

ENERGY EFFICIENCY  
PROGRAMMES IN  
DEVELOPING AND  
TRANSITIONAL  
APEC ECONOMIES

**2003**

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## FOREWORD

Most APEC economies have implemented programmes of one kind or another to enhance the efficiency of their energy use. The potential benefits in terms of lower energy costs, enhanced energy security, and reduced environmental impacts are widely understood. However, there have always been significant barriers to achieving these benefits, among which are lack of motivation, information, expertise and financing. Thus, programmes aimed at addressing and surmounting these barriers are vital to both economic well-being and sustainable development.

Developing and transitional APEC economies are often growing rapidly from relatively low levels of output, income and energy use. Thus, energy efficiency programmes can be particularly valuable to them as a means of harbouring scarce financial and energy resources. Yet their energy efficiency programmes are much less often discussed and analysed than those of more developed economies, and hence much less well understood. Through a systematic presentation of these programmes, the outlines of a successful approach to promoting energy efficiency may emerge.

The present document follows up on several earlier works related to energy efficiency indicators. It is published by APERC as an independent study and does not necessarily reflect the views or policies of the APEC Energy Working Group or individual member economies. But we hope it will serve as a useful basis for discussion as energy efficiency programmes move forward.



Masaharu Fujitomi  
President  
Asia Pacific Energy Research Centre

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## LIST OF ABBREVIATIONS

Following are a few abbreviations used in this report, many of which are of a technical nature. Abbreviations of most institutions and organisations in APEC economies are defined in the text.

APEC	Asia-Pacific Economic Cooperation
APEREC	Asia Pacific Energy Research Centre
Bcm	billion cubic metres (one thousand Mcm)
cc	cubic centimetre
CHP	combined heat and power
CFL	compact fluorescent lamp
DCS	district cooling system
DSM	demand-side management
EER	energy efficiency ratio
EMC	energy management company
ESCO	energy service company
gce	grammes coal equivalent
GDP	gross domestic product
GJ	gigajoule (one billion joules or one thousand MJ)
GW	gigawatt (one billion watts or one million kW)
GWh	gigawatt hour (one billion watt-hours or one million kWh)
HVAC	heating, ventilation and air conditioning
kcal	kilocalories
kgce	kilogrammes coal equivalent
km	kilometres
kW	kilowatt (one thousand watts)
kWh	kilowatt hour (one thousand watt-hours)
Mcm	million cubic metres
MEPS	minimum energy performance standard
mg	milligrammes
MJ	megajoule (one million joules)
Mkcal	million kilocalories
Mt	million tonnes
Mtoe	million tonnes of oil equivalent
MW	megawatt (one thousand kW)
MWh	megawatt hour (one thousand kWh)
PAC	port of attention
Tcal	trillion calories (one billion kcal or 100 toe)
TJ	terajoule (1 trillion joules or one thousand GJ)
toe	tonne oil equivalent (ten million kcal)
TOU	time-of-use
TWh	terawatt hour (one trillion watt-hours or one billion kWh)
UNDP	United Nations Development Programme
VSD	variable-speed drive
WACS	water-cooled air conditioning system

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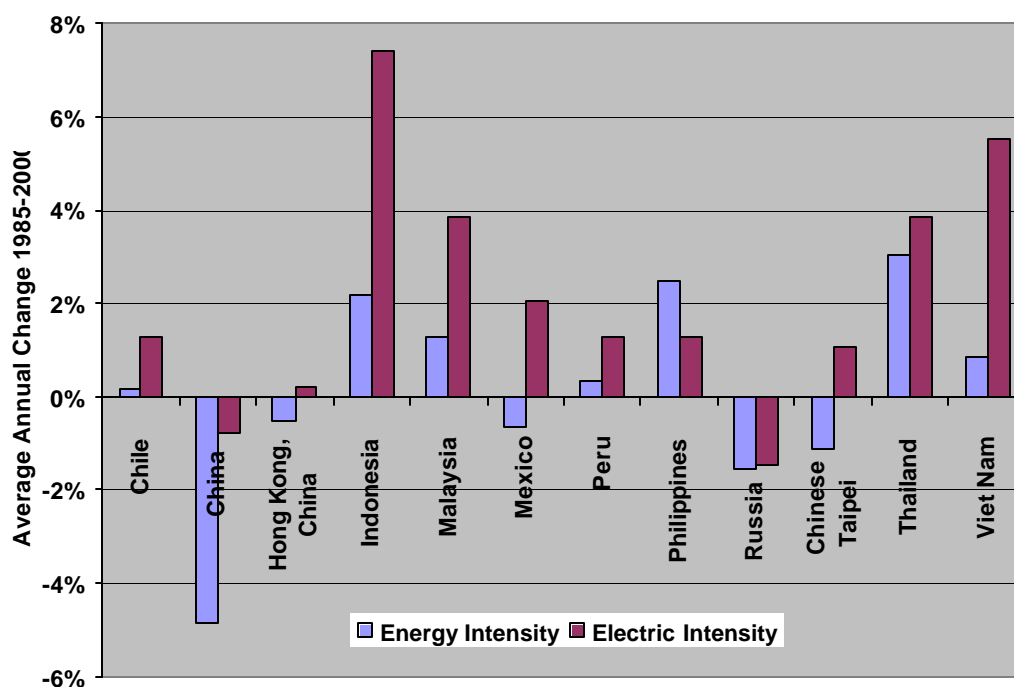


# INTRODUCTION

## GROWING ECONOMIES, GROWING ENERGY USE

Energy efficiency programmes in developing and transitional APEC economies are taking place against a background of significant growth in economic output, energy use, and electricity use. Almost all of these economies have shown substantial increases in their electricity intensity, or ratio of electricity demand to gross domestic product (GDP). Some have also experienced clear increases in their energy intensity, or ratio of overall primary energy demand to GDP. Thus, as output has increased, energy use has also increased and electricity use has increased a lot.

**Figure 1 Energy Intensity and Electric Intensity in Developing APEC Economies**



Source: Institute of Energy Economics, Japan

Among developing and transitional economies, the following groupings may be noted:

- Very rapid growth in electric intensity with substantial growth in energy intensity may be said to characterise Indonesia, Malaysia, Thailand and Viet Nam. Of these economies, Indonesia and Malaysia are major oil and gas exporters, while Thailand and Viet Nam are largely self-sufficient in their energy supply. Thus, the value of energy efficiency programmes for these economies would lie not so much in enhancing security of energy supplies as in raising the amount of energy available for export.
- Substantial growth in electric intensity or energy intensity could be said to characterise Mexico and the Philippines. Mexico has experienced substantial growth in electric intensity but a slight decline in energy intensity. The Philippines have had substantial growth in energy intensity and modest growth in electric intensity. Both of these economies have substantial energy resources but also large populations and energy consuming sectors. So energy efficiency programmes might help both to raise energy exports and to reduce energy imports.

- *Little change in energy intensity or electricity intensity* has been seen in Chile, Hong Kong, Peru, or Chinese Taipei. In these economies, both energy and electricity consumption have grown in pace with economic output. Except for Peru, they import most of their energy requirements. Thus, energy efficiency programmes could be a valuable way for these economies to improve energy supply security.
- *Very rapid or substantial decline in energy intensity or electric intensity* has been seen in the transitional economies of China and Russia. As these economies have restructured, much of the energy consumption that had gone into unprofitable state enterprises is no longer taking place. In China, energy use per unit of output has declined dramatically, but electricity use per unit of output has not. In Russia, energy and electricity use per unit of output have both declined steadily.

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### TYPES OF ENERGY EFFICIENCY PROGRAMMES

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All of the developing and transitional APEC economies have undertaken energy efficiency programmes of some sort. Many programmes are directed at raising the efficiency of energy and electricity use in residential and commercial buildings. Others are directed at raising the efficiency of energy-intensive industry or transport. Still others are broad informational and training efforts to raise the readiness of society to implement efficiency measures in a range of economic sectors.

**Building sector** energy efficiency programmes include the following categories:

- Building codes regulating the energy efficiency of building shells or overall energy use per unit of square area of residential or commercial floors space;
- Appliance efficiency standards which prescribe the minimum energy efficiency of household appliances and office equipment;
- Appliance efficiency labels which inform consumers about the energy efficiency or energy consumption of appliances so that they can make more intelligent choices among them;
- Financial incentives for construction of energy efficient buildings or purchase of energy-efficient equipment;
- Information on best practices in building design and construction.

**Industrial sector** efficiency programmes are of several types including:

- Equipment efficiency standards prescribing the minimum energy efficiency of various types of industrial equipment;
- Energy audits to identify potential areas for energy efficiency improvement;
- Financial incentives to make or install energy-efficient equipment and processes;
- Voluntary agreements for raising energy efficiency in particular industries;
- Demand-side management efforts to reduce electricity demand and peak load.

**Transportation sector** efficiency programmes include the following:

- Vehicle efficiency standards for distance travelled per unit of fuel;
- Taxation of vehicles to encourage the purchase of more energy-efficient models;
- Taxation of fuel to encourage the more efficient use of existing vehicles;
- Promotion of fuel-efficient public transport modes like trains, buses and bicycles.

This report aims to summarise the energy efficiency efforts that are taking place in APEC's developing and transitional economies and to suggest ways in which they might be enhanced.

# ENERGY EFFICIENCY IN BUILDINGS

## INTRODUCTION

Energy efficiency programmes in the buildings sector face particular challenges associated with the nature of residential and commercial energy consumers. For typical households and many small businesses, energy expenditures are a small share of overall expenditures. In addition, energy efficiency measures may entail a greater or lesser degree of inconvenience, disrupting household or business activity. Thus, the incentives to undertake cost-saving energy efficiency measures may be limited even in the case of measures that would pay themselves back in a very short period of time.

A number of strategies have been tried by governments to cope with these challenges. Building codes which specify maximum energy use per unit of floor area or otherwise regulate overall building energy use can compel the purchase of homes and offices that use less energy for heating, cooling and ventilation. Similarly, efficiency standards which prescribe the minimum efficiency of household appliances and office equipment sold on the market can be used to compel the purchase of energy-efficient devices. If compulsion is deemed unwarranted, efficiency labels which accurately indicate the energy use of buildings, appliances and office equipment can help consumers make better choices about which ones to buy. Finally, financial incentives for the construction of energy efficient buildings or purchase of energy-efficient devices may influence consumer choice.

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## APPLIANCE EFFICIENCY STANDARDS AND LABELS

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Energy efficiency standards and labels have been recognised by ministers of the Asia Pacific Economic Cooperation (APEC) as a promising approach to raising energy efficiency. At their meeting in San Diego in May 2000, APEC energy ministers endorsed an Energy Standards and Labelling Cooperative Initiative to promote this approach. Standards and labels are seen not only as a means of enhancing energy efficiency in individual economies, but also as a way of expanding trade in and use of energy efficient products throughout the APEC region. In this light, a Steering Group on Energy Standards (SGES) has been established to work on harmonising energy testing standards in order to help reduce barriers to trade among APEC economies.

Energy efficiency standards and labels have also been endorsed by the Association of South East Asian Nations (ASEAN). The ASEAN Plan of Action for Energy Cooperation 1999-2004 includes the development of an energy efficiency standards and labelling system for the ASEAN region. By providing information on product energy use according to a common measure, the system should enhance consumer understanding and lead to greater demand for energy-efficient products in the marketplace. An ASEAN energy efficiency standards and labelling group organised by the ASEAN Centre for Energy (ACE) agreed on a voluntary label for magnetic lamp ballasts which ASEAN's 20<sup>th</sup> Energy Ministers meeting endorsed in Bali in July 2002. The group was also expected to arrive at voluntary labels for air conditioners, refrigerators and freezers in 2003.

Most developing and transitional economies in APEC have adopted energy efficiency standards or labels of some sort. However, there is considerable variation in the range of appliances and equipment that is covered, as well as in the balance between voluntary and mandatory measures. Efficiency standards and labelling programmes in APEC economies fall roughly into three groups:

**Table 1 Efficiency Standards and Labels in Developing and Transitional Economies**

APEC Economy	Air Conditioners	Refrigerators and Freezers	Lighting Equipment	Clothes Washers and Dryers	Cooking Equipment	Water Heaters	Office Equipment
Chile	O O	O O	O O O ML	O O	O O	O O	O O
China	MS VL	MS VL	MS VL MS cl	MS VL	O VL	O cl	
Hong Kong	cs VL	cs VL	cs VL cs VL	O VL	O VL	O VL	
Indonesia	cs VL	cs VL	cs O cs O	O O	cs O	O O	
Malaysia	O O	O O	MS O O O	O O	O O	O O	
Mexico	MS ML	MS ML	MS VL MS ML	O O	MS ML	O O	
Peru	O O	cs cl	VS ML O O	O O	cs cl	O O	
Philippines	MS ML	cs ML	O ML O cl	O O	O O	O O	
Russia	MS O	MS O	O O cs O	MS O	MS O	MS O	
Chinese Taipei	MS VL	MS VL	MS VL O VL	O VL	MS VL	O VL	
Thailand	cs VL	cs ML	cs VL O VL	O cl	O O	O VL	
Viet Nam	cs cl	O cl	cs cl O cl	O O	O cl	O cl	

KEY: MS = Mandatory Standard VS = Voluntary Standard ML = Mandatory Labelling VL = Voluntary Labelling  
 cs = considering standard cl = considering labelling O = no standard or labelling, none under consideration

Sources: APEC Energy Standards Information System, World Energy Council Survey on Energy Efficiency Policy Measures

- **A range of mandatory efficiency standards** can be observed in China, Mexico, Russia and Chinese Taipei. Mexico also has mandatory labels on most appliances to which efficiency standards apply. China and Chinese Taipei have voluntary labelling, and Russia has no labelling at all.
- **A range of efficiency labelling** can be seen in Hong Kong, Indonesia, the Philippines and Thailand. Labelling is mandatory in the Philippines and generally voluntary in the other economies, though also mandatory for refrigerators and freezers in Thailand. Standards exist as well for air conditioners in the Philippines and are being considered for several appliances in Hong Kong and Thailand.
- **Efficiency standards or labels are absent or very limited** in Chile, Malaysia, Peru and Viet Nam. Chile has only mandatory labels for clothes dryers. Malaysia has only mandatory standards for compact fluorescent lamps (CFLs). Peru has voluntary standards and mandatory labels for CFLs. In Viet Nam, efficiency standards and labels are under consideration for application by 2005.

In broad terms, then, the APEC economies seem to have adopted two different approaches. One approach, followed by China, Mexico, Russia and Chinese Taipei, emphasises the application of mandatory efficiency standards, with or without labels. Another approach, followed by Hong Kong, Indonesia, the Philippines and Thailand, relies primarily on providing information to consumers through efficiency labelling. The philosophy here generally seems to be that businesses making more efficient products will want to put labels on them because it will boost their profits. Standards and labels have been found to be effective means for accelerating the penetration of energy efficient appliances and equipment into the marketplace. They have apparently yielded measurable reductions in energy use, electricity use, and environmental impacts. Probably they have also facilitated trade of energy-efficient products among APEC economies that utilise them.

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## BUILDING CODES

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Most APEC economies have building codes that regulate the energy consumption of buildings in one way or another. However, the approaches taken vary considerably. Some economies have adopted a voluntary approach to compliance with building codes, while others have adopted or moved towards a mandatory approach. Many building codes apply just to commercial buildings, while some apply to residential buildings instead or in addition. Several building codes are quite comprehensive, applying to a broad range of building types, while some apply to only a few types of buildings. Some building codes specify a high level of energy efficiency, while others have weak requirements that probably have little influence on actual construction practices. Finally, most building codes specify the performance characteristics of particular building systems, but at least one code specifies maximum building energy consumption per unit of floor space instead.

**Mandatory codes for both residential and commercial buildings** are in place in Chinese Taipei. Maximum energy consumption per unit of floor space is specified by the energy-saving design code for office buildings, department stores, shopping centres, hotels, hospitals, and residential buildings. Energy consumption indexes for building envelopes and air conditioning systems, together with building inspection and testing systems and energy audit programmes, are used to measure progress toward energy efficiency.

**Mandatory codes for commercial buildings only** are in place in Mexico, the Philippines and Thailand. The codes apply to major systems such as building shells, lighting systems and air conditioning. In the Philippines, the codes were instituted on a mandatory basis immediately in 1994, while in Thailand they were initially voluntary in 1994 before becoming mandatory in 1995. Mexico put codes in place for lighting systems in 1995 and building shells in 2001. In the Philippines, the codes apply only to new buildings with energy consumption of greater than 10 watts per square metre. In Thailand, they apply to both new and existing buildings with an energy consumption rate greater than 1 megawatt; building shells must limit the rate of energy use per square metre for heating and cooling to 55 watts in existing buildings and 45 watts in new buildings. In Mexico, the building shell code applies to all new buildings and extensions to existing buildings, while the lighting systems code applies only to those with more than 20 kilowatts of electric load. Mexico also expects to issue a residential building shell code around the end of 2003.

**Voluntary codes for commercial buildings** are in place in Hong Kong, Indonesia, and Malaysia. Like mandatory codes, voluntary codes apply to major systems like building shells, lighting and air conditioning. In Malaysia, mandatory building codes have also been drafted by the housing ministry but have not yet been adopted. In Indonesia, the codes have not been widely adopted by builders or designers. In Hong Kong, China, electrical systems and lifts and escalators are covered by the codes, but building shells are not. A promising approach adopted in Hong Kong is to issue certificates for buildings that meet the codes as well as logos that can be displayed for publicity purposes; the approach has been well received by developers, architects and engineers.

**Codes for residential buildings but not commercial buildings** exist in Chile and Russia. The code in Chile is still under development; an efficiency standard for construction of roofs was issued in 2000, while efficiency standards for walls windows and flooring were expected in 2003. The code in Russia applies to public buildings as well as residential buildings. Thirteen regions of the Russian Federation have adopted building codes that provide for the same energy efficiency as federal building codes but allow greater flexibility in design, building envelopes and equipment.

**Buildings codes are weak or non-existent** in China, Peru and Viet Nam. China has building codes for four different climate zones, but they do not provide for a high degree of energy efficiency. However, stricter efficiency building codes have been implemented in a few regions and are being considered for broader application based upon building technology guidelines that have already been issued. Viet Nam plans to establish building energy efficiency standards by 2005 under its electric demand-side management programme.

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## FINANCIAL INCENTIVES

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Several APEC economies provide financial incentives for the installation of energy-efficient materials and equipment in buildings. These may take the form of tax breaks for purchase of energy-efficient items, penalties for failure to install such items, incentive payments for the purchase of such items, or even the free installation of such items. Interestingly, two of the economies with some of the weakest building codes, China and Viet Nam, have some of the strongest incentives for the purchase and installation of energy-efficient materials and equipment in buildings.

**Tax exemptions** are a key feature of financial incentives for efficient buildings in China and Chinese Taipei. In parts of China with hot summers and cold winters, investments in energy efficient buildings are exempted from fixed asset investment taxes and city facility fees. In addition, facilities used to produce energy-efficient wall materials are exempted from land-use tax. In Chinese Taipei, investment in efficient buildings, like investment in efficient industrial equipment, can receive tax credits of 5 to 20 percent against income, as well as accelerated depreciation.

**Penalties** are also an important feature of financial incentives for building efficiency in China. Between October 2002 and December 2005, all agencies that construct new buildings or retrofit old buildings without using efficient new wall materials must pay a penalty of up to RMB 8 per square metre of their total floor space. The funds raised are then used to subsidise projects for research, development, demonstration, deployment and production of efficient new wall materials.

