products such as recycled cooking grease. These incentives are indirect production subsidies, which helped increase the threshold price blenders are willing to pay for ethanol and biodiesel from producers.

Import Duty

To support domestic production, the US imposes a 2.5 percent ad-valorem duty and a US$ 0.54 per gallon tariff on imported ethanol. While Brazilian sugarcane ethanol is more competitive both in terms of production costs and GHG abatement, the tariff reduces imports and supports domestic production. The US, however, maintains free imports for ethanol from the Caribbean Basin on volumes of up to 7% of US domestic consumption in order to promote "a stable political and economic climate in the Caribbean region." This has created a loophole since there is an incentive for economies where the tariff is effective to process their ethanol in the Caribbean Basin economies and enjoy the zero import duty to the US.

[134] According to some studies, the rise of biofuels production accounted for a major portion of the increase in food prices in the latter half of the last decade, leading to the reconsideration of biofuels policies in the UK, Italy, and other economies (Harrison et al., 2008). In the US, it is generally thought by those in government agencies that biofuels production only accounted for about 3% of the increase (U.S. DOE and USDA, 2008), although this fraction is the subject of intense debate worldwide (Runge et al., 2007). In principle, if corn remains a widely used feedstock then increased demand for ethanol will ensure that corn prices remain high, which would likely affect the rest of the food market by raising prices of other crops. It is precisely for this reason that so much interest is being invested in alternative feedstocks such as cellulosic feedstocks.

FINANCIAL INCENTIVES

Grant programs for R&D have also played a role in developing biofuels technology, although to a lesser extent than mandates and fiscal incentives. In general, these programs have funded researchers working on developing the fundamentals behind biofuels technology, such as enzyme and microbial developments to improve yields.

There are also programs that provide money to industry for demonstrations and pilot plants. These programs, such as the Biomass Research and Development initiative created in 2000 (which funds general R&D as well), allow the government more direct control to bring a greater measure of technological development directly to commercial viability, provided that the demonstrations are successful. Most recently, given the perceived urgency of the movement to non-corn ethanol, government demonstration programs have been investing in cellulosic plants. For example, 9 such biorefinery projects were chosen by the DOE for a cumulative award of US$ 240 million dollars to be distributed between them, with the remainder of the funding for these projects (US$ 495 million) coming from private industry and investors (DOE Press Release, 2008).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

All government regulations should have clearly defined policy objectives, and alternative regulatory approaches should be judged in relation to those policy objectives. Will they achieve stated policy goals? And will they achieve them at the lowest cost, relative to other alternatives to achieve such goals? The economic efficiency and effectiveness of US biofuel policy thus need to be assessed in relation to the stated goals of energy security, environmental sustainability and economic development.

(i) Costs, Benefits and Promotion

Government support for the US conventional biofuels industry has been the subject of a large literature on the costs and benefits of various aspects of mandates, fiscal and financial policies and regulations over the past several decades. There has been an extensive debate on the costs and benefits of the program to achieve the energy security, environmental and developmental or industrial policy goals that policy makers have identified in support of the program. Given that this literature is now very extensive, our goal is to summarize some of the key findings of the existing research in the context of the objectives of the present study.

The Environmental Protection Agency (EPA) Assessment of the Renewable Fuel Standard 2

The EPA in its 2010 Regulatory Announcement (EPA, 2010a) provides the most recent official estimates of the potential costs and benefits of the increased volume requirements under the RFS2 if standards are met through 2022. Citing reduced dependence on foreign oil and enhanced energy security as a major benefit, the EPA estimates that by 2022, if the RFS2 regulations are in force, approximately 13.6 billion gallons of imported gasoline and diesel fuel (7% of projected annual US transportation fuel consumption in 2022) will be replaced. RFS2 is expected to reduce oil imports by US$ 16 billion. The projected reduction of oil imports under the RFS2 scenario of US$16 billion in 2022 constitutes slightly less than 8% of total projected oil imports of US$ 208 billion (in 2022). The EPA reports increased energy security benefits of US$ 3.7 billion in 2022, citing a study by Oak

Ridge National Laboratory (ORNL) that estimates the security benefit at US$ 12.38/barrel in US $2006 terms (Leiby, 2007).[135]

The EPA also expects that by 2022, the increased use of renewable fuels is expected to decrease gasoline costs by 2.4 US cents per gallon and diesel costs by 12.1 US cents per gallon. The market for agricultural products, especially corn and soybeans, is expected to expand considerably, resulting in an estimated increase of US$ 13 billion in annual net farm income. With respect to climate change as well as local, state-wide and regional environmental goals, the expanded use of biofuels under the RFS is expected to reduce annual greenhouse gas emissions by 138 million metric tons – equivalent to taking about 27 million vehicles off the road by 2022. The impacts of these emissions will be geographically heterogeneous; however, the overall emission changes are projected to lead to increases in population-weighted annual average ambient particulate matter and ozone concentrations. With respects to costs, the EPA identifies the increased cost of food in the United States as a result of using corn for feedstock. By 2022, the RFS2 program is expected to raise the cost of food by about US$ 10 per person by 2022, or over US$ 3 billion for the US.

Economic Impact Assessment of US biofuels policy

Impacts on the Fiscal Budget

An economic analysis of US biofuels policy must consider the 3 key elements at the Federal level that constitute the policy: the consumption mandate, the federal tax credit and the import tariff on ethanol. Given that biofuel prices are higher than gasoline prices, the consumption mandate of RFS2 increases the costs of blended transport fuels, reduces the welfare of fuel consumers and increases the welfare of feedstock and biofuel producers and blenders. The consumption mandate also has an impact on the rest of the economy since it reduces the quantity of resources used in the production of other goods (since more resources are pulled into biofuels production), increasing the relative price of other goods and hence reducing consumer welfare of consumers of other goods.

The tax credit of US$ 0.45/gallon for corn-based ethanol increases the price of ethanol and the quantity produced, and has similar welfare implications as the consumption mandate described above. The tax credit benefits will be shared among biofuel producers, blenders and consumers, depending on market supply and demand elasticities among these groups. But in the case of the tax credit, there is also the impact on Federal fuel tax revenues foregone which will be determined by the size of the tax credit (nominal US$ 0.45/gallon), the quantity of the biofuel that receives the tax credit (number of gallons), and the energy-equivalence of biofuel and gasoline (CBO, 2010).[136] The US Energy Information Administration estimated the Federal government tax expenditure (as foregone revenue from the Federal gasoline excise tax) to be US$ 2.9 billion in 2007, compared to US$920 million in 1999 (EIA, 2008). According to the GAO (2011), the Volumetric Ethanol Excise Tax Credit (VEETC) cost US$ 5.6 billion in revenue in 2010, increasing to some US$ 6.75 billion by 2015 with increased ethanol output under RFS2.

[135] The ORNL study reports the marginal benefits of reducing petroleum imports based on estimates of monopsony premium that the US (as a large importer) could theoretically exercise by imposing tariffs on imports and on the avoided macroeconomic disruption and adjustment costs premium (Leiby, 2007).

[136] A gallon of ethanol is not energy equivalent to a gallon of gasoline, so the displacement of gasoline by biofuels is not one-for-one.

In 2006, the excise tax credits for ethanol and biodiesel alone cost US$ 3 billion (Steenblik, 2007). In 2007, this amount was US$ 3.2 billion (EIA, 2008). In 2009, this increased to US$ 6.1 billion (CBO, 2010). Assuming the tax credits remain at the same rates, if the renewable fuel standards are actually implemented as mandated, the federal budget losses are projected to increase from around US$ 6.7 billion in 2010 to a range of US$ 19 billion to US$ 27 billion in 2022 (Yacobucci, 2010; Steenblik, 2007). Moreover to the extent that a larger proportion of biofuels is slated to come from cellulosic biofuels which are subsidized at a higher rate, the sustainability of the subsidy is in question in the larger context of the recession and massive budget deficits in the US since 2008.

The ethanol import tariff of US$ 0.59/gallon is prohibitive, but imported ethanol also receives the ethanol tax credit of US$ 0.45/gallon, yielding a net tariff of US$ 0.14/gallon. According to the USITC (2009), if the tariff is dropped, imports would be cheaper by 25%, volumes imported would grow annually by over 200% annually and domestic production would be reduced by 2% relative to that under the import tariff. Given all three policies (consumption mandate, ethanol tax credit and the ethanol import tariff) operating together, the result is broadly a function of the mandated consumption quantity and the net price impact of the tax credit and the import tariff (National Academy of Sciences (NAS), 2011).

Several other studies have provided quantitative estimates of the burden that biofuel subsidies have placed on the budgets at the federal and local level. Steenblik (2007) estimated that in 2006, the US spent approximately US$ 5.4 to US$ 6.6 billion, to support 5.8 billion gallons of ethanol and biodiesel. If biofuels production keeps growing at the historical double-digit rate, tax credits would pose a considerable strain on future Federal budgets. Intertemporal budgetary impacts could negatively affect future spending on alternatives that are better aligned to the economy's stated energy security, environmental and industrial development policy objectives.

Federal tax incentives are used in conjunction with volumetric regulations and mandates in the US. To the extent that these regulations are effective in binding the volume requirements, tax credits are not the main driver for production, but transfer the costs borne by producers (due to the higher prices) to tax payers. Moreover, whilst generous subsidies often help promote technologies, they do so at great cost. Very often, indirect costs are excluded from the calculus. This makes the relative magnitude of the benefits vis-à-vis the costs larger. They also engender unintended consequences. Consider for instance the tax exemptions extended to fuel ethanol production. These helped fuel ethanol production grow 16-fold, from 175 million gallons in 1980 to 2,800 million gallons in 2003 at an average annual growth of 14%.[137] However, this substantially drained the Federal Highway Trust Fund (to which the federal fuel tax is credited), reducing credits available to infrastructure projects.

Impact on Energy Security

The purported energy security benefits of biofuels hinge on the diversification option that they provide. Biofuels do offer a diversification benefit, inasmuch as they may be less vulnerable to the same kinds of disruptions that threaten supplies of petroleum from politically unstable regions of the world.[138] However, the cost per unit of import displacement is very high. Moreover, the feedstocks

[137] RFA Ethanol Industry Statistics. Available at http://www.ethanolrfa.org/pages/statistics

[138] It should be noted however that, given that the world oil market is highly fungible, the impact of supply disruptions from any producing economy will have a similar impact on all importers, whether they buy their oil supplies from the affected areas or not.

from which biofuels are currently derived are also vulnerable to their own set of costly and unpredictable risks, such as adverse weather and crop diseases.

It is also important to note the scale of import displacement that can realistically be expected under the Renewable Fuel Standard 2 (RFS2) implementation scenario. The EPA's projected reduction of oil imports under the RFS2 scenario of US$ 16 billion in 2022 constitutes slightly less than 8% of total projected imports of US$208 billion (in 2022), as already mentioned above. An 8% reduction in oil imports does not alter the picture very much with respect to the US reliance on imports of crude oil and petroleum products. Indeed, far more leveraging to the projected US oil import-export balance are the remarkable development of unconventional oil resources from shale formations.[139]

Impacts on Emission Mitigation

Early life-cycle cost-benefit studies had found that corn ethanol reduced greenhouse gas (GHG) emissions relative to gasoline. An Argonne National Laboratory meta-study which reviewed 22 separate cost-benefit studies between 1979 and 2005 found emission reductions of 20 - 30% for corn-based ethanol. However, more recent studies have either reduced estimates of emission mitigation or found it to be net negative, after taking into account direct and indirect effects of land use change caused by the ethanol support program. The use of nitrogenous fertilizers and the land use change that occurs in switching grasslands and forests to biofuels farming use leads to GHG emissions which can outweigh or drastically reduce the net benefits biofuels might yield in reducing fossil fuel-based emissions. One study published in *Science*, which reviewed six previous studies, estimated GHG emission reductions at 13% (Farrell et al, 2006). Two other studies, both published in 2008, concluded that once emissions that arise from land use change for the purpose of biofuel production are factored in, there is a likely *net increase* in emissions (Fargione et al, 2008; Searchinger et al, 2008).

With respect to the economic effectiveness of biofuels policy for climate change goals, biofuels are an extremely expensive means of GHG abatement. The Congressional Budget Office (CBO, 2010) estimated the costs borne by tax payers to reduce GHG emissions through biofuel tax credits: one metric ton of CO_2e of GHG avoided costs US$ 750 for ethanol, about US$ 300 for biodiesel, and US$ 275 for cellulosic ethanol. Given that the cost of an emissions certificate on the European Union's Emissions Trading Scheme has not crossed US$ 50 per ton of CO_2 since its inception in 2005, the support of the biofuels industry as a means of reducing CO_2 emissions is a very costly one. One recent study found that the range of biofuel crops available for US growers were much less effective for reducing GHG emissions than two alternative policy options: an increase in the gasoline tax and the implementation of energy efficiency improvements (Jaeger and Egelkraut, 2011). The study estimated that US biofuels would cost between 20 and 31 times more than energy efficiency improvements that would reduce gasoline consumption by 1%.

Impact on Food Supply

Another major cost aspect of biofuels relates to its impacts on food resources. The United Nations Environment Program reports "vigorous and contentious debate over economic and environmental merits of biofuels, including questions of direct competition with food resources" (UNEP, 2008).

[139] The "shale gas revolution" of the US of the past few years has been the subject of fundamental revisions in the outlook for US oil trade balances. See Rascoe (2012).

According to the U.S. National Academies of Sciences, even if all the corn and soybeans produced in the US in 2005 had been used for bioethanol production, this would only have replaced 12% of the economy's gasoline demand and 6 % of its diesel demand (cited in UN FAO, 2008). If the whole US corn and soybean production was taken out of the food market and into the biofuel domain, it would have a massive impact on global food prices (UN FAO, 2008). According to the FAO report for 2008 on the state of world food and agriculture, biofuels production has a significant negative impact on global food supply while yielding relatively modest energy savings (UN FAO, 2008).

R&D Expenditure Impacts

In the case of R&D, except in cases where technology transfer programs were successfully carried out, it is difficult to judge the full extent of the effect these programs had in promoting recent growth, if at all. In most cases, such programs are supposed to promote increased fundamental knowledge during the early stages of development, but when the technology becomes commercially viable, it is the companies involved that drive further developments. As a result, R&D programs from the 70s, 80s and 90s may have had some role to play, but the extent to which they did remains unclear.

Assessments of the US's public sector energy R&D investments have not been very encouraging. In 2001, the National Research Council (NRC) completed a Congressionally-mandated assessment of the benefits and costs of DOE energy R&D programs.[140] It found that 0.1% of US$ 13 billion spent on R&D between 1980–2000 accounted for 75% of all estimated benefits of the research programs pursued; the spending of some US$ 9 billion provided "no quantifiable benefit."

In the quarter century since the US government established the Department of Energy (US DOE), federal government subsidies for renewable energy (biomass, waste combustion, geothermal, wind and solar) amounted to US$ 11 billion via investment tax credits, production credits, accelerated depreciation allowances, low interest loans and grants, mandatory purchases of renewable energy at "avoided cost",[141] and publicly funded R&D. The DOE has spent approximately US$ 19 billion since its inception on electricity conservation (US$ 8 billion-US$ 9 billion) and non-hydro renewable (US$ 10.7 billion), in 1996 dollars; at the state level, demand-side management programs added approximately US$ 16 billion more. According to Bradley (1997), the US$ 30 billion to US$ 40 billion cumulative 20-year investment "represents the largest governmental peacetime energy expenditure in U.S. history, outranking the Strategic Petroleum Reserve program to date as well as the cumulative expenditure of the 1974-88 synthetic fuels program."[142] Given this historical trend of high costs without quantifiable benefits, public R&D expenditure on biofuels should be viewed with caution.

[140] See Committee on Prospective Benefits of DOE Energy Efficiency and Fossil Energy R&D Programs, National Research Council, "Energy Research at DOE: Was It Worth It?" (2005). The data reported here is sourced from Fri (2006), "From energy wish lists to technological reality," *Issues in Science and Technology,* Fall 2006.

[141] Avoided cost is the marginal cost for the same amount of energy acquired through another means such as construction of a new production facility or purchase from an alternate supplier. For example, a megawatt-hour's avoided cost is the relative amount it would cost a customer to acquire this energy through the development of a new generating facility or acquisition of a new supplier. Short run avoided cost refers to avoided cost calculated based on energy acquisition costs plus ongoing expenses. Long run avoided cost factors in necessary long-term costs including capital expenditures for facilities and infrastructure upgrades.

[142] Based on US DOE data cited by (Bradley, 1997)

Given the serious concerns of the impact of corn-based ethanol biofuel program on food supply, cellulosic biofuel production has come under intense focus of R&D efforts. To date, cellulosic biofuels are not commercially viable. The National Research Council (2011) estimated that a cellulosic feedstock market would be competitive when oil prices are at or above US$ 191 per barrel or a combination of oil prices at US$ 111 per barrel and carbon price at US$118-US$ 138 per tonne of CO_2e. A subsidy of US$ 1.01 per gallon of cellulosic biofuel is not sufficient to close the price gap at US$ 111 per barrel of oil. This suggests that commercialization of cellulosic ethanol is still uncertain and at best several years down the road.[143] Assuming that technologies are available by 2015, the National Academy of Sciences (2011) estimated that capacity must be built at double the rate at which corn-grain ethanol has grown historically to deliver 16 billion gallons of cellulosic biofuels in 2022. The resources that are needed to make this a possibility are substantial.[144]

Summary of Costs, Benefits and Promotion

The analysis on costs and benefits above leads to the conclusion that the various subsidies that the biofuels sector has received appear to be unsustainable and disproportionate to the benefits achieved. This overall assessment on the US biofuels program is consistent with the studies done for the EU. According to a 2008 study by the European Commission, "the cost disadvantage of biofuels is so great with respect to conventional fuels…that even in the best of cases, they exceed the value of external benefits that can be achieved" (EC, 2008). It estimates the net present value of EU's efforts in biofuels substitution for diesel and gasoline at a negative €35 – 65 billion through 2020.[145]

A significant if often un-noted cost of supporting the biofuels industry is that the billions of dollars of annual subsidies distort investment markets by redirecting venture capital and other investments away from competing alternative energy sources and technologies. Additionally, taxpayers are being asked to finance increasing biofuels subsidies that can have intertemporal effects on future budgetary choices, further constricting future choices in energy sources and technologies. Other costs the industry generates include the potential for social dislocation, the potential to put upward pressure on food prices and infrastructure, and transport bottle necks. Second generation biofuels may help address some of these issues but they are still at the development stage and widespread deployment is uncertain (Brown et al., 2011).

(ii) Scientific Integrity

Biofuels research conducted by congressionally-mandated agencies such as the Environmental Protection Agency or the Energy Information Administration is soon tested and either verified or challenged by a range of independent research institutes and university faculties across the economy. The large technical literature on the biofuels industry is characterized by high quality policy-focused research published by academics and independent think tanks, several of which have been cited above. Scientific integrity and robust research methodologies are the hallmarks of these studies, and provide a source of ready information and policy guidance to US Federal agencies and regulators.

[143] For instance, the Department of Energy's goal is to make cellulosic biofuels cost-competitive with corn ethanol by 2012. Other groups are less optimistic.

[144] Pressure on public spending created by the size of the budget deficit has become an intensely partisan area of politics, and federal funds for renewable energy are set to face binding constraints. See for instance, "Renewable subsidies to shrink", *Financial Times*, 18 April 2012.

[145] Given the negative findings of a study appointed by the EC, it required a news agency to acquire and report the data by suing on Freedom to Information Act rules. See Harrison, P. "Once hidden EU report reveals damage from biodiesel," Reuters, April 21, 2010.

In the campaigns that created the biofuel mandates and targets in the United States, proponents emphasized the environmental benefits that could come from biofuels use through reduced greenhouse gas (GHG) emissions. Emissions from biofuels and petroleum fuels were compared in a life-cycle approach. Studies have shown that most of the GHG benefits accrue solely through the carbon sequestration potential of biofuel feedstocks.[146] This feedstock carbon uptake credit is large enough to offset net emissions from growing feedstocks, refining, distribution and combustion of biofuels relative to conventional fossil fuels.

These earlier studies, nonetheless, fail to take into account emissions arising from land-use change which can be significant (Fargione et al., 2008). Land use change emissions refer to the release of carbon stored in plants or soils through decomposition or fire when forest and grasslands are cleared in order to grow biofuel feedstock. It is estimated that each hectare of land converted for biofuel crops results in average emissions of 351 metric tons of CO_2e (Searchinger et al., 2008). In the long term, this "carbon debt" will be offset by the feedstock carbon uptake credit, which stands to increase annually as productivity improves. This payback time is estimated to be 167 years for US corn-based ethanol in the case study. In a very optimistic scenario, it would still take more than 30 years to neutralize emissions for corn-based ethanol. Nonetheless, these estimates, similar to any GHG emission calculations for biofuels, are highly sensitive to how the biofuel is processed (using natural gas, coal or biomass), from which feedstock it originated (corn, soybean, sugarcane or waste) and which type of land it replaced. In its life-cycle analysis, the EPA (2009) found that in 30 years, most corn-based ethanol achieve positive GHG reduction.

A similar debate applies to calculating the net energy value (NEV) of biofuels.[147] For example, ethanol made from corn in the US can be seen to have a significantly lower NEV than that made from other feedstocks, such as cellulosic ethanol or ethanol from sugarcane in Brazil (Shapouri et al., 2004). This is because energy input is required for every step of the biofuels chain and different technologies and feedstocks have different efficiencies. Therefore, while the resulting ethanol from two different feedstocks may be chemically identical, the wide-scale adoption of one versus the other can have differing effects on the environment (Fargione et al., 2008).

Ethanol is easily degraded in the environment and human exposure to ethanol itself does not pose considerable health impacts. However, a high blend of ethanol into gasoline will impede the natural attenuation of BTEX (benzene, toluene, ethylbenzene, and xylenes) in groundwater and soil, posing a great risk for human exposure in the event of underground storage tank leaks. The James A. Baker III Institute for Public Policy (2010) also pointed out that increased corn-based ethanol production in the Mid-West could cause detrimental effects to ecosystems and fisheries along the Mississippi River and in the Gulf of Mexico and create water shortages in some areas experiencing significant increases in fuel crop irrigation. In addition, there is concern that the large-scale diversion of agricultural resources to fuel could threaten protected areas such as rainforests, turning it into farmland.

[146] The carbon sequestration potential arises from the fact that the plant feedstock used in the production of biofuels absorbs carbon dioxide from the atmosphere.

[147] The NEV ratio is determined by the amount of energy available from burning the fuel compared to the amount of energy that went in to producing it. Although these numbers can vary widely depending on the model of analysis, according to a USDA study in 2001, corn ethanol had an NEV of 1.06 without considering co-products, and an NEV of 1.67 considering co-products. Cellulosic ethanol, on the other hand, has an NEV in the range of 5 to 10, depending on the source of biomass used (Shapouri et al. 2004).

In light of the results of research on the environmental impact of biofuels, EPA regulatory policies were revisited and changes were made to ensure environmental soundness. For instance, the Renewable Fuel Standard 2 requires ethanol production and use to emit 20 percent less greenhouse gases than gasoline, and advanced biofuels (made from agricultural waste or crops like switch grass) to release 50 percent less.

(iii) Flexibility

Uncertainties of future cost paths of biofuels technologies and their integration into existing energy systems are the single most important unknown for policy makers. Constantly evolving technological and economic environments together with changing social and institutional norms inevitably lead decision makers and regulators to adjust and change existing policies. The patchwork of state-level biofuel support policies, operating together with Federal regulations, has both advantages and disadvantages. The US Federal-state structure allows for a level of experimentation and diversity in the use of various policy instruments. However, the lack of coordination and the existence of over-lapping regulatory jurisdictions also lead to duplication, redundancy and unintended consequences.

Renewable Fuel Standard (RFS)

The Renewable Fuel Standard allows for revision; however, there is some lag time between review and revision of the standards. The Environment Protection Agency (EPA), which is the appointed administering authority, reserves the right to review and determine the total renewable fuel standards for each calendar year based on gasoline and diesel projections and market analysis from the Energy Information Administration. The finalized standards are announced not later than November 30 of the preceding calendar year.

For any year that EPA feels that "implementation of the requirement would severely harm the economy or environment of a region in the US" or "there is a significant renewable feedstock disruption," it can reduce the standards for cellulosic biofuel or biomass-based diesel. Similarly, the standards for other advanced biofuels or the total renewable standard can also be revised. In its February 2010 Regulatory Announcement, the EPA set the 2010 cellulosic biofuel standard at 6.5 million ethanol-equivalent gallons as compared to the mandated requirements of 100 million gallons, a downward reduction of nearly 95% (EPA, 2010b). Then, in July 2010, EPA lowered the 2011 RFS for cellulosic biofuels to 6.6 million gallons as compared to the mandate of 250 million gallons (EPA, 2010a). This raises questions over the credibility of the mandate and creates uncertainties which may discourage biofuel investments in the future.

Renewable Volume Obligation (RVO)

Under the Renewable Volume Obligation (RVO), each gallon of transportation fuel that meets the required ratio of biofuels is issued a unique Renewable Identification Number (RIN), and at the end of the year, companies must prove that they have enough RINs to satisfy RVO. RINs, however, afford some degree of flexibility in terms of their lifespan and transferability. A RIN can be used to meet either the current year's or the following year's RVO. Furthermore, a market exists for transferring RINs from companies that have met the standard to companies that have not. The flexibility in administering the RINs enhances the probability of fulfilling the renewable fuel standards.

ADMINISTRATIVE AND POLITICAL VIABILITY

The administrative and political viability of US biofuel policy is a function not only of the attributes of the policy instruments used but also of existing institutional and societal norms and practices. The viability of biofuel policy depends on the efficiency of regulations in achieving the stated policy goals, the ease with which it can be amended or reversed (flexibility), and the magnitude and distribution of costs and benefits.

In general, best practice regulations rely on market-based instruments (MBIs) as far as possible. Thus, for efficiently reducing GHG emissions, first best policy instruments include a carbon tax or a system of trading emission certifications. But this is not politically viable in many economies. Similarly, nationwide carbon caps or taxes, though proposed in some legislative initiatives at the Senate and the House, have not been implemented in the US, in part due to powerful opposition by a range of powerful constituencies.[148]

(iv) Transparency

The overall impression that a researcher gets when searching for information on US regulatory policy with regard to stakeholder inclusion or the open government approach encouraged by the best practice guides is that there are well-developed mechanisms to reflect stakeholder views. For instance, with regard to the RFS and all relating acts, information was made available to the public access and the dissemination and regular updating was carried out by the administering agency, in this case, the Environment Protection Agency (EPA). According to Section 202 of the EISAct of 2007, the EPA is appointed as the regulatory authority responsible for promulgating the use of renewable fuels and administering the progress.

Similarly, in the case of biofuels tax incentives, data is made available and transparent to the general public. Information on a specific tax incentive and the applicable rates are accessible through the Internal Revenue Service (IRS) website. Producers who wish to apply for any respective incentive can find all the requirements and forms with ease. Beside the IRS, updates on incentives are well published under other support programs and well-studied by scholars. Examples include the Federal Legislation for Biomass by the US Department of Energy and the Energy Efficiency & Renewable Energy Program.[149]

It must however be recognized that government revenue and expenditure decisions are made in political markets, and the role of political forces in the design of government revenue structure and expenditure allocation should be considered when analyzing issues of regulatory transparency. In the biofuels industry, given the nature of the farm lobby, such an analysis is particularly pertinent. For instance, in studying the link between agriculture and climate-change mitigation, Hornstein (2010)

[148] One study, for instance, found that consumption mandates such as the RFS are 2.5 to 4 times as expensive as cap and trade system, yet such mandates persist despite their evident inefficiency (Holland et al., 2011). Under a cap and trade system, average abatement costs are estimated to be US$ 20/ton CO_2e while consumption mandates such as the RFS cost some US$ 50-80/ton CO_2e. Yet, the political economy of public regulations supports the persistence of inferior policies such as the Renewable Fuel Standard. The skewed distribution of gains and losses, where many states or counties incur small net losses but a few states or counties enjoy large net benefits, support consumption mandates over more efficient market based instruments in the biofuels sector, even if the overall cost-benefit outcome is negative. The Holland et al study supports the private interest theory of regulation, where well organized groups capture rents at the expense of more dispersed groups (see for instance Stigler, 1971).

[149] Available at http://www1.eere.energy.gov/biomass/federal_biomass.html

notes the influence of the farm lobby in the policy formulation process. Skidmore et al (2011) examine the factors that determine the adoption of economic development incentives in the ethanol industry in the US at the local level from 1984–2007. They found that the institution of subsidies/tax credits for ethanol was especially influenced by political considerations.

(v) Alignment

The main US agencies that are involved in the promulgation and implementation of biofuels policy include:

- United States Department of Agriculture (USDA)
- Department of Energy (DOE)
- Environmental Protection Agency (EPA)
- Internal Revenue Service (IRS)
- Department of Transportation (DOT)
- US Customs and Border Protection (CBP).

In general, each agency implements the policy requirements related to it, but there are some significant overlaps in terms of the mechanisms employed. For example, the IRS accommodates tax law changes, the EPA handles mandates through regulations and standards, and CBP enforces tariffs and trade restrictions. When it comes to subsidies, however, the DOE, USDA, DOT, and EPA all play various roles.

The main activities of the DOE have been focused around the theme of research, development, and demonstration. As such they invest in research at federal laboratories and provide grants and loan guarantees for external research and technology demonstrations at companies and universities. The USDA, naturally, has been more focused on agricultural developments, such as the administration of loan guarantees, capital reimbursements, and grants that go to participants in the agricultural sector, both large companies and small farms. Likewise, the EPA also administers specialized funding programs related to air quality, while the DOT focuses on fuel economy standards such as Corporate Average Fuel Economy and other highway initiatives.

With regard to the Renewable Fuel Standard in particular, several regulatory bodies provide inputs into determining the annual level of requirements as well as conducting assessment on the potential environmental and economic impacts of these requirements. The EPA sets the production mandate every year based on the Energy Information Administration's market analysis and projections. In case which the mandated level is not likely to be met, the EPA, in consultation with the US Department of Agriculture will determine the reduction level.

However, several government programs have been created to support virtually every stage of production and consumption relating to ethanol and biodiesel, from growing the crops that are used for feedstock to the vehicles that consume the biofuels. In many locations, producers have been able to tap into multiple sources of subsidies. Overlapping programs may also carry a high cost for little benefit in terms of energy infrastructure. At the federal level, production is subsidized even though consumption of it is mandated through the RFS. Also, the maintenance of a high tariff on imported ethanol is at odds with the goal of encouraging the substitution of gasoline by ethanol. Coordination failures and far from optimal policy coherence seem to be apparent in some aspects of US biofuels policy.

3.1.2 Conventional Biofuels in Indonesia

Key Findings

- Indonesia first introduced national biofuel policies in 2006 to help protect against falling oil production and rising oil prices.
- To support the biofuels industry, the Indonesian Government has introduced biofuel targets together with subsidies and fiscal incentives.
- Policy support for biofuels has helped bolster its production; however, it appears the Indonesian government's biofuels production targets have not been met. Biofuels remain an expensive alternative to petroleum fuels and the subsidies extended to the industry will add to Indonesia's existing fuel subsidy burden.

Costs, benefits and promotion

- Despite the purported energy security benefits of biofuels in the context of rising oil prices, biofuels remain more expensive than petroleum fuels.
- Biofuel subsidies will add to Indonesia's existing fuel subsidy burden and may not be the most efficient means of achieving social objectives such as helping the poor.
- While biofuels can contribute to greenhouse gas mitigation, they have the potential to cause environmental damage such as deforestation and agricultural pollution. This risk increases if policies to protect the environment are weakly enforced or not enforced at all.

Scientific integrity

- The potential for environmental damage from biofuels does not appear to have been adequately taken into account when biofuel policies were introduced, but recent policy initiatives have sought to make palm oil production sustainable and imposed a moratorium on the clearing of forest areas.

Flexibility

- The target-based approach is not flexible enough to respond automatically to changing circumstances. Initial biofuel targets have not changed substantially.

Transparency

- Indonesia has made progress in promoting transparency in the development of regulations but further efforts are recommended to involve stakeholders and to quantify the true cost of support for the biofuel industry.

Alignment

- More effort is needed as Indonesia does not have adequate structures in place to coordinate policy development among central government agencies and local governments. Indonesia should introduce a coordination mechanism to facilitate policy coherence across central government agencies.

A. Size and Significance

The Indonesian Government began supporting the development of a national biofuel industry in 2006. The main driver for the new policy was a reduction in oil production.[150] A rise in the price of oil put pressure on subsidized fuel prices and caused the government to almost double the price of transport fuel and triple the price of kerosene in 2005 (GSI, 2008). This caused a rethink of Indonesia's broader energy strategy.

In January 2006, the Indonesian Government introduced the National Energy Policy which required the Ministry for Energy and Mineral Resources (MEMR) to develop a National Energy Management Blueprint for the development and exploitation of priority energy sources. This included biofuels which were targeted to make up more than 5% of national energy consumption by 2020. The blueprint provided that Indonesia would develop a biodiesel production capacity of 1.16 billion litres in 2010 and 4.16 billion litres in 2025 (Caroko et al., 2011).

B. Policy Formulation

(i) History and Background

The first step to achieving Indonesia's biofuel targets was to legalize the use of up to 10% bioethanol in petrol and 10% biodiesel in diesel. The Indonesian Government then instructed the State Owned Oil Company, Pertamina, to start selling a 5% blend of biofuel and petroleum products. In July 2006, the Indonesian Government developed the Losari Concept (named after the town in which it was conceived) to support the development of Indonesia's nascent biofuel industry. The plan committed to meet 10% of Indonesia's transport fuel needs from biofuels by 2010 (USDA, 2010). At this time many agricultural commodity prices were relatively low and energy prices relatively high which made biofuels an attractive proposition (GSI, 2008). As a result it was believed that achievement of the Losari targets would help create 3.6 million jobs, reduce the poverty rate by 16% and lower fuel imports by US$5billion (the Indonesian Government also suggested it would reduce fossil fuel subsidies) (GSI, 2008).

To help coordinate Indonesia's approach to biofuel development, the Indonesian Government established a National Team for Biofuel Development (Timnas BBN) in July 2006. Timnas BBN included representatives from government, institutions, corporations and individuals with an interest in biofuels. Timnas BBN developed a roadmap for biofuel development and proposed fiscal and non-fiscal incentives, the creation of special biofuel zones and an increase in the number of energy self-sufficient villages in Indonesia using biofuels (Caroko et al., 2011).

[150] Indonesia became a net importer of oil in late 2004 (PWC, 2011a)

At the beginning of 2007, the Indonesian Government co-hosted the Joint Initiative for Biofuel Development with industry partners. At this event, 67 contracts for industry development were signed with an estimated value of US$ 12.4 billion. The Indonesian Government also announced another US$ 2.4 billion in interest rates subsidies for the industry to be provided through national banks (USDA, 2007).

However, much of the potential promise of the new announcements was not realized, largely due to a fall in the price of fossil fuels and a rise in the price of Crude Palm Oil (CPO) which made biofuels financially less attractive. This led to a reduction in output or temporary closure of 17 biodiesel companies in late 2007, and a fall in production of 60% in 2008 (Caroko et al 2011). To help reverse the industry decline, the Indonesian Government introduced new biofuel targets in 2008 which legislated the minimum targets for the use of biofuels in the transportation, industry and power sectors out to 2025. The regulation also provided that licensed biofuel entities contributing to the targets may be eligible for fiscal and non-fiscal incentives.

In 2011, the production of biodiesel was expected to reach up to 650 million liters and up to 700 million liters in 2012 (USDA, 2011). Pertamina and PLN had also agreed with state-owned plantation companies to construct three biodiesel power plants with operation to begin in 2012 (USDA, 2011). However, the utilization of Indonesia biodiesel capacity remained low (at 17% in 2011 (USDA, 2011)) and Indonesia's fuel based bioethanol production had stopped due to a pricing dispute between Pertamina and producers (USDA, 2010).

(ii) Policy Description

MANDATES

Biofuels targets

The Indonesian Government has introduced a number of biofuel targets including the Biofuel blueprint prepared to support the National Energy Policy, the development plans prepared by Timnas BBN and the Losari concept. In 2008, the Indonesian Government introduced mandatory five yearly biofuel targets out to 2025 through MEMR Regulation 32/2008. The targets applied to the household, transport, industrial and power generation sectors (see Table 3.1.2).

Table 3.1.2 ***Indonesian biofuel targets (minimum percentage of biofuel required in fuel)***

	2010	2015	2020	2025
Biodiesel				
Subsidised transport fuel	2.5	5	10	20
Non-subsidised transport fuel	3	7	10	20
Commercial and industry	5	10	15	20
Power plants	1	10	15	20
Bioethanol				
Subsidised transport fuel	3	5	10	15
Non-subsidised transport fuel	7	10	12	15
Commercial and industry	7	10	12	15

Source: USDA, 2009

Environmental regulations

The Indonesian Government has made provisions for the protection of the environment from biofuel development, including the need for an environmental impact assessment or AMDAL as described in Ministry of Environment Regulation 8/2006 (Spitz and Husin, 2009); MEMR Regulation 32/2008 that requires biofuel producers to ensure feedstock sustainability and prove no harm to the environment by way of environmental impact analyses (Kuen and Chalmers, 2010); the 2011 Ministry of Agriculture Indonesian Sustainable Palm Oil standard (Caroko et al., 2011); and the Presidential Decree (10/2011) imposing a two year moratorium on the conversion of forest and development on peat land.

FISCAL INCENTIVES

Subsidies

The Indonesian Government provides the biofuel industry with significant subsidies, including:

- *Fuel subsidies*

  The Indonesian Government provided a biofuel subsidy of IDR 1000 per liter[151] beginning in 2010 in addition to existing petroleum fuel subsidies. This was increased to IDR 2,500 to 3,000 per liter[152] for biodiesel and IDR 3,000 to 3,500 per liter[153] for bioethanol in 2012 (USDA, 2011).

- *Interest rate subsidies*

  In 2006, the Indonesian Government introduced an interest rate subsidy for a period of five years to support plantation development and revitalization, including for biofuel crops (GSI, 2008).

- *Fertilizer subsidies*

  The Indonesian Government provides fertilizer subsidies to the agricultural sector (which reached IDR 15 trillion[154] in 2008 (Osori et al., 2011)). This is important because the cost of fertilizer is a key variable in ensuring the economic viability of biofuel feedstock (Winrock International, 2009).

Other fiscal incentives

The biofuel industry is eligible for a range of fiscal incentives including a reduction in stamp duty, relief from import duties, an investment tax allowance, accelerated depreciation, a loss carry forward facility, a reduced tax on dividends, and an exemption from value added tax for some strategic goods.

[151] This is approximately 11 US cents per liter (assuming that 1 USD = 9000 Indonesian rupiah).
[152] This is approximately 27 to 33 US cents per liter.
[153] This is approximately 33 to 38 US cents per liter
[154] This is approximately 1.7 billion USD.

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

Indonesia initially introduced biofuel policies to improve energy security (including affordability) in the face of falling oil production and rising oil prices. It was expected that biofuels could also provide a range of other benefits. Purported benefits included the exploitation of large areas of land that were categorized as forests but considered degraded beyond repair; the promotion of jobs in regional areas, including in Indonesia's crude palm oil sector (which is now the world's largest); the exploitation of land that was not suitable for food crops; and the mitigation of greenhouse gas emissions.

The purported benefits notwithstanding, biofuels are expensive relative to petroleum fuels, which makes them unattractive to Indonesia's largest distributor of petroleum fuels, the state-owned oil company Pertamina. This is because the price at which Pertamina is allowed to sell most of its fuel is regulated by the government at below cost, with the difference made up through government subsidy. Until 2010 no additional subsidy was provided to Pertamina to cover the extra cost of biofuels. This led to large losses for Pertamina (for example it lost US$ 70 million in 2008 (Caroko et al., 2011)). Consequently, Pertamina reduced the supply of biofuels. The state-owned electricity company, PLN, which sells subsidized electricity, has also elected not to use biodiesel for electricity production because it received no additional compensation from the Indonesian Government (USDA, 2008). The biofuel industry has also been costly for private investors, as it is estimated they lost around US$ 2 billion between January and May 2009 (USDA, 2009).

The Indonesian Government's decision (Presidential Regulation 45/2009) to allow the Ministry for Energy and Mineral Resources (MEMR) to determine the price of petroleum and biofuels has also limited the attractiveness of biofuel production for private firms. The price offered by Pertamina for bioethanol is based on a monthly average price of fuel ethanol in Thailand (USDA, 2011). At this price producers prefer to leave production facilities idle or produce industrial ethanol rather than sell fuel ethanol to Pertamina at uneconomical prices (USDA, 2011). A similar issue also faces suppliers of crude palm oil who may be discouraged from selling to the biofuel industry because they can find higher prices for their product in other markets (e.g. for use in cooking).

To address this issue, the Indonesian Government has introduced regulated biofuel targets and provided interest rate subsidies and other fiscal incentives such as a reduction in stamp duty (the biofuel industry is also eligible for fertiliser subsidies) to help achieve those targets. In 2010, the Indonesian Government approved an additional subsidy of IDR 1000 per liter[155] of biofuel sold by Pertamina, to be raised to between IDR 2,500 and IDR 3,500 per liter[156] in 2012. The Indonesian Government is also reported to be considering increasing the price offered to biofuel producers and providing additional incentives for biofuel feedstock suppliers (USDA, 2011). Essentially, the approach has been to provide subsidies to biofuels on top of existing fuel subsidies to improve the uptake of a fuel that is economically unviable for the biofuels producers.

[155] This is approximately 11 US cents per liter (assuming that 1 USD = 9000 Indonesian rupiah).
[156] This is approximately 27 to 39 US cents per liter.

Indonesia's biofuel policies have helped increase the production of biodiesel from 24 million liters from two refineries in 2006 to 650 million liters from 22 refineries in 2011. However, it appears the government's Losari target of meeting 10% of transport fuel needs from biofuels by 2010 (3% from biodiesel and 7% from bioethanol) has not been met. For instance, according to the Directorate of Bioenergy, while the 2010 target for utilization of biodiesel was 1.076 million kilolitres (KL), the actual amount utilized was 0.223 million KL or only 21% of the target. The low price of bioethanol constrained its supply to the extent that 0% of Indonesia's transport fuel needs were met from bioethanol in 2010 (Directorate General of New Renewable Energy and Energy Conservation, 2011).

The promotion of the biofuels industry via subsidies has entailed substantial costs. To help achieve the benefits outlined above, the Indonesian Government allocated US$ 1.6 billion to the biofuel industry between 2006 and 2008. But because the government did not enforce its targets actual spending was estimated to have been US$ 197 million which included training, research and development, Pertamina's losses, and interest rate subsidies (Caroko et al., 2011).[157] These costs are likely to have significantly increased with the introduction of a specific biofuel subsidy in 2010 and will increase even further in 2012 as the subsidy is more than doubled.

Furthermore, biofuel policies have been connected with environmental damage. For example, they may provide an incentive for an expansion of the plantation estate to produce biofuel feedstock. If this expansion occurs on previously forested land or land that contained native vegetation then the production of biofuels is likely to be a net contributor to greenhouse gas emissions (GSI, 2008) and may cause other environmental damage e.g. habitat destruction. Biofuel policies could also contribute to increased agricultural pollution (e.g. from fertiliser and pesticides). They may also contribute to a rise in food prices and thus undermine the purchasing power of the poor.

Further investigation of the unintended consequences of biofuel development including broader environmental and social impacts should be considered. A key issue in this regard is enforcement. Indonesia has already taken steps to address the potential negative impacts of the biofuel industry on the environment, through initiatives such as the AMDAL[158] and the forthcoming roll out of the Indonesian Palm Oil Standard. But there is a suggestion that enforcement is limited (Winrock International, 2009) and many plantation companies tend to neglect what they have promised in their environmental and monitoring plans (Caroko et al., 2011).

A conclusion on the benefits and costs of Indonesia's biofuel subsidies is difficult to reach due to the paucity of data, and because the industry is still relatively small[159]. Many of the benefits and costs are likely to be driven by other factors such as the market price for food grade Crude Palm Oil (CPO) and the market price for timber. However, some general observations can be made.

[157] It is estimated that if the Indonesian Government had enforced its biofuel targets the actual cost to tax payers would have been double the total allocated (GSI, 2008).

[158] AMDAL refers to the provisions made by the Indonesia government for the protection of the environment from biofuel development, including the need for an environmental impact assessment.

[159] It is estimated the only 6% of Crude Palm Oil (CPO) produced in Indonesia is used to produce biofuels (Caroko et al., 2011).

- Biofuels remain more expensive than petroleum fuels and have therefore not helped reduce the cost of meeting the nation's energy needs.

- Biofuel subsidies will add to Indonesia's existing fuel subsidy burden (which was forecast to reach IDR 129.7 trillion[160] in 2011 (Jakarta Post, 2011) which the Indonesian Government has pledged to phase out over the medium term.[161]

- Biofuels have the potential to cause environmental damage, particularly if biofuel targets are met by using extensive forested land or land with native vegetation.

- The contribution of the biofuel industry to social objectives is difficult to determine due to the influence of broader agricultural market and government policies. However, there is evidence that subsidies will not be the most efficient means of helping the poor. For example, the Indonesian Coordinating Ministry of Economic Affairs advised in May 2008 that the wealthiest 40% of families receive 70% of [broader] fuel subsidies while the bottom 40% benefit from only 15% (Mourougane, 2010).[162] There is also some suggestion that the palm oil boom may have benefited large corporations at the expense of Indonesia's poor (GSI, 2008). In addition, increased food prices resulting from biofuel policies have a regressive impact with the poorer households affected the most.

One rationale offered by Indonesia for supporting a mature technology such as biofuels is that it will help internalize the public benefits of production (e.g. greenhouse gas emission reductions). However, in the case of achieving rural development benefits the observations above suggest that the subsidy is poorly targeted. The funds earmarked for biofuel subsidies may have more of an impact if allocated to Indonesia's rural poor through direct transfer mechanisms. Indonesia has a long history with such payments (Mourougane, 2010) but care would need to be taken to ensure it is well targeted. Alternatively the funds could be used to support public services in rural areas.

The least cost approach to achieving Indonesia's objectives of energy security would be through a broad market based mechanism (such as a tax on greenhouse gas emissions) to ensure that biofuels contribute to the social objective by offering a least cost solution. This approach would help promote additional development of the biofuel industry up to the point where the social benefits of doing so justify the costs rather than according to a bureaucratically determined and potentially very costly biofuel target.

(ii) Scientific Integrity

Indonesian biofuel policies were originally introduced to help reduce Indonesia's dependence on imported fossil fuels and improve fuel security. The production of biofuels has been criticized because feedstock plantations may be established on previously forested land or native grass land, thus contributing to deforestation, habitat destruction and greenhouse gas emissions. They could also

[160] This is approximately 14 billion USD (assuming that 1 USD = 9000 Indonesian Rupiah).
[161] G20 Leaders Statement at Pittsburgh Summit: Acting on Our Global Energy and Climate Change Challenges
[162] A similar finding is reported for fertiliser subsidies by Osori et al (2011) who report that public spending to subsidise urea [a fertiliser] is regressive and a large share of the benefits is captured by the larger farmers.

contribute to increased agricultural pollution (e.g. from fertilizers and pesticides). These issues do not appear to have been considered at the time that biofuel policies were introduced.

However, in 2011 the Indonesian Government introduced the Indonesian Sustainable Palm Oil Standard which is designed to make palm oil production sustainable in compliance with Indonesian laws and regulations (Caroko et al., 2011). The Indonesian Government also agreed to a two year moratorium on the issue of licenses for the clearing of forest and development on peat lands except in certain priority areas such as the sugar cane sector.

(iii) Flexibility

Indonesia has adopted a legislated target based approach to the development of its biofuel industry supported more recently by subsidies for transport fuels. A target based approach may be useful for directing attention toward a government priority. It could also reduce industry risks and encourage additional industry investment. However, Indonesia has previously not met targets so they may not encourage additional industry investment.