**Incentive payments for the purchase of efficient equipment** are noteworthy in Viet Nam and Indonesia. To encourage use of compact fluorescent lamps (CFLs), Electricity of Vietnam (EVN) provides a subsidy to customers for replacing bulb lamps of US\$1.50 in the first year, US\$1.00 in the second year, and US\$0.60 in the third year, and guarantees CFLs for one year. In Indonesia, a discount of 3,000 rupiahs was offered during 2003 for the purchase of each of up to three CFLs, with a target of selling 5 million energy-efficient lamps. Such incentives should help to overcome barriers of high initial cost for CFLs and lack of public awareness of CFL benefits.

**Incentive payments for acceptance of direct load controls** are also used in Viet Nam. These payments are aimed at limiting heating and air conditioning loads in commercial buildings at times of peak electricity demand. Some 2000 large customers, with an average load of about 10 kilowatts each, were offered an annual payment of US\$25 to accept direct load controls. These load controls are expected to last an average of 15 minutes over a 2-hour period each year.

**Free installation of energy-efficient appliances** is a key programme approach in Mexico and Indonesia. In Mexico, various programmes have funded the installation of 8.6 million CFLs and over 19,000 efficient new air conditioning units, as well as the insulation of some 74,000 homes. A specialised programme is aimed at installing more efficient refrigerators and air conditioners, along with CFLs and better insulation, in cities with a hot climate. In Indonesia, efforts have included the installation of 100,000 CFLs in residential and commercial buildings (of which 40,000 were sold), and 60,000 efficient lamps and ballasts in commercial and public buildings (of which 24,000 were sold with rebates), as well as 15,000 energy-efficient street lamps.

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## ENERGY MANAGEMENT AND AUDITS

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Several APEC economies attempt to bridge the gap between energy efficiency opportunities and realities in the buildings sector by helping building owners and operators manage energy use. While many energy efficiency measures for buildings are technically feasible and cost-effective, building owners often lack the information and expertise to implement most or all of these measures by themselves. The gap between what they would benefit from doing and what they are able to do can be narrowed significantly through energy efficiency audits and other management services that are typically provided by energy service companies (ESCOs).

ESCOs can provide a full range of energy management services including:

- **Energy efficiency audits** or technical assessments to evaluate opportunities for cost-effective energy efficiency measures in particular buildings;
- **Consulting services** or information to assist building owners and operators in choosing which energy efficiency measures to implement;
- **Installation** of efficiency measures that building owners or operators select;
- **Financing** for the energy efficiency measures that are chosen;
- **Performance guarantees** for the efficiency measures that are chosen.

Typically, the ESCO will finance all or most of the cost of the measures chosen, obtaining a return on its investment through a share of the value of resulting energy savings over a defined period of time. After the measures are installed and the agreed period of time has elapsed, the value of all remaining energy savings accrues to the building owner. Basically, most of the thinking and all of the work is done by the ESCO, so informational and motivational barriers to installing efficiency measures are lowered significantly. In addition, the building owner's capital remains free for other ventures, eliminating any financial barriers to installation of efficiency measures as well.

Among the developing and transitional APEC economies, Malaysia and the Philippines have both implemented a fairly comprehensive set of energy management services through ESCOs. In Chinese Taipei, however, ESCOs offer only part of the range of potential services, being limited to energy efficiency audits and consulting services for planning and designing buildings to incorporate efficiency measures. In Thailand, the role of ESCOs is mainly confined to energy efficiency audits.

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## INFORMATION AND EDUCATION

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Some APEC economies have aggressive programmes of information and education to increase public awareness of the opportunities for cost savings through energy efficiency.

In Peru, several different approaches are taken to increase awareness of energy efficiency:

- Energy efficiency educational programmes in elementary schools;
- Publicity and informational campaigns through the media to inform the public of efficiency options available and help create an energy efficiency culture;
- Printed materials and telephone information on ways to reduce electricity bills.

In Malaysia, the main approach to providing information on energy efficiency opportunities to the public is through cooperation with building service consultants, manufacturers and suppliers. This approach has aided the market penetration of numerous energy-saving technologies such as compact fluorescent lamps (CFLs), more efficient fluorescent tubes and ballasts, low-voltage quartz halogen lamps with special reflectors to enhance light output, and air conditioning plants that incorporate multi-compressor chillers, variable air volume systems and other advanced features. It has also speeded the deployment of ice storage in air conditioning systems to reduce peak power demand, as well as power factor correction capacitors to reduce reactive power demand.

In Hong Kong, Mexico and Chinese Taipei, informational efforts related to energy efficiency rely heavily on the internet. In Hong Kong, a website has been developed with information on energy efficiency of different building designs, appliances and equipment, as well as test results from energy efficiency programmes. In Mexico, "ports of attention" or PACs have been set up in public high schools to provide technical assistance on energy efficiency through a government web page, help energy users identify the energy savings potential of specific measures, and help establish the economic and financial feasibility of particular energy efficiency projects. In Chinese Taipei, the Energy Commission's website has information on energy-saving practices for households, offices, and many kinds of appliances, as well as on energy efficiency standards, energy audits, energy-saving services, and training programmes for energy professionals.

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## TECHNOLOGY DEVELOPMENT

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In Chinese Taipei, an advanced energy-efficient refrigerator has been developed through cooperation between the Energy and Resources Laboratory and a local manufacturer. Its energy efficiency in 1999 was 23 percent higher than that of a baseline model in 1997. Energy-efficient features include a high efficiency compressor, vacuum insulation panel, high leak-protected gasket, and photoelectric automatic defrosting sensing system. Further technology development aims to raise refrigerator efficiency by another 30 to 40 percent. The Energy and Resources Laboratory also works to raise the efficiency of other appliances such as lamps and air conditioners.

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## DISTRICT HEATING

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China has several programmes to promote district heating, in order to obtain the efficiency benefits of district heating systems and combined heat and power (CHP) systems. The heat efficiency is typically around 70 percent for the large boilers used in district heating systems and 80 percent for CHP plants, far above the 50 percent efficiency of the small-scale boilers they replace. These programmes, which were set forth in 1998 and revised in 2002, have the following elements:

- Local governments are requested to consider CHP systems when planning for heat supply needs, electric power needs, and environmental protection.
- CHP plants are required to meet minimum standards for thermal efficiency and the ratio of heat production to electricity output, which vary depending upon generator type and capacity.
- New and enlarged cogeneration plants can be exempted from fees for connecting to the power grid, and power utilities are enjoined to sign power purchase agreements (PPAs) with such plants.
- Boilers with a capacity of 20 tonnes per hour or greater that are used more than 4,000 hours per year should be retrofitted to cogeneration if it is profitable.
- In regions with CHP facilities or district heating networks, the operation of smaller and less efficient boilers is forbidden by government regulation.
- New residential buildings are requested to install heat meters for each household so that the full value of CHP systems can be realised.
- Incentives are provided for combined cycle gas turbines in cogeneration plants.

By the end of 1998, more than two-fifths of China's 668 cities had district heating supply facilities. In these facilities, slightly over a third of steam and hot water came from district heating boilers that produce heat only, while nearly two-thirds came from CHP systems that also produce electricity. District heating plants provided space heat to 807 million square metres of building space, accounting for nearly one-eighth of total floor space with space heating in China.

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## PUBLIC BUILDINGS

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Public buildings owned and operated by federal, provincial and municipal governments can be an attractive target for government energy efficiency programmes. Typically, the potential energy and budgetary savings are substantial in both absolute and relative terms. And because efficiency measures can be implemented by the governments directly, there is no need to engage individual building owners and operators to put the measures in place. However, there may still be a need to assist various government agencies with technical assessments of energy savings potential in their buildings and to train such agencies in operational changes that can reduce energy requirements.



Public buildings in developing and transitional APEC economies typically account for a limited but not insubstantial percentage of overall building energy use:

- In China, energy use by government agencies and publicly funded facilities such as military installations, hospitals, schools, universities and research institutes accounts for roughly 5 percent of total energy consumption.

Within the public buildings subsector, potential energy savings are often very significant:

- In Hong Kong, China, it is estimated that energy use in government buildings could be reduced by 30 percent through the applications of technologies such as energy optimisers in escalator motors, intelligent control systems for lifts, efficient fluorescent lamps, room occupancy sensors to turn off equipment when offices are empty, and indirect evaporating heat recovery units for air conditioners.
- In Mexico, the National Energy Savings Commission, CONAE, has estimated that electricity consumption in public buildings could be reduced by 21 percent through the application of more efficient lighting systems.
- The Philippines Enercon programme that was launched in December 2000 requires all government agencies, bureaus and offices to reduce their annual electricity and fuel consumption by at least 10 percent.
- Russia has set a target to reduce energy consumption in federal government buildings by 14 to 16 percent between 2000 and 2005 through the application of mandatory energy efficiency standards.

Indeed, the actual energy savings achieved have often been significant:

- Some 342 participating public buildings in Mexico were able to reduce their energy consumption by an average of 12 percent between 1998 and 1999, with average year-on-year monthly declines of 13 percent between 1998 and 2000.
- Of 215 buildings in Mexico with energy efficiency retrofits, about one-fifth were able to reduce their electricity consumption by 20 percent between 1998 and 2000.

Moreover, the payback period for energy efficiency investments in public buildings is often very short, indicating a high rate of return on public expenditure:

- In Hong Kong, China, the Energy Efficiency Office has estimated that the payback period is 3 years for electronic ballasts used in lighting systems and 4 years for variable speed drives used in air conditioners.
- In Mexico, the average payback period for efficiency improvements in the lighting systems of public buildings is estimated to be just 17 months.

Among the economies surveyed, perhaps the most thoroughgoing programme for energy efficiency in public buildings can be found in Mexico. This programme, which is mainly targeted at office buildings, hospitals and schools, has several key features:

- The programme focuses on both technical measures, which involve upgrading or replacing obsolete equipment with more energy-efficient equipment, and operational measures, which involve changes in operating procedures.
- The programme has expanded gradually, initially involving 100 public buildings in its pilot stage in 1996, expanding to 342 buildings in 1998 (including all buildings with at least 5,000 square metres of floors space and electricity consumption of at least 60 kWh per square metre per annum), and further expanding to 877 buildings in 2001 (including all those with 1,000 square metres of floor space or more).
- Each building sets up an energy savings committee to coordinate programme implementation, but larger and more energy-intensive buildings also provide quarterly progress reports and participate in designated courses and workshops.

- A central technical committee for the energy savings programme systematically monitors the progress of participating agencies, with each agency reporting annually on how much it has been able to reduce energy consumption and also reporting quarterly on specific energy efficiency actions that have been taken.
- The programme has a heavy emphasis on training, showing high-level agency officials how to set up energy efficiency programmes in their areas of responsibility and giving building operators tools to help them assess opportunities for efficiency improvement and to operate their facilities more efficiently. Distance learning, making use of videoconferencing technology, is a key feature of training efforts.
- The internet is used to provide building operators not only general information on energy efficiency options, but also specific evaluations of which options would work in their buildings. Building operators perform equipment assessments and transmit them to CONAE, whose software is used to generate specific efficiency improvement recommendations which are sent back to the building operators.

In summary, a broad range of economies surveyed have implemented energy efficiency programmes for public buildings. These have yielded measurable energy savings while reducing peak electricity loads and requirements for new electric generating capacity. In addition, they have produced significant net cost savings for governments, reducing pressures on public budgets.

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# ENERGY EFFICIENCY IN INDUSTRY

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## INTRODUCTION

Energy efficiency programmes for industry face a much different set of circumstances than those that prevail in the buildings sector. For industrial consumers, energy expenditures often constitute a major share of overall expenditures. It follows that industrial consumers usually have to pay attention to their energy costs in order to stay in business. Moreover, production processes and associated patterns of energy use differ substantially, so particular industries often have specialised expertise that is essential to identifying and implementing the full range of potential energy efficiency efforts. This is especially likely to be the case for large, energy-intensive enterprises and may also hold to some degree for smaller, less energy-intensive industrial firms.

In this context, voluntary industry roadmaps for raising energy efficiency are a promising approach that can harness industry's natural profit motive to reduce energy costs as well as the special expertise of each particular industry in finding ways to do so. Other approaches that governments have tried to improve industrial energy efficiency include equipment standards and labels, financial incentives, energy management and audits, combined heat and power systems, efficiency programmes in public enterprises, and demand-side management efforts by public power utilities. These are similar to approaches in the buildings sector but can be implemented differently.

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## EQUIPMENT EFFICIENCY STANDARDS AND LABELS

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Energy efficiency standards and labels are used far less for industrial equipment than for building appliances in the developing and transitional economies of APEC. While eight of these economies have significant standards or labels in place for building appliances, only two have standards or labels in place for industrial equipment.

Chinese Taipei has established mandatory energy efficiency standards for industrial motors, boilers, transformers, water chillers and heating, ventilation and air conditioning (HVAC) systems. All of this equipment must be tested by an authorised agency or technician and certified as meeting the standards before it can be imported or sold. The standards call for energy efficiency 5 percent to 25 percent greater than that of average products in service. There is also a voluntary labelling programme in place for transformers, but not for other industrial equipment. In China, there are mandatory efficiency standards and voluntary labels for motors, but no other industrial devices.

Peru has been developing mandatory energy efficiency labels and voluntary efficiency standards for industrial boilers and electric motors. While neither efficiency labels nor standards are yet in place, efficiency testing methods for boilers and motors have been approved as a preliminary step. China has approved efficiency testing methods for a wide range of industrial equipment but has so far used these only for energy auditing and not for implementing efficiency standards or labels.

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## FINANCIAL INCENTIVES

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Several developing and transitional APEC economies provide financial incentives for the installation of energy efficient processes and equipment by industry. These generally take the form of tax breaks such as reduced tax rates on income, tax exemptions or credits for efficiency investments, accelerated depreciation of equipment for income tax purposes, low-interest loans, and exemptions from sales tax, value added tax or import duty.

**Reduced income tax rates** are used to promote industrial energy efficiency measures in Viet Nam. New projects incorporating energy-efficient equipment can receive preferential income tax rates of 15 percent, 20 percent or 25 percent instead of the normal income tax rate of 30 percent.

**Income tax exemptions or credits** are used to promote industrial energy efficiency in Malaysia, Chinese Taipei, and Viet Nam. In Malaysia, energy service companies have been exempted from tax on 70 percent of statutory income over five years for energy efficiency projects they install. Alternatively, they have received an investment allowance of 60 percent of capital expenditures on energy efficiency equipment over five years, to be applied against 70 percent of statutory income. In Chinese Taipei, industrial firms investing in energy conservation equipment can receive investment tax credits of 5 to 20 percent against their income tax. In Viet Nam, energy efficiency projects can receive a complete exemption from tax on profits during the first one or two years of their operation and a 50 percent exemption during the next two years.

**Accelerated depreciation** of energy efficiency investments for income tax purposes is used in Malaysia and Chinese Taipei. In Malaysia, industrial firms making capital expenditures for reducing their own energy consumption can write off the expenditures in three years. In Chinese Taipei, two-year accelerated depreciation applies to industrial energy efficiency investments.

**Exemptions from sales tax, value-added tax or import duty** on energy efficiency investment by industry are provided to industry in China, Malaysia and Viet Nam. China allows a 50 percent exemption from value-added tax on the sale of energy-efficient products, as well as a total exemption from value added tax and import duties for imported equipment that is used to manufacture energy-efficient products. Malaysia provides a sales tax exemption on all equipment and an import duty exemption for imported equipment that is used in energy efficiency projects. Viet Nam exempts energy-efficient equipment and materials from import tariffs if they are used in certain high-technology zones or in designated high-technology projects.

**Low-interest loans** for industrial energy efficiency investments are available in Chinese Taipei. Malaysia has also offered zero-interest loans to finance half the project and equipment costs of four energy service company demonstration projects. Chile has funds to finance investments in clean production processes and environmental protection which include energy efficiency investments.

**Financial penalties** for failure to install energy-efficient industrial equipment are imposed in Chinese Taipei. At least in the case of the largest hundred firms, which are subject to on-site energy audits by the government, firms found to have low energy efficiency are required to improve their energy efficiency within a certain period of time. If they fail to do so, they are subject to fines and are given a new deadline to raise their efficiency. If they fail to meet the new deadline, the fines can be doubled, and energy supplies to the firms can be limited or suspended for up to 30 days.

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## ENERGY MANAGEMENT AND AUDITS

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In the industrial sector, as in the buildings sector, several developing and transitional APEC economies have active energy management and auditing programmes to identify potential energy efficiency measures and put them in place. While industrial firms typically have greater motivation and expertise for installing efficiency measures than building owners do, they can often still benefit from the assistance of energy service companies (ESCOs). The services provided by ESCOs may include energy efficiency audits to evaluate opportunities for cost-effective efficiency measures, installation of efficiency measures that industrial firms select, and financing for these measures. As in the buildings sector, the ESCO will often finance part of the cost of the measures chosen, take a share of the resulting energy savings until the investment has paid itself back with an agreed return, and thereafter leave the remaining energy savings to be enjoyed entirely by the facility owner.

China, Indonesia, Malaysia and Thailand have particularly vigorous energy management and auditing programmes for industrial firms. China's three ESCOs had invested in 30 projects by mid-1999, of which about one-third had already fully recovered their costs through their share of project savings and the other two-thirds were on track to do so as energy cost savings continued to accrue.

Indonesia's ESCO carried out detailed audits of more than 30 large industrial facilities over a five-year period and installed energy-saving equipment in many of them. In Thailand, which provides industrial firms with grants for energy audits and financial support for conservation planning, some 2,500 factories received energy efficiency audits between 1997 and 2002.

The Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP) has completed 48 energy audits in 8 targeted industrial sectors: cement, ceramics, food, glass, iron and steel, pulp and paper, rubber, and wood. It also plans to extend energy audits to the plastic, textile and chemical industries. Audit teams have been formed in each sector, with active participation of industrial firms and associations. Industry-specific energy audit guidelines are being prepared to assist energy professionals in carrying out further audits. With inputs from audits to date, energy efficiency benchmarks have been established in each targeted sector, against which progress may be measured. Thermal and energy monitoring kits are to be made available to all audited factories and other interested industrial facilities to help them monitor energy use in each production process. MIEEIP has a support programme for ESCOs that aims to enhance their technical and business skills and improve the institutional and legal framework in which they operate. As a result, 32 ESCOs have registered with the Malaysian government. Four of these ESCOs have been selected to conduct energy efficiency technology demonstration projects in energy-intensive industries.

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### **INFORMATION AND EDUCATION**

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A few developing and transitional APEC economies have information and training programmes aimed at improving energy efficiency in industry. These appear to be much less prevalent and vigorous than parallel efforts in the buildings sector, probably due to the very substantial expertise that already exists in most energy-intensive industries.

In Malaysia, the government has identified five industrial firms to be trained in the manufacture of energy-efficient motors, boilers, fans and blowers, pumps and heat exchangers, respectively. It is also organising workshops to explain the financial viability of industrial energy efficiency projects to financial institutions. Peru has developed training courses in providing energy efficiency services, as well as manuals and guidebooks on energy efficiency in various industries for use by specialists.

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### **TECHNOLOGY DEVELOPMENT**

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In Chinese Taipei, the Industrial Technology Research Institute (ITRI) has performed research and development related to energy-efficient air conditioning, refrigeration, heat exchange, electro-technology and combustion. The results of its R&D efforts are transferred to local industry to help them use energy more efficiently and thereby to increase their overall productivity.

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### **DISTRICT HEATING**

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China is actively promoting combined heat and power (CHP) systems for industry as it is for buildings. Such systems can provide both electricity and process heat to industry, as well as lower-temperature heat for residential and commercial space heating and water heating. As explained earlier, CHP plants typically have an overall efficiency of around 80 percent, which is much higher than the 50 percent efficiency of the conventional boilers that they displace. Chinese Taipei is also encouraging such systems through tax incentives for their construction, favourable prices for natural gas as their fuel input, and favourable prices for the purchase of their power output.

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## VOLUNTARY AGREEMENTS

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Despite their potential to capitalise on industry profit motives and expertise, voluntary agreements to improve industrial energy efficiency are relatively uncommon in developing and transitional APEC economies. This is partly because some key energy-consuming firms are state-owned firms, whose efficiency efforts are described below in the section on public enterprise.

Probably the most active programme of voluntary agreements in the group of economies surveyed can be found in Chinese Taipei. There, the key energy-intensive iron and steel, chemical, cement, pulp and paper and fibre industries have all been assisted by the government in forming voluntary energy-saving action plans. To help carry out the plans, industries can receive low-interest loans and investment tax credits as described in the section on financial incentives above.

In the Philippines, voluntary industrial efficiency agreements focus on the electric power industry. Private utilities and electric cooperatives are assisted in lowering system losses through technical reviews, system load balancing, thermal scanning of lines, and equipment load management. They are also assisted in improving the availability, output and operational efficiency of thermal power plants, thereby reducing their operating costs and extending their operating lives.

China has selected two steel plants as pilot projects for developing a programme of voluntary energy efficiency agreements with industry. The pilot projects should help develop methods for assessing the energy efficiency potential and setting energy efficiency targets within industrial firms. They should also help examine the planning, monitoring and evaluation activities, as well as supporting government policies, that can help voluntary industry efficiency programmes succeed. The participating firms can receive priority consideration for government grants and soft loans, as well as a tax exemption on incremental output resulting from their energy efficiency efforts.

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## PUBLIC ENTERPRISE

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In Chile, Mexico and Russia, voluntary efficiency efforts by private industrial firms are complemented by government-led efficiency efforts at state-owned public enterprises. In Chile, the enterprise is the National Copper Corporation (CODELCO), the world's largest copper producer. In Mexico, the public firm is PEMEX, the state-owned oil company, which is one of the ten largest oil companies in existence. In Russia, the main target is Gazprom, the state-owned gas producer. As with public buildings, the potential energy and budget savings can be very substantial.

In the Russian case, Gazprom is cooperating with defense companies to develop and introduce new technologies for drilling, pumping and heat utilisation. It is estimated that energy-saving and resource-saving technologies saved Gazprom some 2 billion roubles (US\$63 million) in 2002. Gazprom has estimated that the cost of saving a given amount of gas through efficiency measures is less than half the cost of finding the equivalent amount of new gas through exploration and development. In parallel efforts, Russia's crude oil producers are installing more efficient technologies and equipment to reduce their technical losses by 30 percent. Power producers in Sakhalin are aiming to reduce the fuel inputs to electricity generation by one-third by the year 2015.

At Petróleos de Mexico (PEMEX), the energy efficiency improvement effort began with studies of energy use in fifty major facilities. These studies determined that about 70 percent of the firm's energy consumption occurred in direct-fired heaters, steam generators and turbines. After this, diagnostic tools to determine energy savings potential, as well as procedural guides for implementing energy savings, were made available to all personnel over the internet. The guides were developed not only for heaters, generators and turbines, but also for lighting, cooling and cogeneration. The programme philosophy was to have managers and operators incorporate energy efficiency considerations into their operating procedures in a systematic and permanent way. A goal was set to reduce energy consumption rates by 5 percent at each of 244 production facilities in one year, and three-fifths of PEMEX facilities were in fact able to meet this goal by mid-2000.

In 2001, energy indicators and controls were applied to every processing plant, system and component in all PEMEX petrochemical and gas processing complexes. An energy consumption index, the ratio of production to fuel consumption, was set up to track and compare efficiency improvements across all facilities in the firm. A goal was introduced to reduce the energy consumption index by 1.5 percent to 5 percent in each business line. After substantial reductions in energy use, costs and carbon dioxide emissions were documented, a similar approach was applied successfully to the national electric utility, Comisión Federal de Electricidad, and to large industrial and mining companies; it may soon be applied to small and medium sized enterprises as well.

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#### DEMAND-SIDE MANAGEMENT BY PUBLIC UTILITIES

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Several developing and transitional APEC economies have active demand-side management (DSM) programmes in which publicly owned electric utilities aim to make more efficient use of their generating and transmission facilities by reducing or shifting electricity demand. One possible objective is to reduce overall electricity use by encouraging customers to use electricity more efficiently. Another possible objective is to reduce requirements for new generating capacity by encouraging customers to use electricity at different times of day or permit their electricity use to be cut off temporarily at times when demand is very high. These objectives often involves building owners as well as industry, as in the case of financial incentives described in the preceding chapter section for purchase of efficient appliances and acceptance of load controls. But since industrial firms are often very large energy consumers, DSM efforts have often been aimed mainly at them.

It is interesting to note that three of the economies with active DSM programmes, namely China, Indonesia and Malaysia, also have vigorous energy auditing programmes and active energy service companies (ESCOs) as described above. Another, Viet Nam, is planning to incorporate energy audits into DSM efforts as they develop. Systematic energy efficiency audits of industrial firms, together with development of ESCOs that can help industry choose, install and finance efficiency measures, can thus be viewed as valuable adjuncts to government-led DSM efforts.

It can also be noted that these economies have electricity industries that are more or less vertically integrated, so that the fruits of DSM efforts are readily enjoyed by the utility undertaking them. In China and Indonesia, the utility both produces and transports power. In Malaysia, where there is active wholesale competition among independent power producers, the utility is still the sole buyer and final supplier. In economies where the electricity industry is restructured to the point where there are multiple retail suppliers, it is difficult or impossible for power utilities to continue to reap the benefits of DSM with end-users. In the Philippines, for example, a planned DSM programme has been postponed indefinitely in the face of reforms that are designed to boost competition in the electric power sector. So in a competitive supply environment, improvement of energy efficiency in buildings and industry may rely to a still greater extent on the efforts of ESCOs.

China's DSM efforts have tended to be localised and technology-specific. For example, there is a pilot DSM project to reduce electric power consumption at Shangli oil field. That project focuses on efficiency improvements by final users, load shifting through time-of-use tariffs, and reduction in losses on the power distribution grid. The associated investments have paid themselves back in three years or less. In Liaoning, meanwhile, the local electric utility has focused on raising the energy efficiency at metal processing plants by upgrading their electric furnaces.

Indonesia's DSM programme is undertaken by the National Electricity Company, PLN. It aims to slow overall electric demand growth through the installation of more efficient industrial motors and high-efficiency lighting. It also aims to slow growth in peak power demand through time-of-use tariffs, in which rates are highest at times of peak demand, and through curtailable and interruptible tariffs, in which industrial firms agree to let the utility reduce or interrupt their power supply for a limited number of brief periods each year.

In Malaysia, DSM efforts are also implemented by the national power utility, Tenaga Nasional Berhad (TNB). They aim to promote energy savings by encouraging the use of the most energy-efficient technologies available, raising public awareness of energy efficiency products and services,

and developing enterprises to supply such products and services. Industry-related DSM efforts include product testing and development of energy-efficient products as well as energy efficiency and cogeneration in the pulp and paper industry.

In Viet Nam, DSM efforts are unfolding in three phases. The first phase, from 2000 through 2002, focused on enhancing load management and energy audit capabilities at Electricity of Vietnam (EVN), as well as on developing efficiency standards for lighting and motors and efficiency codes for commercial buildings. The second phase, from 2003 through 2005, is focusing on expanding load management capabilities to all power companies, developing an industrial energy audit programme, and putting efficiency standards for equipment and buildings in place. The third phase, from 2005 through 2010, is to establish DSM as the demand-side component of integrated resource planning at all power companies. It will also focus on technical and financial assistance for implementation of energy efficiency measures at state-owned industrial enterprises.

Already, the DSM programme in Viet Nam has achieved substantial success in flattening electricity loads through time-of-use tariffs. By June 2002, a time-of-use tariff had been applied to 6,800 industrial customers of EVN, shaving system peak load by some 250 megawatts. By 2005, some 6,000 time-of-use meters are to be installed for large customers with an average load of 100 kilowatts each, reducing the system peak load by a further 59 megawatts.



# ENERGY EFFICIENCY IN TRANSPORT

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## INTRODUCTION

Energy efficiency programmes for the transport sector can strongly affect energy security with respect to oil supply. Most road transport, including cars, buses and trucks, relies almost exclusively on gasoline and diesel fuel derived from petroleum. Thus, policies to increase the efficiency of road vehicles, such as vehicle fuel efficiency standards, vehicle taxes related to vehicle efficiency, and taxes on vehicle fuel use, can significantly affect oil consumption and imports. In addition, measures that encourage the use of more fuel-efficient forms of road transport, such as buses, or less oil-intensive forms of transport, such as ships, railroads and subways, can also measurably reduce oil consumption and imports. Such measures to raise the energy efficiency of oil-based transport modes and to encourage shifting to non-oil-based transport may be of value not only for passenger travel, but also for the shipment of freight, that is, the products people buy.

Policies to raise the efficiency of gasoline and diesel vehicles, while relatively common in developed economies in the APEC region and elsewhere, are fairly rare in the developing and transitional economies. Public transport modes are likewise often less elaborate in developing and transitional economies. However, the survey of these economies found some interesting energy efficiency policies for transport which are briefly described below.

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## A COMPREHENSIVE TRANSPORT EFFICIENCY STRATEGY

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Among the economies surveyed, Chinese Taipei probably has the most comprehensive strategy for promoting energy efficiency in transport. Elements of this strategy include:

- Raising energy efficiency standards for cars, motorcycles and fishing boat engines.
- Building a high-speed railway system and mass rapid transit system.
- Developing intelligent transportation systems and management strategies.
- Taxing vehicle fuel use based upon the amount of fuel consumed.

Vehicle fuel economy in Chinese Taipei is regulated under an Energy Management Law. Fuel economy requirements for various types of vehicles are stated in terms of kilometres per litre of gasoline or diesel. Vehicles which meet the requirements in a given calendar year are issued a certificate of conformity and can be sold through the end of the following calendar year. Standards are gradually being tightened; for example, the standard for vehicles with engine displacement of 50 to 100 cc will be raised from 37 km per litre to 42 km per litre in 2004.

Before 2002, vehicle fuel tax was levied on each type of vehicle twice a year, regardless of the amount of fuel it consumed. The tax was higher for heavier, less fuel-efficient vehicles than for lighter, more fuel-efficient vehicles, so it encouraged the purchase of more efficient vehicles. But the fuel tax essentially functioned as an efficiency-variable vehicle tax; thus, it did not encourage efficient use of vehicles once they were purchased. Now, however, there is a real fuel tax based upon the amount of fuel consumed. The tax is currently levied at a rate of some 50 percent on the base cost of gasoline. It is believed that the revised tax system will provide an equally clear incentive to buy more fuel-efficient vehicles while adding a strong incentive to drive vehicles less.

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**AN ENERGY EFFICIENCY STRATEGY FOCUSED ON PUBLIC TRANSPORT**

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Viet Nam has recently elaborated an interesting strategy for promoting the use of public transport, which is needed not only to limit growth in oil consumption but also to cope with rapidly worsening congestion in major cities. Public transportation in Viet Nam is underdeveloped and meets only 5 percent of travel demand. Yet motorcycles and other forms of private transportation are already choking major roads in large cities while raising oil import requirements. Thus, the government has established a goal to increase the share of public transport to 30 percent of travel demand in large cities. This is to be accomplished mainly by promoting bus enterprises with fixed routes and frequent and dependable service. Specific measures to promote bus transport include:

- Exemption from import tax and excise tax on buses for public transportation;
- Exemption from tax on capital expenditure;
- Exemption from parking fees, tolls, registration fees and license fees;
- Provision of free land for bus stations and bus stops.

The incentives for public transportation are to be financed through higher tariffs on imported cars and motorbikes. In addition, several measures have been implemented to discourage excessive use of private transportation and improve the traffic safety:

- Taxation of cars and motorcycles by their size and capacity;
- Increased taxes on gasoline and diesel fuel;
- Compulsory insurance for motorcycles;
- Parking fees on public roads and walkways.

Several other economies surveyed are also building or expanding public transportation systems which may help reduce road congestion and consumption of gasoline and diesel fuel:

- In China, subways are being expanded in Beijing and Shanghai.
- In the Philippines, the elevated rail transport system is being extended in Manila.
- In Thailand, Bangkok has built a monorail and is building a subway.

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**MISCELLANEOUS TRANSPORT ENERGY EFFICIENCY EFFORTS**

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Among the other programmes aimed at energy-efficiency transportation in APEC's developing and transitional economies are the following:

- China has a regulation to eliminate old vehicles and motorcycles that exceed a certain age or distance travelled, thus raising the fuel efficiency of the vehicle fleet.
- Russia aims to achieve 3 percent energy savings in transport through new equipment and better maintenance on the federal rail system that accounts for some 10 percent of the economy's total energy consumption in transport.
- Peru has an information campaign on vehicle maintenance and driving habits that can reduce vehicle fuel use; it distributes vehicle fuel efficiency manuals and trains public transport operators and taxi drivers in efficient driving methods.
- The Philippines also have a programme to disseminate information on operation and maintenance practices that can lower fuel consumption; it aims to reach the owners and operators not only of individual vehicles but also of vehicle fleets.

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# CONCLUSIONS AND SUGGESTIONS

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## EFFICIENCY PROGRAMME OPTIONS FOR BUILDINGS

Developing and transitional economies of APEC have instituted a wide range of programmes for improving the efficiency of energy use in residential and commercial buildings. These have included appliance efficiency standards and labels, building energy efficiency codes, financial incentives for the purchase of energy-efficient equipment and products, energy management and audits, public information, technology development, promotion of district heating, and efforts to raise the energy efficiency of facilities occupied by government agencies. Together, efficiency programmes have often had measurable success in overcoming barriers to the implementation of efficiency technologies in the building sector, including lack of information, expertise and financing.

Among the economies studied, four have a range of mandatory efficiency standards for home appliances and office equipment, four have voluntary or mandatory efficiency labels for a range of appliances and equipment, and four have little or no programme in place for efficiency labels or standards. The following policy options may be useful for developing and transitional economies to consider in their efforts to broaden and strengthen energy efficiency standards and labels:

- Economies with mandatory efficiency standards may wish to consider extending these standards to additional categories of appliances and equipment.
- Economies with voluntary efficiency labelling may wish to consider labelling for additional types of appliances and also to make labelling mandatory if voluntary labelling has not penetrated a substantial portion of particular product markets.
- Economies with no efficiency labelling or standards may benefit from developing and establishing labels or standards for energy-intensive products.

Only one of the twelve economies studied has mandatory building codes with significant energy efficiency features for both residential and commercial buildings. Two of the economies studied have mandatory energy efficiency codes for commercial buildings only, while three have voluntary codes for commercial buildings and another two have codes only for residential buildings. In four of the economies studied, building codes with major energy efficiency features are absent. In this context, the following policy options may be worth considering:

- Economies with mandatory energy efficiency building codes should actively monitor the energy savings and cost savings that the codes are producing and consider strengthening the codes if doing so would be cost-effective. Where the codes apply to commercial buildings only, careful thought should be given to the cost-effectiveness of extending codes to residential structures as well.
- Economies with voluntary energy efficiency building codes should consider extending them to additional types of buildings and should make their codes mandatory if empirical evidence shows that adherence to voluntary codes is weak.
- Economies where building codes are weak or non-existent should strengthen or establish them where justified by the potential savings in energy and costs.
- Whole-building standards for maximum energy consumption per unit of area may be a practical way to lower the costs of implementing energy efficiency measures by giving commercial enterprises greater flexibility to design their buildings in ways that limit energy consumption in the most cost-effective manner.

Five economies surveyed have provided financial incentives of one sort or another for the installation of energy efficient materials and equipment in buildings. Two use tax exemptions, two use incentive payments, two install efficient equipment for free, and one uses financial penalties. In view of the budgetary burden that financial incentives may entail, several suggestions may be made:

- Instead of distributing energy-efficient products for free to a limited portion of the public, it may make sense to offer discounted products to a broader segment of the public, achieving greater penetration of efficient products with a given budget.
- Tax exemptions or incentive payments for purchasing energy-efficient equipment could be financed in part through penalties for failure to install such equipment.

Energy management and auditing services are a key element of energy efficiency policy in at least four of the APEC economies reviewed. Energy efficiency audits can help building owners evaluate cost-effective energy efficiency measures, while consulting services can help them choose which ones to implement. Energy service companies (ESCOs) can also help with installation and financing of efficiency measures that are selected, as well as guarantee their performance. APEC economies might usefully consider providing energy management and auditing services if they do not do so already or expanding the range of services provided if not all of them are available yet.

Informational and educational efforts aimed at expanding awareness of energy efficiency opportunities in APEC economies have included school curricula, publicity campaigns, printed information, telephone information, provision of information on internet websites, and working with manufacturers and suppliers to offer efficiency information on energy-consuming products. All of these approaches can be effective at a low cost and should thus be carefully considered. It is important, of course, to ensure that the information provided is accurate and up-to-date.

District heating systems have been successfully promoted in over two-fifths of the cities in China. Such systems have much higher efficiency than conventional boilers and should therefore be a promising option in all urban areas with substantial heating loads. The potential may be limited, however, in those APEC economies where the climate is hot and heating loads are small.

Several developing and transitional economies have ambitious energy efficiency programmes for public buildings. Such programmes are limited in impact to a relatively small subset of the total building floor space in service. However, they can presumably be readily implemented by governments since their main target is government buildings. Here, it is important to ensure that the information and expertise held by the ministry responsible for energy efficiency policy is disseminated to other government ministries, provincial governments, and municipal governments.

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#### **EFFICIENCY PROGRAMME OPTIONS FOR INDUSTRY**

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Industrial efficiency programmes in developing and transitional APEC economies include equipment efficiency standards and labels, financial incentives for the manufacture or installation of energy-efficient equipment and processes, energy management and audits, voluntary agreements to raise energy efficiency in particular industries, efforts to raise energy efficiency in public enterprises, and demand-side management to reduce electricity demand and peak load for public utilities.

Whereas eight of the twelve economies surveyed have active standards and labelling programmes for appliances in buildings, only two have such programmes for industry. Perhaps this is due to a presumption that the greater expertise of industrial firms precludes the need for such programmes. However, one of the economies surveyed has mandatory energy efficiency standards for a wide range of industrial equipment including motors, boilers, transformers, as well as for water chillers and for heating, ventilation and air conditioning (HVAC) systems. Another has mandatory labels and voluntary standards for motors and boilers only. Since not all industrial firms will have the expertise to make the most cost-effective choice of models for each type of equipment to which standards or labels would apply, these examples are worth emulating. All developing and transitional economies might usefully consider standards or labels for industrial equipment.

At least four of the economies surveyed employ a variety of financial incentives for the installation of energy-efficient equipment by industry. On the income tax side, three of these offer tax exemptions or credits for the purchase of such equipment, two provide for accelerated depreciation of such equipment, and one allows reduced tax rates on projects that incorporate such equipment. In addition, three economies grant full or partial exemption from sales tax, value added tax, or import duties on energy efficient industrial equipment. Two or three economies make low-interest loans available for industrial energy efficiency investments as well. Only one of the economies, however, imposes penalties on firms that fail to install energy-efficient equipment. While not all economies may be able to afford financial incentives to promote energy efficiency in industry, such incentives do appear to be effective where they have been implemented. They may thus make sense as a component of overall tax policy toward promoting industrial development.