A target based approach is also not flexible enough to automatically respond to changing market conditions. For example, the target will not respond to changes in the cost of alternative fuels or biofuel feedstock. The lack of in-built flexibility means that if the price of biofuels rises, Indonesia could choose not to meet the targets (as it has done in the past) or end up spending a lot more money than originally anticipated. Nor has the Indonesian government significantly modified its biofuel targets in response to changing economic circumstances. After the target of meeting 10% of transport fuel needs from biofuels by 2010 was set in 2006, falling fossil fuel prices and a rise in the price of Crude Palm Oil (CPO) made biofuels an economically less attractive proposition. However, the new biofuel targets set by Indonesia in 2008 continued to require 10% of transport fuel needs to be met from biofuels by 2010 (with 3% from biodiesel and 7% from bioethanol).[163]

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

Indonesia has established a formal law/regulation making framework through the National Legislation Program (Prolegnas).[164] Stakeholders are required to play an active role in this process. For example, relevant stakeholders such as political and civil society groups, academics, experts and practitioners are invited to help prepare the text to support draft laws and regulations. Public comment is then sought on the draft proposal.

Otsuka et al. (2011) notes that the government has introduced more institutionalized public consultation processes for new policies and strengthened appeal processes, yet many business associations do not have the capacity to effectively critique/discuss government proposals which may limit their influence over government policy (OECD, 2010b).

[163] Refer to Table 3.1.2

[164] The description of the steps involved in policy development is based on (OECD, 2010b)

Evidence on transparency in the development of biofuel policies appears limited. However, there is some suggestion that government performance could be improved. For example, it has been reported that the Timnas BBN blueprint for biofuel development was produced by a few scientists at the Agency for the Assessment and Application of Technology (BPPT) with stakeholder input only sought on the final draft (Caroko et al., 2011). GSI (2008) also reports that the Indonesian Government could be more transparent in the information on biofuel subsidies that it provides to the public.

(v) Alignment

The alignment of policies in Indonesia has been a challenge. One reasons for this is that Indonesia 'does not have a systematic mechanism to develop, monitor and evaluate laws/regulations or a centralized regulatory oversight body with 'whole of government' responsibility for regulatory policy' (OECD, 2010b).

Another reason is that since the fall of Suharto in 1998 Indonesia has pursued a program of decentralization which has led to the sharing of powers between the central and more than 500 local governments (The Asia Foundation, 2010). This approach has provided greater autonomy to the regions but has led to some confusion about the division of responsibility between the levels of government and resulted in the responsibility for some policies resting with local government that did not always have the capacity to establish a regulatory environment conducive to business (OECD, 2010a).

The systems in place to promote alignment of policies in Indonesia are inadequate to coordinate policy among many central government agencies (Winrock International (2009) estimates that 13 were involved in the development of biofuel policy) and potentially hundreds of local governments. At a broad level this has contributed to the development of a large number of laws and regulations which are often overlapping, inconsistent or conflicting. It has also been a problem for the biofuel industry, for example, it has:

- Led to overlap in the national biofuel research agenda (Winrock International, 2009).
- Contributed to the development of overlapping and inconsistent policies. For example, Indonesia wishes to achieve self-sufficiency in edible sugar production but is simultaneously promoting the use of sugar cane for use as a biofuel feedstock (Winrock International, 2009).
- Led to the development of targets that are not supported by broader regulations. For example, there appears to be no link between the oil plantation area that is granted for development and government biofuel targets (Caroko et al., 2011).
- Promoted the objectives of one central government agency over another. For example, the Indonesian Government has agreed to increase the subsidy provided to Pertamina for the biofuel petroleum blends but also wishes to reduce the fuel subsidy paid by the Ministry of Finance (MOF).

To help address this problem the Indonesian Government has cancelled many local regulations that conflict with higher level laws/policies (Otsuka et al., 2011). Some central government agencies have also taken steps to review regulatory policies; and in the 2010 – 2014 Medium Term Development Plan, the

Indonesian Government committed to review and simplify laws and regulations between the central and local governments. This review will be undertaken by the OECD and the National Task Force for Regulatory Reform Review (Indonesian Minister of Finance, 2011). The Task Force will be housed in the MOF and will include several other government agencies and institutions.

3.1.3 Concluding Remarks

The US has had a longer history of policy support for the biofuels industry than Indonesia. The US policy support has come in the form of mandates, tax incentives, import tariff, and loans and grants whereas Indonesia has employed biofuel targets and subsidies to achieve its policy objectives. The economies articulate similar drivers for their support for the biofuels industry, namely improving energy security, achieving environmental objectives and providing income to farmers.

However, the US experience has shown that trying to meet these objectives can be costly. The program to support the US biofuels industry began in the 1970s; however, to date biofuels remain an expensive alternative to conventional fossil fuels.[165] Furthermore, the fiscal burden of subsidies for the industry has been growing rapidly in the past few years. Even where the environment is concerned, biofuels are a costly CO_2 abatement option for the US. Indonesian policymakers ought to take heed of the intertemporal opportunity costs of supporting an industry that is not commercially viable in the US despite the support given for three decades.

For Indonesia, land use change on account of biofuels production is a serious issue that militates against the environmental benefits of biofuels. Indonesia needs to institute a formal mechanism whereby policy decision making is based in cost-benefit analysis. This would allow Indonesia to side step potentially costly energy policy decisions such as those that have been made in the US biofuels context. Cost benefit analysis also serves to reduce the probability of pressure from powerful interest groups in guiding policy making as this raises transparency. That being said, in the US context, cost-benefit analysis has not been able to reduce the influence of the powerful farm lobby.

The US renewable fuels standards are not very flexible as they are updated on a yearly basis. However, Indonesia's target-based approach provides even lower flexibility. Indonesia should reconsider its biofuel subsidy arrangements. The value of the subsidy (if any) should be set to reflect the social value of the biofuel industry (e.g. in terms of energy security or emission reduction benefits) rather than achieve bureaucratically determined biofuel targets. Indonesia should ensure that policies to address the potential negative consequences of biofuel policies, for example, on the environment are adequately enforced. Finally, both the US and Indonesia need to consider increasing the coherence and alignment of policies at the federal and local levels. The overlapping jurisdictions of several authorities raise the cost of regulations.

The analysis of US regulatory practices for the biofuels sector leads to the conclusion that the support that the biofuels sector has received appears to be unsustainable and disproportionate to the realized benefits, such as improved energy security and CO_2 emissions reductions. Indonesia's policy support for biofuels has helped bolster its production; however, it appears the Indonesian government's biofuels production targets have not been met. Biofuels remain an expensive alternative to petroleum fuels and the subsidies extended to the industry will add to Indonesia's existing fuel subsidy burden.

In conclusion, the evidence suggests that policy support extended to the biofuels industry in both economies needs careful reexamination. There is a significant mismatch in the perceived and realized

[165] Brazil is often considered a success story when it comes to biofuels policy. Whilst some experts consider Brazil's biofuels industry to be a model for other economies, others have argued that ethanol production in Brazil is a unique situation and it is not replicable in other economies, particularly the US. See Sperling and Gordan (2009) pp. 95–96.

benefits from biofuels be they expected improvements in energy security, CO_2 emissions reductions, or augmentation of farm incomes.

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3.2 Geothermal Energy

Geothermal energy is heat that is stored in the rock and fluid contained in the Earth's crust (Geothermal Resources Council, 2011). The heat is generated by the natural decay over millions of years of radiogenic elements, including uranium, thorium and potassium (Geoscience Australia and Australian Bureau of Agricultural and Resource Economics, 2010). This heat is constantly moving from the Earth's core to the surface and can therefore provide a sustainable energy source.

Low temperature geothermal resources (with temperatures typically between 38°C and 150°C (Geothermal Resources Council, 2011) can be used directly (without conversion to electrical energy) for the purpose of heating or cooling. Heating applications can include: agricultural purposes (for example, greenhouse heating), industrial purposes (for example, evaporation drying, sterilization and chemical extraction), space heating, bathing, aquaculture, and water desalination (KPMG, 2010).

Another application of geothermal resources is to produce electricity – the geothermal policies of Australia and Indonesia have focused on the use of geothermal resources for the production of electricity so this use is the focus of this paper.

Electricity production usually requires a geothermal resource with a temperature of more than 100°C (International Energy Agency, 2011). The geothermal heat required to produce electricity typically comes from hydrothermal or "conventional systems." These systems use naturally occurring hot water or steam circulating through permeable rock. They are commonly associated with active volcanoes. To use these resources it is necessary to drill a production well to extract the hot water or steam. The used water is typically returned to the geothermal reservoir via an injection well. Conventional systems use a mature technology. They are typically shallow (<3km), have a relatively low well cost and temperatures between 200^0C to 350^0C.

Until recently, geothermal exploitation was limited to conventional systems – in areas with high temperatures and where the fluid will transfer to the surface without additional lift (International Energy Agency, 2011). New technologies now permit the exploitation of deeper and cooler resources as found in hot sedimentary aquifers and enhanced geothermal systems (KPMG, 2010). These technologies have significantly expanded the global geothermal resource potential.

- To extract energy from Enhanced Geothermal Systems it is necessary to pump high pressure water through an injection well into a deep body of hot compact rocks causing it to fracture, artificially creating a reservoir. The water is heated by the rocks and returned to the surface via a production well. This technology is relatively new and not yet commercially proven (Electric Power Research Institute, 2010).

- Hot sedimentary aquifer systems are similar to conventional systems. They contain naturally occurring reservoirs of hot water or steam. To use these reservoirs it is necessary to drill both a production and injection well. The key difference between hot sedimentary aquifers and conventional systems is that hot sedimentary aquifers involve drilling into hot sedimentary basins with temperatures typically lower than conventional systems. Furthermore, they occur at greater depths than conventional systems. While hot sedimentary aquifer systems are

considered to be less risky than enhanced geothermal systems they nonetheless remain to be proven commercially.

The use of geothermal resources to produce electricity provides a number of benefits. It can reduce a economy's reliance on imported fuels and thus promote energy security; it is environmentally friendly – geothermal power stations emit effectively no greenhouse gases (Geoscience Australia and Australian Bureau of Agricultural and Resource Economics, 2010) and when compared to coal based power generation virtually eliminate local air pollutants such as sulphur dioxides, nitrogen oxides and particulates (Asian Development Bank, 2010); and unlike many other forms of renewable energy geothermal power is not subject to short term or seasonal weather variations and can therefore provide reliable base-load capacity.

3.2.1 Geothermal Energy in Australia

Key findings

- Australia's geothermal resource is projected to be very large. However, its potential to support commercially viable power plants has not yet been proven and early projects have produced sub-optimal results.

- The key barriers to development of Australia's geothermal industry are resource uncertainty, cost, and financing difficulties. To overcome these barriers Australian governments have supported basic research and development (R&D) programs and grants for research, development and deployment. Geothermal power is also eligible for the renewable energy target (RET).

- Australia's geothermal sector has leveraged a significant amount of private sector capital to date. This capital has flowed in the early development and exploration phase of the technology. However, additional capital is still required to take these investments through to the demonstration stage.

Costs, benefits and promotion

- Australian government grants to companies for research, development and deployment have looked to mitigate early mover risk. However, governments have faced significant challenges in trying to co-manage the development of new technologies. This has led to significant implementation delays and makes grants hard to justify on a benefit/cost basis.

Scientific integrity

- Australian estimates of the resource indicate a substantial technical potential. It is now estimated that if just 1% of Australia's geothermal resource to a maximum depth of 5km and a minimum temperature of 150°C could be accessed, it could provide roughly 25,000 times Australia's primary energy use.

Flexibility

- The flexibility of Australian government geothermal programs differs. At the national level support for the industry is flexible because governments have not committed to any specific development targets.

- In terms of grant-based programs, governments have typically provided one-off funding rounds which are regularly changed. However, once announced, grant programs lack flexibility.

Transparency

- Australian governments have developed a number of mechanisms to facilitate the stakeholder input to the policy development process. This includes the Australian Government's

Commonwealth Grant Guidelines introduced in 2009 to promote better practice approaches to grants including stakeholder consultation, and the Australian Government's Best Practice Regulation Handbook, most recently updated in 2010.

Alignment

- Some alignment problems have been highlighted by stakeholders, but Australian governments have taken a number of steps to achieve policy alignment. Policies between the Australian and State and Territory governments are coordinated through the Council of Australian Governments (COAG), while a system of Ministerial Councils under COAG facilitates consultation and cooperation between jurisdictions in specific policy areas.

A. Size and Significance

The Australian Government has identified geothermal as a strategically important technology class due to its potentially significant role in Australia's future energy mix as well as generating additional spill over benefits in the form of intellectual property or export earnings (Australian Government, 2011a). Australian Government modeling indicates that geothermal could account for between 13% and 23% of total Australian electricity generation in 2050 (Australian Treasury, 2011). It is estimated that this would require the generation of between 5000 MW and 9500 MW of power from geothermal in 2050 (The Age 2011). The Australian Government does not have a specific geothermal target. As such, the role it will play in the future will be determined by factors such as overcoming resource barriers at a competitive cost.

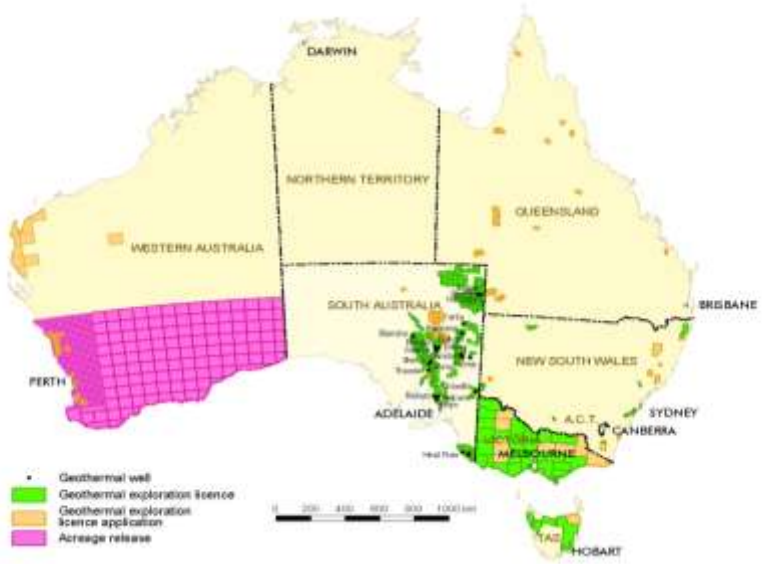
The exploration of geothermal resources in Australia is governed by State and Territory governments. Between 2001 and 2009 all Australian jurisdictions except the Australian Capital Territory (ACT) developed new legislation or amended existing legislation (developed for minerals or oil) to allow the exploration and exploitation of geothermal resources. South Australia has been described as "Australia's hot rock haven" and this renewable energy form could provide an estimated 6.8% of Australia's base load power needs by 2030. Investors have continued to support capital requirements for geothermal projects, and funding continued to increase.

In 2006, Geodynamics, Petratherm, Green Rock Energy, Eden Energy, and Geothermal Resources raised AU$20.78 million (US$ 19.7 million) from public share subscriptions during the year. As of 31 December 2006, the market capitalization of these five companies amounted to about AU$ 172 million (US$ 163.4 million).[166] In the first two months of 2007, Geodynamics, Petratherm and Torrens Energy all announced significant additional injections of capital. There are indications that investors remain willing to back geothermal energy projects. By 2010, 57 companies held exploration licenses over an area of more than 457,900 square km (Bendall et al., 2011). However, current installed capacity is still limited to an 80 kW power plant that has been operating at Birdsville, Queensland since 1992. Most of the companies that hold licenses are speculative and are not involved in exploration activity (Allen Consulting Group, 2011).

[166] Please refer to the assessment by Department of Manufacturing, Innovation, Trade, Resources, and Energy accessed at http://www.pir.sa.gov.au/geothermal/ageg/geothermal_basics/potential_use.

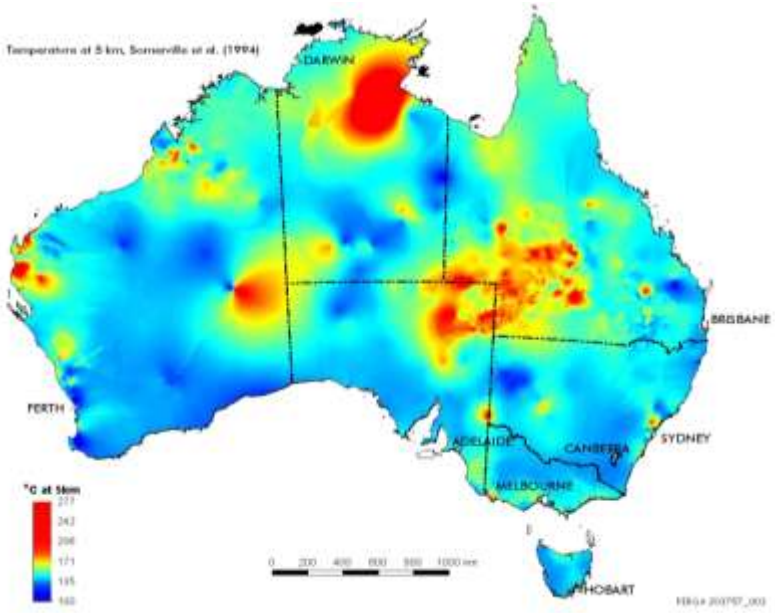
Figure 3.2.1 below shows the geothermal licenses, applications and gazettal areas as of February 2009. The map indicates that most exploration licenses have been awarded in South Australia whereas acreage releases are the most is Western Australia. And Figure 3.2.2 shows extrapolated temperature at 5km intervals across Australia. It indicates that the region in and around the border of South Australia and Queensland shows technical promise for geothermal energy in addition to some parts of the Northern Territory.

Figure 3.2.1 ***Geothermal licenses, applications, and gazettal areas***



Source: Department of Manufacturing, Innovation, Trade, Resources, and Energy (2012) accessed at http://www.pir.sa.gov.au/geothermal/ageg/status_of_geothermal_licence_activity

Figure 3.2.2 ***Temperature map of Australia***



Source: Somerville et al. (1994)

B. Policy Formulation

(i) History and Background

Due to the fact that there are no conventional geothermal resources available in Australia, the prospect of using geothermal energy has only recently emerged with the development of enhanced geothermal systems and hot sedimentary aquifer systems. Nonetheless Australian governments[167] have been active in updating their regulatory systems to accommodate the needs of the geothermal industry for over a decade.

In recognition of the early stages of geothermal technology development applicable to Australian circumstances (no conventional resources available) the Australian and State Governments provided grants for early stage industry research and development and provided to individual companies and research organizations. In total, such measures to support the development of the geothermal industry amounted to AU$ 297 million (US$ 282.2 million) to 2010 through government budgets (Bendall et al., 2011).

(ii) Policy Description

MANDATES

Regulations governing geothermal exploration and exploitation

Each State and Territory government (with the exception of the Australian Capital Territory) has introduced legislation setting out the rules for geothermal exploration and exploitation. They have so far encouraged the registration of 380 geothermal exploration licenses.

The regulatory regime adopted by each jurisdiction is different but includes some significant similarities. For example all regimes include the right to collect a royalty based on exploitation of the geothermal resource (although some States choose not to enforce this right) and include provision for the following types of licenses:

- *An exploration license*

  A firm that wishes to explore geothermal resources must obtain an exploration license. Exploration licenses may be issued via tender (for working areas identified by the government) or after application from a geothermal firm.

- *A retention lease*

  Firms that find a geothermal resource that is not yet commercially viable but is expected to become viable may apply for a retention lease.

[167] Australia is governed by a federal system consisting of a national government, six state, and two territory governments. To help promote the development of Australia's geothermal industry, Australian governments (the national and state and territory governments) have introduced a range of policies.

- *An exploitation lease*

  Firms that wish to exploit a geothermal resource (but not the right to build a power plant or build facilities for the direct use of geothermal resources, as these are governed by separate regulations) must apply for an exploitation lease.

Renewable Energy Target

The Australian Government introduced the renewable energy target (RET) in 2001 to promote the development of a range of renewable energy sources including geothermal. The RET is designed to achieve approximately 20% of Australia's electricity production by 2020 from broad range of renewable energy sources including hydro, wind, solar, biomass, wave, tidal, and geothermal. The scheme requires liable entities to obtain and surrender renewable energy certificates up to the target for that year. The scheme includes two components: the Large-scale Renewable Energy Target Scheme (LRET) and the Small-scale Renewable Energy Scheme (SRES) which includes the Solar Credits rebate scheme.

The RET provides generators of renewable energy sources with a premium over the price of other electricity sources such as coal. In this way the RET is similar to a feed-in tariff (FiT)[168] scheme. However, it is not technology specific (one premium price is offered to all renewable energy technology types) and the price is not determined in advance but responds to changes in the cost of achieving the set target. For example, if the price of renewable energy falls then the cost of meeting a set target and the price of the premium paid to renewable energy sources will also fall.

FINANCIAL INCENTIVES

Research and development (R&D) grants

Australian governments have provided support to basic geothermal research and development (R&D) through public organizations such as the Commonwealth Scientific and Industrial Research Organization (CSIRO), geothermal centers of excellence, universities, and Geoscience Australia. This funding aims to support technological innovations and develop an improved understanding of Australia's geothermal resources.

Beyond basic research, Australian governments have provided significant support to private sector research, development, and demonstration of geothermal projects in the field. For example, the Australian Government allocated AU$ 50 million (US$ 47.5 million) to seven projects under the Geothermal Drilling Program and AU$ 152.8 million (US$ 145.2 million) to two projects under the Renewable Energy Demonstration Program. This is in addition to support provided through the RET (see above).

FUTURE PROGRAMS

In July 2011, the Australian Government introduced a range of new climate change policies to begin in July 2012. This included a national carbon pricing scheme that will initially impose a fixed price of

[168] Feed-in tariffs refer to a guaranteed purchase agreement for electricity generated from renewable energy sources. These agreements are generally framed within long-term (15–25 year) contracts.

AU$23 (US$ 21.9) (rising at 2.5% in real terms) per ton of CO_2e emissions on around 500 of Australia's largest polluters (liable entities) including stationary energy and then transition to an emissions trading scheme on 1 July 2015 (Australian Government, 2011c). It also included the AU$ 3.2 billion (US$ 3.1 billion) Australian Renewable Energy Agency (ARENA) to promote the research and development, demonstration, commercialization and deployment of renewable energy projects to improve the sector's competitiveness; and the AU$ 10 billion (US$ 9.5) Clean Energy Finance Corporation (CEFC) to provide commercial or concessional loans or equity investments to clean energy companies.

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

The main focus of State and Territory Government interventions has been the creation of a regulatory environment conducive to geothermal exploration and exploitation. In addition, Australian governments (including at the national level) have provided R&D funding to accelerate the maturation process of technologies that may lead to the commercial exploitation of the non-conventional geothermal resources available in Australia.

Assessing the economic efficiency and effectiveness of Australia's geothermal policy against these goals is not straightforward given that they are relatively intangible and/or will involve long payback periods. Some of the key barriers governments are trying to help address for the fledgling geothermal industry are discussed in the following paragraphs.

One of the barriers to the development of Australia's geothermal industry is that the technologies for exploiting *enhanced geothermal systems* and *hot sedimentary aquifer* resources are still at the development stage. While both are believed to be technically feasible (Electric Power Research Institute, 2010) – and Australian stakeholders have expressed confidence that they can be successfully applied under Australian conditions (Allen Consulting Group, 2011) – more development is required before commercial viability is achieved.

Another barrier is resource risk. Even if non-conventional technologies can be used in Australia it will still be necessary to develop geothermal resources for which a number of factors remain uncertain until substantial investments are undertaken. These include temperature, flow rates, acidity, depth and other factors that affect costs and therefore commercial viability.

Financing is another challenge. The cost of drilling geothermal exploratory wells is large (around AU$ 15 million to AU$ 20 million (US$ 14.3 million to US$ 26.6 million) (Australian Government, 2011b), may significantly exceed initial expectations[169] and is an expense that must borne prior to confirmation of the geothermal resource. This makes it risky and difficult to finance. The challenge of financing exploratory drilling is particularly acute in Australia because there is only one domestically based drilling rig and the cost of sourcing a rig from overseas is high due to the large distances involved, the small size of the industry and inexperience in drilling (Australian Government, 2011b). This will limit

[169] For example, the cost to Petratherm (a geothermal company) of drilling was approximately AU$ 15 million (US$ 14.3 million) higher than expected and the cost to another geothermal company, Geodynamics, as AU$ 30 million (US$ 28.5 million) instead of an expected AU$17 million (US$16.2 million) (Allen Consulting Group, 2011).

the number of geothermal companies that can finance geothermal exploration and slow the pace of industry development.