Energy management and auditing programmes in developing and transitional APEC economies frequently go hand in hand with demand-side management (DSM) programmes for limiting growth in electricity demand. China, Indonesia and Malaysia have vigorous auditing programmes for large industrial facilities, as well as active DSM efforts at publicly owned electric utilities. In Viet Nam, where DSM programmes are still being developed, industrial energy audits are planned as a key component. Except for Indonesia, these economies offer financial incentives for efficiency investment by industry as well. However, it is possible, as in the case of Thailand, to have a comprehensive and effective programme of industrial energy efficiency audits without DSM. As in the buildings sector, audits are generally carried out with the assistance of energy service companies (ESCOs) which can help firms evaluate, install and finance suitable efficiency measures. Insofar as economies may reform their electricity markets to separate generation from transmission and distribution, it will become harder for power utilities to reap the benefits of DSM programmes, and the importance of ESCOs for implementing industrial energy efficiency measures may grow.

Voluntary agreements with industry to raise the efficiency of energy-intensive production processes are a promising avenue for harnessing industry's natural profit motive to reduce costs as well as the specialised expertise of each industry with respect to its production methods. Only three of the economies surveyed (China, the Philippines and Chinese Taipei) utilise such voluntary agreements. Another three have programmes to boost the energy efficiency of very large state enterprises (Chile for copper, Mexico for oil, and Russia for gas). At least with respect to firms that are large enough to have significant expertise that governments are unlikely fully to share, other developing and transitional APEC economies might usefully consider voluntary agreements as well.

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#### EFFICIENCY PROGRAMME OPTIONS FOR TRANSPORT

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Approaches taken by developing and transitional APEC economies to raising the energy-efficiency of transport include vehicle fuel efficiency standards, vehicle taxation to encourage the purchase of energy-efficient models, fuel taxes to encourage the efficient use of vehicles, and promotion of public transport. However, most of programmes in these economies aimed at making transportation more energy-efficient are limited in scope.

The two main exceptions appear to be Chinese Taipei and Viet Nam, which are interestingly at roughly opposite ends of the spectrum among the economies studied in terms of income per capita and overall level of development. Both economies impose taxes on vehicles (which vary with vehicle size and fuel consumption) or on fuel (collection of which is also proportional to fuel use). Both economies also have active programmes to encourage public transportation. In Chinese Taipei, these focus on high-speed railways and mass transit, as well as intelligent transportation management systems. In Viet Nam, they focus on a broad array of tax incentives for buses. The main difference is that Chinese Taipei also has minimum vehicle fuel efficiency standards.

Other developing and transitional economies would do well to consider more comprehensive energy efficiency efforts for their transport sectors as well. Growing populations, urbanisation and increasing wealth are causing rapid growth in transport demand and ownership of private vehicles. This will mean rapid growth in oil use absent vigorous efforts to make transport more efficient.

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**ENERGY EFFICIENCY AND ENERGY PRICES**

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While energy prices were not a principal focus of the energy efficiency programme sketches undertaken for this study, the impact of prices on energy efficiency is worth a brief mention. Where prices are subsidised or otherwise fail to reflect the full costs of producing energy and transporting it to customers, the economic incentives for individuals and firms to use energy efficiently are obviously diminished. This may compound the difficulty of overcoming obstacles to energy efficiency such as lack of motivation (owing to the small share of energy in many household and business budgets), lack of expertise (since many homeowners and business owners are not specialists in energy efficiency technology options), and lack of financing.

In two of the economies surveyed, Malaysia and Indonesia, domestic gas prices are held substantially below the market levels indicated by export prices, at least for large industrial customers and electric power producers. The artificially low gas prices reduce incentives for energy-intensive industries and power plant owners to use gas efficiently in production processes. Active energy efficiency auditing and demand-side management programmes in both economies, as well as financial incentives in Malaysia, may not be able fully to overcome this pricing handicap.

In the transitional economies surveyed, Russia and China, there continue to be some energy price distortions despite enormous progress toward market economy models in recent years. In China, for example, while regulators recognise in principle that delivered natural gas prices should fully reflect the costs of both production and transportation, there remain some price caps in place at city gates that make it difficult for some pipelines to recover their investment costs while limiting the incentive for cost-effective energy efficiency measures in the cities concerned. In Russia, as in the developing economy cases discussed above, domestic gas prices are often held below export prices, needlessly reducing both government revenues and the incentive to use energy wisely.

It is worth noting, more generally, that few if any APEC economies, including those surveyed, have fully internalised the environmental costs of energy in energy prices. There are some fuel and vehicle taxes that help to encourage conservation of petroleum products in the transport sector, but these appear to be aimed mainly at raising general revenues or limiting imports rather than reducing emissions of air pollutants or carbon dioxide. Thus, energy efficiency programmes almost everywhere are fighting an uphill battle against energy prices that do not fully reflect energy costs. This holds not only for developing and transitional economies, but in the APEC region as a whole.

ENERGY EFFICIENCY  
PROGRAMME SKETCHES  
FOR DEVELOPING  
AND TRANSITIONAL  
APEC ECONOMIES





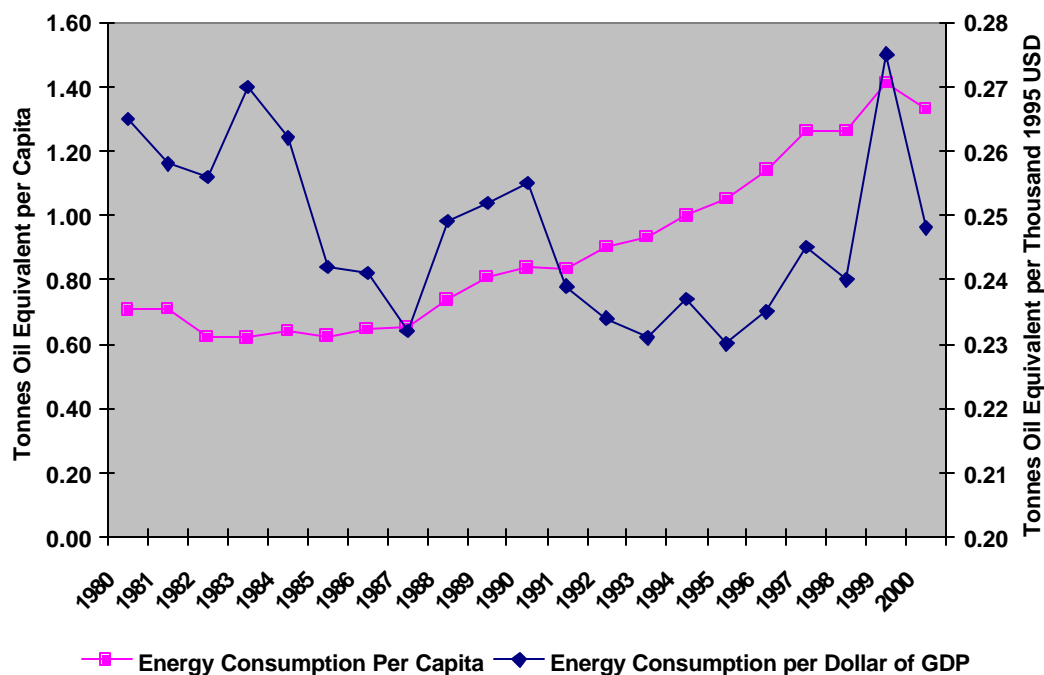
# CHILE

## BACKGROUND

In Chile, energy efficiency programmes are coordinated by a small department of the National Energy Commission with a staff of three people. They are mainly focused on evaluations of mining sector activities, standards for the construction sector, and standards for electric appliances.

Between 1985 and 2000, Chile's GDP grew at an average annual rate of 6.6 percent, while its energy consumption grew at an average rate of 6.8 percent and its electricity demand grew at an average rate of 8.0 percent. Thus, its energy intensity (ratio of energy use to GDP) grew an average of just 0.2 percent per annum, fluctuating with no clear upward or downward trend. Its electrical intensity (ratio of electricity use to GDP) grew more steadily at an average of 1.3 percent per year. The economy's energy consumption per capita also increased at a steady pace over the period.

**Figure 2** Energy Efficiency Indicators for Chile, 1980-2000



## BUILDING SECTOR EFFICIENCY PROGRAMMES

### BUILDING CODES

In 1996, Chile's government established a programme for regulating thermal insulation in new residential construction. The programme issued an efficiency standard for construction of roofs in 2000 and expected to issue efficiency standards for walls, windows and flooring in 2003. A "thermal certification" for new construction projects is planned for the near future.

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### APPLIANCE EFFICIENCY STANDARDS

Starting in 2000, energy efficiency standards for electrical appliances are being developed jointly by the National Energy Commission and the National Standards Institute as a means to improve the performance of common household appliances and allow the general population to benefit from available technical, economical and environmental improvements.

Most technical standards in Chile are homologous with those of the International Standards Organisation (ISO) and the International Electrotechnical Commission (IEC). There are fourteen standards for electric home appliances, nine for lighting equipment, seven for air conditioning and heating equipment, five for electric motors and pumps, and two for transformers and cables.

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### INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES

#### FINANCIAL ASSISTANCE

As an endorsement to the Government's commitment to energy efficiency policies, Chile's Production Promotion Corporation (CORFO) has different types of financing funds available that can be readily applied to actions for the improvement of energy efficiency in productive enterprises:

- A fund for "investment financing for environmental protection for small and medium enterprises" is intended for investments in improving energy consumption or fuel switching.
- "Investment financing for small and medium enterprises" is a fund applicable to infrastructure investments in new machinery, installations, constructions, cattle, engineering services, decontamination and environmental protection.
- The "technical assistance fund specialised in clean production" can be used to contract specialised consulting services on clean production practices and optimisation of processes and products from a productive point of view as well as from an environmental point of view.
- "Co-financing for environmental pre-investment studies" aids in the financing of environmental impact assessment studies and engineering assessments for improved productivity.

There are also a number of funds for technological innovation and technology transfer, available to small and medium enterprises, that can be used for efficiency improvement measures.

#### EFFICIENCY EVALUATIONS

An evaluation of energy efficiency in the mining sector began in 2002 and is intended as a tool to uncover areas for potential optimisation of energy utilisation. This type of evaluation is expected to be performed every two years. No targets for efficiency gains in mining have been established.

In the industrial sector, an evaluation of energy intensity was recently carried out to gain insight on the factors behind the sector's consumption practices.

#### EFFICIENT COPPER MINING

The copper mining industry accounts for 10 percent of final energy consumption and more than 30 percent of electricity consumption in Chile, and is by far the main industrial energy consumer. The National Copper Corporation (CODELCO), the world's biggest copper producer, is implementing a series of energy efficiency programmes. These include improvements to reduce energy consumption, diversification of energy sources, introduction of energy-efficient technologies and the establishment of energy indicators. As a result, average energy consumption decreased from 3,600 MWh to 3,400 MWh per metric tonne of fine copper between 1995 and 2000. Recently CODELCO finalised the process of incorporating energy efficiency in its corporate directives.

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**SUMMARY**

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Energy efficiency in Chile is still in an early stage. To date, governmental efforts have concentrated mostly on assessing efficiency potentials, information campaigns and promoting voluntary standards. However, most of the industrial sector and the electricity utilities have yet to incorporate energy efficiency in their practices. One notable exception has been the National Copper Corporation, which has developed corporate directives for energy efficiency.

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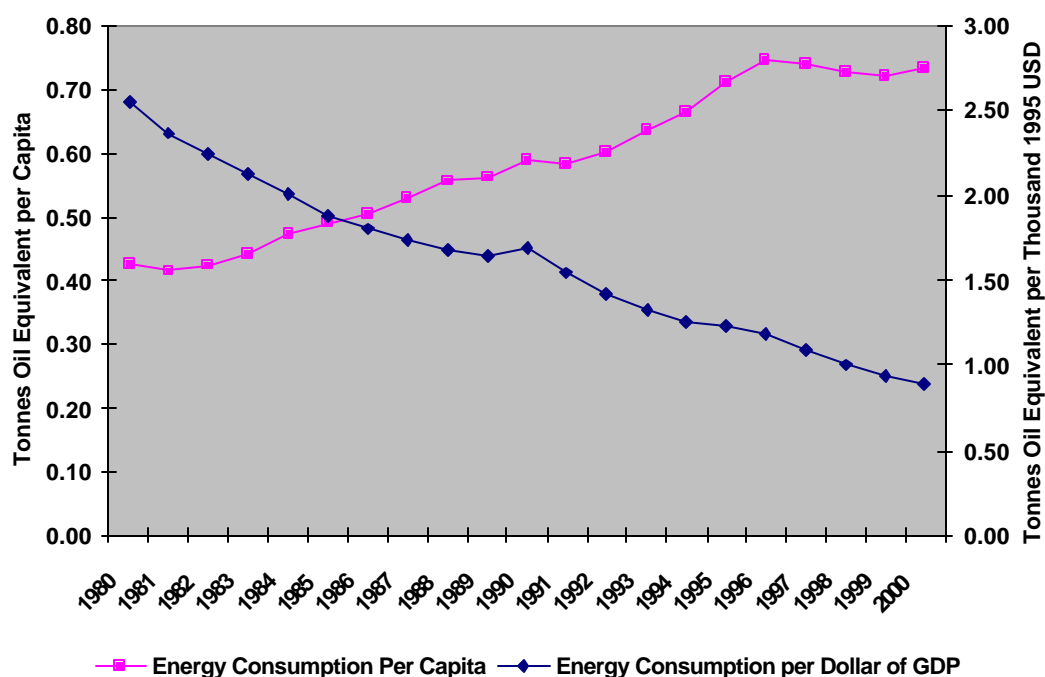
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# CHINA

## BACKGROUND

China's energy intensity (ratio of energy use to GDP) is one of the highest in the APEC region, but it has been declining as energy efficiency improves and the economy restructures. From 1985 to 2000, China's GDP grew at an average annual rate of 9.3 percent, while its energy consumption grew an average of 4.0 percent and its electricity demand grew an average of 8.4 percent yearly. While China's energy consumption per capita has been steadily increasing, its energy intensity has been steadily declining, at an average rate of 4.8 percent per annum over the period. Its electrical intensity (ratio of electricity use to GDP) has been declining at a much more modest rate averaging 0.8 percent per annum. The Tenth Five-Year Plan targets a further decline of 20 percent in energy intensity by 2005 which would not be out of line with the trends of the last two decades.

**Figure 3 Energy Efficiency Indicators for China 1980-2000**



Efficiency policies in China are driven by the need to ensure adequate energy supplies and improve environmental quality in the face of rapid economic growth. China's energy use, notably coal use, discharges 19 million tonnes of sulphur dioxide into the atmosphere annually and affects 30 percent of the economy's territory with acid rain. China's cities have some of the worst air quality in the world, with only a third of cities meeting international air quality standards. Better energy efficiency and environmental control technologies are needed to improve the situation.

As government energy efficiency budgets have declined and the private market economy has grown, China has sought ways to use the market economy to promote energy efficiency. The Energy Conservation Law of 1998 sets forth general principles and directions for energy efficiency practices. Detailed implementing regulations for the law include energy standards, an energy efficiency certification system for energy-using products, and energy management regulation for key energy consumers. Authorities in charge of energy efficiency include the State Development and

Reform Commission (SDRC), the Ministry of Science and Technology (MOST), the Ministry of Agriculture, the Ministry of Construction, the Ministry of Railways, and various provincial agencies.

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## **BUILDING SECTOR EFFICIENCY PROGRAMMES**

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### **BUILDING CODES AND STANDARDS**

Buildings are divided into four zones, each of which has a building code geared to its specific weather conditions: (1) cool winter and hot summer, (2) drainage area of Yangtze River, (3) southern and (4) cold. These building codes do not provide for a high degree of energy efficiency; the code in Beijing, for example, is similar in energy terms to European codes of the 1950s. However, new building codes are under consideration by the central government, and regions like Chongqing have already implemented stricter efficiency building codes in limited areas. Also, the central government has issued technology guidelines for efficient buildings covering wall materials, heat preservation materials, doors and windows, roofs, space heating and cooling. A standard regulating electricity consumption in hotels was issued by the central government in 1990.

### **APPLIANCE EFFICIENCY STANDARDS AND LABELS**

In 1989, nine China-wide appliance standards were issued, specifying minimum energy efficiency for room plugs using alternating current, audio receivers and recorders, clothes washers, fans, irons, refrigerators, rice cookers, televisions and fluorescent lamp ballasts. Since 1995, these standards have been mandatory; products that fail to meet them cannot be sold. In 1999, standards were revised upwards for refrigerators and fluorescent lamp ballasts. In 2000, new standards were issued for room air conditioners. Voluntary labelling also applies for split-type room air conditioners, refrigerators, freezers, rice cookers, microwave ovens, televisions, fluorescent lamp ballasts, and electric water heaters. Efficiency standards and labels play a very important role in appliance efficiency improvement. The energy efficiency of new refrigerators increased 20 percent from 1997 to 1999 and another 10 percent by 2001. Cumulative savings from efficient refrigerators by 2001 reached 1.17 billion kWh or RMB 670 million at an electricity price of RMB 0.57 per kWh.

### **FINANCIAL INCENTIVES FOR EFFICIENT BUILDINGS**

There are several financial incentives for investment in energy-efficient buildings, as defined by the Energy Efficient Design Standards for Residential Buildings in the Hot Summer - Cold Winter Region (JGJ 134-2001). These most notably include exemptions from city facility fees and fixed asset investment tax. In addition, there is an exemption from land-use tax on facilities used to produce new, energy-efficient wall materials for buildings. However, the progress of energy efficiency in buildings has remained slow; building energy consumption reached 356 Mte accounted for 27.8 percent of total energy consumption in 2000.

In order to promote the utilisation of new wall materials (most of them are energy efficient products), a fund-raising regulation is implemented between 1 October 2002 and 31 December 2005. During this period, all agencies that construct new buildings or retrofit old buildings without using new wall materials (as listed in an official document) must pay a penalty equal to a maximum of RMB 8 per square metre of their total construction. Funds raised in this manner will be used to subsidise projects that produce, demonstrate, research, develop and disseminate new wall materials.

### **DISTRICT HEATING PROGRAMME**

The Chinese government has several policies in place to promote district heating, in order to obtain the efficiency benefits of large boilers and combined heat and power (CHP) systems. These policies, which were initially set forth in 1998 and revised in 2002, include the following elements:

- Local governments are requested to consider CHP systems when planning for heat supply needs, electric power needs, and environmental protection.

- CHP plants are required to meet minimum standards for thermal efficiency and the ratio of heat production to electricity output, which vary depending upon generator type and capacity.
- New and enlarged cogeneration plants can be exempted from fees for connecting to the power grid, and power utilities are enjoined to sign power purchase agreements (PPAs) with such plants.
- Boilers with a capacity of 20 tonnes per hour or greater which are used more than 4,000 hours per year should be retrofitted to cogeneration if it is profitable.
- In regions with CHP facilities or district heating networks, the operation of smaller and less efficient boilers is forbidden by government regulation.
- New residential buildings are requested to install heat meters for each household so that the full value of CHP systems can be realised.
- Incentives are provided for combined cycle gas turbines in cogeneration plants.

By the end of 1998, 286 out of China's 668 cities had district heating supply facilities. The capacity of these district heating facilities reached 65,207 tonnes of steam and 69,539 TJ of hot water per hour, bringing their annual output to 206 Mt of steam and 62.7 TJ of hot water. About 62.9 percent of the steam and hot water came from combined heat and power (CHP) plants that produce electricity as well as heat, while 35.75 percent came from district large-scale boiler houses that produce heat only. District heating plants provided space heat to 807 million square metres of building space, accounting for nearly one-eighth (12.2 percent) of total floor space with space heating. The thermal efficiency is 80 percent for CHP plants and 70 percent for district boilers, far exceeding the 50 percent efficiency of the small-scale boilers that they replaced.

In 1998, the 120 TWh of power and 1.036 billion GJ of heat generated by CHP plants saved 41 million tonnes of coal while reducing particulate emissions by 620,000 tonnes, sulphur dioxide emissions by 820,000 tonnes, and carbon dioxide emissions by 1.8 million tonnes. Local air quality has improved a lot due to CHP plants. For example, total suspended particulates in Mudanjian city during the winter fell from 800 mg to 369 mg per cubic metre after a CHP plant entered service.

### GREEN LIGHTING

China's Green Lighting Programme started in October 1996, supported by the Chinese government as well as UNDP and other international organisations. Lighting accounts for approximately 13 percent of electric energy use in China, and both lighting use and general electric usage have been growing at double-digit rates for most of the past decade. Lighting use is growing very rapidly with the construction of more international-style commercial buildings and higher income levels in residential households. This Green Lighting Programme focuses on increasing consumer awareness of the economic and environmental benefits of energy efficient lighting systems working with manufacturers to increase quality and market share for efficient products, and developing new mechanisms and programmes to promote efficient lighting products and systems.

In six years of effort, substantial achievements have been made. According to a survey conducted by the SETC/UNDP/GEF China Green Lighting Promotion Project Office, 177 million efficient lamps and lighting fixtures were adopted in year 1998, saving 17 TWh of electricity. More than 90 percent of large department stores adopted efficient lighting products. China is the world's number one producer of lamps, lighting fixtures, and some other categories of lighting equipment. In 2001, China's output of compact fluorescent lamps (CFLs) reached 756 million units, more than 70 percent of the world total. Chinese lighting equipment is exported worldwide. The ratio of fluorescent to incandescent lamps in China grew from 1:8.9 in 1993 to 1:2.7 in 2001.

### INFORMATION ON BEST PRACTICES

Nine best practice cases have been developed by the Energy Conservation Information Dissemination Centre (ECIDC) on how best to install and operate energy systems: (1) waste heat recovery from central air conditioning systems in hotels, (2) information management systems for

space heating supply, (3) heat meter utilisation for space heating supply, (4) compact fluorescent lamp (CFL) utilisation in hotels, (5) central air conditioning systems for households, (6) solar hot water heaters for hotels, (7) insulation materials for residential buildings, (8) air conditioning system retrofitting for large department stores, and (9) variable-speed fans and pumps for hotels.

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## **INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES**

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### **EQUIPMENT AND SYSTEM EFFICIENCY STANDARDS**

There are several China-wide standards for energy conservation auditing of industrial processes and equipment. They apply to boilers, electric furnaces, fired furnaces, heat transport systems, electric heaters, cooling supply systems, fans and network, steam heaters, on-site electricity distribution systems, air-compression systems, pumps and electric welding equipment. These auditing standards, together with standard methods for measuring and calculating energy savings, were issued between 1994 to 1996. A standard to measure and use the waste heat resource from fluid-gas of boilers and furnaces was issued in 1999. There is a mandatory energy efficiency standard, with voluntary labelling, for industrial motors. There are no efficiency standards or labels for other industrial equipment.

### **FINANCIAL INCENTIVES FOR MANUFACTURE OF ENERGY-EFFICIENT PRODUCTS**

Tax breaks are offered as financial incentives for the manufacture of energy-efficient products by industrial enterprises. There is a 50 percent reduction of value-added tax on energy-efficient products sold. There is also an exemption from import and value added taxes for imported equipment that is used in the manufacture of energy-efficient products

### **PROMOTION OF EFFICIENT EQUIPMENT AND SYSTEMS**

To provide investment direction for industries and financial organisations, the central government published a guidance catalogue of types of investment in energy conservation to be encouraged, as well as a list of energy-saving technologies to have priority for research and development. According to a survey of 2,300 energy efficiency projects, the accumulated investment on energy efficiency in the economy reached RMB 136.3 billion from 1981 to 1998. Most of this investment was used to upgrade the equipment and processes in state-owned enterprises. An annual energy conservation capacity of 44.62 million tce was provided through technical improvement projects. Another 45.8 million tce of energy conservation capacity came from energy efficiency demonstration projects and large energy efficiency retrofit projects.

In 1999, a guideline for energy conservation management by key energy-consuming enterprises was published. All firms with annual energy consumption of more than 10,000 tce must submit their energy consumption data to the State Development and Reform Commission (SDRC). The 7,200 firms of this size account for half of the economy's total energy consumption. Just the 540 largest firms, each of whose annual energy consumption exceeds 200,000 tce, account for 40 percent of the economy's total energy use. Better energy management for these key enterprises will contribute a lot to energy efficiency.

Specific tax incentives are provided for the use of waste materials in manufactured products. There is an exemption from income tax on incremental output resulting from the use of waste products as raw material inputs. There is also an exemption from value-added tax for products that use coal ash or certain other waste products for at least 30 percent of their raw material inputs.

### **PROMOTION OF COMBINED HEAT AND POWER**

The energy and environmental benefits of combined heat and power (CHP) have been recognised in China for many years. The main recently built CHP plants are located in industrial complexes to replace on-site boilers and supply process heat. According to estimates, for every 100 megawatts of power, CHP can save 2,500 to 4,000 tonnes of coal equivalent compared to

conventional power generation and heat supply by boilers. As for development of village and township enterprises (VTEs), there are 50,000 towns with more than 1 million VTEs in all. CHP plant construction in these towns will promote energy efficiency further (Table 1).

**Table 2 Comparative Efficiency of Combined Heat and Power Systems in China, 1998**

	<b>CHP</b>	<b>Powerplant (&gt;6MW)</b>	<b>Boiler</b>
<b>Power generation</b>	200 gce/kWh	373 gce/kWh	
<b>Heat supply</b>	Average 40.39 kgce/GJ		55 - 62.1 kgce/GJ

Source: China Energy Network

### ENERGY AUDITING

Energy auditing in China started in the early 1990s when the Asian Development Bank (ADB) required energy audits of all projects for which it made loans. Chinese experts have developed a methodology for energy audits of industrial firms, and a standard of "Enterprise Energy Auditing Technical Guidelines" was published in 1997. A pilot project started in 1999 to gain experience for setting up a regular national energy auditing system. But energy auditing has not been frequently used by enterprises when considering energy efficiency issues, and there is no policy or management framework to identify the role of energy auditing for energy efficiency improvement.

### VOLUNTARY AGREEMENTS

Voluntary agreements have been chosen as a pilot policy under the China Industrial Energy Efficiency Policies Project. The goal of this project is to develop a policy framework and associated implementing regulations required to establish a comprehensive industrial sector energy efficiency policy in China under changing market conditions. After estimating the energy-efficiency potential in different energy-intensive industries and assessing candidate projects in terms of technical and management capabilities, pollution abatement, water saving, trade implications, and other issues for each sector, two steel plants in Shandong Province were selected as pilot projects. Through the projects, the government expects to develop a methodology for assessing enterprise-level energy efficiency potential, a methodology for setting enterprise-level efficiency targets, supporting government policies, an energy conservation plan, and monitoring and evaluation activities.

The following incentives and supporting policies will be provided to pilot plants:

- Public recognition: Title of "VA Pilot Enterprise" is conferred on participating firms.
- Preferential financing: Plants get priority eligibility for government grants to resource conservation projects and for soft loans from the proceeds of public bond issues.
- Income tax exemption: Pilot firms can apply to the government for a tax exemption on incremental output resulting from energy conservation from the pilot plants.
- Technology funding: Firms can seek funds from SETC and MOST for science and technology research, development, and implementation related to the pilot plants.
- Priority consideration for international cooperation projects.

Interim and final evaluations will be conducted in 2005 and 2010 respectively.

### ENERGY MANAGEMENT COMPANIES

During the 1980s, China's central and provincial governments funded more than 180 energy conservation service centres with 3,000 staff that provided technical services to enterprises seeking to conserve energy. But as central planning has diminished, these conservation service centres have been superseded by energy management companies (EMCs) which are set up along the lines of energy service companies (ESCOs) in other economies to promote energy efficiency in China's



developing market economy. By the first half of 1999, three EMCs had conducted 30 projects with grants of RMB 24.91 million from the European Union. Total investment in these projects had reached RMB34.98 million while their total returns had so far amounted to RMB24.91 million. Nine of the projects had fully recovered their initial investment for the EMC through its share of project cost savings. The other projects had not yet recovered their initial investment but were expected to do so eventually as the EMC's share of cost savings continued to accrue. The government intends that more EMCs will be established in the future.

#### **DEMAND-SIDE MANAGEMENT**

A pilot demand-side management (DSM) project has been conducted since 1997, with strong support from the central government, to reduce electric power consumption at Shangli oil field. This project covers load adjustment, reduction of distribution system losses, efficiency improvement for final users, adoption of time-of-use (TOU) tariffs, and many measurements. The project investment was paid back in less than three years through the resulting savings, which included reductions of more than 200 GWh of electricity use between 1997 and 1999.

The successful DSM programme indicated that there is a large potential to improve the efficiency and reliability of electricity supply in China. Most of China's DSM programmes focus on the use of specific technologies. For example, the Shanghai Power Utility has promoted the adoption of cool storage air conditioning systems by hotels. Liaoning Power Utility, meanwhile, has focused on electric furnace upgrading in metal processing plants.

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### **TRANSPORT SECTOR EFFICIENCY PROGRAMMES**

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#### **TRANSPORTATION POLICY FRAMEWORK**

China's government promotes the use of public transport facilities in cities. However, it also promotes development of automobile manufacturing to help keep the Chinese economy on a fast growth track. More and more families are able to afford private vehicles as their incomes grow. This brings more traffic in large cities and reduces fuel efficiency per distance travelled.

Most Chinese use railways for transportation between cities, which is much more energy-efficient than air travel. But railway customers are requiring greater comfort, including air conditioning of rail cars that increases energy consumption. Road transport has replaced railways for short trips between cities, which is another factor boosting energy consumption in transport.

#### **VEHICLE FUEL EFFICIENCY STANDARDS**

There are seven national standards related to vehicle fuel efficiency. Two of them, issued in 1984, regulate the fuel consumption of trucks and buses. Another two, issued in 1990 and 1991, specify the method to be used in measuring vehicle fuel consumption and heat supply. In order to regulate market development, a standard for assessment of fuel saving technology in vehicles was issued in 1994. Finally, two standards for assessment of energy efficiency additives in fuel systems and lubricant systems were issued in 1999. However, the main contribution to vehicle fuel efficiency improvement comes from a regulation that eliminates old vehicles and motorcycles which exceed a certain age or distance travelled. Although new cars have better efficiency than old ones, there is no policy that would compel carmakers to pay greater attention to fuel efficiency.

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### **PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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#### **ENERGY EFFICIENCY ACTION INITIATIVE FOR GOVERNMENT AGENCIES**

In 2001, the State Economic and Trade Commission (SETC), the Ministry of Finance (MoF) and the Administration of State Council Affairs proposed energy conservation measures for all government agencies and publicly funded bodies such as the military, hospitals, education and

research institutes. Energy use by such organisations accounts for roughly 5 percent of total energy consumption. Government pays more than US\$10 billion for energy every year, which is a substantial proportion of the fiscal budget. The proposed conservation measures include:

- making energy and water saving and waste recycling regular activities;
- conducting a survey to identify the energy conservation potential for lighting, space heating, cooling, office equipment, and vehicle fleets;
- purchasing equipment and products verified by Energy Conservation Products Certification Commission;
- eliminating all inefficient equipment and products forbidden by authorities;
- adopting energy-efficient design and building materials when constructing or retrofitting buildings;
- recycling computers, batteries and waste paper, and using more recycled paper.

An energy management company (EMC) has already started an energy audit to identify what measures should be adopted for SETC's office building.

#### **INFORMATION ON BEST PRACTICES**

Six best practice cases have been developed by the Energy Conservation Information Dissemination Centre (ECIDC):

- (1) efficient gas-fired boiler utilisation at Dong District government of Beijing;
- (2) a new type of harmonic filter for research institutes;
- (3) a new type of heater for hospitals;
- (4) audits of engineering agencies that design energy consuming facilities to identify whether energy-efficient technologies and equipment are adopted in their designs;
- (5) a new cooling agent for air conditioning systems in office buildings; and
- (6) a heat pump central air conditioning system for hospitals.

These cases transferred technical and economic information to the public and promoted the adoption of energy efficiency measures by other government agencies. Information on the cases is available on the internet where it had been accessed on over 2000 occasions by the end of 2002.

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#### **EDUCATION, TRAINING AND PUBLIC AWARENESS PROGRAMMES**

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##### **ENERGY CONSERVATION MONTH AND NATIONAL ENERGY SAVING WEEK**

In October 1979, the State Council decided to conduct a regular China-wide activity on energy conservation to raise public awareness on sustainable development, energy conservation and environmental protection. Since then, Energy Conservation Month activity has been conducted every November. In addition, since 1991, an Energy Saving Campaign Week begins on the first Friday of November with a different focal topic each year. For example, the topic in 2002 was "to save energy by following legal procedures and achieve sustainable development." Through exhibitions, workshops, television programmes, publications and other media, the central government and local authorities, as well as related associations and NGOs, disseminate the information and knowledge of energy conservation to the general public, schools and communities.

##### **ENERGY CONSERVATION INFORMATION DISSEMINATION CENTRE**

The Energy Conservation Information Dissemination Centre (ECIDC) was set up in 1997 under an energy efficiency promotion project supported by World Bank and the State Economic and Trade Commission of China. ECIDC's mission is to provide valid independent information on energy efficiency to the public, promote use of energy-efficient technology, and achieve economic benefits and environmental protection targets through energy efficiency improvement.

By 2002, the Centre had developed 56 best practice case studies that cover a board range of conservation measures in the industrial and public sectors. Each best practice case study presents information on investment requirements, energy savings, payback period, emission reductions, host entity for the project, and auditing agency. The public can access this information free of charge. The Centre has also published technical guidelines on eight topics, including retrofitting air conditioning systems in commercial buildings, improving industrial boiler efficiency, and recycling condensing water in steam networks. The public can buy these guidelines for RMB 60 each.

#### DEMAND SIDE MANAGEMENT ADVISORY CENTRE

The former Ministry of Power Industry set up a Demand Side Management Advisory Centre, which is now funded by the State Power Corporation that succeeded the Ministry when it was dissolved. The Centre's mission is to disseminate the concept of demand-side management and integrated resource planning (DSM/IRP) in China. It provides training programmes on DSM for the staff of utilities and large industrial enterprises, as well as for officials who are in charge of electricity consumption, energy conservation, technical retrofitting and enterprise management. It also publishes a DSM journal and works to enhance international cooperation on DSM.

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#### SUMMARY

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China is gaining from experience on energy efficiency in other economies and has sometimes emulated measures adopted by developed economies. China could usefully pay greater attention to monitoring and reviewing the implementation of energy efficiency measures. It could also benefit from efforts to improve the quality of energy consumption data that is gathered and published.

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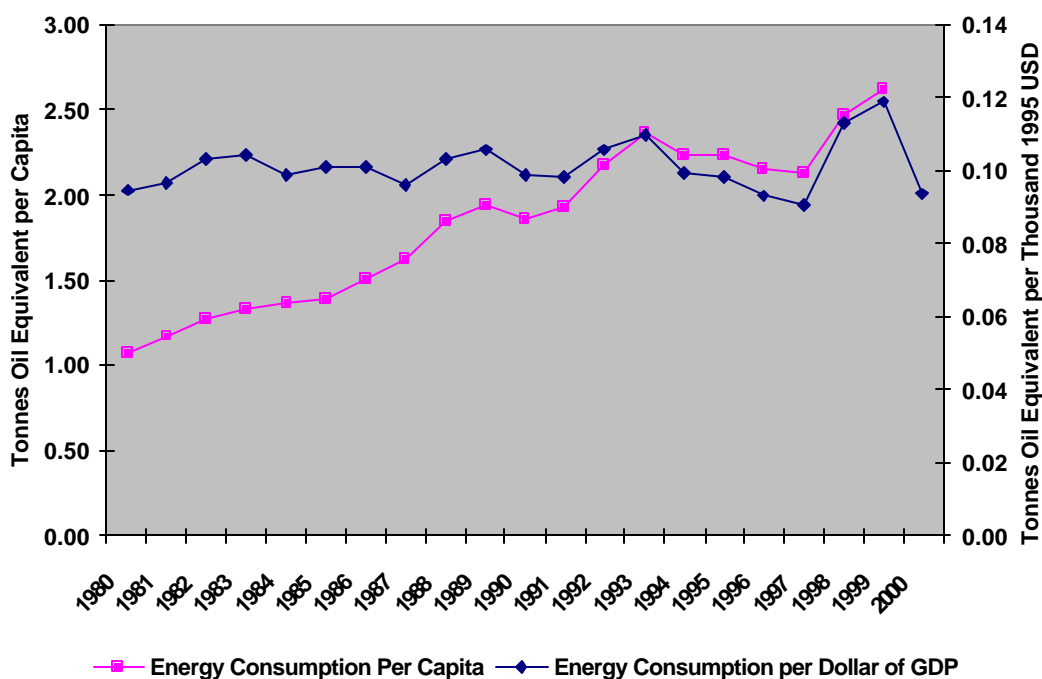
# HONG KONG, CHINA

## BACKGROUND

Energy efficiency programmes in Hong Kong, China are promoted by the Energy Efficiency Office (EEO) which was established in 1994 under the Electrical and Mechanical Services Department (EMSD). The programmes are largely focused on energy use in commercial buildings.

Between 1985 and 2001, Hong Kong's GDP grew at an average annual rate of 5.4 percent, while its energy consumption grew at an average rate of 4.9 percent and its electricity demand grew at an average rate of 5.6 percent. While the economy's energy consumption per capita has been increasing quite steadily, its energy intensity (ratio of energy use to GDP) has fluctuated within a narrow band, declining by an average of 0.5 percent per annum over the period. Its electrical intensity (ratio of electricity use to GDP) increased slightly by an average of 0.2 percent per annum.

**Figure 4** Energy Efficiency Indicators for Hong Kong, China, 1980-2000.



## BUILDING SECTOR EFFICIENCY PROGRAMMES

### BUILDING CODES

Commercial buildings are a key energy consumer in Hong Kong, accounting for 34 percent of total energy end-use. The Energy Efficiency Registration Scheme for Buildings was launched in 1998 to encourage developers and architects to adopt energy efficient building designs. The scheme provides a voluntary framework for implementing the Building Energy Codes, which set out minimum energy efficiency requirements for buildings in terms of power consumption, system design, and monitoring. The Building Energy Codes cover air conditioning, lighting, electrical systems, and lifts and escalator systems. Buildings that meet the codes receive a registration certificate and are allowed to display an energy efficient building logo for publicity purposes. More

than a hundred registration certificates have been awarded. Programme reviews have found that the scheme and codes are well received by developers, property owners, architects and engineers.

A research project is underway to develop a performance-based code of practice for buildings taking a total-energy-budget approach. The performance code will cover energy-efficient features that do not figure in existing codes, such as the use of natural light in building design and recycling of waste heat. The new code aims to advocate a higher level of innovative building design.

#### **APPLIANCE EFFICIENCY LABELS**

The Energy Efficiency Labelling Scheme, which was instituted on a voluntary basis in 1995, covers a broad range of household appliances including room air conditioners, dehumidifiers, refrigerators and freezers, rice cookers, clothes washers and dryers, electric water heaters, and compact fluorescent lamps. It also covers passenger vehicles and several types of office equipment such as photocopiers, printers and multifunction devices. Surveys have found that for each major type of appliance, 30 to 70 percent of the units sold on the market have so far adopted labels.