All of these barriers contribute to the cost of geothermal power. To be competitive on a large scale, geothermal will have to supply power into a competitive wholesale electricity market (there may be a few opportunities to supply electricity directly to users in some regions). The largest market is known as the National Electricity Market (NEM) and covers every Australian jurisdiction with the exception of Western Australia and the Northern Territory. In 2010, the average wholesale price in the NEM was AU$ 45/MWh (US$ 42.8/MWh). At this price and including a modeled AU$ 65/MWh (US$ 61.8/MWh) premium under the Australian Government's Renewable Energy Target scheme it is estimated that there is currently a shortfall of AU$ 10 – $40/MWh (US$ 9.5 – US$ 38/MWh) before the cost of electricity from geothermal resources could be commercially competitive (Allen Consulting Group, 2011). In other words, the enhanced geothermal systems and hot sedimentary aquifer technologies required to access Australia's non-conventional geothermal resources are not yet competitive with other renewable technologies.

Some studies suggest that this may change in the future and non-conventional geothermal technologies may become competitive with other renewables and some fossil fuel sources (Electric Power Research Institute, 2010). However, some caution may be necessary as these declining price projections are not based on any operating Australian examples and will be heavily influenced by site-specific factors such as temperature, acidity and flow rates. In addition, they do not account for the cost of connecting to the grid (which could be very large). [170]

To help overcome these barriers Australian government have introduced geothermal regulations and a range of support mechanisms. The costs and benefits of each of these policies, including impact on promotion is described below.

(i) Costs, Benefits and Promotion

Regulations and administrative procedures

Formal cost benefit analysis is difficult in this area given that regulations are meant to be enabling the exploration and exploitation of the still immature technologies that apply to the Australian context (no conventional geothermal resources are available). It therefore remains unclear whether State and Territory geothermal regulations have helped maximize the benefits while minimizing the costs of the geothermal industry on society.

That said there is evidence that Australian State and Territory government have considered the cost impact of their geothermal regulations. For example, South Australia has a single window for project applications so that companies do not have to apply to separate agencies for different permits. Under this approach an application takes an average of four months (Holroyd and Dagg, 2011). There are no suggested improvements in the geothermal regulatory regime although problems could become more evident as the industry develops.

[170] It is estimated that the cost of connecting one of the more promising sites in the Cooper Basin in South Australia to the national could be around AU$ 1 billion (US$ 0.95 billion). (Allen Consulting Group, 2011)

Research and development (R&D) grants

A feature of Australian government grants available to the geothermal industry is that much of the funding remains unspent. This problem is not unique to the geothermal sector. Daley et al (2011) estimate that over the last decade Federal and State governments have announced more than AU$ 7.1 billion (US$ 6.8 billion) in competitive grants aimed at reducing greenhouse gas emissions. Yet on average only 3% of funding is spent within 5 years and 18% within 10 years. The likely reason for these delays is it is difficult for governments to select the best projects when the projects involve cutting-edge technologies and are highly complex (Daley et al, 2011). This underscores the informational problems associated with governments choosing technological winners.

The delay in implementing grant programs means that Australian government funding has often not been spent. It will, however, still impose a cost on Australia in terms of under-utilized funding which could have been allocated to more productive areas of the economy. This suggests that many Australian government grant programs to the geothermal industry are unlikely to have minimized costs, making grants difficult to justify on a cost-benefit perspective. Governments should consider if grant programs are the most appropriate form of assistance to support research, development, and deployment.

Renewable Energy Target

The RET provides generators of renewable energy sources with a premium over the price of other electricity sources such as coal. Important design features of the RET to improve the efficiency of the scheme include that it does not favor one renewable technology over others (one premium price is offered to all renewable energy technology types), and the price is not determined in advance but responds to changes in the cost of achieving the set target. For example, if the price of renewable energy falls then the cost of meeting a set target and the price of the premium paid to renewable energy sources will also fall.

Government support for the RET could in the past be justified on the basis that it helped internalize the cost of greenhouse gas emissions. This rationale will be weakened when the national carbon pricing scheme is introduced in July 2012. The government has decided to continue to support the RET on a transitional basis up to 2020 in order to bring forward the development of renewable energy sources. This provides an opportunity to reduce the long term cost of emission reductions but will increase the short term cost of the emissions trading scheme because it will crowd out some potentially lower cost emission reduction options, for example, in the forestry or energy efficiency sectors.

The costs and benefits of the RET have been assessed through a number of studies. For example, in 2009 it was projected that the cost of achieving Australia's target of 20% renewable energy by 2020 would be AU$ 4/MWh (US$ 3.8/MWh) or a 3% increase in electricity prices (McLennan Magasanik Associates, 2009). There is also evidence on the actual performance of the RET. In 2010, it was estimated to have achieved abatement of 8.8 Mt CO_2e more than any other on-going Australia climate change program[171] and has done so at a cost of between AU$ 30 – $70/t$CO_2$e (US$ 28.5 – US$ 66.5/tCO_2e) (Daley et al, 2011) and impact of around 1 to 2% on electricity prices (Productivity Commission 2011).

[171] The largest contribution to emission reductions activities is land clearing reforms introduced by the States of Queensland and NSW. However, this only provides a one-off reduction in emissions.

The abatement costs of the RET compares well relative to some other policies. For example, abatement under solar subsidies has cost up to AU$ 1000/tCO_2e (US$ 950/tCO_2e). However, it is more expensive than energy efficiency standards (which are estimated to provide net benefits) and some grant programs (although the abatement achieved through grant programs is low) (Daley et al, 2011). The RET by itself is unlikely to provide an incentive for the geothermal industry because emission reductions can be achieved more cheaply from other technologies such as wind.

(ii) Scientific Integrity

Australia has historically been considered "cold" with limited geothermal potential but more recent research has provided a different outlook (Ghori, 2008). It is now estimated that if just 1% of Australia's geothermal resource to a maximum depth of 5km and a minimum temperature of 150°C could be accessed, it could provide roughly 25,000 times Australia's primary energy use (Geoscience Australia and Australian Bureau of Agricultural and Resource Economics, 2010).[172] This resource is estimated to be spread across Australia and includes enhanced geothermal systems and hot sedimentary aquifer systems resources but not conventional high temperature systems because there are no volcanoes on the Australian continent.

The benefit to society of government support to develop Australia's geothermal resource is that it provides the potential for base load power at a competitive price and with a near zero environmental footprint (Allen Consulting Group, 2011). However, it is not without risks. This is because evidence of Australia's potential resource is still limited and unevenly distributed, and where no data is available the existing data has been interpolated over large areas to generate national scale maps (Allen Consulting Group, 2011). Australia is also yet to confirm the existence of a commercially viable geothermal plant.

(iii) Flexibility

The flexibility of Australian government geothermal programs differs. At the national level support for the industry is flexible because governments have not committed to any specific development targets. (It does have a 20% renewable energy target but this can be met using a number of different technologies including potentially electricity from geothermal resources).

In terms of grant-based programs, governments have typically provided one-off funding rounds which are regularly changed. However, once announced, grant programs lack flexibility. For example, grants are likely to be provided according to a set of criteria designed to ensure that government funds are not misused. These criteria may limit the firm's ability to respond to changed circumstances (which are quite likely during the early stages of technology development). This occurred in the Geothermal Drilling Program (GDP). The GDP was initially expected to cover around half of recipients drilling costs; however, by 2010 the funding was expected to cover less than a third of the costs. This made it harder to

[172] The estimate of Australia's geothermal resource is based on a set of more than 5700 temperature data points taken from deep drill holes used for the petroleum and mineral industry and more than 150 heat flow data points. This information has been improved over time including through the recent Australian Government's Geothermal Energy project.

finance the additional costs and more than half of the recipients agreed to hand back their grant funding in August 2011.

Market mechanisms offer a more flexible policy approach. They have been applied to large range of emission reduction activities and therefore provide businesses with greater freedom to choose how they will contribute to the environmental target (e.g. a business may choose to contribute to the RET through the development of solar, wind, geothermal, or any other eligible technology). This flexibility allows business to respond to market conditions, for example, to reduce the use of a particular technology in response to price rises or vice versa. This helps to minimize costs for business while still ensuring the environmental objectives are achieved.

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

Australian governments have developed a number of mechanisms to facilitate the stakeholder input to the policy development process. This includes:

- The Australian Government's *Commonwealth Grant Guidelines: Policies and Principles for Grants Administration* introduced in 2009 to promote better practice approaches to grants including stakeholder consultation.

- The Australian Government's Best Practice Regulation Handbook, most recently updated in 2010 (see Box 3.2.1 for an overview of the Australian Government's approach to best practice regulation).

Box 3.2.1 ***Australian Government approach to best practice regulation***

The Australian Government's approach to regulatory impact assessment (RIA) is described in the Best Practice Regulation Handbook (Australian Government, 2010) (Handbook). In most cases a regulatory proposal cannot go to Cabinet or other decision maker unless it has complied with the RIA requirements.

The Handbook provides detailed guidance to policy makers on how to conduct an RIA with particular attention given to preparation of analysis of the costs and benefits of regulation through a regulatory impact statement (RIS). A RIS is mandatory for all decisions made by the Australian Government and its agencies that are likely to have regulatory impact on business or the not-for-profit sector, unless that impact is of a minor or machinery nature and does not substantially alter existing arrangements. This includes amendments to existing regulation and the rolling over of sun-setting regulation. A RIS includes detail on:

- the nature and scale of the problem that will be addressed by the regulation;
- the objectives of government action;
- an impact analysis (an assessment of the environmental, economic and social costs and benefits of the proposal to society);
- stakeholder consultation (which should comply with a set of government consultation principles);
- a recommendation; and
- a strategy for implementation and review.

The Australian Government has established the Office of Best Practice Regulation (OBPR) to assist agencies in meeting RIA requirements. The OBPR also monitors and reports on compliance by government departments and agencies with these requirements.

There is evidence that stakeholders have had an opportunity to contribute to the range of government policies and that a copy of these policies is readily available.

Regulations

The development of State government geothermal regulations began more than 10 years ago (with the South Australian Petroleum and Geothermal Energy Act). The South Australian Government indicates that this piece of legislation was developed over a four year period and involved extensive stakeholder consultation (Government of South Australia, 2012). The development of more recent regulatory regimes has also involved stakeholder input. For example, in 2009, the Queensland Government released the Geothermal Energy Bill 2009 Consultation Paper. This paper provided an overview of the Geothermal Energy Bill 2009 and explanatory material and questions to guide public submissions prior to the finalization of the Geothermal Energy Act 2010. The Northern Territory Government also released a discussion paper on its Geothermal Energy Bill in 2006 to assist in developing legislation that was finalized in 2009.

All State and Territory governments have made a copy of the geothermal legislation available on-line.[173] To further promote transparency some state and territory governments have provided additional explanatory material. For example, the Northern Territory Government has prepared an Explanatory Statement to the Geothermal Energy Bill 2009 and Victoria has prepared the *Geothermal Energy in Victoria: Landholder Information* to advise landholders with land that is subject to geothermal exploration or extraction of their rights.

Research and development grants

The Australian Government has taken steps to understand the barriers facing the geothermal industry and promote stakeholder involvement in the development of grant programs, for example:

- In 2008, the Australian Government Department of Resources, Energy and Tourism released the *Australian Geothermal Industry Development Framework* and the *Australian Geothermal Industry Technology Roadmap*. The documents were developed in consultation with National, State, and Territory government agencies; private interest groups; and research organizations and outlined key barriers to industry development and strategies for addressing the challenges.

- In 2008, the Australian Government announced the two largest geothermal grants so far: the Geothermal Drilling Program (GDP) and the Renewable Energy Demonstration Program (REDP). The GDP was developed in consultation with industry (Minister for Resources and Energy, 2008a) and draft guidelines for the REDP were released for public comment prior to finalization (Minister for Resources and Energy, 2008b).

- In 2009, the Australian Government released the *Commonwealth Grant Guidelines: Policies and Principles for Grant Administration* (2009). The Guidelines note the importance of involving stakeholders in the development and modification of grant programs. They also suggest that grants programs should be advertised to stakeholders through modern technology or traditional media and advertised on government web portals such as Grantslink.[174]

- In 2010, the Australian Centre for Renewable Energy (ACRE) established by the Australian Government commissioned the Allen Consulting Group to consult with industry participants and report on the challenges facing the industry and recommend a pathway to overcome these challenges. The findings were discussed by geothermal experts from government, industry and research organizations, State and Territory governments, and the ACRE Board, to develop a strategy to support the further development of the geothermal industry.

However, there is also evidence that stakeholders have not always been adequately consulted on grant programs. For example, the Australian National Audit Office (ANAO) (2010) conducted a review of 5 large climate change grant programs that commenced between 1999 and 2005. This review suggests that

[173] For example, the Queensland Geothermal Energy Act is available at www.legislation.qld.gov.au and the Victorian Geothermal Energy Resources Act 2005 is available at www.legislation.vic.gov.au.
[174] Please refer to www.grantslink.gov.au

some early grant programs (including some that were open to the geothermal industry) were designed with significant stakeholder input but others were not.

Market Mechanisms

Stakeholders (from business, different levels of government and the non-for-profit) sector have had an opportunity to provide input to the development of the RET and the national carbon pricing scheme. For example, a 2003 independent review of the mandatory renewable energy target (MRET) received 264 substantive submissions, met with 115 different stakeholders and travelled to 16 different communities (Mandatory Renewable Energy Target Review Panel, 2003). More recently stakeholders have been asked to provide feedback on the 2009 and 2010 RET legislative amendments including feedback on scheme design options, exposure drafts of legislation and regulation, and input to parliamentary inquiries.

To help develop the national carbon pricing scheme the government organized a series of roundtables with business groups, environmental/non-government organizations, community sector groups, and primary industry representatives over a 6 month period (Australian Government, 2011d). The government also received over 1300 submissions from individuals, business groups, non-government organizations, community groups, state and local government bodies, and industry associations.

The legislation and regulation underpinning both schemes is available at the Australian Government's ComLaw website[175] and through the website of the Department of Climate Change and Energy Efficiency. The interpretation of regulations and legislation is assisted by explanatory memoranda and overview documents developed by Australian Government agencies. For example, the Office of the Renewable Energy Regulator has developed a range of guidance material on the operation of the RET.

(v) Alignment

Australian governments have taken a number of steps to achieve policy alignment. At a broad level policies between the Australian and State and Territory governments are coordinated through the Council of Australian Governments (COAG). The COAG includes the Australian Prime Minister as its Chair, State Premiers, Territory Chief Ministers, and the President of the Australian Local Government Association. It has been operating since 1992.

Australia has also established a system of Australian and State and Territory government Ministerial Councils under COAG to facilitate consultation and cooperation between jurisdictions in specific policy areas. An Organization for Economic Co-operation and Development (OECD) review found that Australia stands out among OECD member economies for establishing mechanisms for systematic coordination and cooperation across levels of government (OECD 2010a).

Australian Governments have taken specific action to achieve alignment on climate change policies. For example, in 2007, the Australian Government commissioned the *Strategic Review of Australian Government Climate Change Programs* (Wilkins, 2008) to review all existing climate change programs to ensure complementarity with its proposed national emissions trading scheme (the Carbon Pollution

[175] www.comlaw.gov.au

Reduction Scheme or CPRS[176]) and rationalize duplicative and overlapping programs. Wilkins (2007) found that there were too many climate change programs, many were ad hoc or not properly targeted, there was no clear framework or logic to organize the policies and there was significant overlap between Australian and State and Territory government programs.

To help address this issue, in 2008 COAG agreed to a set of principles to ensure complementarity between mitigation measures and the CPRS and that each jurisdiction would review existing policies. The review identified 488 State and Territory government climate change programs (Australian National Audit Office, 2010). As a result of the review State and Territory governments agreed to redesign or terminate some of their programs. For example, NSW reported on 26 programs and agreed to terminate three and redesign or partially terminate another 16 programs.

Australian governments have also worked collaboratively through COAG on the design of the expanded RET, this included the replacement of existing national and state based schemes with a single national approach. Outside of the COAG process, alignment of policies at the Australian and State and Territory government level is encouraged through best practice regulatory and grants processes, for example, the Australian Government's Best Practice Regulation Handbook (see Box 3.2.1, above). More informal alignment is achieved through cooperative industry-government-research organizations such as the Geothermal Research Institute and the Australian Geothermal Energy Group (AGEG).

The lack of alignment and coordination of policies has been raised by stakeholders as an issue to be addressed. For example, the Allen Consulting Group (2011) finds that geothermal research and development activity should be better coordinated. The lack of alignment of State government regulations was also identified in the Australian Geothermal Industry Development Framework (2008) as a possible barrier to industry development (Department of Resources, Energy and Tourism, 2008). Concerns were raised that inconsistencies between regulations could increase costs for geothermal firms and encourage exploration in regions with the best regulatory regime rather than the best geothermal resource. This issue does not seem to have been addressed; however, it has not been raised as a key barrier to development in subsequent industry reviews.

[176] The Carbon Pollution Reduction Scheme was rejected by the Australian Parliament and has been superseded by the national carbon pricing scheme.

3.2.2 Geothermal Energy in Indonesia

Key findings

- Indonesia has an existing commercially competitive installed geothermal capacity of around 1200MW but its potential (at cost competitive rates) is estimated to be much larger.
- The key barrier to the cost effective development of Indonesia's geothermal industry has been the institutional pricing arrangements that have limited the incentive of the sole buyer of electricity, state-owned company Perusahaan Listrik Negara (PLN), to provide acceptable conditions, including acceptable tariffs, to geothermal producers.
- Indonesia has been unsuccessful in promoting development of its geothermal industry. This suggests that existing policies, such as electricity planning and pricing arrangements, are likely to be discouraging geothermal development. Other disincentives include regulatory uncertainty and permitting arrangements.

Costs, benefits and promotion

- The price paid for electricity (from fossil fuel and renewable energy sources) for a given region is bureaucratically determined. This price distortion does not allow the government to choose the least cost supply option and requires the enactment of potentially costly geothermal development targets.

Scientific integrity

- There are indications that government policies to support the development of Indonesia's geothermal resources are founded on evidence of a large, relatively low risk and cost competitive geothermal resource of between 27,500 MW and 30,000 MW, which equates to around 40% of the global total.

Flexibility

- Indonesian geothermal policies are based on targets and fixed prices. Targets are not flexible enough to respond to changing market conditions and could potentially be costly for Indonesia if enforced.

Transparency

- Indonesia has established a formal law/regulation making framework through the National Legislation Program (known as Prolegnas) which requires stakeholders to play an active role in the regulatory formulation process. Nevertheless, many business associations do not have the capacity to effectively critique government proposals which may limit their influence over government policy.

Alignment

- There is a general sense that further work is required to coordinate policy development among central government agencies and local governments. Overlapping responsibilities for climate change policy, industry development and electricity market arrangements are leading to policy coordination difficulties within the central government as well as with local governments.

A. Size and Significance

Geothermal currently provides about 0.3 percent of global electricity and 0.2 percent of global heat supply. Analysis by the International Energy Agency (IEA) reveals that under conditions of favorable government support, geothermal' s share of global electricity and heat could reach 3.5 per cent and 3.9 per cent respectively (IEA, 2011). To date, Indonesia has tapped approximately 4 percent of its geothermal potential, which is estimated to be approximately 28,100 MW of geothermal capacity.[177] This potential of 28,000 MW is approximately 40% of the world's geothermal reserves (Brenhouse, 2010). At present, Indonesia is the third largest producer of geothermal energy in the world after the US and the Philippines (Allard, 2010). This was used mostly in the electricity generation. In 2007, 3.7% of Indonesia's electricity was supplied by geothermal energy (IEA, 2008). The current administration, led by President Yudhoyono, has announced aggressive plans to develop Indonesia's untapped geothermal resource. The aim is to build 44 new geothermal plants by 2014. This would raise Indonesia's geothermal electricity generation capacity to 4,000 MW – a nearly threefold increase. The longer-term goal is to become the world's leading geothermal producer with installed capacity of 9,000 MW (Allard, 2010).

B. Policy Formulation

(i) History and Background

Indonesia's geothermal power industry has a long history and regulatory policies date back nearly four decades. The first regulation (Presidential Decree 16/1974) was in developed in 1974, and assigned Pertamina, the state-owned oil company, to explore and develop geothermal resources on behalf of the Indonesian government.[178] The first commercial plant (30 MW) was opened in 1983.

Indonesia has gradually opened up its geothermal industry (exploration, exploitation and power production) to private enterprises. It has provided a range of incentives to encourage development of the industry and produced several industry development targets, including:

- A National Energy Policy that aimed to increase the role of geothermal in total national energy consumption to 5% by 2020;
- A Roadmap of Geothermal Development which proposed that geothermal capacity would reach 3,442 MW in 2012, 6,000 MW in 2020 and 9,500 MW in 2025 (International Energy Agency, 2008a); and
- An Electricity Fast Track Program[179] that aimed to develop 10,000 MW of new generation capacity by 2014, including an additional 3,967 MW of geothermal power – with 3,097 MW

[177] This is roughly equivalent of about 12 billion barrels of oil.

[178] Article 33 of the Constitution (1945) states that the land, water and whatever is contained therein, is government property and shall be utilized to the maximum welfare of the people. Geothermal resources fall within this definition and hence have been managed as government property (Castlerock Consulting 2010).

[179] The first electricity Fast Track Program was announced in 2006 and planned to develop 10,000MW of new coal based generation.

to be developed by Independent Power Producers (IPPs)[180] (PricewaterhouseCoopers, 2011a). This would take total geothermal capacity in Indonesia (including existing projects and other project under development) to 5,710 MW by 2014 (Castlerock, 2010).

The international community has also agreed to provide funding. For example, the Asian Development Bank negotiating the provision of a US$ 500 million loan to support the development of three geothermal power projects with a capacity of 165 MW (Jakarta Post, 2011a). Despite the incentives and government development targets, and a high annual growth rate in the demand for electricity, Indonesia's installed geothermal generation capacity is only around 1200 MW (PricewaterhouseCoopers, 2011b) – less than half the 2012 capacity forecast by the Government's Roadmap of Geothermal Development.

(ii) Policy Description

In addition to the targets mentioned above, the Indonesian Government has introduced the following key policies to help promote the development of Indonesia's geothermal industry:

The legacy and new geothermal regulatory frameworks

The *legacy framework* applies to all geothermal work areas known as WKP (wilayah kuasa pengusahaan) issued by the Ministry of Energy and Mineral Resources (MEMR) prior to 2003. These WKPs are largely governed under Presidential Decree 45/1991. This Decree allowed the development of small scale geothermal plants (of 10MW capacity or less) by entities other than Pertamina. It also allowed Joint Operating Contracts or JOCs (contracts between Independent Power Producers (IPPs) and the State Owned Oil Company, Pertamina) to build and operate power plants and sell the electricity to Perusahaan Listrik Negara (PLN).[181] With the exception of two WKP held by PLN, all legacy WKPs are now held by Pertamina Geothermal Energy (PGE) and many have already been developed and are now operated through JOCs (Castlerock, 2010).

In 2003, Indonesia introduced a new geothermal law (Geothermal Law 27/2003) and has subsequently issued a number of supporting regulations including Government Regulation 59/2007 on Geothermal Business Activity. The *new regulatory framework* removed the need for IPPs to operate geothermal power stations in partnership with Pertamina through JOCs, mandated the use of competitive tendering for allocating WKP and provided an active role for regional governments (Castlerock, 2010). The new framework applies to all WKP issued since 2003 and is most relevant to the future development of the industry. (Box 3.2.2 provides an overview of the key steps for exploiting geothermal resources under this framework.)

[180] An independent power producer is considered to be an entity that owns facilities to generate electric power for sale to utilities and end users.

[181] Perusahaan Listrik Negara (PLN) is the state-owned, electricity distribution company.

Box 3.2.2 ***Key steps in developing geothermal power plants under the new regulatory framework***

Preliminary survey. A preliminary survey and community consultation must be undertaken before a WKP is defined by MEMR. The relevant government authority (the Minister for MEMR, governor or regent/mayor[182]) may undertake the survey or MEMR may assign another party to do it. The party undertaking the survey may subsequently bid for the WKP but is not automatically entitled to it. The activities involved in a preliminary survey include desktop data research and analysis, regional reconnaissance, preliminary geology and geochemistry resource studies aimed at identifying the prospects of a site (Castlerock, 2010).

Tender process. A WKP must be offered through competitive tender by a tender committee headed by the relevant government authority. The lowest cost bidder carries a preference to win the bid although the entity that undertook the preliminary survey has a right to match the lowest price bid. The WKP does not grant rights to access land which must be negotiated separately. Winning bidders are offered a geothermal development license known as an IUP (Izin Usaha Pertambangan).

Exploration. Exploration includes surveys, test drilling and drilling exploration wells for the purpose of discovering or accessing geothermal resources. Exploration must be started within 6 months of being awarded an IUP and must be completed within 3 years (but it may be extended twice for a period of one year provided technical and financial requirements are met). Exploration may be undertaken by a company (together with a feasibility study and exploitation) or undertaken by the Central government in which case it may be undertaken separately.

Feasibility studies. To commence the feasibility phase a firm must apply for a feasibility study license by outlining a work program. A feasibility study license is valid for 2 years and is not extendable. This phase of development includes securing a PPA.

Exploitation. The IUP holder must submit an exploitation plan to the relevant government authority, including information on proposed wells, financing, geothermal utilization plans and an analysis of environmental impacts. This stage is valid for 30 years and is extendable for a further 20 years. Exploitation involves obtaining drilling permits, development of production and re-injection wells and construction of field facilities and power plants.

Utilization. Utilization of the geothermal resource (often referred to as downstream activities) may be direct or indirect (the conversion of geothermal energy into electrical energy). This stage involves the operation and monitoring of production and reinjection wells and geothermal facilities. It may also involve drilling new make-up wells if required.

Electricity supply. To sell and supply electricity geothermal firms must also obtain an Electricity Supply Business Permit (IUPTL – Izin Usaha Penyediaan Tenaga Listrik) under Electricity Law 30/2009.

Electricity pricing

The price paid for electricity by PLN is determined through one-on-one negotiations with the independent power producer (IPP) or as stipulated in regulation. The most recent regulation on geothermal pricing is MEMR Regulation 2/2011. This regulation applies to all WKP identified as part of

[182] The relevant government authority is MEMR if the WKP lies across regional boundaries otherwise it is the governor or regent/mayor.

the 2nd Electricity Fast Track program. It provides that PLN must accept the geothermal tender price up to a maximum of US$ 0.097 per kWh or may enter into one-on-one price negotiations with the winning bidder if the price exceeds US$ 0.097 per kWh.

Fiscal and non-fiscal incentives

Independent power producers (IPPs) may be eligible for a range of incentives including tax and VAT exemptions and investment credits. IPPs may also benefit from the Ministry of Finance (MOF) Regulation 77/2011 that provides assurance on the financial viability of Perusahaan Listrik Negara (PLN).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

(i) Costs, Benefits and Promotion

It is estimated that Indonesia has a large a geothermal resource that would likely be cost competitive without policies such as subsidies that are required to promote the development of many other renewable resources. A World Bank analysis indicates that geothermal power would be competitive with coal power up to almost 4GW (up from around 1.2GW today) without any additional payments and up to more than 10GW if carbon and local environmental benefits are considered (World Bank, 2010). However, Indonesia has been largely unsuccessful in promoting development of its geothermal industry. This suggests that existing policies, such as electricity planning and pricing arrangements, are likely to be discouraging geothermal development. Other disincentives include regulatory uncertainty and permitting arrangements. It should be noted that a formal cost-benefit analysis does not form a part of the regulatory process.[183] Akin to the evidence from other sectors and economies, the policy formulation process focuses on the benefits that accrue from promoting a particular technology. The costs of such interventions are often accorded low weightage.

Key disincentives to geothermal development

Electricity planning and pricing arrangements

The Indonesian electricity market is dominated by the state-owned electricity company; Perusahaan Listrik Negara (PLN). PLN is the sole buyer, seller and distributer of electricity in Indonesia.[184] It controls around 86% of generation capacity and purchases the rest from Independent Power Producers (IPPs) with the price and other conditions set out in a long term power purchase agreement (PPA). PLN plays a key role in electricity planning through preparation of a 10 year electrification development plan (RUPTL)

[183] Based on interviews held with the following Ministries in Indonesia on the 15 – 16 March, 2012: Ministry of Energy and Mineral Resources, Ministry of Environment, BAPPENAS (the national development planning agency), and the Ministry of Finance.

[184] The new Electricity Law (30/2009) provides that other parties may also distribute and sell electricity but PLN retains a priority right to do so. Despite these recent legal changes the role of private enterprise in Indonesia's electricity sector is still limited to generation (PWC 2011a).

which contains amongst other things, future expansion plans, fuel requirements (e.g. coal, gas, geothermal etc) and identifies the role of PLN and IPP investors (PricewaterhouseCoopers, 2011a).[185]

PLN also plays a role in determining the price that will be paid for electricity. In the 1990s the price paid for geothermal was between US$ 0.06 and US$ 0.09 per kWh (Schlumberger Business Consulting, 2008). However, in 1997, Indonesia was hit by the Asian Financial Crisis. The crisis caused the Indonesian Rupiah to depreciate by 83% against the US dollar between June 1997 and July 1998 (Purra, 2010) and created significant losses for PLN which had agreed to pay contracts for electricity in US dollars but received revenues in Rupiah. As a result, PLN sought to renegotiate contracts with many IPPs and indefinitely suspended seven geothermal projects in late 1997 (Geothermex, 2010). Following the crisis the price paid for electricity from geothermal power plants fell (it was estimated in 2008 that the average price paid for geothermal power was US$ 0.0452 per kWh – less than other technology types including coal[186]) and industry development stalled.

To help address the pricing issue, Indonesia has introduced a range of fiscal incentives, including, for example, exemptions on import duties and value-added tax and investment credits. More recently Indonesia introduced MOF Regulation 77/2011 to provide assurance to geothermal firms that PLN would be able to meet its financial obligations. These arrangements are likely to be welcome to geothermal IPPs. However, they are typically also provided to other technology types and are therefore unlikely to provide a competitive advantage to the geothermal sector over other technology types.

Indonesia also introduced MEMR Regulation 32/2009 which allowed PLN to pay a maximum price of US$ 0.097 per kWh of electricity from geothermal power plants (which was above the price typically offered for coal power and above the average selling price of electricity). This approach relied on PLN paying the price offered by an IPP for a WKP through competitive tender as required by Geothermal Law 27/2003. However, the relationship between the tender price and the actual price paid by PLN was unclear (Castlerock, 2010); and PLN, which relies on government subsidies for its financial survival (see Box 3.2.3), did not have an incentive to pay IPPs any more than the average selling price of electricity. The price was therefore likely to have been agreed through lengthy negotiations between PLN and IPPs.

Box 3.2.3 ***Indonesia's electricity subsidy arrangements***

The price at which PLN can sell electricity to consumers is determined by the government and since 1998 has, on average, been less than the cost of buying electricity (Morgan Stanley, 2011). The difference is made up by government subsidy which is approved by the Indonesian Parliament on an annual basis. The subsidy is typically very large – it peaked at Rupiah 78.58 trillion (US$ 8.5 billion) in 2008 (PLN 2009) when the price of oil peaked and was forecast to reach Rupiah 65.6 trillion (US$ 7 billion) in 2011 (Ministry of Finance 2011). The subsidy approved by the Indonesian Parliament has often not been sufficient to cover PLN's costs. This provided an incentive for PLN to agree to pay a price for electricity that is no greater than the average selling price of electricity.

[185] PLN shares electricity planning decisions with MEMR who prepare an electricity master plan (RUKN) and must approve the 10 year electrification development plan (RUPTL). Regional governments also play a role through the development of a regional development plan (RUKD) which must be consistent with the RUPTL.

[186] In 2008, it was estimated that the electricity from coal fired power stations was sold at an average price of 5.5 cents per kWh; electricity from gas at an average price of 7.1 cents per kWh; and from diesel oil at an average of 17.1 cents per kWh (Schlumberger Business Consulting 2008).

To address this issue Indonesia replaced MEMR Regulation 32/2009 with MEMR 2/2011. This new regulation (which applies to all projects listed under the 2nd electricity crash program) requires PLN to accept the bid price offered by IPPs through the WKP tender process without further negotiation up to a maximum price of US$ 0.097 per kWh. For bid prices over US$ 0.097 per kWh it still allows PLN to negotiate a final price with the IPP. The benefit of this new regulation is that it may speed up the development of some geothermal projects. However, it is unlikely to maximize benefits for Indonesia because it does not address the following issues.

Geological uncertainty

The price paid by PLN for geothermal power must be agreed prior to development of the geothermal resource to provide price certainty and allow the IPP to raise finance. This price must be bid (or negotiated with PLN) on the basis of the results of a preliminary geological survey. The survey may be undertaken by the Government or a private firm who may subsequently bid for the WKP. Castlerock (2010) have identified three problems with this approach: the information in the survey may not be sufficient to facilitate tendering, the survey may not be undertaken by a qualified firm, or the firm may have an interest in withholding information because they wish to subsequently bid for the WKP.

The provision of poor information at the time of tender will negatively impact the development of geothermal resources. It will likely increase resource risk (and hence development costs); reduce competition between IPPs for WKP; and encourage IPPs to undertake their own additional and possibly duplicative research. It also creates uncertainty for PLN about the likely cost of producing geothermal power. In cases where PLN is not required to automatically accept the bid price this uncertainty is likely to lead to lengthy price negotiations. This is because IPPs will not be willing to accept a low price as there is a risk that as the geothermal resource will turn out to be less productive than first thought; and PLN may be unwilling to pay a higher price in case the resource turns out to be more productive than first thought.

Fossil fuel subsidies

The price paid for electricity by PLN excludes a range of subsidies provided to fossil fuel-based electricity generators, including:

- *The cost of future rises in the price of fossil fuels (known as the fuel price pass through)* If the price of fossil fuel rises over time the Indonesian Government and not the IPP will pay the additional cost. This provides fossil fuel generators with a free fuel price hedge.

- *The opportunity cost of foregone revenues from fossil fuel exports* Indonesia requires domestic coal producers to provide coal to meet domestic needs at a discount to export prices. This reduces production costs for domestic coal-based generators and deprives Indonesia of additional export revenues.

- *The cost of carbon emitted by fossil fuel based generators* Indonesia has voluntarily committed to reduce greenhouse gas emissions by 26% by 2020 compared to business as usual levels or 41% with international assistance. At the moment there is no clear mechanism

for encouraging the power sector to contribute to these targets either through incentives or access to international carbon markets.

- The free use of infrastructure such as roads, ports and storage facilities needed to transport fossil fuels to power stations.

The failure to account for these subsidies reduces the headline cost of fossil fuel based electricity and is likely to encourage decision makers including PLN and the Indonesian Parliament to favor fossil fuel based generation over other potentially cost effective renewable energy sources such as geothermal.

Fixed national price

A further reason why current arrangements are unlikely to maximize the benefits of Indonesia's geothermal resource is the use of a bureaucratically-determined national pricing formula of US$ 0.097 per kWh for geothermal electricity. The problem with this approach is that in some low cost regions such as the main Java-Bali grid, a price of US$ 0.097 per kWh is higher than the average cost of electricity. In this case, PLN may be required to pay more for geothermal power than for alternatives such as coal. In other regions, PLN may choose to renegotiate the bid price leading to lengthy development delays even if the bid price was less than the average price for electricity in that region.

Potential solutions

To promote the cost effective development of Indonesia's geothermal industry the government could consider the following strategies:

- *Leveling the playing field* The Indonesian Government should ensure that the price paid by PLN for electricity includes the full costs and benefits of electricity production. This means that the price should exclude subsidies so that fossil fuel-based generators are not favored over renewable sources such as geothermal. The Indonesian Government should also establish a mechanism to allow geothermal IPPs to benefit from international carbon markets.

- *Offer a market-based price for geothermal* The Indonesian Government should offer geothermal IPPs a tariff that reflects the market price of achieving a given amount of generation capacity in a given region (rather than the national approach that is currently being used). In other electricity markets such as Australia, the market price for electricity is determined through competition between generators in a wholesale market. Investors must make their own assessment of likely future wholesale prices before deciding to invest. Indonesia lacks a wholesale market but the market price could still be approximated based on the assessment of demand and relative technology costs in a given region over time. This price would reflect the cost of electricity in that region and should be offered to IPPs by PLN without further negotiation.

- *Addressing resource uncertainty* The Indonesian Government should take steps to ensure that PLN is willing to sign geothermal PPAs without delay. This involves addressing the uncertainty around the cost of geothermal power generation. This could be achieved through two policy measures. Firstly, the Indonesian Government should introduce their proposed

geothermal risk mitigation scheme[187] to improve the quality of data available to PLN and IPPs at the time that WKPs are offered through competitive tender. The second would be to introduce a profit sharing mechanism that allows the Government to also benefit if the geothermal site turns out to be more productive than first anticipated. There are precedents for such an approach in Indonesia's oil and gas sector.

Other barriers to geothermal development

Regulatory policy

The slow rate of development of Indonesia's geothermal industry may also be explained by the way in which laws and regulations are prepared. Typically, Indonesian law leaves specific details to implementing regulations (Organization for Economic Co-operation and Development, 2010b). In many cases these regulations take a long time to develop, creating uncertainty for investors. This has occurred in the geothermal sector. The Geothermal Law (23/2003) was introduced in 2003 but many supporting regulations were not issued until many years later (for example, MEMR Regulation 11/2008 on procedures for determining geothermal work areas and MEMR 11/2009 on guidelines for implementation of geothermal business activities). This issue may be addressed by the MOF-OECD regulatory review task force.

Transaction costs

Another potential explanation for the delay in developing Indonesia's geothermal sector is the cost of doing business in Indonesia. The World Bank prepares an annual Ease of Doing Business assessment which examines issues such as starting a business, enforcing contracts and dealing with construction permits. In 2012 the World Bank ranked Indonesia 129 and of 183 assessed economies. The relatively poor assessment of Indonesia in this area is supported by others. For example, Otsuka et al (2011) found that new or revised regulations on taxes and levies on business activities have proliferated at the local level and added to the burden for investors; Goodpaster (2011) reported that applicants seeking requisite permits or permit renewals face many difficulties; and Caroko et al. (2011) found that among the key reasons for the slow investment rates in the post-decentralization period has been the conflicting and overlapping nature of licenses issued by local and central government authorities. There is also some evidence that permitting issues have specifically impacted the geothermal sector. For example, Castlerock (2010) report that of the 56 geothermal work areas under development in Indonesia in 2010, 12 of these (21%) face delays due to permitting issues (largely related to forestry approvals).

To address this burden the Indonesian Government has introduced one-stop integrated services (PTSP) for investors at both the central and local levels. The PTSP seeks to cut processing time and improve the predictability and transparency of investment registration. However, there remain an excessively large number of licenses which should be further streamlined and local level implementation of PTSP has been uneven (Otsuka et al, 2011).

[187] The Indonesian Government committed US $128 million in the 2011 state budget to establish a geothermal risk mitigation fund to undertake exploratory drilling prior to tender (Castlerock 2010) with a view to improving pre-tender information. However, no final details on the operation of the fund have yet been announced.

(ii) Scientific Integrity

There are indications that government policies to support the development of Indonesia's geothermal resources are founded on evidence of a large, relatively low risk and cost competitive geothermal resource.

Indonesia is located in the "ring of fire" volcano belt and has more than 200 volcanoes spread across the islands of Sumatra, Java, Bali and the islands of Eastern Indonesia (Darma et al, 2010). It has a total estimated geothermal resource of between 27,500 MW and 30,000 MW (Geothermex, 2010), which equates to around 40% of the global total. This includes around 11,400 MW of probable reserves, just over 1000 MW of possible reserves and around 2,300MW of proven reserves. The rest is still a speculative or hypothetical resource (PricewaterhoouseCoopers, 2011b).

In addition to a large potential resource, the quality of the resource is very high in Indonesia, leading to typically higher well capacity and lower drilling costs than in most in other economies (Geothermex, 2010), and much of Indonesia's estimated geothermal resource is close to load centers. It is projected that these characteristics could support the development of a relatively large amount of low cost geothermal power.

(iii) Flexibility

Indonesia has adopted relatively rigid policies to support the development of its geothermal industry. A key policy is the 2nd electricity crash program which aims to develop an additional 3,967 MW of geothermal capacity by 2014. This target-based approach may help focus resources but is an inflexible and potentially costly way to achieve geothermal development outcomes because it does not automatically respond to changing market conditions. For example, the target will not increase if the cost of competing technologies such as coal increase and will not decrease if Indonesia's geothermal resource turns out to be less productive than initially forecast.

The following section consists of an assessment of Indonesia's geothermal regulations on the basis of political feasibility and distributional equity which include transparency and alignment.

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv)Transparency

Indonesia has established a formal law/regulation making framework through the National Legislation Program (known as Prolegnas) (see Indonesian Biofuel Case Study)[188] which requires stakeholders to play an active role in the regulatory process. For example, relevant stakeholders such as political and civil society groups, academics, experts, and practitioners are invited to help prepare the text to support draft laws and regulations. Public comment is then sought on the draft proposal.

Otsuka et al (2011) notes that the government has introduced more institutionalized public consultation processes for new policies and strengthened the appeal processes, yet many business

[188] The description of the steps involved in policy development is based on OECD (2010).

associations do not have the capacity to effectively critique government proposals which may limit their influence over government policy (Organization for Economic Co-operation and Development, 2010b). The Geothermal Law 27/2003, the Electricity Law 30/2009, the Government Regulation 59/2007 and MEMR Regulations 11/2008, 2/2009, 11/2009 and 2/2011 are all available in Bahasa Indonesian from the Ministry of Energy and Mineral Resources website (www.esdm.go.id).

(v) Alignment

One of the reasons for the struggles in policy coordination is that Indonesia "does not have a systematic mechanism to develop, monitor and evaluate laws/regulations or a centralized regulatory oversight body with 'whole of government' responsibility for regulatory policy" (Organization for Economic Co-operation and Development, 2010b).

Another reason is that, after the Suharto government in 1998, Indonesia has pursued a program of decentralization that has led to the sharing of powers between the central and more than 500 local governments (The Asia Foundation, 2010). This approach has provided greater autonomy to the regions but led to some confusion about the division of responsibility between the levels of government and resulted in the responsibility for some policies resting with local government that did not always have the capacity to establish a regulatory environment conducive to business (Organization for Economic Co-operation and Development, 2010b).

Coordination has also proved difficult in development of geothermal policies. There are a several agencies with an interest in the geothermal industry, including MEMR, the Ministry of Finance (MOF), PLN, PGE, Ministry of Forestry and Bappenas (the national development planning agency). Many of these ministries also have their own international advisors on geothermal policies. For example, MEMR has engaged the consulting firm Castlerock to advice on geothermal electricity tariffs and the MOF had previously engaged EcoPerspectives to advice on a range of industry issues including an appropriate tariff.

The findings from these consultants are shared across government agencies but there is no formal policy coordination process. This may help explain why PLN continues to provide a cost pass through for fossil fuel used by fossil fuel-based generators even though this conflicts with the MOF's objective of reducing subsidies for the electricity sector. This reduces the chance of Indonesia meeting its climate change objectives.

Stakeholders interviewed for this study were of the view that additional institutional structures would not provide the answer to the coordination problems afflicting geothermal policy development. Instead, they pointed to the need for institutions with existing coordination roles to renew their engagement and redouble efforts.[189]

[189] Interviews were held with the following Ministries in Indonesia on the 15 – 16 March, 2012: Ministry of Energy and Mineral Resources, Ministry of Environment, BAPPENAS (the national development planning agency), and the Ministry of Finance

3.2.3 Concluding Remarks

The geothermal industry in Australia and Indonesia are at different stages of maturity. Indonesia is amongst the top three economies as far as installed geothermal capacity is concerned, whereas Australia has only recently begun exploring its geothermal potential. The technical nature of their reserves differs as well. Hence, the dynamics of regulations in these two economies make for an interesting comparison.

Consider the basic issue of the structure of the electricity industry in the two economies. Australia's evolution to a competitive electricity market allows for a price signal that is the best reflection of the cost of supplying electricity. However, in Indonesia, the price paid for electricity for a given region is still determined by the bureaucracy. In following market-based pricing, the Indonesian government will be in the position to choose the least cost electricity supply option without having to frame potentially costly geothermal development targets.

Both economies could use a regulatory approach that is more flexible. The fixed targets and prices that underlie the Indonesian geothermal policies are unable to respond to changing market conditions and could prove to be very expensive. The pan-Australian strategy of non-commitment to specific development targets for geothermal energy is a preferred approach given its flexibility. However, the opportunity cost that arises from the inflexibility of Australia's grant programs is something that the Indonesians can learn from.

Facilitation of stakeholder involvement is at the core of Australian regulatory policy. Australia has instituted several mechanisms to facilitate the stakeholder input. Indonesia too has formalized the process of stakeholder involvement in the regulatory formulation process. Australia has instituted formal mechanisms to ensure policy cohesion. This is an area where Indonesia has been facing difficulty given the ill-defined roles of the myriad government institutions at the national and local level with overlapping jurisdictions. Indonesia might consider setting up a formal coordinating agency as in Australia to drive policy coordination.

Australia's geothermal sector has leveraged a significant amount of private sector capital to date despite its resource being viewed as unconventional. Capital has flowed in the early development and exploration phase of the technology. However, additional capital is still required to take these investments through to the demonstration stage. Conversely, Indonesia has been largely unsuccessful in promoting development of its geothermal industry. This suggests that existing policies, such as electricity planning and pricing arrangements, are likely to be discouraging geothermal development. Other disincentives include regulatory uncertainty and permitting arrangements.

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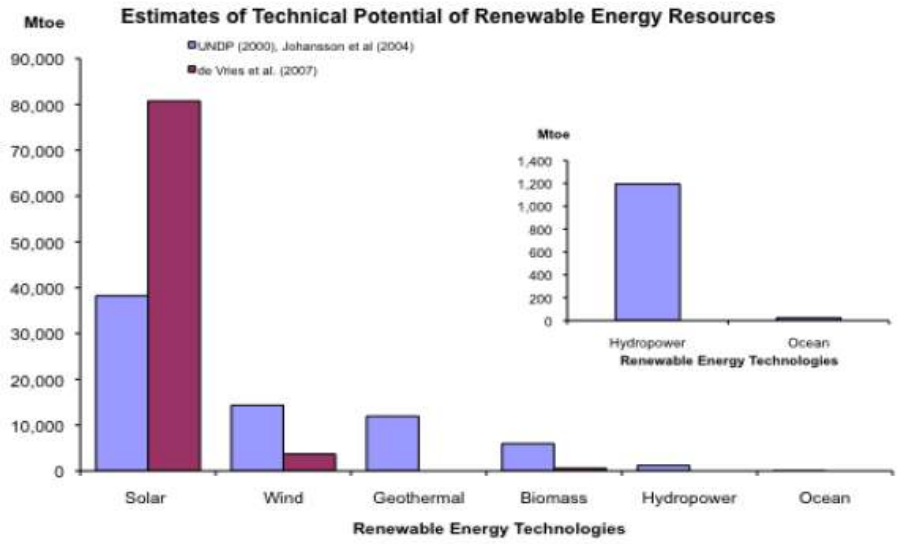
3.3 Solar PV

Theoretically, the entire global energy demand is much smaller than the resource potential of solar energy (European Photovoltaic Industry Association, 2007). In fact, solar energy has the greatest technical potential amongst all the renewable energy technologies (see Figure 3.3.1).

Figure 3.3.1 ***Technical potential of renewable energy technologies***



Source: Goldemberg (2000), Johansson et al. (2004) and de Vries et al. (2007)

Active solar energy technologies[190] harness solar energy such that it can be converted for other applications such as electrical energy. Active solar energy can be broadly classified into two groups: (1) photovoltaic (PV) and (2) solar thermal.[191] This paper will focus on the use of solar PV for the purpose of electricity production as it is currently the dominant solar technology.