#### **DEMAND-SIDE MANAGEMENT**

Power companies began a three-year demand-side management (DSM) programme in July 2000 to encourage commercial customers to switch to energy-efficient appliances for lighting, ventilation and air conditioning. By the end of June 2002, more than 4000 applications had been received and processed, representing a projected annual energy saving of 154 GWh, equivalent to the annual consumption of over 25,000 households.

#### **EFFICIENT COOLING SYSTEMS**

With air conditioning accounting for a third of commercial energy use, a government study found that water-cooled air conditioning systems (WACS) use 7 to 17 percent less energy than air-cooled air conditioning systems. An interdepartmental working group coordinated by EMSD launched a two-year pilot scheme in 2000 to promote the use of WACS in non-domestic buildings. It worked to relax the ban on use of fresh water for WACS and set up a registration and licensing system to ensure proper design, operation and maintenance of cooling towers. As of the end of 2002, there were 14 applications to install WACS in buildings with total floor area of about 800,000 square metres. It is estimated that annual energy savings from these systems would be 9 GWh.

District cooling systems (DCS) can bring tangible benefits in terms of energy savings and cost savings to developers, landlords and tenants alike. To promote use of DCS in the future, EMSD has conducted two studies to identify the technical, environmental and institutional requirements for implementing DCS. The studies address legislative, regulatory, financial, economic and land use issues. Potential customers include commercial buildings and shopping malls, government and community buildings, hotels, and underground railway stations.

#### **ENERGY PERFORMANCE CONTRACT**

An energy performance contract was signed in December 2001 by a service provider called CLP Engineering Limited to retrofit a hospital with energy-efficient equipment. Under the contract, the service provider is responsible for all the retrofit costs and will guarantee an annual energy savings of HK\$150,000. The contract period is four years, after which the hospital will enjoy all the cost savings resulting from the retrofit.

#### **PUBLIC EDUCATION WEBSITE**

EMSD is developing an interactive website to provide people in Hong Kong with knowledge of energy efficiency. The website will contain useful information on energy principles, the energy efficiency of appliances, the energy efficiency of different types of equipment, the energy efficiency of buildings, and energy efficiency in the transport sector. It will also contain the testing results from energy efficiency programmes and pilot projects.

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**PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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In 1995, the Energy Efficiency Office (EEO) began a three-year Phase 1 Pilot Energy Management Opportunity (EMO) Implementation Programme to examine the cost-effectiveness of various advanced energy-efficient technologies in government buildings. The programme targeted 20 major government buildings that had regular working hours, typical floor layouts and adequate coverage of various technical designs. Use of electronic ballasts for lighting and variable-speed drives (VSDs) for air conditioners resulted in savings of 6.8 TJ and HK\$1.7 million each year. The estimated payback period is 3 years for electronic ballasts and 4 years for VSDs.

In 2000, a Phase 2 Pilot Programme began for the installation of additional efficiency technologies in public buildings. These technologies include energy optimisers to reduce power losses in escalator motor drives, intelligent lift control systems, T5 fluorescent lamps, room occupancy sensors that turn lights on and off, and indirect evaporating heat recovery units for air conditioners. It is estimated that energy use in government buildings could be reduced by 30 percent through the application of these technologies.

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**SUMMARY**

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Energy efficiency efforts in Hong Kong focus largely on commercial buildings. Each programme has begun with a pilot project, has established a clear target before its implementation, and has quantitatively assessed its actual results after implementation and has a quantitative assessment. This systematic approach has contributed to programmatic success.

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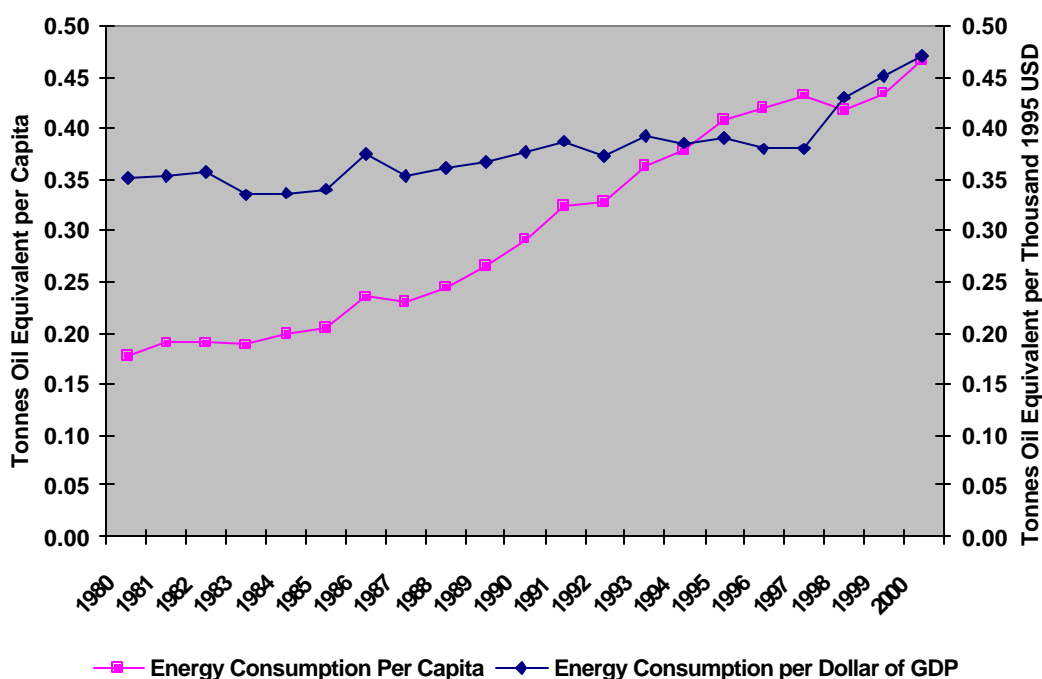
# INDONESIA

## BACKGROUND

Energy efficiency programmes in Indonesia are coordinated by the Department of Energy and Mineral Resources through its Directorate for General Electricity and Energy Utilisation (DGEEU) and Subdirectorate for Energy Conservation. Overall policy for energy resource development and utilisation is set by a National Energy Coordinating Board (Bakoren), which is chaired by the Minister of Energy and Mineral Resources and has energy suppliers and consumers as members.

From 1985 through 2000, Indonesia's GDP grew at an average annual rate of 5.2 percent, while its energy consumption grew at an average rate of 7.5 percent and its electricity demand grew at an average rate of 13.0 percent. As a result, the economy's energy intensity (ratio of energy use to GDP) increased at a steady pace of 2.2 percent per year on average, while its electrical intensity (ratio of electricity use to GDP) increased at a very rapid clip of 7.4 percent per year. Energy consumption per capita has also increased steadily, as shown in the figure below.

**Figure 5 Energy Efficiency Indicators for Indonesia, 1980-2000**



Indonesia's energy efficiency programmes are driven by rising energy demand, declining oil reserves and rising public awareness of environmental quality issues. A presidential decree in 1991 led to the National Master Plan for Energy Conservation in 1995. The plan included programmes for training, efficiency awards, energy management, and industrial energy audits. It also outlined fiscal incentives such as tax reductions and soft loans for energy conservation projects. The plan set a target for 15 percent energy savings by 1999 which was not achieved; while energy use declined by 11.5 percent between 1995 and 2000, this was largely due to the financial crisis of 1997. In 2000, a more realistic target was set, to reduce energy intensity by 1 percent per year. Energy conservation was one of five key directions announced in the Second National Energy Policy of 1998. In 2002, government-industry partnerships were announced for demand-side management, appliance labelling and improved efficiency information.

The economy's energy efficiency programmes have long laboured against a tide of energy subsidies, which have reduced the price of energy to consumers and thereby their incentive to use energy efficiently. As a net energy exporter, Indonesia has subsidised its energy prices for over three decades, making them among the lowest in the APEC region. But the International Monetary Fund has insisted upon removal of energy subsidies as a condition for financial support. Petroleum subsidies were partially removed in 2003, but street protests required that some be left in place. Nevertheless, the government plans for energy subsidies to be entirely removed in 2004.

## **BUILDING SECTOR EFFICIENCY PROGRAMMES**

### **BUILDING CODES**

Along with all ASEAN member governments except Brunei, Indonesia adopted voluntary commercial building energy codes in 1992. ASEAN and USAID have estimated that long-term energy savings of 20 percent could be realised from full adoption of the codes. Indonesia's codes apply to building shells, lighting and air conditioning equipment. However, it does not appear that the codes are widely understood or adhered to by Indonesia's builders and designers.

### **APPLIANCE STANDARDS AND LABELS**

National energy standards for equipment and testing have been established for air conditioners, irons, lighting products, refrigerators, freezers, televisions, cloth washers and electric hot water heaters for showers. Except for a mandatory standard for compact fluorescent lamps (CFLs) that was promulgated in 2000, these energy standards are voluntary. Refrigerators will also be subject to a mandatory standard in 2005, with a maximum allowable consumption of 250 kWh per year. Voluntary labelling has been in effect since 1992 for air conditioners, refrigerators and freezers.

### **DEMAND-SIDE MANAGEMENT**

Demand-side management (DSM) was first introduced by the National Electricity Company (PLN) in 1992 to slow growth of power demand. With assistance from the United States Agency for International Development (USAID), PLN studied potential DSM programmes and proposed efforts on improved motor efficiency, high-efficiency lighting, and time-of-use tariffs. Revised DSM targets were established in 2002, focusing on the introduction of more efficient lighting and application of time-of-use, interruptible and curtailable tariffs. The targets are shown in the tables below. A recent assessment indicates that as of October 2002, DSM programmes had only resulted in 6.7 MW of power savings, so a long way remains to go if the targets are to be achieved.

**Table 3 Targets for PLN's Demand-Side Management, 1994-1998**

<b>Fiscal Year</b>	<b>Energy Savings Target</b>	<b>Peak Load Reduction Target</b>
1994/1995	40.3 GWh	9.0 MW
1995/1996	93.7 GWh	20.2 MW
1996/1997	173.9 GWh	36.1 MW
1997/1998	316.5 GWh	61.8 MW

Source: Jufri Djula, (1997).



**Table 4 Targets for PLN's Demand-Side Management, 2002 - 2005**

Sub Program	2002 Target	2003 Target	2004 Target	2005 Target
Efficient Lighting	26.7 MW	44.0 MW	97.2 MW	152.0 MW
TOU/IC Tariff	174.7 MW	325.4 MW	796.1 MW	1,403.4 MW
<b>Total</b>	201.4 MW	369.4 MW	893.3 MW	1,555.4 MW

In 1994, pilot programmes for efficient residential and commercial lighting were instituted with US\$8 million of support from the Power XIII loan project of the Asian Development Bank. Some 100,000 compact fluorescent lamps (CFLs) were installed, of which 40,000 were sold. In addition, 60,000 lamps and ballasts have been retrofitted in commercial and public buildings, of which 24,000 lamps were sold through a rebate programme. Under a more recent effort to get households to replace 40-watt bulbs with more efficient 8-watt CFL bulbs, 295,000 CFL bulbs had been sold by the end of 2002, reducing electric capacity needs by 8.8 MW. Street lighting improvement programmes have installed 15,000 efficient bulbs in Medan, Semarang and Yogyakarta, and will be extended to other cities. During 2003, a discount of 3000 rupiahs was offered on the purchase of each of up to three lamps, with a target of 5 millions efficient bulbs to be sold.

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## INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES

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### ENERGY SERVICE COMPANIES

In 1987, with financial assistance from the World Bank, the Government of Indonesia established PT Konservasi Energi Abadi (KONEBA), Indonesia's National Energy Conservation Company (ESCO). KONEBA has made significant accomplishments in the past five years, including detailed energy audits of over 30 large industrial facilities, energy conservation planning activities, database development, training, information dissemination, and the procurement and installation of energy saving equipment. KONEBA was established as a for-profit institution, the first such donor-funded effort in a developing economy. By 1990, KONEBA was operating at a profit on a cash-flow basis. More recently, KONEBA has been able to maintain self-financing operation. Nonetheless, the company will provide an excellent resource for the design and implementation of a national DSM programme.

### ENERGY AUDITING

An industrial and commercial sector partnership programme is targeted to reduce energy demand by industry and commercial buildings by providing free energy audit and consultation. Studies indicated that potential energy savings could amount to 10 percent to 30 percent for large industries and between 5 percent and 40 percent for small and medium-sized companies.

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## EDUCATION, TRAINING AND PUBLIC AWARENESS PROGRAMMES

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### INFORMATION DISSEMINATION

An information programme began in 1980 to generate community awareness of the need to use energy efficiently and ultimately to influence consumer behaviour. The programme has included seminars, distribution of posters and brochures, and radio and television programmes. Energy conservation has also been introduced as a subject in formal education curricula from elementary schools to universities. To enhance dissemination of energy information, an Energy Information Centre under the Department of Energy and Mineral Resources was established in 2001.

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## SUMMARY

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Although Indonesian energy efficiency programmes have more than twenty years of history, their results have been limited by several factors:

- subsidised energy prices which limit incentives to use energy efficiently,
- lack of mandatory minimum energy performance standards,
- absence of financial incentives such as tax exemptions and soft loans,
- lack of efficiency targets in the transport sector, and
- weak institutional support for energy efficiency programmes.

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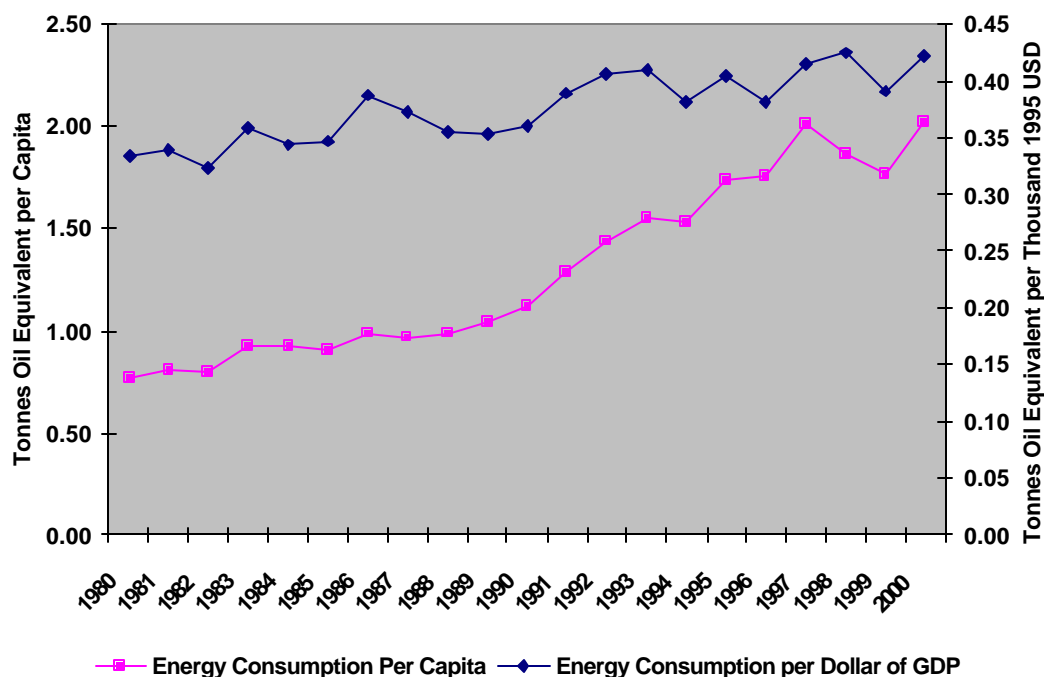
# MALAYSIA

## BACKGROUND

Malaysia's energy efficiency programmes are coordinated by the Energy Commission and the Malaysia Energy Centre (Pusat Tenaga Malaysia – PTM). They are primarily focused on the industrial sector, which is energy-intensive and growing rapidly, but also involve the building sector. They include regulations, financial incentives, demonstration projects, public information, training, energy audits and benchmarking, promotion of energy service companies, and demand-side management (DSM) projects for reducing electricity demand.

Between 1985 and 2000, Malaysia's GDP grew at an average annual rate of 7.0 percent, while its energy consumption grew at an average rate of 8.4 percent and its electricity demand grew at an average rate of 11.1 percent. While the economy's energy consumption per capita has been increasing quite rapidly, except for a brief period following the Asian financial crisis of 1997, its energy intensity (ratio of energy use to GDP) has increased more slowly, by an average of 1.3 percent per annum over the period. Its electrical intensity (ratio of electricity use to GDP), however, has increased at a rapid pace averaging 3.9 percent per annum.

**Figure 6** Energy Efficiency Indicators for Malaysia, 1980-2000.



## BUILDING SECTOR EFFICIENCY PROGRAMMES

### BUILDING GUIDELINES

Malaysia established a voluntary building code for new structures in 1989. This code of practice on energy efficiency and renewable energy in non-residential buildings applies to building shells, lighting and air conditioning equipment. Mandatory Universal Building By-Laws have been drafted by the Ministry of Housing and Local Government but have not yet been adopted.

### APPLIANCE STANDARDS

Malaysia established mandatory efficiency standards for fluorescent lamp ballasts in 1999 and 2000. There are no voluntary or mandatory efficiency standards for any other appliances.

### PUBLIC INFORMATION AND COOPERATION WITH MANUFACTURERS AND SUPPLIERS

The government promotes energy efficiency through awareness programmes and cooperation with building service consultants, manufacturers and suppliers. So far, Malaysia has achieved a certain degree of success in promoting the use of energy efficient equipment. For example:

- More efficient 36-watt and 18-watt fluorescent tubes of 26 mm diameter have replaced the 40-watt and 20-watt tubes of 38 mm diameter on the market.
- Compact fluorescent lamps of various types have been widely used in places of the less efficient tungsten filament lamps.
- Low-voltage quartz halogen lamps with glass mirror reflector and diachronic reflector coating are fast replacing the more energy-consuming parabolic aluminised reflector (PAR) lamps as flood lights and down lights.
- Fluorescent tubes with efficacy as high as 90 to 95 lumens per watt are widely used in commercial complexes and government buildings.
- Fluorescent ballasts sold in the market are those with losses ranging from 6.5 watts to 12 watts instead of those with losses ranging from 15 watts to 20 watts.
- Fluorescent fittings with parabolic reflector to improve lighting efficiency are commonly used in commercial complexes and government buildings.
- More efficient air-conditioning plants are used which incorporate multi-compressor chillers, variable air volume systems, and other energy-saving features.
- Ice storage is used in air-conditioning systems to reduce peak power demand.
- Power factor correction capacitors are installed to reduce reactive power demand.
- Building service management systems are installed in big complexes to optimise energy consumption.

### DEMONSTRATION OF ENERGY-EFFICIENT HOUSING

A demonstration house incorporating advanced energy efficiency features has been built by the University Putra Malaysia. The Centre for Environment, Technology and Development Malaysia (CETDEM) is planning a demonstration and documentation centre for sustainable energy solutions for urban households, aimed at modern homes with air conditioning and hot water.

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### INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES

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#### FINANCIAL INCENTIVES

The government announced several financial incentives for energy conservation in its fiscal 2001 budget. Energy service companies (ESCOs) received the following tax breaks on energy efficiency projects, provided an application for assistance was made by the end of 2002 and the project was completed within a year of its approval:

- Income tax exemption of 70 percent on statutory income for five years, or investment allowance of 60 percent of capital expenditure incurred within a period of five years to be utilised against 70 percent of statutory income;
- Sales tax exemption on all equipment;
- Import duty exemption on equipment that is not produced locally.