Solar PV technology converts radiant energy into electrical energy when light falls upon semiconductor materials that exhibit the photovoltaic effect[192] (Sorensen, 2000). Two types of PV technology are currently available in the market: (a) crystalline silicon-based PV cells and (b) thin film technologies made out of a range of different semi-conductor materials, including amorphous silicon,

[190] Solar energy technologies can broadly be classified into passive and active. As the name suggests, passive solar energy technologies use radiant solar energy but do not convert this into other forms of energy such as electricity. Examples of passive technologies include maximizing the use of day light or heat through building design (Bradford, 2006).

[191] The estimated technical potential ranges from 1,338 EJ/year to 14,778 EJ/year for photovoltaic and 248 EJ/year to 10,791 EJ/year for concentrating solar power technology (Arvizu et al., 2011). Since the amount of solar energy that can be utilized depends significantly on local factors such as land availability, metrological conditions and demands for energy services, technical potential varies between different regions and locations.

[192] The photovoltaic effect is the creation of voltage or electric current in a material upon exposure to light. The photovoltaic effect was first observed by Alexandre-Edmond Becquerel in 1839.

cadmium-telluride and copper indium gallium diselenide. Crystalline silicon has been the dominant PV technology till date and is expected to be the mainstay up until 2020 (IEA, 2008).

PV systems have two main applications, off-grid and grid-connected. Off-grid PV systems are used to provide electricity to rural areas without connection to a local electricity grid while grid-connected systems are able to supply electricity generated to existing electricity grids. Grid-connected PV systems are further classified by distributed and centralized systems. Distributed systems are small scale systems, usually installed on buildings or sites in an urban area. Centralized systems are large-scale utility systems of more than 1 MW that are usually ground mounted.

Global solar energy use

Over the past couple of decades, the solar industry has experienced rapid growth buoyed by government legislated subsidies or other forms of policy support like feed-in tariffs (FITs) in industrialized economies such as Germany and Spain (Doshi et al., 2011) and declining module prices.

From 1990 to 2009, the cumulative installed capacity of solar electricity grew at a compounded annual growth rate (CAGR) of 33.2%. Over the same period, the average module price fell from around US$ 10/Wp to US$ 2.8/Wp,[193] which is a decline of 72% in real terms. Of course, this price decline has not been monotonic. Factors such as a bottleneck in polysilicon production capacity caused an increase in module prices from 2003 to 2007 (Doshi et al., 2011). Nevertheless, the broad trend seems to point to declining costs of solar modules with several industry watchers indicating that this is likely to continue in the near future.

By December 2010, global installed capacity for PV had reached around 40 GW of which 85% is grid connected and 15% is off-grid (REN21, 2010). This market is currently dominated by crystalline silicon-based PV cells, which accounted for more than 80% of the market in 2010. The remainder of the market consists almost entirely of thin film technologies that use cells made by directly depositing a photovoltaic layer on a supporting substrate. The recent trend is strong growth in grid-connected PV development with installations that are over 200 kW, operating as centralized power plants (Timilsina et al., 2011). The leading markets for these applications include Germany, Italy, Spain and the United States.

[193] In PV, the maximum possible output of a solar module operating under standard conditions is defined as its peak output, which is measured as Wp (watt peak) or kWp (kilowatt peak).

3.3.1 Solar PV in Australia

Key findings

- Solar PV provided 0.3% of Australia's total electricity production in 2010 and is expected to provide 3% of Australia's large scale electricity generation by 2050.
- Key policies relating to solar PV in Australia include the Renewable Energy Target, feed-in-tariffs, rebates and the national carbon pricing scheme that will come into effect in July 2012.
- Australia's regulatory policies have contributed to significant growth in the solar PV industry, largely in on-grid residential scale systems. The evidence suggests that the benefits of small scale solar PV subsidies and feed-in tariffs (FiTs) have come at a high cost and government objectives in terms of greenhouse gas emission reductions and the development of the renewable energy sector could have been achieved at lower cost through broad market based instruments such as an economy wide carbon pricing scheme.

Costs, benefits and promotion

- The costs of solar PV are high relative to alternative forms of energy, especially for large scale solar. Technology-neutral policies such as the Renewable Energy Target have not incentivized solar PV as emissions reductions can be achieved more cheaply from other technologies such as wind.
- Australian government subsidies (including feed-in-tariffs) for small scale solar PV systems have led to a significant growth in the solar PV industry, but have proved a very expensive means of reducing CO_2 emissions. The estimated cost of abatement across all subsidy schemes is between approximately USD 431 and USD 1043/tCO_2e, compared to the abatement cost under the Renewable Energy Target which is in the USD 30 – \$70/CO_2e range.
- Australian government grants to large scale solar PV demonstration projects appear to be aimed at addressing early mover risks. However, governments have faced significant challenges in trying to co-manage the development of new technologies, leading to significant implementation delays.

Scientific integrity

- The technical potential for solar PV in Australia is large, with the total solar radiation every year amounting to 10,000 times Australia's annual energy consumption.

Flexibility

- Policies such as the Renewable Energy Target and the carbon pricing scheme (that is to be adopted starting from July 2012) are not technology-specific and thus allow the level of support provided to solar PV to be automatically adjusted in response to changing market conditions.

- By contrast, government grant programs, rebates and feed-in-tariff schemes are not flexible enough to respond automatically to changes in market conditions, which has led to larger than expected costs in the case of subsidies and project delays in the case of grants. However, the government has shown a willingness to periodically revise the rules for grant programs and the level of assistance for rebates and feed-in-tariffs.

Transparency

- Australian governments have introduced and generally implemented measures to promote transparency and stakeholder engagement across a range of solar PV policies. Most Australian solar PV policies appear to have been developed with stakeholder input.

Alignment

- Australian governments have introduced measures to promote alignment across policies, with policies between the Australian government and the State and Territory governments coordinated through the Council of Australian Governments (COAG). Despite the existence of COAG and best practice processes, there has been some overlap between Australian Government and State and Territory government solar policies.

- The duplication of support measures for small scale solar PV systems across jurisdictions led to large program demand and a surge in scheme costs. The co-existence of the Renewable Energy Target and the national carbon pricing is likely to drive up the cost of achieving emission reductions in Australia, without adding measurably to the total level of abatement achieved due to the duplication of efforts.

A. Size and Significance

Australia has the highest average solar radiation per square meter of any continent and it is estimated that total radiation could provide approximately 10,000 times Australia's annual energy consumption (Geoscience Australia (GA) and Australian Bureau of Agricultural and Resource Economics (ABARE), 2010).

The solar PV industry has been growing at very high rates in recent years. For instance it expanded almost five fold between 2009 and 2010 (Australian PV Association, 2011). While these growth numbers are impressive, they happened from a low base. Indeed, by August 2011 installed solar PV capacity had only reached 1031 MW (Clean Energy Council, 2011a).

Australian Government modeling suggests that the solar industry will grow at a more modest but still very fast 17% per year over the period to 2029-30. By this time it is projected that solar PV may provide around 1% of Australia's total electricity production (Syed et al., 2010) up from around 0.3% in 2010 (Morris and Johnston, 2011).

The Australian Government has singled out large scale solar as a strategically important technology due to its potentially significant role in Australia's future energy mix as well as generating additional spill

over benefits in the form of intellectual property or export earnings (Australian Government, 2011a). The government is expecting that large scale solar could provide around 3% of Australia's large scale electricity generation by 2050 (Australian Government, 2011a).

B. Policy Formulation

(i) History and Background

Australia led the world in the development and application of solar PV systems for telecommunications and remote area power supply in the 1970s and 1980s (Australian Business Council for Sustainable Energy (ABCSE), 2004). In the 1980s, the first government support scheme, the NSW Remote Area Power Assistance Scheme, was established and was followed by support schemes in other States. In 1989 the University of NSW established the Centre for PV Devices and Systems and in 1993, the Aurora Project in Melbourne, Victoria was established as one of Australia's first on-grid facilities (Australian Business Council for Sustainable Energy (ABCSE), 2004).

Interest in Australia's solar PV industry increased in the 2000s and Australian governments (at the national and State and Territory level) introduced a range of incentives including, for example:

- the Photovoltaic Rebate Program (2000) to provide rebates for the installation of solar PV on homes and in community buildings;
- the national Mandatory Renewable Energy Target (2001) to increase the share of renewable energy in national electricity generation; and
- State and Territory government solar feed-in-tariff (FiT) schemes (2008-10) to provide a premium for electricity generated by solar PV systems.

These policies have contributed to significant growth in the solar PV industry, largely in on-grid residential scale systems.[194] The most dramatic change in the industry began in 2009 when FiT schemes were introduced and favorable changes to Australia's Renewable Energy Target were made. At the same time, the price of PV systems fell dramatically due to factors such as excess system supply (AECOM, 2010), increasing market scale, favorable foreign exchange rates and increasing system size (Morris and Johnston, 2011). These factors helped account for the extraordinary growth in the industry from 2009 to 2010 (480% according to the Australian PV Association, 2011).

The Australian Government does not have a specific target for solar PV in general, nor for large scale solar PV more specifically. Instead, solar PV can generate renewable energy certificates under the renewable energy target and therefore has to compete with other renewable technologies. As such the role it will play in the future will be determined by factors such as relative system costs and broader climate change policies.

[194] Systems of more than 100 kW provide less than 1% of total capacity (Morris and Johnston 2011) and the largest PV system has a capacity of only 1.2 MW (Clean Energy Council 2011a).

(ii) Policy Description

MANDATES

Feed-in-tariffs

In 2008 Australian State and Territory governments started introducing mandatory Feed in Tariff (FiT) schemes to promote the deployment of largely small scale, on-grid solar PV systems in residential settings. These schemes provided a premium payment (above the residential cost of electricity) for solar energy that was sold back into the grid. The cost of the scheme was typically shared between all electricity consumers but rules varied between jurisdictions. During 2010 and 2011 most jurisdictions either stopped or rolled back their FiT schemes due to larger than expected demand and costs.

Renewable Energy Target

The Australian Government introduced the renewable energy target (RET) in 2001 to promote the development of a range of renewable energy sources including geothermal. The RET is designed to achieve approximately 20% of Australia's electricity production by 2020 from a broad range of renewable energy sources including hydro, wind, solar, biomass, wave, tidal and geothermal. The scheme requires liable entities to obtain and surrender renewable energy certificates up to the target for that year. The scheme includes two components: the Large-scale Renewable Energy Target Scheme (LRET) which is applicable to renewable energy power stations (e.g. wind and solar farms, hydro-electric power stations), and the Small-scale Renewable Energy Scheme (SRES) which is applicable to small-scale renewable energy installations (e.g. solar water heaters, heat pumps) and which includes the Solar Credits rebate scheme (described later).

The RET provides generators of renewable energy sources with a premium over the price of other electricity sources such as coal. In this way the RET is similar to a FiT scheme. However, it is not technology specific (one premium price is offered to all renewable energy technology types) and the price is not determined in advance but responds to changes in the cost of achieving the set target. For example, if the price of renewable energy falls then the cost of meeting a set target and the price of the premium paid to renewable energy sources will also fall.

FINANCIAL INCENTIVES

Research and development grants

Australian and State governments have allocated significant amounts of funding to public research organizations, centers of excellence and universities for the development of solar PV technologies and improved information about Australia's solar resources. A key example is the Australian Government's Australian Solar Institute (ASI) that has been provided with AU$ 150 million to select and fund other organizations to conduct solar research.

Demonstration and deployment grants

Australian and State and Territory governments (with the exception of NSW and Tasmania) have provided a large range of competitive grants to support the demonstration of larger scale solar projects. The biggest example is the Australian Government's AU$ 1.5 billion Solar Flagships Program which aimed to support the development of 1000 MW of large scale grid connected solar facilities. It has so far committed to support two projects valued at AU$ 770.5 million, including AU$ 306.5 million for a 150 MW solar PV project.

Rebates

The Australian Government has supported three solar PV rebate programs to provide upfront cash refunds to buyers of solar systems: the Solar Homes and Communities Program or SHCP; the Remote Renewable Power Generation Rebate or RRPGR; and the Solar Credits program which was introduced to replace the SHCP. Rather than being awarded on a competitive process, rebates were provided to all applicants that met a set of eligibility criteria. Rebates have typically been of lower value than a grant (and therefore supported smaller systems) but provided funding to more recipients. The SHCP and RRPGR were terminated early and the incentives under the Solar Credits scheme were reduced due to larger than expected demand and costs.

Future programs

In July 2011, the Australian Government introduced a range of new climate change policies. These included a national carbon pricing scheme that will initially impose a fixed price of AU$ 23 (rising at 2.5% in real terms) per ton of CO_2-e emissions on around 500 of Australia's largest polluters (liable entities) including stationary energy from 1 July 2012 and then transition to an emissions trading scheme on 1 July 2015 (Australian Government, 2011b).[195] They also included the AU$ 3.2 billion Australian Renewable Energy Agency (ARENA) to promote the research and development, demonstration, commercialization and deployment of renewable energy projects to improve the sector's competitiveness; and the AU$ 10 billion Clean Energy Finance Corporation (CEFC) to provide commercial or concessional loans or equity investments to clean energy companies.

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

The stated benefits of using solar PV in Australia are that it can leverage Australia's world leading research and development facilities and may support innovations that generate export revenues. It can also generate electricity that produces no greenhouse gas emissions (and therefore contributes to emission reduction targets). Additional benefits cited include that solar PV output tends to correlate with daytime demand, is scalable from household to utility scales, can be combined with storage and dispatched with a high degree of predictability, and is supported by the community (Australian Government, 2011c).

[195] The stationary energy sector includes the generation of electricity and the combustion of fuels for purposes other than transport.

The major cost of using this resource is its cost relative to alternative forms of energy, including from fossil fuels and other renewable energy sources. High costs are particularly acute for the large scale solar PV industry. This is because these systems have not yet been demonstrated under Australian conditions and therefore face a range of implementation risks that are likely to increase the cost of finance. Large scale solar PV systems also face the challenge of grid connection, land acquisition, acquiring relevant solar data and negotiating long term pricing agreements (Clean Energy Council, 2011b).

The costs for small scale solar are lower than for large scale solar. This is due to the fact that the technology has been widely used under Australian conditions and therefore the risks are lower and also because small scale systems do not need to compete against wholesale electricity prices but instead compete against the final cost of electricity facing consumers (which includes transmission and distribution charges). There is evidence that the cost of solar from these small scale systems is approaching 'grid parity' under some conditions.

(i) Costs, Benefits and Promotion

Small scale solar subsidies and feed-in-tariffs

Australian governments have introduced a number of subsidies for small scale solar systems including Australian Government rebate programs and State and Territory government FiT schemes. These schemes are aimed at a commercially mature technology.

Australian government subsidy schemes have helped support a significant growth in the solar PV industry from around 29 MW in 2008 to more than 1000 MW in 2011 (Clean Energy Council, 2011a). They have provided significant benefits to some consumers, by lowering the price of electricity paid by them. They have also contributed to industry employment, which was estimated at around 14,000 in 2010 (Morris and Johnston, 2011). But their contribution to emission reductions is small: it is estimated that the Solar Homes and Communities Program will reduce emissions by around 0.09Mt CO2e/yr over the life of the rebated PV systems or 0.015% of Australia's 2008 emissions (Macintosh and Wilkinson, 2010) at a cost to government of around USD 1.05 billion (Australian National Audit Office (ANAO), 2010).

While FiT schemes do not cost governments money (other than in terms of scheme administration), they impose a high cost on electricity consumers. For example, it is estimated that the NSW FiT scheme alone will cost around USD 1.44 billion (Independent Pricing and Regulatory Tribunal (IPART), 2011). Overall, the Productivity Commission (2011) estimated that the cost of reducing greenhouse gas emissions across all solar PV subsidy schemes (including FiTs given the classification used in the Productivity Commission study) is between USD 431 and USD 1043/tCO_2e (Productivity Commission, 2011). This is significantly higher than other renewable energy support schemes such as the RET (see below). The FiT and solar PV rebate schemes have also been criticized for being regressive and benefiting the relatively wealthy at the expense of poorer households.[196]

The analysis above suggests that the benefits of small scale solar PV subsidies and FiT have come at a high cost and government objectives in terms of greenhouse gas emission reductions and the

[196] Macintosh and Wilkinson (2010) found that 66% of all successful applicants for the SHCP were in the medium-high and high income postal codes.

development of the RE sector could have been achieved at lower cost through broad market based instruments such as an economy wide carbon pricing scheme. Some may argue that the cost of solar PV subsidies could be reduced through more rigorous policy design. However, FiTs have also proven to be very expensive in other parts of the world (e.g. Germany).[197] This suggests that Australia should reconsider whether small scale solar PV subsidies and FiTs are appropriate. The industry is mature so additional market failures (other than those that can be targeted by broad market based instruments) are unlikely to play a significant role. In addition, Australia already has a mechanism to internalize the cost of greenhouse gas emission which makes additional support difficult to justify.

Renewable Energy Target

The costs and benefits of the RET have been assessed through a number of studies. For example, in 2009 it was projected that the cost of achieving Australia's target of 20% renewable energy by 2020 would be USD 4/MWh or a 3% increase in electricity prices (McLennan Magasanik Associates, 2009). There is also evidence on the actual performance of the RET. In 2010 it was estimated to have achieved abatement of 8.8 Mt CO_2e, more than any other on-going Australia climate change program and has done so at a cost of between USD 30 – \$70/tCO_2e (Daley et al., 2011) and impact of around 1 to 2% on electricity prices (Productivity Commission, 2011).

The abatement costs of the RET compares relatively well to other policies. For example, abatement under solar subsidies has cost up to USD 1000/tCO_2e. However, the RET is more expensive than energy efficiency standards (which are estimated to provide net benefits) and some grant programs (although the abatement achieved through grant programs is low) (Daley et al., 2011). The RET by itself is not sufficient to incentivize solar PV at current prices as emission reductions can be achieved more cheaply from other technologies such as wind.

While the RET compares well to other renewable energy policies in terms of the cost of achieving emissions reductions, Australia will introduce an economy-wide carbon pricing scheme in July 2012. This should, from an efficiency perspective, greatly weaken the rationale for supporting the RET scheme because a broad based carbon price incentivizes emissions reductions that are cheapest, including those from renewable energy deployment. Indeed, the co-existence of carbon pricing and the RET is likely to increase the cost of achieving Australia's emissions reduction target and suggests that once the national carbon price is fully operational the RET should be wound down.

Basic research and development

Australian governments have provided significant support to basic solar PV research and development (R&D) through programs such as the Australian Solar Institute, solar centers of excellence, universities, Geoscience Australia and an R&D tax incentive. This funding has supported technological innovations, the adaptation of technology to Australian circumstances and an improved understanding of Australia's solar resources.

[197] The Australian Productivity Commission estimates that the cost of abatement from Germany's solar FiT is (2010) USD 864/tCO_2e (Productivity Commission 2011, Appendix F).

The major benefit of solar R&D is that it may reduce long term industry costs and contribute to emission reductions both in Australia and overseas (by way of technology diffusion). Other benefits may include the generation of export revenue from solar innovations and the potential to leverage Australia's high quality solar resources and world leading R&D facilities and researchers.

Without specific data on the benefits and costs of government supported solar R&D programs it is only possible to make some general observations. While benefits of R&D support indeed exist, the question is whether net benefits are realized after taking into account the costs associated with raising the funds for R&D support and the potentially distortive effects of assistance for specific projects over others.

A recent statement by a group of prominent economists and scientists issued after a meeting in Stanford University in 2008 to discuss the role of R&D in developing effective policies for addressing the adverse potential consequences of climate change captures this well (Arrow et al, 2009). [198] The statement pointed to the downside of R&D subsidies that tend to support favored firms, industries and organized interests, and advocated agency independence to overcome such distortions.[199] Australia's R&D grants for solar PV technologies are mostly directed at public research organizations, centers of excellence and universities, as opposed to private firms and industry. As such, R&D grants are unlikely to be allocated so as to support favored firms or organized interests.

Demonstration grants

Australian governments have provided significant support for the demonstration of large scale solar PV projects under Australian conditions. For example, the Australian Government committed AU$ 1.5 billion to the Solar Flagships program to support the development of 1000 MW of large scale grid connected solar power. The Australian Government has also agreed to provide USD 75 million to support a 100 MW solar power plant under the Low Emissions Technology Demonstration Fund (LETDF) (this project has also received AU$ 50 million in funding from the Victorian Government).

The major potential benefit of government support for demonstration projects is that it can demonstrate how key industry risks can be overcome, thus reducing long term financing costs, encouraging industry development and providing the opportunity for large scale emission reductions. Demonstration schemes may also support regional employment. For example, one estimate suggests that the development of a 100 MW plant under the Solar Flagships program will create around 300 jobs during construction.

The problem with Australian government grant programs is that they require governments to be involved in project decision making (e.g. in project selection and in ensuring that projects adhere to the terms of the grant program). This is a difficult role for governments because the projects are likely to involve cutting edge technologies and processes which may be poorly understood. This may lead to lengthy contract negotiation and poor project selection. Governments are also likely to include inflexible

[198] Arrow, K. et al, "A statement on the appropriate role for R&D in climate policy", *Economists Voice*, February 2009 (www.bepress.com/ev)

[199] The problem of agency dependency is well recognized in the public choice literature on the widely observed phenomenon of regulatory capture (for instance, Stigler, G. 1971. The theory of economic regulation. *Bell J. Econ. Man. Sci*. 2:3-21.)

terms and conditions to safeguard the use of government funds. This may mean that original contracts cannot be fulfilled, particularly if there is a change in the assumptions under which they were originally made. These issues have led to significant project delays and in some cases project termination.

The issue of grant program delays was initially reported by the Australian National Audit Office (2004) in relation to Australian government climate change programs more broadly. It was repeated in Australian National Audit Office (2010) who found that Solar Cities had spent only 26% of its original budget over a 5 year period and the Low Emissions Technology Demonstration Fund (LETDF) spent less than 5% of its budget over a 5 year period. Moreover, this problem seems set to continue. For example, in December 2011 it was reported that the two large scale solar projects to be funded under the Australian Government's Solar Flagship program had missed a deadline for financial close (Climate Spectator, 2011).

There is a cost associated with grant program delays in terms of under-utilized funding which could have been allocated to more productive areas of the economy. The delays also mean that none of the potential benefits have been realized. This suggests that many Australian government grant programs to the large scale solar PV industry are unlikely to have minimized costs and maximized benefits.

One potential argument for continued support of the industry is that it will help bring long term industry costs down (the infant industry argument). However, Australian governments have been supporting large scale solar PV projects for a number of years and commercial production is yet to commence.[200] Another argument for continued (but temporary) support of demonstration projects is that it will help address early mover market failures including barriers in financial markets and the cost of interaction with governments to establish an appropriate regulatory regime. A problem with this approach is that it will be difficult to quantify the level of funding that is justified by the market failures. If governments are able to overcome this barrier they still face the challenge of targeting the funding to the most prospective projects. This can be assisted by bringing market pressures to bear on project selection decisions (rather than relying on the judgment of bureaucrats).

On this basis, it is recommended that Australian governments reconsider if funding for solar PV demonstration projects is appropriate. The final decision on appropriate policy mechanism and funding allocation (if any) should include analysis of a range of policy options and consideration of their full range of costs and benefits as recommended in guides to best practice regulation.

(ii) Scientific Integrity

Australia has the highest average solar radiation per square meter of any continent. Geoscience Australia and the Australian Bureau of Agricultural and Resource Economics (2010) have estimated that total solar radiation is 58 million petajoules (PJ) annually, which is approximately 10,000 times Australia's annual energy consumption. This implies that the technical potential for electricity generation from solar PV is large and unlikely to act as a capacity constraint, providing a scientific basis for supporting solar PV in Australia.

[200] This funding could produce results in the near future but there is also a risk that government support may be continue to be needed over the long term – which is unlikely to provide value for tax payer money.

Australian R&D funding for solar PV has supported technological innovations, the adaptation of technology to Australian circumstances and an improved understanding of Australia's solar resources. However, it remains unclear whether the design of solar PV policies took into account the findings of such R&D efforts.

(iii) Flexibility

The flexibility of Australian government solar programs is different for different programs. The overall level of support for the industry is flexible because governments have not committed to any specific development targets. This allows governments to respond to changes in relative market prices, for instance by increasing efforts in the solar PV sector if relative prices fall, or vice-versa. However, it reduces certainty for investors potentially delaying investment in the sector and other supporting sectors (e.g. supply channels).