For companies that incur capital expenditure for reducing their own energy consumption, the following financial incentives were provided:

- Accelerated capital allowance on related equipment to be fully written off within a period of three years;
- Sales tax exemption on all equipment;
- Import duty exemption on equipment that is not produced locally.

In addition, an energy efficiency project lending scheme (EEPLS) has been set up at the Malaysian Industrial Development Finance Bhd (MIDF), for RM8 million to finance four ESCO demonstration projects (detailed below). Loans with zero percent interest are being offered to finance half of the project costs for ESCO demonstrations as well as half of the costs for local equipment manufacturers to produce energy efficient equipment.

### **INDUSTRIAL ENERGY EFFICIENCY IMPROVEMENT PROJECT**

The Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP) was undertaken to reduce barriers to energy efficiency and conservation in the economy's industrial sector. It was funded over four years (2000-2004) with RM 80 million from the Government of Malaysia, private sector sources, the Global Environment Facility (GEF) and United Nations Development Programme (UNDP). MIEEIP encourages implementation of energy efficiency improvements in eight energy-intensive manufacturing sectors: cement, ceramics, iron and steel, food, glass, wood, pulp and paper, and rubber. Its target is to reduce total industrial energy consumption and greenhouse gas emissions by 10 percent below the reference "business as usual" scenario by the year 2004.

MIEEIP is to develop benchmarks for energy use in each of the eight sectors, enhance the capacity of each sector to identify and evaluate energy saving measures, provide training and education, and demonstrate the viability of new energy saving technologies through pilot projects. It has distinct programmes on energy use benchmarking, energy audits, energy rating, energy promotion, support for energy service companies (ESCOs), energy technology demonstration, energy efficiency equipment manufacturing support, and financial institution participation.

### **INDUSTRIAL ENERGY AUDITS**

MIEEIP has completed 48 energy audits in eight targeted industrial sectors: cement, ceramics, food, glass, iron and steel, pulp and paper, rubber, and wood. On average, it has been found that industries that lack proper energy management programmes can reduce their energy requirements by 23 percent through installation of efficiency measures. MIEEIP has also formed audit teams in each sector, including individual industrial enterprises and industrial associations as well as PTM. The teams should help to ensure that audits continue and will also conduct training for auditors. Energy audit guidelines are being prepared for the use of energy professionals, giving industry-specific advice and recommendations on how energy audits can best be carried out. It is anticipated that energy auditing efforts will be extended to plastic, textile and chemical industries.

### **ENERGY USE BENCHMARKING**

With inputs from energy audits, energy use benchmarks have been established for the eight target industrial sectors. Information on benchmarking has been disseminated to the iron and steel, rubber, cement, pulp and paper, and glass industries through various websites and newsletters. A portable thermal and energy monitoring kit will be made available to all audited factories and other interested factories to help them monitor their energy consumption and set energy use benchmarks, not only for their overall production processes, but also for their various sub-processes.

### **ENERGY SERVICE COMPANIES**

Energy service companies (ESCOs) provide a comprehensive range of services that improve the energy efficiency of factories and buildings. These services include energy management

consulting, energy performance contracting, and energy efficiency investment with third party financing. Companies can benefit from the services of ESCOs in several ways:

- technical assessment and project implementation by an energy efficiency specialist;
- ESCO project financing leaving the company's capital free for other investments;
- immediate reduction of energy costs and overall production costs; and
- ownership of equipment at the end of operation, without any initial capital outlay.

MIEEIP's ESCO Support Programme is targeted at stimulating the establishment of credible and proactive ESCOs that can finance energy efficiency projects and guaranteeing their performance through energy performance contracts (EPCs). The programme helps promote ESCO project management, develop the institutional and legal framework for ESCOs, and enhance ESCOs' technical and business skills in collaboration with the Malaysian Association of ESCOs (MAESCO). So far, 32 ESCOs have registered with the Malaysia Energy Centre (PTM).

In August 2002, four local ESCOs were selected by MIEEIP to implement energy efficiency technology demonstration projects. These projects will serve as a testing ground for implementing and monitoring energy cost saving projects through the ESCO concept. They will also demonstrate to financial institutions the business viability of ESCO projects. The wood sector project began in April 2003, and the cement sector project was to start in the third quarter of 2003.

#### **EDUCATION AND TRAINING**

Under the local energy efficient equipment manufacturing support programme, MIEEIP has identified five industrial firms to be trained in the manufacture of energy efficient motors, boilers, fans and blowers, pumps and heat exchangers, respectively. MIEEIP is also organising workshops and seminars to explain the financial viability of energy efficiency projects to financial institutions.

#### **DEMAND SIDE MANAGEMENT BY THE ELECTRIC POWER INDUSTRY**

Demand side management (DSM) initiatives by electric utilities, particularly tariff incentives, have had some impacts on efficient utilisation and consumption. Past DSM programmes have often relied on regulatory manipulations and massive subsidies. But more recently, DSM programmes have been based on more commercial principles, with less emphasis on subsidies and more on information services, working with customers and obtaining profits from DSM services.

The largest DSM programme is implemented by the national power utility, Tenaga Nasional Berhad (TNB), which generates more than half of the economy's electricity and is the sole buyer of electricity from independent power producers in the wholesale market. The DSM programme aims to promote energy savings by encouraging the use of state-of-the-art energy efficient technologies. It also aims to create a market for energy-efficient products and services by increasing public understanding of these products and services. Finally, the programme aims to develop small and medium-scale enterprises to supply energy efficient products and services to the economy. The major DSM programmes planned or carried out by TNB and others include the following:

- Pilot DSM Marketing (to promote the "Smart Saver" brand, extend sales of "Smart Saver" products, and increase the range of "Smart Saver" products and services);
- Product Testing and Development for DSM Marketing (of products that are made in Malaysia or about to be made in Malaysia within two years, competitively priced, field-tested for at least six months, and in compliance with standards set by the Standards and Industrial Research Institute of Malaysia [SIRIM] or similar independent organisations);
- TNB Model Buildings Programme (whereby existing TNB buildings must undergo energy audits and implement cost-effective measures, while all new TNB buildings must incorporate energy efficiency features);

- TNB-California Energy Commission Joint DSM Project (preparation of a long-term DSM plan for TNB; implementation of DSM demonstration projects);
- Promote Shared-Saving Programme (promotion of shared-saving schemes in conjunction with EASISAVE Energy Consultants Sdn. Bhd, and other companies, with assistance given by TNB to recover payments through electricity bills);
- Development of Direct Customer Load Control System (pilot project to control air conditioning loads in several TNB buildings in Kuala Lumpur and Petaling Jaya using a telecommunications-activated control system with radio or pager signals);
- Community Outreach Programme (training of local contractors in the installation and maintenance of energy efficient technologies, with competent contractors becoming TNB panel contractors);
- Public Competition (for energy-efficient appliances);
- Energy Efficiency and Cogeneration Programme for Malaysian Forest and Pulp and Paper Industries;
- Energy Optimisation Scheme in University Malaya;
- Energy Efficiency and DSM Programmes by TNB Groups;
- University of Technology of Mara (UiTM) Energy Management Project;
- Poster and Essay Competition for Secondary Schools;
- Industrial waste-to-energy plant burning paper sludge at Genting Sanyen Paper Mill, Selangor (supported by NEDO, Japan's New Energy and Industrial Technology Development Organisation).

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## **PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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### **ENERGY AUDITS OF GOVERNMENT BUILDINGS**

The Malaysian Electricity Supply Industry Trust Account (MESITA) funds a 5-year Energy Audit in Government Buildings (EAGB) project with total budget of RM 5-million. The aim is to create awareness and disseminate relevant information on energy efficiency in government agencies, while giving an initial boost to the development of energy efficiency business in Malaysia. This project has the following specific objectives:

- Determine the baseline of current energy consumption in government buildings in Malaysia.
- Create awareness among the commercial sector especially government's offices/buildings on EE practice particularly through energy audit activities.
- Stimulate an active market for EE technologies and services.
- Promote energy efficient buildings which utilise energy efficient technology in Malaysia as model demonstration buildings.
- Promote a sustainable EE programme in the management of government buildings.

Since there is no energy audit standard to be followed, a guideline has been developed by the Malaysian Association of Energy Service Companies (MAESCO) with the purpose of standardization of the energy audit procedure in commercial buildings. In July 2002, twelve ESCOs were selected to conduct energy audits in government buildings throughout Malaysia. This project aims to equip more businesses with energy audit skills.

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**SUMMARY**

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In developing the energy efficiency market in Malaysia, concerns on the supply of equipment and services have been viewed as critical. To provide and disseminate energy efficient products, increased synergy is needed between and among national and local authorities, energy suppliers (electricity, oil, gas, and coal), technical providers of equipment and services (manufacturers, suppliers, consultants, and engineering firms), and customers (especially industrial customers).

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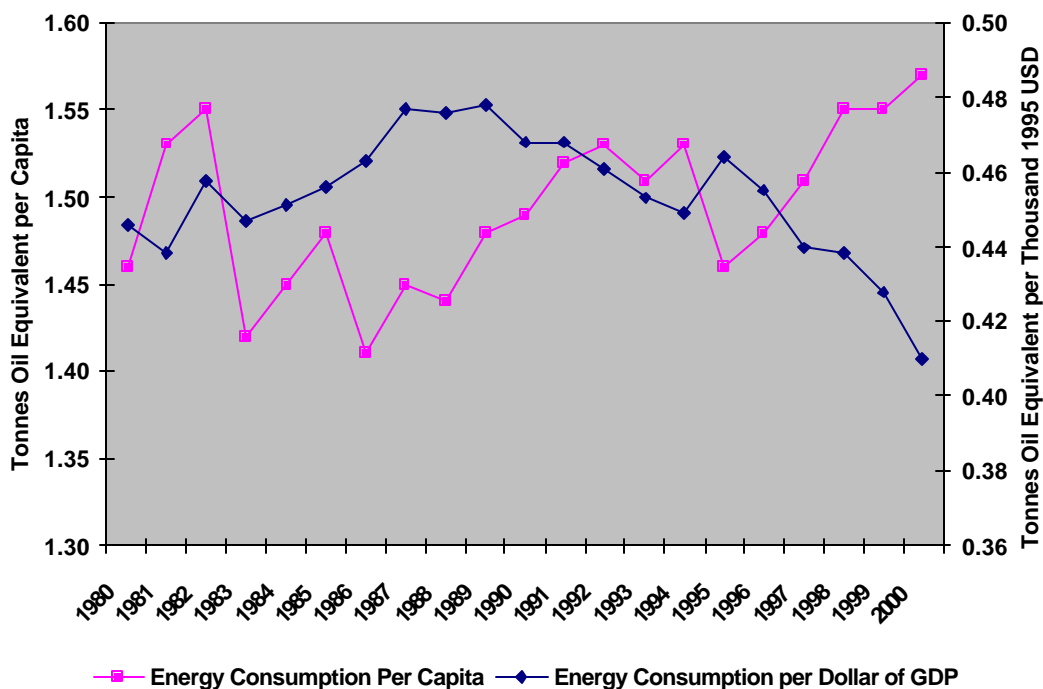
# MEXICO

## BACKGROUND

Mexico's energy efficiency programmes are overseen by the National Commission for Energy Conservation (CONAE). They are largely focused on public buildings and the facilities of the national oil company, PEMEX. Created in 1989 as a government consulting agency, CONAE provides technical advice on efficient energy use to public institutions and state governments.

From 1985 through 2000, Mexico's GDP grew at an average annual rate of 2.9 percent, while its energy consumption grew at an average rate of 2.2 percent and its electricity demand grew by an average rate of 5.0 percent. Thus, the economy's energy intensity (ratio of energy use to GDP) declined by 0.7 percent per annum over the period, while its electrical intensity (ratio of electricity use to GDP) increased by roughly 2.1 percent per annum. Energy consumption per capita has fluctuated sharply over the last two decades but has been on a steady upward path in recent years.

**Figure 7 Energy Efficiency Indicators for Mexico, 1980-2000.**



## BUILDING SECTOR EFFICIENCY PROGRAMMES

### BUILDING CODES

Mexico has mandatory energy efficiency codes for lighting systems and building shells in commercial buildings. The code for lighting systems, which was instituted in 1995 and is being revised, applies to all offices, schools and educational centres, hospitals and clinics, hotels and motels, restaurants and cafeterias and commercial establishments (stores) that have an electricity load of more than 20 kilowatts. The code for building shells, which was established in 2001, applies to all new commercial buildings and extensions to them. A new code for building shells of residential buildings under preparation and is expected to be issued around December 2003.

### APPLIANCE STANDARDS AND LABELS

The Mexican Energy Secretariat develops and publishes technical standards for electrical and thermal equipment and appliances, which are compulsory for all equipment manufacturers. Standards have been established for a broad range of appliances including refrigerators, freezers, washing machines, air conditioners, fluorescent lamps, indoor and outdoor lighting systems, and water heaters. They have also been established for industrial equipment including boilers, motors, pumps and transformers. In addition, most appliances are required to carry labels which specify their relative energy efficiency as compared to similar tested and certified products. Testing laboratories and certification boards have been established to certify new equipment and verify that appliance standards are properly implemented. Three government organisations have teamed up to accredit 2 certification boards, 47 testing laboratories and 379 verification units. In 2002, standards are estimated to have reduced electricity demand by 9,120 GWh and capacity needs by 1,543 MW.

### INSTALLATION OF EFFICIENCY MEASURES

Several programmes are in place to make homes in Mexico more energy efficient:

- The ILUMEX programme initially funded by the World Bank has allowed the installation of 8.6 million fluorescent compact bulbs as replacements for conventional bulbs with the purpose of educating the general public on the advantages of efficient lighting.
- There are Mexico-wide programmes to equip homes with better insulation, more efficient air conditioners and compact fluorescent light bulbs. They funded the installation of insulation in 74,000 homes and provided 19,300 efficient new air conditioning units. For 2002, goals were to have 3,800 additional residences insulated, 8,400 air conditioning units replaced and a million fluorescent lamps installed. Annual savings amount to 1,013 GWh and 631 MW of avoided demand.
- There is also a programme to better insulate homes, install more efficient air conditioners and refrigerators, and provide compact fluorescent bulbs in northern cities with a hot climate. Total estimated savings yearly are 2,470 GWh of electricity and 700 MW of deferred capacity.

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### INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES

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#### COLLABORATION WITH NATIONAL OIL COMPANY

PEMEX, or Mexican Petroleum, the national government-owned oil company, is the most important public sector company in Mexico and is one of the ten largest oil companies in the world. It is a large energy-consuming entity, using in all its operations in 1999 a total of around 108 million barrels of oil equivalent. As such, it offers the potential for huge energy savings. PEMEX and CONAE established a joint committee to plan the systematic analysis of energy use practices in PEMEX installations and then design and implement energy saving measures. PEMEX owns a large number of productive installations throughout the economy, including oil refineries, gas processing facilities, and transportation systems for crude oil, oil products and natural gas. This diversity of facilities posed major difficulties for analysis of energy use and for arriving at decisions on the best route of action to implement strategies for energy conservation in the organisation.

From 1995 to 1997, a first stage of the plan was carried out in fifty PEMEX facilities consisting of energy studies on utilisation patterns. It was determined that as much as 70 percent of energy consumption from PEMEX productive units came from direct-fired heaters, steam generators and turbines, a fact which presented major potential for energy savings. Prospects for as much as US\$40 million per year in fuel and electricity savings were identified, as well as opportunities for significant savings in the use of water and for reductions in greenhouse gas emissions.

For the second stage of the programme, the Committee focused on areas that could benefit the most from low-cost efficiency investments. Due to the fact that the energy efficiency opportunities were scattered throughout all the facilities of the PEMEX organisation, the Committee decided on a company-wide strategy of efficiency measures that could be applied simultaneously to all productive units. A set of diagnostic tools and procedural guides for energy savings was produced and made available to PEMEX operating personnel through the CONAE web page. Afterwards, a “bottom-up” administrative approach was designed to have managers and operators at different levels include these efficiency guides into their own daily operating procedures in such a way as to become a systematic and permanent practice. The dissemination of tools and procedures to all PEMEX personnel across Mexico through the web page proved an innovative method that reduced the transaction costs and made for a quick and simple way to make rapid diagnoses with direct help from experts online. The energy efficiency procedures applied at this stage were directed at the use of residual heat from gases in marine and land installations, the efficient use of energy in direct-fired heaters, the rational use of cooling water, efficient steam generation and distribution, energy assessment of lighting systems, and efficiency improvements in cogeneration.

**Table 5 Energy Savings Prospects Identified in PEMEX**

System	Energy Savings Potential	Monetary Savings
Cooling towers	81,000 MWh per year	US\$1.6 million per year
Direct fire heaters	10 Mkcal per hour	US\$140.4 million per year
Lighting	5,100 MWh per year	US\$2.4 million per year
Heat recovery	170 Mkcal per hour	US\$7.2 million per year
Steam generation and distribution	40 Mcm per year	US\$2.4 million per year

Source: Directorate for Thermal Processes, CONAE.

The strategy was later complemented with additional diagnostic tools and establishment of an institutional training programme as a major component. In 1998, the main elements of this energy efficiency campaign were taken over by the newly instituted Industrial Safety and Environmental Protection Integrated Management System (SIASPA), a corporate strategy for the implementation of energy efficiency, industrial safety and environmental protection policies throughout PEMEX. This corporate strategy was kicked off with a goal to reduce energy consumption rates by 5 percent in 244 production facilities in one year. In July 2000, it was reported that 60 percent of PEMEX installations had achieved the 5 percent reduction goal, obtaining savings equivalent to US\$1.9 million while reinforcing an energy-savings culture among the company’s workers.

From 1997 to 2000, total impacts of the PEMEX energy efficiency campaign were reported to include annual reductions of around 27,000 MWh in electricity consumption, 12 million cubic metres in water consumption, 24,000 tonnes in CO<sub>2</sub> emissions, and 110 tonnes in NO<sub>x</sub> emissions. The campaign also reduced natural gas use by 12 million cubic metres from 1998 to 2000.

As a third stage, starting in 2000, the programme was made permanent with the introduction of the 2001 Permanent Campaign for Energy Efficient Use and Savings. As part of this campaign, an energy indicators control and follow-up system was applied to every processing plant, system and individual component in all PEMEX petrochemical and gas processing complexes. An energy consumption index, which tracks the ratio of total production to total fuel consumption, was established to allow the measurement and follow-up of results as well as comparison of energy efficiency accomplishments across all PEMEX facilities. A goal was introduced of reducing the energy consumption index by between 1.5 percent and 5 percent in each PEMEX business line.

CONAE, together with the United States Agency for International Development (USAID), developed a method to calculate the total energy consumption index in a facility by performing energy audits that allowed quantification of fuel and raw input materials as well as final products for

an accurate index allowing for specific production levels. The method, initially tested and perfected at two of PEMEX petrochemical centres, Independencia and Pajaritos, revealed potential savings of nearly 650 million cubic feet of natural gas. This new approach made it possible to estimate the potential for energy savings in all equipment and systems under their current operating conditions, as well as the potential for improved performance through additional investments.

Altogether, it is estimated that the PEMEX-CONAE collaboration will save 10.6 million barrels of oil or roughly US\$200 million per year at PEMEX production facilities, while reducing annual carbon dioxide emissions by 3.2 million tonnes. The joint effort has also improved the attitude of PEMEX personnel toward a culture of energy efficiency and has allowed such a culture to become systemic to PEMEX's daily operations. The knowledge and tools acquired can be applied to other sectors and are being considered for transfer into other economies.