In particular, policies such as the Renewable Energy Target and the carbon pricing scheme (that is to be adopted starting from July 2012) are not technology-specific and thus allow automatic adjustments to the level of support to be made in response to changing market conditions. For instance, the RET covers a large range of renewable technologies and therefore provide businesses with greater freedom to choose how they will contribute to the renewable target (e.g. a business may choose to contribute to the RET through the development of solar, wind, geothermal or any other eligible technology). This flexibility allows business to respond to market conditions, for example, to reduce the use of a particular technology in response to price rises or vice versa. This helps to minimize costs for business and the broader economy while still ensuring the environmental objectives are achieved.

In the case of demonstration grants, governments have typically provided one-off funding rounds which provide the government with flexibility to change the rules for subsequent programs. However, once announced, grant programs lack flexibility. For example, grants are likely to be provided according to a set of criteria designed to ensure that government funds are not misused. These criteria may limit the firm's or government's ability to respond to unexpected market conditions (which are quite likely during the early stages of technology development). As a result many grant programs have not allocated their full funding commitment[201] or have taken many years to negotiate a final funding agreement.[202]

Government rebates and FiT schemes have provided pre-determined levels of assistance to recipients. The level of assistance can be changed (and has been changed) through government policy intervention or regulatory amendment, but the policies are not flexible enough to automatically adapt when market conditions change. For example after 2008 the price of solar PV systems fell but the level of government assistance provided to recipients did not respond. This provided a larger benefit to solar investors than originally anticipated and led to a large increase in scheme demand and scheme costs, and finally to the early termination of some of the policies such as the SHCP as well as various FiT schemes. Due to these

[201] Funding for the Australian Solar Flagships program was reduced by AU $150 million in the May 2011 budget and in July 2011 it was agreed that allocated programs funds would be absorbed by ARENA with future funding decisions to be made by the ARENA Board.

[202] A solar PV project agreed under the LETDF (which closed for applications in March 2006) did not finalise a funding agreement with the Australian Government until June 2011.

changes, the PV industry in Australia has been subject to very pronounced and highly undesirable boom and bust cycles.

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

Australian governments have developed a number of mechanisms to facilitate stakeholder input to the policy development process, including best practice approaches to regulation and grants (see the Australian Geothermal Case Study for details).

Most Australian government solar PV policies appear to have been developed with stakeholder input. For example:

- *Demonstration grants*. The Australian National Audit Office (ANAO) reports that two support mechanisms - the Low Emissions Technology Demonstration Fund (LETDF) and Solar Cities program - both issued draft guidelines and a Statement of Challenges and Opportunities prior to finalizing program rules (Australian National Audit Office, 2010). These were widely disseminated to stakeholders and the programs were further communicated through workshops. The Australian National Audit Office (2010) suggests that the consultation process initially delayed the roll-out of the programs but led to more targeted and higher quality applications.

- *Feed-in tariff schemes*. Many FiT schemes were introduced through legislation and developed with stakeholder input. For example, in 2008, the NSW Government established the NSW Feed-in Tariff Taskforce to advise on the design of a feed-in tariff for New South Wales (NSW Government 2012). The Taskforce was required to investigate the likely cost of a FiT scheme and ensure it was complementary to the proposed national carbon pricing scheme. Stakeholders were invited to comment on the proposals of the task force. The Australian Capital Territory (ACT) Government also released a FiT scheme discussion paper and held community consultation sessions to seek input to the design and amendments of a FiT scheme.

- *Renewable energy target*. Stakeholders (from business, different levels of government and the non-for-profit sector) have had an opportunity to provide input to the development of the RET. For example, a 2003 independent review of the RET (previously known as the Mandatory Renewable Energy Target or MRET) received 264 substantive submissions, met with 115 different stakeholders and travelled to 16 different communities (Mandatory Renewable Energy Target Review Panel, 2003). More recently stakeholders have been asked to provide feedback on the 2009 and 2010 RET legislative amendments including feedback on scheme design options, exposure drafts of legislation and regulation, and input to parliamentary inquiries.

- *National carbon pricing scheme*. To help develop the national carbon pricing scheme the Australian Government organized a series of roundtables with business groups, environmental/non-government organizations, community sector groups and primary industry

representatives over a 6 month period (Australian Government, 2011c). The government also received over 1300 submissions from individuals, business groups, non-government organizations, community groups, state and local government bodies and industry associations.

There is also evidence that some policies did not follow best practice approaches. For example, the Australian National Audit Office (2010) reports that Australian Government rebate schemes (SHCP and the RRPGP) were introduced with minimal stakeholder consultation and were not assessed through formal policy processes by government agencies. As noted above, cases wherein there are minimal stakeholder consultations seem to be the exception rather than the norm.

More recently, the Australian Government has sought feedback from stakeholders on the broad challenges and opportunities facing the solar industry. This was achieved, for example, through the 2010 release by the Australian Centre for Renewable Energy (ACRE)[203] of a draft of its Strategic Directions paper. The paper sought stakeholder views on ACRE's future funding strategy to support the development, commercialization and deployment of renewable energy and enabling technologies, including solar PV. In 2011, the Australian Government convened a large scale solar roundtable to seek the input of the solar industry, solar researchers and State governments on the opportunities and challenges facing the large scale solar industry. The results of the workshop were released in a large scale solar discussion paper and it was indicated that they would contribute to future consideration by Governments and institutions on policy settings for large scale solar.

The legislation to support Australian Government market mechanisms (the national carbon pricing scheme and the RET) is available at the Australian Government's ComLaw website and through the website of the Department of Climate Change and Energy Efficiency. The interpretation of regulations and legislation is assisted by explanatory memoranda and overview documents developed by Australian Government agencies. For example, the Office of the Renewable Energy Regulator has developed a range of guidance material on the operation of the RET.

(v) Alignment

Australian governments have taken a number of steps to achieve policy alignment. At a broad level, policies between the Australian and State and Territory governments are coordinated through the Council of Australian Governments (COAG). COAG includes the Australian Prime Minister as its Chair, State Premiers, Territory Chief Ministers and the President of the Australian Local Government Association. It has been operating since 1992.

Australia has also established a system of Australian and State and Territory government Ministerial Councils under COAG to facilitate consultation and cooperation between jurisdictions in specific policy areas. An OECD review found that Australia stands out among OECD member economies for establishing mechanisms for systematic coordination and cooperation across levels of government (OECD, 2010).

[203] ACRE is an Australian Government funded body established in 2009 through legislation to manage more than AU $690 million of renewable energy investment. It has an independent Board of Directors and Chief Executive Officer.

Australian governments have taken specific actions to achieve alignment on climate change policies. For example, in 2007, the Australian Government commissioned the *Strategic Review of Australian Government Climate Change Programs* (Wilkins, 2008) to review all existing climate change programs to ensure complementarity with its proposed national emissions trading scheme (the Carbon Pollution Reduction Scheme or CPRS[204]) and rationalize duplicative programs. The Wilkins Review found that "the programs that governments (throughout Australia) collectively have for supporting solar energy are confused and duplicative" (Wilkins, 2008, p.141) and more generally that there were too many climate change programs, many were ad hoc or badly targeted, there was no framework or logic to organize the policies and there was significant overlap between Australian and State and Territory government programs.

To help address this issue, in 2008 COAG agreed to a set of principles to ensure complementarity between mitigation measures and the CPRS and that each jurisdiction would review existing policies. The review identified 488 State and Territory government climate change programs running concurrently (Australian National Audit Office, 2010). As a result of the review State and Territory governments agreed to redesign or terminate some of their programs. For example, NSW reported on 26 programs and agreed to terminate three and redesign or partially terminate another 16 programs.

Australian governments have also worked collaboratively through COAG on the design of the expanded RET: this included the replacement of existing national and state based schemes with a single national approach. Outside of the COAG process, alignment of policies at the Australian and State and Territory government level is encouraged through best practice regulatory and grants processes (for details on these processes see the Australian Geothermal Case Study).

Despite the existence of COAG and best practice processes, there has been significant overlap between Australian Government and State and Territory government solar policies. In 2008, the Australian Government doubled the rebate available to households for small scale solar PV systems through the Solar Home and Communities Program (SHCP). At the same time State and Territory governments introduced FiT schemes that in the case of NSW offered to buy energy from solar PV systems at a rate that was up to three times the price paid by consumers.[205] The combined impact of the two incentive schemes plus increasing electricity prices and falling solar PV systems prices led to large program demand. This caused a surge in scheme costs and subsequently led to the premature cancellation of the SHCP and many FiT schemes. This parallels the experience in Germany and Spain where the solar boom was followed by a crash due to overwhelming demand due to overly generous FiT schemes.

There is also overlap between Australian Government schemes. The Australian Government has legislated to introduce a national carbon pricing scheme in July 2012 which will operate in tandem with the Renewable Energy Target (RET). The operation of the two schemes together is unlikely to achieve significant additional abatement because emission reductions achieved by the RET will also contribute to the national mitigation target. Moreover, abatement costs are likely to increase. This is because the RET requires some of the abatement to be achieved from a specific source (renewable energy) when cheaper

[204] The CPRS was rejected by the Australian Parliament and has been superseded by the national carbon pricing scheme.

[205] The NSW FiT provided a gross feed-in tariff of AU $0.60 per kWh compared to retail electricity prices of between AU $0.20 and $0.25 per kWh (Independent Pricing and Regulatory Tribunal, 2011).

abatement may be available through other means such as energy efficiency or in other sectors such as forestry, industrial processes or transport. The overlap will also increase administrative costs. To help address this issue the government plans that the RET will be a transitional mechanism only and will not provide support beyond 2020. In the meantime, however, it will increase the cost to Australia of achieving its emission reduction objectives.

3.3.2 Solar PV in Thailand

Key findings

- Thailand has allocated a substantial amount of funds to promote the renewables sector in general and to the solar PV industry in particular. This stems from Thailand's solar resource potential and the imperative of energy diversification.
- The subsidies provided by the Thai government have encouraged rapid growth in Thai solar installations. However, the promotion of the industry has come at a large cost in terms of the tariff burden on consumers. Because of the high costs and concerns about the impact on electricity consumers, the Thai government has often changed the regulations and tariffs governing the industry. This has adversely impacted investor confidence. Furthermore, if the aim of promoting the industry was the reduction of emissions, the high cost of solar PV relative to other alternatives makes it a very expensive option in Thailand.

Costs, benefits and promotion

- The costs of abating a ton of CO_2 by replacing conventional fossil-fuel electricity with solar PV are very high at around US$ 417 per ton of CO_2.
- Adder tariffs for solar PV on consumers impose a significant price burden on consumers that amounts to around US$ 600 million annually.

Scientific integrity

- There is some indication that scientific evidence and analyses are taken into account in the design of Thailand's policies relating to solar PV, though lack of technical expertise is a challenge to the development of rural or off-grid PV applications.

Flexibility

- The government of Thailand has periodically revised it solar PV targets, tariffs and conditions. While this has provided important flexibility to government to react to changing market conditions (e.g. fuel prices, technological change), this sort of flexibility may increase the risks and therefore the costs faced by investors.

Transparency

- The process for the formulation of Thailand's building energy efficiency policies allows stakeholders' views to be reflected.
- Information on renewable energy programs and their environmental impact is not readily available, or out-of-date.

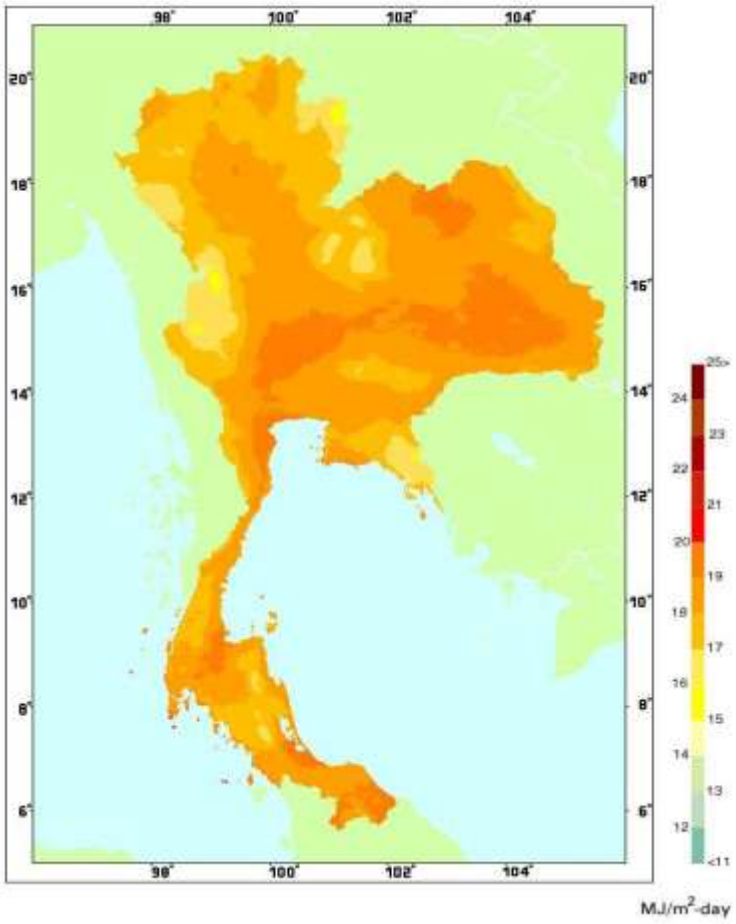
Alignment

- Many different agencies are in charge of renewable energy policy in general and solar PV policy in particular. However, it is not clear that agencies are able to coordinate effectively amongst each other.

A. Size and Significance

Roughly half of Thailand's total land cover enjoys high levels of solar radiation of over 5 kWh/m^2 (see Figure 3.3.2). The highest radiation level is observed in the northern region and part of the central region, which occupies 14% of Thailand's total land cover. The potential installed capacity has been estimated to be as high as 50,000 MW (Asian Development Bank, 2008).

Figure 3.3.2 ***Solar energy map of Thailand***



Source: Department of Alternative Energy Development and Efficiency (DEDE) and Faculty of Science at Silpakorn University (2009).

It is estimated that Thailand's potential installed capacity from solar PV exceeds that of all other renewables combined (see Table 3.3.1). Biomass, with the next biggest potential, stands at 4,400 MW. However, care must be taken when using the potential installed capacity to make judgments about the generation potential of different renewables. A renewable such a solar is intermittent in nature. When the sun does not shine, there is no electricity produced. Hence the key in comparing the electricity generation potential across different technologies is to take into account capacity factors (the fraction of the number of hours in a year that a power plant operates). With a capacity factor of 20% for solar, the 50,000 MW solar installed capacity gives an output of 87,600,000 MWh a year. A capacity factor of 80% for a biomass plant puts the electricity generated from the 4,400 MW installations at 30,835,200 MWh a year. Thus, while solar remains the renewable with the highest potential output, its relative potential is closer to other renewables than the straightforward comparison of the potential installed capacities would suggest.

Table 3.3.1 ***Potential capacity additions***

Energy Type	Potential (MW)
Solar	50,000
Wind	1,600
Hydropower	700
Biomass	4,400
Biogas	190
Municipal Solid Waste	5

Source: Asian Development Bank, 2008.

B. Policy Formulation

(i) History and Background

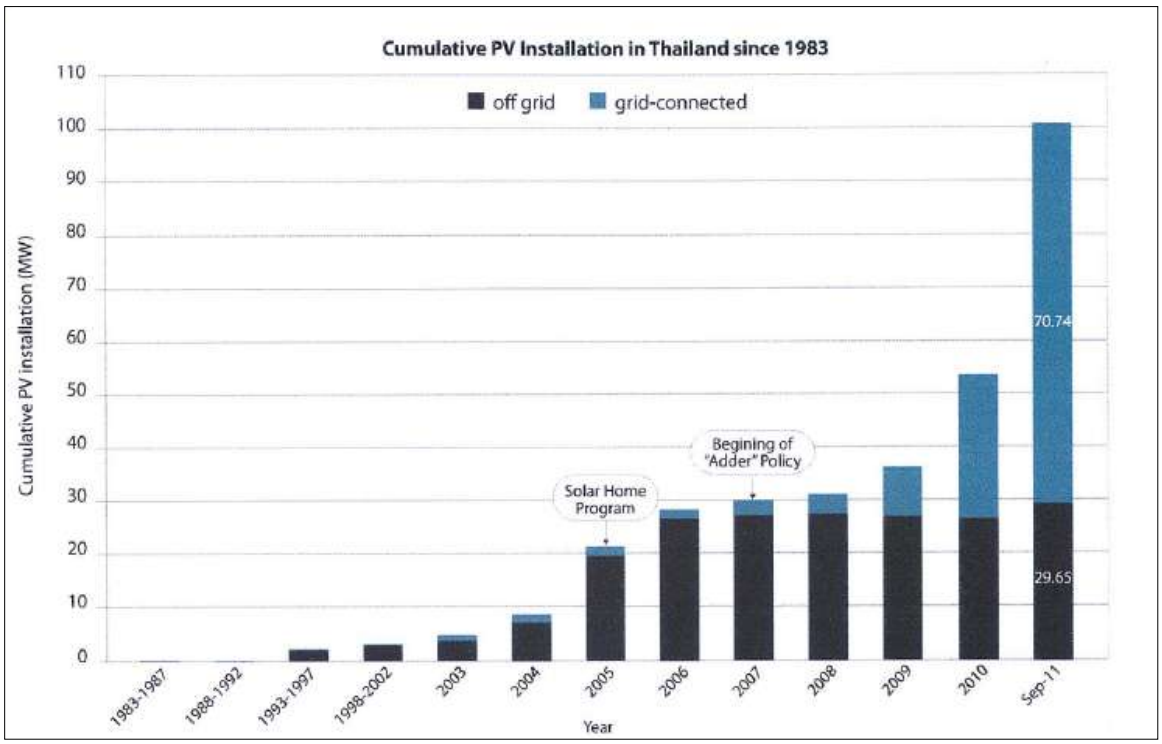
Solar PV installations in the Thailand have a long history. The first phase of nation-wide PV installations occurred around 1976 (Kirtikara, 1997). Nearly 300 panels were installed at rural health stations for communication equipment by the Ministry of Public Health and the Medical Volunteers. PV technology was first incorporated into the national energy development plan as part of the 5th National Plan (1982–1986) following the oil crises during the 1970s. Major early PV applications in Thailand include powering telecommunication links, PV water pumping systems and PV centralized battery charging systems for rural villages.

The installed capacity of solar PV rose from 0.5 MW in 1990 to 2.5 MW in 1996 (Kirtikara, 1997). Over the next decade and a half, solar capacity grew at an average rate of approximately 24% per annum. By September 2011, Thailand had a cumulative installed PV capacity of about 100 MW, with about 30

MW being off-grid systems (See Figure 3.3.3). By the end of 2010, grid connected PV systems accounted for 0.01% of electricity demand (Department of Alternative Energy Development and Efficiency, 2011). The annual market during 2010 was about 10 MW, mostly grid-connected systems.

A number of PV farms are under construction, totaling about 160 MW – with expansion plans up to almost 400 MW. In December 2011, one of the world's largest solar PV projects, the Lopburi solar power plant began operation. It has a capacity of 73 MW that will increase to 84 MW upon completion (Pattaya Mail, 2011). The Lopburi plant is the first alternative energy project in the region that has received support, through a long-term loan, from the Asian Development Bank (ADB) under the recent Asian Solar Energy Initiative (ASEI).

Figure 3.3.3 ***Cumulative PV installation in Thailand since 1983 (updated September 2011)***



Source: Department of Alternative Energy Development and Efficiency, 2011

(ii) Policy Description

Thailand's solar power policies are laid out in the Renewable Energy Development Plan (REDP) (2008-2022). The broad objectives of the 15-year REDP are:

- to increase the share of alternative energy to 20% of Thailand's final energy demand in 2022,
- to utilize alternative energy as a major energy source, replacing oil imports,
- to increase energy security,
- to promote integrated green energy utilization in communities,
- to enhance the development of the domestic alternative energy technology industry, and

- to research, develop and encourage high-efficiency alternative energy technologies.

The REDP aims to increase the installed capacity of solar from 55 MW in 2011 to 500 MW by 2022, which is ultimately targeted at bringing renewable energy to around 20.3% of the energy mix (Sutabutr, Choosuk and Siriput, 2010). This will contribute to the target of reducing Thailand's GHG emissions by at least 42 million tons (CO_2 equivalent) by 2020, relative to 1990. Achievement of the REDP will be assisted by the policies described below.

Before we launch into specific policies, it is important to note that elements of Thailand's efforts to restructure the electricity sector have a strong influence on small renewable power installations. In this respect, one important move was the liberalization of the Thai electricity sector, encouraging private participation via the Small Power Producers (SPPs) program and the Very Small Power Producers (VSPPs) program.[206] The Small and Very Small Power Purchase Agreements policy was implemented by the Electricity Generating Authority of Thailand (EGAT) in 1994 and updated in 2002, following the amendment of the EGAT Act (Amatayakul & Greacen, 2002), and gave small power producers certainty regarding the conditions under which they can sell power into the grid.

MANDATES

Feed-in tariffs (or adder feed-in premiums)

In May 2001, the government initiated a "pricing subsidy" in the form of energy payment adder for electricity generated by renewable energy for a period of five years at a maximum rate of 0.36 THB/kWh,[207] under competitive bidding. A budget of 3,060 million baht[208] was allocated from the ENCON (Energy Conservation Promotion) Fund for this purpose. This pilot scheme was expected to generate about 300 MW of electricity from renewable energy.

In mid-2002, the Thai authorities announced that the two power distribution utilities, the Provincial Electricity Authority (PEA) and the Metropolitan Electricity Authority (MEA), would purchase power from installations with a capacity of 1 MW or less. This program was initiated because meeting the existing SPP regulations of Electricity Generating Authority of Thailand would be too costly for power producers with installations of 1 MW or less. In recognition of the fact that the compliance burden associated with the SPP regulations affected the viability of installations with a capacity greater than 1 MW, in September 2006, the government, via the National Energy Policy Council (NEPC), re-defined the capacity limit for VSPPs, increasing it from 1 MW to 10 MW. Furthermore, technical interconnection requirements were revised to better cater for VSPPs.

In December 2006, the NEPC approved an increase in the power purchased from SPPs (i.e. power producers with capacity ranging from 10MW to 100MW), from 3,200 MW to 4,000 MW. At the same time, the "Adder Provision" was initiated, providing an additional increment over and above the prices that power producers were already receiving for electricity they were selling to utilities.

[206] The capacity range for VSPPs is less than 10 MW and that for SPPs is between 10 MW and 100 MW.
[207] This is approximately 1 US cent (assuming that 1 USD = 30 Thai Baht).
[208] This is approximately US$ 102 million.

These Feed-in Premiums were very effective at encouraging the deployment of renewables, leading to an oversubscription (Sutabutr, Choosuk and Siriput, 2010). However, despite the fact that solar enjoyed a higher adder than other renewable sources of 8 Baht/kWh[209] (plus an additional special adder of 1.5 Baht/kWh[210] in the three southernmost provinces), no solar projects were being initiated as of 2008, due to the high relative cost of solar PV generation. As a result, the government increased the timeframe over which the adder would be provided from 7 to 10 years (Ruangrong, 2008).

The extension of the period over which the feed in premium would operate, coupled with declining technology costs for solar PV, led to a much higher level of interest in solar PV than the government was anticipating. There were over 1,600 MW of solar PV applications under the VSPP program, compared to the Thai solar targets of 55 MW by 2011, 95 MW by 2016, and 500 MW by 2022 (Rangsan, 2009).

Fears of a blowout in costs for electricity consumers from this large volume of solar PV, given the high adder rates, led the Thai Cabinet to reduce the solar adder from 8 to 6.5 Baht/kWh[211] in June 2010 for all projects that had not yet been approved, including those already submitted. In addition, it was stipulated that no new applications would be accepted until the finalization of a revision of the adder to a new Feed-in-Tariff (FiT) arrangement (Tongsopit, 2011). As of December 2011, the Energy Policy and Planning Office (EPPO)[212] has suspended the adder tariffs for all renewable energy projects except for solar projects to allow implementation of the FiT.[213]

In addition, Thailand was for a time looking at implementing a renewable portfolio standard, which is essentially a quota on the amount of electricity that a producer has to generate from renewables. In 2003, a Renewable Portfolio Standard (RPS) was proposed for new power plants whereby 5% of their generation capacity must be generated by renewable energy (Lidula et al., 2007). In 2003, the RPS was imposed only on the Electricity Generating Authority of Thailand (EGAT). In 2008, DEDE planned to impose a RPS on Independent Power Producers (IPPs), but the legislation was not approved. In the 2012, a RPS has once again been proposed for IPPs.[214]

FISCAL INCENTIVES

There are several fiscal incentive schemes that are currently in operation in Thailand. A short overview of the most prominent of these, namely the Energy Conservation Promotion Fund (ENCON Fund), the Power Development Fund, and tax incentives through the Board of Investment (BoI) is provided in the following discussion.

[209] This is approximately 27 US cents (assuming that 1 USD = 30 Thai Baht).
[210] This is approximately 5 US cents.
[211] This is a reduction from approximately 27 US cents to 22 US cents.
[212] The Energy Policy and Planning Office is the executive body of the National Energy Policy Council (NEPC) and recommends economy-wide energy policies and planning.
[213] This information was gleaned from the interviews that we conducted with members of the Department of Alternative Energy Development and Efficiency, Thailand (19 Jan 2012).
[214] This information was gleaned from the interviews that we conducted with members of the Department of Alternative Energy Development and Efficiency, Thailand (19 Jan 2012).

Energy Conservation Promotion Fund (ENCON Fund)

The ENCON Fund was established in 1995, following the launch of the ENCON Act in the same year. Its revenues are derived from levies from petroleum producers and importers, power surcharges, and remittance rates from consumer petrol prices (Ministry of Natural Resources and Environment, 2002).

Through the ENCON Fund, 1,000 million Baht (US$ 33 million) is made available for a co-investment scheme to encourage renewable energy projects. The scheme utilizes several facets of project-financing schemes to share risks with private developers, such as equity investment, venture capital, equipment leasing, creation of carbon credit market, and credit guarantee facility (IEA, 2010)[215]. By March 2011, the fund had stimulated investments in renewable energy and energy efficiency projects with a total value of over 4,500 million baht/year (US$ 150 million/year).

The ENCON Act has various programs targeting different groups and sectors. Under the Voluntary Program, the ENCON Fund financially supports the development and use of renewable energy sources. This is undertaken through three sub-programs: renewable energy and rural industry, industry liaison, and research and development. The two types of financial support for the implementation of the Voluntary Program are non-binding grants and investment subsidies (IEA, 2010).[216] For government agencies and non-profit organizations, non-binding grants cover the operational costs of managing, administration, marketing, maintenance and after-sales services of the funded renewable energy project. Investment subsidies, which are available to private sector investors, encourage investment in renewable energy projects. Subsidies can cover up to 60% of the project cost, depending on the investment amount, and in practice generally cover between 35 to 45% of the cost.

Power Development Fund

Following the Energy Industry Act of 2007, the Power Development Fund was set up in the Office of the Energy Regulatory Commission. In addition to being used to promote renewable and environmentally friendly energy generation technology, the Fund is also used to implement the subsidy arrangements for underprivileged power consumers, rehabilitate localities, and compensate people affected by power plant operations. Revenue for the Fund is provided by a levy on power generators through the electricity tariffs. All power plants have to pay a levy to the Fund during the plant commissioning at the following rates (Energy Regulatory Commission, 2009). [217] As Table 3.3.2 below illustrates, the levy for renewable energy sources such as wind, solar and biomass is lower than the levy for fossil fuel sources such as coal and diesel.

[215] IEA Global Renewable Energy Policies and Measures Database, Energy Conservation Program, Thailand

[216] IEA Global Renewable Energy Policies and Measures Database, Energy Conservation Program, Thailand

[217] The Energy Business Act (December, 2007) created a single regulatory body, the Energy Regulatory Commission (ERC), the first in Thailand's history, with the responsibility to regulate the activities of operators in the electricity sector, in addition to ensuring their compliance with the Act.

Table 3.3.2 ***Levy on power generators for different fuel types***[218]

Fuel Type	Satang/unit
Natural Gas	1.0
Fuel Oil/Diesel	1.5
Lignite/coal	2.0
Wind/Solar	0
Biomass/msw	1.0
Hydro	2.0

Source: Energy Regulatory Commission, 2009

Tax Incentives through the Board of Investment (BoI)

There are a series of tax incentives to lower investment costs in energy efficiency and renewable energy projects. These include exemptions of duties for imported machinery and a corporate income tax holiday of eight years combined with a 50% reduction of corporate income tax on net profits from the 9th to 13th years (Sutabutr, Choosuk and Siriput, 2010). In addition, the facility installation and construction cost of projects, not exceeding 25% of investment capital, is discounted from net profits for taxable purposes. Specific to the solar industry, the Board of Investment (BOI) gives producers of solar cells its maximum incentive of 8 years of an income tax holiday.[219]

Research and development (R&D) Funds

Solar R&D on topics ranging from solar cell materials to PV applications is being conducted by universities, government research institutes and the private sector (Department of Alternative Energy Development and Efficiency, 2011). The Research and Development sub-program of the ENCON Fund aims to develop new technologies and improve on existing ones, provide support to small-scale demonstration projects and facilitate information dissemination. The Fund has supported more than 50 R&D projects for energy technology development and conservation undertaken by various government agencies and academic institutions. R&D projects eligible for funding include policy studies, adaptation of technologies used in other economies and dissemination of research through small-scale demonstration projects, workshops and conferences (IEA, 2010). Grants have been given to encourage R&D on solar energy (Ministry of Natural Resources and Environment, 2002). Examples of funded projects are:

- the development of solar radiation measuring station network for Thailand;

[218] 100 Satang = 1 Baht

[219] See for instance http://ns.boi.go.th/english/download/publication_investment/60/april06.pdf

- the demonstration project of electricity generation and distribution system using solar cells in Mae Hong Sorn Province in northern Thailand;
- the establishment of a "Solar Energy Park" to serve as a demonstration center and to disseminate information on solar energy.

In addition, the Thailand Research Fund, an independent organization under the Office of the Prime Minister, is another institute supporting R&D and facilitating information on solar cells (Ministry of Natural Resources and Environment, 2002).

FINANCIAL INCENTIVES

Asian Solar Energy Initiative (ASEI) [220]

The ASEI is a three year project launched by the ADB in order to implement 3,000MW of solar electricity generation capacity in Asia and the Pacific (Asian Development Bank, 2011). The target will be achieved by facilitating solar technology transfer to Asia and the Pacific, providing assistance in project development and implementing innovative financing schemes. In the first year of the ASEI, the first projects supported were two private sector–led solar PV electricity generation projects with capacities of 73.0 MW and 44.5 MW in central Thailand.

The ADB plans to finance up to US$2.25 billion directly under the ASEI and leverage an additional $6.75 billion in solar investments over the same period, using instruments such as London interbank offered rate (LIBOR)–based loans, donor contributions, grant funds, innovative risk mitigation mechanisms, carbon market support measures and direct support. In addition, a separate Asia Accelerated Solar Energy Development Fund of up to $500 million is used to mitigate risks associated with solar energy projects and push down the initial cost of solar energy development. This will encourage commercial banks and the private sector to invest in solar technologies and projects.

Energy Efficiency Revolving Fund

The Thai Ministry of Energy (MoE) has established a "Revolving Fund" to assist the investors in RE and EE projects by allocating budget from the ENCON Fund for 2-stepped loans via commercial banks. This scheme is currently in the fourth period (2009- 2011) and has a loan ceiling of 400 million baht.[221] The interest rate has been set at maximum 4% for a loan period of 7 years. The past three periods of the project were fully subscribed and initiated a total investment of 6,724 million baht (US$ 225 million), which is expected to reduce energy consumption by 2,200 million baht or US$ 73 million annually (Sutabutr, Choosuk and Siriput, 2010).

[220] Although this fund is instituted by a multilateral agency, it has been included given that this financing avenue has been tapped by the Thai solar energy sector.

[221] This is approximately US$ 13 million (assuming that 1 US$ = 30 Thai Baht)

Clean Development Mechanism

The Clean Development Mechanism (CDM) allows developed economies to fulfill their commitments under the Kyoto Protocol (an international climate change agreement under the United Nations Framework Convention on Climate Change) by incentivizing emissions reductions in developing economies and is another avenue through which solar PV projects in Thailand can receive additional funding. However, the uptake of CDM through solar PV projects has been slow. Of the 154 projects that have been approved by Thailand's Designated National Authority (the body that manages CDM credits in Thailand), only 4 are solar energy projects (Department of Alternative Energy Development and Efficiency, 2011). A lack of technical specialists for many renewables and the inability of the authorities to focus on the development of many renewables as a priority issue are some of the reasons that have been suggested to explain this (Dabbaransi, 2010).

C. Regulatory Review

ECONOMIC EFFICIENCY AND EFFECTIVENESS

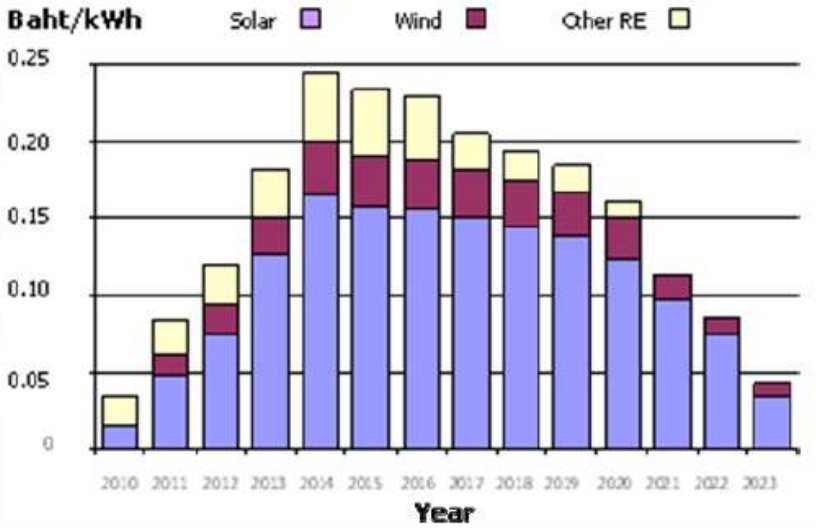
(i) Costs, Benefits and Promotion

The VSPP programme combined with the adder tariff has increased the incentives for the establishment of small scale renewable energy projects. In recent years, solar PV applications to the SPP and VSPP programs have greatly exceeded government expectations (Wongdeethai, 2011). As of October 2011, about 3,500MW of solar PV and concentrating solar thermal projects were in the pipeline. This is significantly higher than the revised target of 2,000MW of solar generation capacity by 2022.

However, the achievement of this expansion is likely to come at considerable cost (Figure 3.3.4). An analysis on the Return of Investment of solar PV projects and the impact of the tariff burden on consumers was conducted by the Energy Policy & Planning Office (EPPO). The findings led the National Energy Policy Committee (NEPC) to reduce the adder rate and to stop accepting new applications (Tongsopit, 2011). Based on the initial adder of 8 baht/kWh,[222] 3 GW of solar at 15% capacity factor could add a net burden to consumers of 31 billion baht/year or US$ 930 million/year (Greacen, 2011). Even with the revision of the solar adder rate to 6.5 baht/kWh[223] in 2009, the annual cost remains high at approximately 25 billion baht/year (US$ 833 million/year).

[222] This is approximately 26 US cents (assuming that 1 US$ = 30 Thai Baht).
[223] This is approximately 22 US cents.

Figure 3.3.4 *Price impact of adder tariffs to consumers*



Source: Sutabutr, Choosuk and Siriput (2010)

If the aim of the scheme was to contribute to emissions reductions, the high cost of solar PV relative to other alternatives makes this a very expensive option. The estimated abatement costs are as high as 417 US$ per tCO_2, which is over ten times higher, for instance, than the peak price of emission certificates under the EU ETS (these have never exceeded €32 per tonne of CO_2e and have been below €10 per tonne for a considerable amount of time).

Because the costs have been so high and the government has been concerned about the impact on electricity consumers, the government has been changing the rules and tariffs regularly. The resulting uncertainty makes project selection and development risky and has negatively impacted on investor confidence. A drawback of the way in which the adder was managed was that many of the project applications were speculative in nature, and were clogging the pipeline by occupying locations denied to legitimate projects (Greacen, 2011).

Fundamentally, a more efficient approach to promoting renewable technologies would be to make policies more technology neutral, such as through a Renewable Energy Standard as was proposed and is still being considered. That way, emissions reductions and energy security objectives could be met at a lower cost than by applying different rates to different technologies, since the least choice mix of technologies is more likely to be achieved through the market mechanism. Energy security objectives[224] could also be met more efficiently by imposing taxes on imported energy sources – the revenues from this could then be recycled into the Thai energy sector, benefitting local production and production technologies that do not rely on imported energy inputs.

In summary, the main challenge faced by the Thai PV sector has been the high cost of solar PV systems. This has made solar uncompetitive in comparison with other electricity generation methods and

[224] The Thai government is concerned about Thailand's high dependence on energy imports, particularly oil. In 2007, net energy imports accounted for 56% of energy supply in the economy (REEEP, 2010).

calls into question programs designed to overcome barriers to the implementation of solar PV on cost benefit grounds. That said, the pace of technological change in the solar PV sector has been very high and grid parity for distributed systems may be reached very soon. Removing non-cost barriers may ensure the technology can develop freely if and when relative prices (including environmental costs) become favorable.

Technical barriers associated with renewables in Thailand have resulted from lack of standards and know-how associated with solar PV systems and equipment. While standards for PV modules are being developed in Thailand, enforcement will only be on a voluntary basis. The service sector for solar PV O&M would also have to grow to support rooftop PV installations (Buranasajjawaraporn, 2012).

The Factory Act (BE2535) prohibits residential units from containing more than 5 horsepower (equivalent to 3.7kW). Buildings with more than 5 horsepower are considered factories and cannot be located in housing developments and within 100m of schools, hospitals, temples, and government agencies (Tongsopit, 2011). This is a legal barrier towards promoting rooftop PV in residential buildings. At the moment, such PV systems are allowed as energy efficiency improvements in buildings, but not as power plants, meaning they are not eligible for the solar adder. Partly as a result of this, at present, 99.9% of solar proposals approved are ground mounted PV. The DEDE is trying to change the laws to allow exceptions for renewable energy. In addition, rules pertaining to solar PV such as warranty, rooftop rental, and building ownership will also have to be reviewed to promote solar PV in Thailand.[225]

Lack of community support is another barrier to renewables in general and solar PV in particular. There has been opposition to some renewable generation projects among the Thai people. Although solar PV is generally recognized as an environmentally friendly way to generate electricity, one negative environmental impact recognized in Thailand is the disposal of lead acid batteries used in solar PV systems (Uddin, Taplin, and Yu, 2010).

(ii) Scientific Integrity

As discussed earlier, the technical potential for solar energy in Thailand is high, with a potential installed capacity of 50,000 MW that exceeds the potential installed capacity of all the other renewables combined. Even after taking into account the fact that the capacity factor (the fraction of the number of hours in a year that a power plant operates) is relatively low for solar, solar remains the renewable with the highest potential electricity output. This provides a scientific basis for policies supporting the uptake of solar PV in Thailand.

There is some indication that scientific evidence and analyses are taken into account in the design of Thailand's policies relating to solar energy. For instance, scientific analysis carried out by the Department of Alternative Energy Development and Efficiency (DEDE) and the Faculty of Science at Silpakorn University (2009) suggests that the highest solar radiation levels in Thailand are observed in the northern region and part of the central region. Consistent with that, many of Thailand's solar PV installations (both existing and planned) are located in the northern and central region. The Lopburi solar plant, one of the world's largest, has been constructed in Lopburi province in central Thailand, supported by policies such

[225] This information was gleaned from the interviews that we conducted with members of the Department of Alternative Energy Development and Efficiency, Thailand (19 Jan 2012).

as the Asian Solar Energy Initiative. In the northeastern Isaan region, the Solar Power Company (SPC) has plans for 34 solar plants that will total 204 MW by 2012 (Wilcox, 2012). To put that into context, Thailand's cumulative installed PV capacity in September 2011 was 100 MW.

However, one issue faced by rural/off-grid PV applications is the lack of maintenance of PV systems partially arising from the lack of technical expertise in those areas. As a result, output from PV systems is reduced and benefits gained by villagers are not maximized (Green, 2004). Such issues are especially pertinent for Thailand given that off-grid applications accounted for around 30% of Thailand's installed capacity in 2011 (see Figure 3.3.3).

(iii) Flexibility

The Renewable Energy Development Plan (REDP) has enumerated the renewables targets for Thailand up until 2022, and will, in a sense, provide the blueprint for the development of the Thai renewables sector. However, the plan by itself does not imply an inflexible approach as the targets do not constitute upper limits and are subject to revision. For example, as mentioned earlier, the REDP solar capacity in 2022 was revised upwards to 2,000 MW from the previous target of 500 MW.

The same appears to be true for the adder tariffs. The Energy Policy and Planning Office (EPPO) revised the tariffs in 2006, due to the lack of uptake, and again in 2009 and 2011 in response to oversubscription. The EPPO recently terminated adder tariffs, a special rate given to private renewable energy producers to promote the sector, and a new feed-in tariff is in preparation. Apart from reducing the tariff rate, stricter approval criteria were implemented in 2009 as well as a provision for the termination of projects which are unable to meet the timelines specified in their contracts (Tongsopit, 2011).

Whilst the ability to revise targets, tariffs and conditions provides the government with some flexibility to react to changing conditions, this sort of flexibility also imposes costs on investors, especially when such changes are not based on criteria that can be predicted. Renewable energy projects across the board require high upfront capital expenditure and are therefore very sensitive to changes in risk (because risk affects the cost of capital). While providing important flexibility to government to balance costs and benefits as new information emerges, the flexibility of Thailand's incentives and renewables targets might be at cross purposes with the recognized fact that the renewables targets will only be met if there is sufficient private sector investment.

A Renewable Energy Standard, as is being considered in Thailand, would provide added flexibility, leaving predictions about which renewable technologies may best achieve emissions reduction objectives to the market rather than requiring that the government regularly change tariffs, conditions and targets for specific RE technologies as technologies and relative prices change.

ADMINISTRATIVE AND POLITICAL VIABILITY

(iv) Transparency

In planning new policies, Thai government agencies follow standard procedures for conducting public hearings with relevant stakeholders.[226] Stakeholders include specialists, academics, suppliers and users (public) and about 3 to 4 public hearings are held. Before the policies/laws are imposed, they are announced 1 year in advance. Following the implementation of policies, the agency responsible (which in the case of renewables policy is the DEDE) monitors and evaluates the policies. Agencies obtain feedback by conducting focus group discussions and fine-tune policies every 3 to 5 years if needed.

The Thai authorities provide information to the public on renewable energy potential. Examples of databases include biomass, wind, solar energy potential, micro-sitting information and information on equipment suppliers (Sutabutr, Choosuk and Siriput, 2010). However, information on renewable energy programs and their environmental impacts is not readily available (Uddin, Taplin, and Yu, 2010).

A visit to the websites of key institutions such as the DEDE revealed that relevant information was not available or out of date. It must be noted, however, that this observation was true for the websites in English and this may not be true for information in Thai. Nevertheless, given the international nature of the renewable industry, the lack of a well-structured English-language interface might pose an impediment to the development of the Thai renewables sector.

(v) Alignment

There are several agencies that have a say with respect to renewable energy policy. The Ministry of Energy is in charge of energy activities in general but shares responsibility with other bodies as follows:

- the National Energy Policy Council (NEPC), a cabinet-level agency prepares guidelines for the implementation of the energy program, while its executing body, the Energy Policy and Planning Office (EPPO), recommends economy-wide energy policies and planning.
- the Department of Alternative Energy Development and Efficiency (DEDE) promotes the efficient use of energy, monitors energy conservation activities, explores alternative energy sources, and disseminates energy-related technologies.
- the Department of Energy Business (DEB) regulates energy quality and safety standards, the environment and energy security, and improves standards to protect consumers' interests.
- the Department of Mineral Fuels (DMF) facilitates energy resource exploration and development.
- the Energy Regulatory Commission (ERC) is responsible for regulating the energy sector.

At present it is not clear whether there is effective coordination across these agencies as well as more broadly across government, NGOs, and multilateral agencies.[227] Since energy planning is decentralized in Thailand, obtaining the necessary information from different agencies can be an issue. Furthermore, there

[226] This information was gleaned from the interviews that we conducted with members of the Department of Alternative Energy Development and Efficiency, Thailand (19 Jan 2012) and with academics from the Joint Graduate School of Energy and Environment (20 Jan 2012).

[227] See, for instance, REEEP (2010).

is often resistance to planning and implementing policies. This happens due to the different perspectives of each of the concerned organizations; even if they have the same end goal, they might not always agree on the processes to reach the target.[228] For instance, while the DEDE was created in 2002 for the sole purpose of promoting renewable energy and energy efficiency, it is unclear how conflicts with other agencies may be resolved when they arise. Furthermore, the extent of overlapping work done by the organizations is unclear.[229] Researchers such as Uddin et al. (2006) have noted that more concerted coordination would be required amongst concerned ministries and departments in monitoring and evaluating the progress of Thailand's renewables program.

[228] This information was gleaned from interviews conducted with officials from the Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, Thailand (19 Jan 2012).

[229] Personal Communication (19 Jan 2012), Prof Surapong Chirarattananon, Asian Institute of Technology, Thailand.

3.3.3 Concluding Remarks

The technical potential for solar energy is high in both Australia and Thailand. Australia has the highest average solar radiation per square meter of any continent, while half of Thailand's land area enjoys high levels of solar radiation. There is thus a scientific basis for policies supporting the development of solar PV in both economies.

Solar PV is, however, expensive relative to alternative sources of energy. The estimated cost of abatement of greenhouse gases from solar PV in Australia is approximately in the range of US $430–1040 per tonne of CO_2e, while the abatement cost from solar PV in Thailand is US$ 417 per tonne of CO_2e.

Given the high costs of solar PV, solar subsidies and feed-in-tariffs impose a significant price burden on consumers and are unlikely to be justified from a financial cost-benefit perspective in either economy, especially since there are cheaper alternative abatement options: in Australia, for instance, the average cost of abatement from renewable energy sources is in the range of US $30–$70 per tonne of CO_2e. Moreover, such schemes do not respond automatically to changing market conditions, meaning that they are modified and revised on a regular basis by the government in both economies. This has created an uncertain environment for investors in the industry.

Technology-neutral policies, which do not discriminate between different technologies, perform better from a cost-benefit perspective. For instance, the Renewable Energy Target adopted in Australia sets an overall target for electricity generation from renewables and allows the market to choose the cheapest mix of renewables to meet the target. Australia's carbon pricing regime goes still further, allowing the market to choose the measures (whether renewable energy or energy efficiency) that allow greenhouse gas abatement to be carried out at the lowest cost. The adoption of such technology-neutral policies is recommended for Thailand, though care should be taken to ensure that the policies adopted are not overlapping or duplicative. In Australia, for instance, the fact that the Renewable Energy Target and the carbon pricing regime duplicate each other is likely to raise the cost of abatement without adding measurably to the total level of abatement. The Renewable Energy Target should therefore be phased out once the carbon pricing regime is operational in Australia.

Australia's regulatory policies have contributed to significant growth in the solar PV industry, largely in on-grid residential scale systems. The evidence suggests that the benefits of small scale solar PV subsidies and feed-in tariffs (FiTs) have come at a high cost and government objectives in terms of greenhouse gas emission reductions and the development of the renewable energy sector could have been achieved at lower cost through broad market based instruments such as an economy wide carbon pricing scheme.

The subsidies provided by Thailand have encouraged rapid growth in Thai solar installations. However, the promotion of the industry has come at a large cost in terms of the tariff burden on consumers. Because of the high costs and concerns about the impact on electricity consumers, the Thai government has often changed the regulations and tariffs governing the industry. This has adversely impacted investor confidence. Furthermore, if the aim of promoting the industry was the reduction of emissions, the high cost of solar PV relative to other alternatives makes it a very expensive option in Thailand.

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