The analytic system developed for this campaign is now part of CONAE's energy efficiency programme for industry. A similar system is being successfully applied to Mexico's national electric utility, Comisión Federal de Electricidad (CFE), and to industrial and mining companies. A similar system is also being developed for small and medium-sized enterprises in Mexico.

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## **PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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### **EFFICIENCY IN FEDERAL PUBLIC BUILDINGS**

The public sector, which represents around 10 percent of Mexico's total demand for goods and services, is also a very large energy consumer. CONAE initially concentrated on analysing the use of energy in government office buildings in major cities to identify wasteful energy practices. By 1996, more than 120 energy audits by CONAE performed on public buildings and involving 20 federal agencies uncovered that the largest potential for energy savings was in lighting systems. This gave way to an initial voluntary pilot programme called 100 Public Buildings, targeted mostly at public office buildings, hospitals and schools. The programme limited its coverage to measures with low transaction costs and a high degree of certainty about costs and quality. As part of the programme, building operators were trained in the methodologies required to conduct their own efficiency assessments with technical support from CONAE. Operators were also trained in follow-up procedures for permanent monitoring of energy use and operation and maintenance of the newly installed energy-efficient equipment.

CONAE's analyses showed that more than half of the electricity in buildings was consumed by lighting systems. The buildings evaluated had lighting systems comprised mostly of fluorescent lamps and, to a lesser extent, incandescent lamps with high discharge intensity. Of the fluorescent lamps in existence at the time, only 16 percent were found to be of the energy-efficient type. After the complete assessment of 90 buildings at the end of 1998, accounting for 800,000 square metres of area and more than 135,000 lamps, CONAE estimated that electricity consumption could be reduced by as much as 21 percent, with savings of 19 GWh and US\$1.3 million per year, 3.5 MW of avoided installed capacity and up to 8,000 tonnes of avoided pollutant emissions. It also estimated that required investments of US\$1.5 million could be recovered in 17 months. Energy savings measures applied were of two types: technical measures, which involved upgrading or substituting obsolete equipment, and operational measures, generally involving a costless change in normal procedures such as turning off unnecessary lights.

In 1999, restrictions on the federal budget and the need to reduce government expenses prompted the creation of a wider programme to be applied economy-wide to buildings and facilities of the federal administration based on the strategies being tested on the 100 Public Buildings program. For this larger scale undertaking, CONAE designed a new programme aimed at both high level officials and building operators. Government officers were taught to establish energy efficiency programmes within their areas of responsibility, and building operators were trained in the use of assessment and operational tools. Robust new tools had to be developed to allow a much larger number of users to carry out energy assessments autonomously.

The criteria for eligible buildings stated a minimum floor space of 5,000 square metres and electricity consumption in the previous year of at least 60 kWh per square metre. The new programme included a requirement for each of the eligible building to establish an Energy Savings Committee to coordinate the programme's implementation, and the need for each committee to designate a representative to the CONAE-chaired Technical Committee for the Energy Savings Programme in Federal Buildings. Specific workshops were carried out to train agency staff and representatives on guidelines, operational mechanisms and general activities required by the programme. The Technical Committee, presided over by the head of CONAE, acts as a coordination, consultation, supervisory and evaluation body for the entire programme. The Committee also oversees an annual awards ceremony to acknowledge agencies that stand out in implementing the programme.

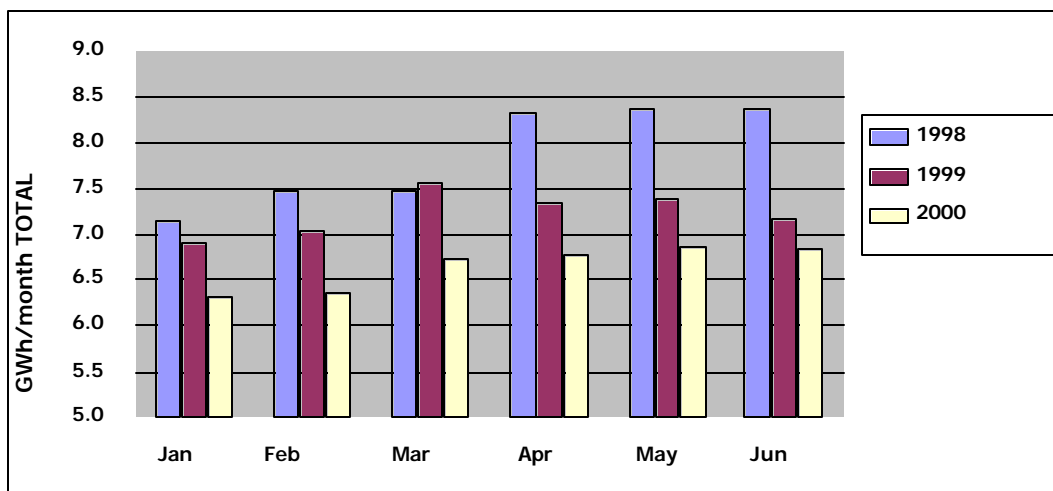
The efficiency programme for public buildings has gone through three stages, each of which adopted changes resulting from lessons learned earlier. During the first stage in 1999, changes included the addition of interactive workshops for federal agency personnel and the broadcasting of distant-training courses on lighting methodology to 300 building operators in 11 cities using videoconferencing technology. A system was also established to help building operators perform equipment assessments and transmit them electronically to CONAE. Special software at CONAE then generated feasibility studies for each building, incorporating specific recommendations. A strategy decreed by the government calling for strict working hour schedules to save on unnecessary energy use helped participating buildings reduce energy consumption by 12.3 percent on average in this first stage of implementation.

The second stage in the implementation of the public buildings programme, which took place in 2000, was characterised by the establishment of new technical workshops to provide additional assistance on energy saving technologies in air conditioning, power equipment and lighting systems. New guidelines were established to allow monitoring and follow-up of the programme that required participating agencies to prepare annual reports stating the current and previous year's energy consumption levels, as well as quarterly reports on energy efficiency actions taken. Additionally, a goal was established to reduce electricity consumption by 20 percent from 1998 levels. But only 42 out of 215 buildings with retrofits, or 19.5 percent, were able to meet this goal during the year.

For the third stage in 2001, regional indices of electric energy consumption were established, and new guidelines allowed each agency to set its own goals based on recommendations by CONAE, energy consumption in previous years and regional climate characteristics. Participating buildings were classified into three operational levels with different reporting requirements. Level 1 buildings were those with 1,000 to 3,000 square metres of floor space. Level 2 buildings included those larger than 3,000 square metres, but with consumption levels lower than the average in regional indices. Level 3 buildings were those larger than 3000 square metres of floor space and consuming more than the average in regional indices. Level 3 buildings are required to propose a biannual working plan, provide quarterly reports, and participate on designated courses and workshops. With the inclusion of smaller buildings, by the end of 2001 the number of facilities registered increased from 493 to 877, totalling 4.6 million cubic metres of floor space.

Data gathered from 342 public buildings participating in the programme between 1998 and 2000 show an electricity consumption decrease of 13 percent on average from one year to the next, or approximately 14 kWh per square metre per year, as shown in the figure below. This represents a total of 27.5 GWh per year for monetary savings of around US\$2 million annually.

CONAE praises the two distinct types of measures used to obtain savings in energy consumption: technological and operational. Technological measures refer to the upgrade or replacement of obsolete equipment, while operational measures refer to low-cost and no-cost changes in energy consumption practices that can lead, even if obvious, to important amounts of savings through methodical re-examination and careful readjustment of everyday routines.

**Figure 8 Declining Energy Consumption in 342 Public Buildings in Mexico**

Source: CONAE

Initial budget restrictions and the need for a low-cost execution meant that effective means of communication had to be set up to put the technological tools at the disposal of the intended clients. The internet was an excellent candidate communications medium but was new and often non-existent for many federal agencies at the time. CONAE therefore established “ports of attention” or PACs at strategically located sites with internet connections operated by CONAE-trained personnel. This innovative communications scheme has allowed building operators, agency officials and CONAE specialists to interact in an organised and efficient way.

After three years, the programme is estimated to have reduced energy consumption by 100 GWh. This translates to public sector savings of some US\$7.4 million that can now be allocated to other areas and sectors of the economy with urgent needs for investment. Also learned from this experience is the fact that investments in energy efficiency in public buildings are often very cost-effective. The average payback period for such an investment was about one and a half years.

## EDUCATION, TRAINING AND PUBLIC AWARENESS PROGRAMMES

### INTERNET PORTS

In 1997, CONAE created a network of “Ports of Attention” (PACs) to provide technical assistance on energy efficiency through CONAE’s web page. PACs are internet-equipped stations that are operated mainly by students and supervised by CONAE’s central and regional offices. Initially, PACs provided technical assistance to small firms and municipalities that lacked access to the internet. More recently, PACs have evolved to support energy facility operators and professionals who implement energy efficiency projects. The PACs programme has several aims:

- provide technical assistance in the field of energy efficiency to consumers;
- help energy users to identify energy savings potential in specific areas;
- help establish the economic and financial feasibility of energy efficiency projects;
- provide guidance and information on energy efficiency and renewable energy.

The PACs have become a highly leveraged way to provide technical assistance on energy efficiency and renewable energy use in both the public and private sectors, while developing a large number of well-trained young professionals and encouraging many of them to consider the field of energy efficiency. The PACs programme also promotes cooperation and coordination among the

host partners, often universities or trade associations. Through use of the internet, the programme has reduced costs of delivering information on energy efficiency without sacrificing its quality. PACs have gradually proliferated throughout Mexico and have become more sophisticated and specialised. They are classified in three types, according to the type of energy user they assist:

- *PACs for municipal and state governments* are located in state or municipal government offices and are formed by an agreement among CONAE, the National Bank for Public Works (Banobras) and the Federal Electricity Commission (CFE). CONAE performs studies to identify technological or operational energy-saving opportunities, CFE provides relevant data to carry out the studies, and Banobras provides financing to carry out the measures proposed.
- *PACs for households* are located in public high schools. Their operators do not require specialised training. They help users to download forms to carry out a residential energy study, and to send completed forms to CONAE for evaluation. These PACs also promote an energy efficiency culture among the students.
- *PACs for business and industry* are located in higher education centres like technical institutes and universities, or in trade associations and industrial chambers.

The PACs are low-cost technical assistance units; each PAC requires only a computer connected to the internet and an operator. Their basic function is to assist energy users in identifying energy savings potentials and evaluating the economic feasibility of specific measures. PACs have their own site within CONAE's web page, which provides operators with updated information on CONAE's tools and methods and allows them to exchange information with CONAE's staff. This site publishes a monthly bulletin, *NotiPac*, which documents PAC activities and successes. A PAC is established through an agreement between CONAE and an interested institution like a centre of higher education, state government office or local industrial chamber.

If successfully carried out from the start, a programme to establish a national network of PACs will trigger a multiplier effect that stimulates network growth on its own. CONAE has built a robust national PAC network that grew steadily in the late 1990s and early 2000s and seems poised to expand further. CONAE believes that PACs' greatest asset is the way they enhance cooperation and coordination among the public and private sector participants. This partnering leads to the successful projects and programmes on energy efficiency that promote CONAE's ultimate goal of saving energy. And by utilising the internet, the PACs programme has reduced costs and maintained quality while substantially expanding CONAE's reach in promoting energy efficiency in Mexico.

The PACs network has become an important source for specialised training and for communicating to the broader public on the benefits of energy efficiency, renewable energy, and their attendant environmental benefits. Through the PACs, these benefits are explained with proven methodologies and can often be illustrated with real-life experiences. PACs network experience runs parallel to the growth, development and maturity of the internet in Mexico. So even though this success could be replicated in another economy, a careful assessment of the current state and potential development of internet availability at the target level should be conducted beforehand. Another crucial element to consider, perhaps even more important, is the strength of the "central" energy office in terms of its capabilities (technical and technological) as well as in the quality and number of personnel available to respond to regional needs and requirements.

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#### SUMMARY

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The CONAE-PEMEX programme for improving energy efficiency in oil industry processes brought large gains for the economy and could achieve major additional energy savings. The programme will become a model for other energy intensive industry in Mexico, and the experience and knowledge gained will be transferred to interested industrial firms.

The programme for energy savings in public buildings has achieved substantial energy savings and developed a number of useful testing tools to identify further potential savings. It has shown that investments in public buildings are often very cost-effective and quickly repaid.

Internet “ports of attention” have proven to be a valuable tool for communication, advice and specialised training. They have also helped explain the benefits of energy efficiency to the public.

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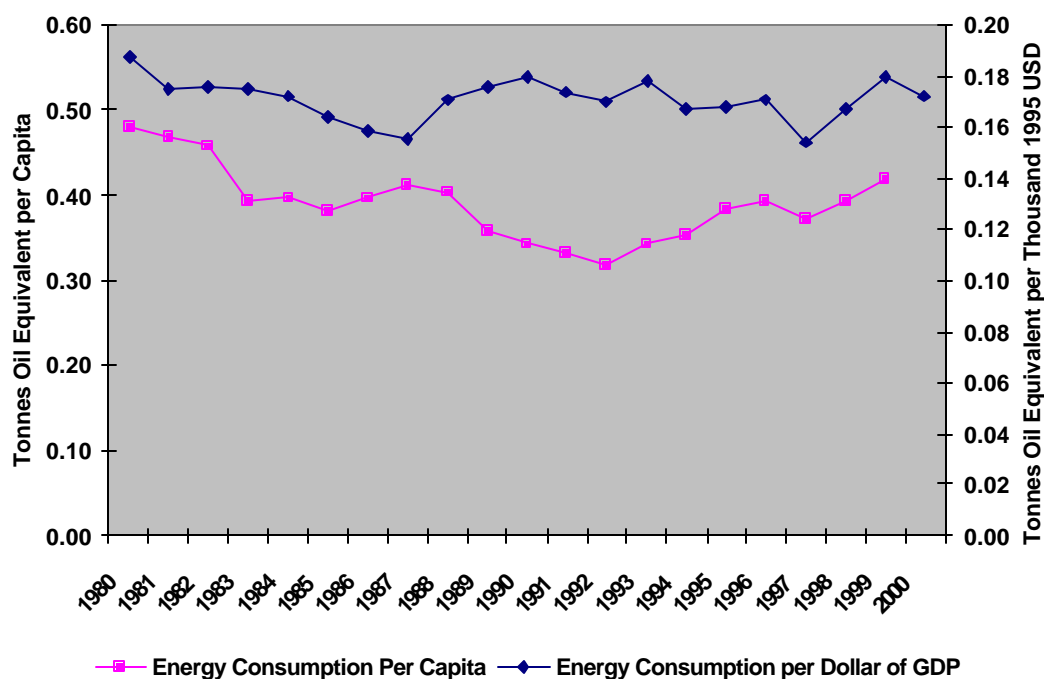
# PERU

## BACKGROUND

Peru's energy conservation programme was instituted by the Ministry of Energy and Mines in 1994 as a tool to alleviate electric power shortages. The shortages were due to rapid growth in power demand and a serious drought that sharply curtailed the output of hydropower facilities that dominate the economy's electricity production. The energy efficiency measures that were instituted successfully avoided the need to ration power in succeeding years, even when the Macchu Picchu hydroelectric plant, which normally generates 25 percent of the power in the South Interconnected System electric market area, was forced off the grid by regional floods in 1998. The two main objectives of the programme are to change the energy consumption habits of the population and to promote the utilization of energy-efficient appliances and equipment. The strategy for achieving these objectives is a continuing information campaign directed at consumers in different sectors.

From 1985 through 2000, Peru's GDP grew at an average annual rate of 2.0 percent, while its energy consumption grew at an average rate of 2.3 percent and its electricity demand grew by an average of 3.3 percent annually. As a result, the economy's energy intensity (ratio of energy use to GDP) increased slightly by 0.3 percent per year, while its electrical intensity (ratio of electricity use to GDP) increased more markedly at a pace of 1.3 percent per year.

**Figure 9 Energy Efficiency Indicators for Peru, 1980-2000.**



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## **BUILDING SECTOR EFFICIENCY PROGRAMMES**

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### **APPLIANCE EFFICIENCY LABELS AND STANDARDS**

Since 1999, mandatory energy labels and voluntary energy efficiency standards have been under development in Peru for compact fluorescent lamps, refrigerators, and residential water heaters. Separate technical subcommittees of the Technical Committee for Rational Use of Energy and Energy Efficiency are working on these. The Peruvian National Institute for Promotion of Competition and Protection of Intellectual Property (INDECOPI) has already issued an efficiency standard and labelling requirements for CFLs as well as efficiency testing methods for refrigerators. But efficiency standards and labels for refrigerators and water heaters are still pending.

### **EFFICIENT LIGHTING PROMOTION**

Average energy consumption in Peru's residential sector has contracted from 128 kWh per month in 1994 to 106 kWh per month in 2000. It is believed that this average consumption has been influenced by the improved habits in energy use among the inhabitants as a result of efficiency promotion campaigns that call for measures such as turning off unnecessary lights and using compact fluorescent lamps. In surveys of residential consumers, while only 14 percent of respondents said they turned off unnecessary lights in 1996, 55 percent so indicated in 1998. While only 25,000 efficient light bulbs had been sold by 1994, some 500,000 were sold in 1995 alone, and an estimated 1.7 million have been sold to date. This massive growth in use of efficient light bulbs has been carried out without government-backed financing schemes or subsidies, and is estimated to have originated a reduction in electricity demand of as much as 80 MW.

### **PUBLIC EDUCATION**

To change energy consumption habits, the Ministry of Energy and Mines has worked with the Ministry of Education to establish an energy efficiency education programme in elementary schools around Peru. Publicity and information campaigns are being carried out through the media to create an energy efficiency culture and to inform the population on efficiency methods available. Printed materials have been distributed with information on ways of reducing electricity bills, and a telephone information service also provides such information. An important part of the campaign proved to be substitution of compact fluorescent lamps for conventional incandescent bulbs. As noted, this is an area where important achievements were made in the last five years.

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## **INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES**

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### **EQUIPMENT EFFICIENCY LABELS AND STANDARDS**

Mandatory energy labels and voluntary energy efficiency standards have been under development in Peru since 1999 for industrial boilers and electric motors. As with appliance standards, separate technical subcommittees of the Technical Committee for Rational Use of Energy and Energy Efficiency are working on these. INDECOPI has issued efficiency testing methods for boilers and motors but has not yet issued efficiency standards or labels for them.

### **TRAINING**

Training courses are being conducted in this area at basic, intermediate and graduate levels to encourage participation in the energy efficiency services market and the formation of service-related businesses. At the same time, studies are being conducted in textile, mining, plastics, and small enterprise industries to determine their energy intensities and efficiencies and identify possible areas for improvement. Manuals and guidebooks have been published for specialists in the field.

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**TRANSPORT SECTOR EFFICIENCY PROGRAMMES**

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**DRIVER TRAINING**

Large energy consumption in the transport sector presents opportunities for significant energy savings. An information campaign has been developed focusing on proper vehicle maintenance procedures and driving habits. Since 1999, vehicle fuel efficiency manuals have been printed and distributed, and training courses have been offered to public transport operators and taxi drivers.

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**PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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**GOVERNMENT BUILDINGS**

A large potential for energy savings exists in public office buildings where payment of energy bills by government has led to a long history of inefficient practices. A campaign for energy savings in public buildings includes informational material for government personnel and the creation of committees in most government agencies to oversee local implementation of efficiency measures.

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**SUMMARY**

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Peru's efficiency programmes are largely reliant on information and training efforts. The programmes have helped to achieve a peak demand reduction of about 100 MW on the Central North Interconnected System (SICN) and limited demand growth on the system to 10 percent over the last five years despite GDP growth for Peru of 20 percent over the same period.

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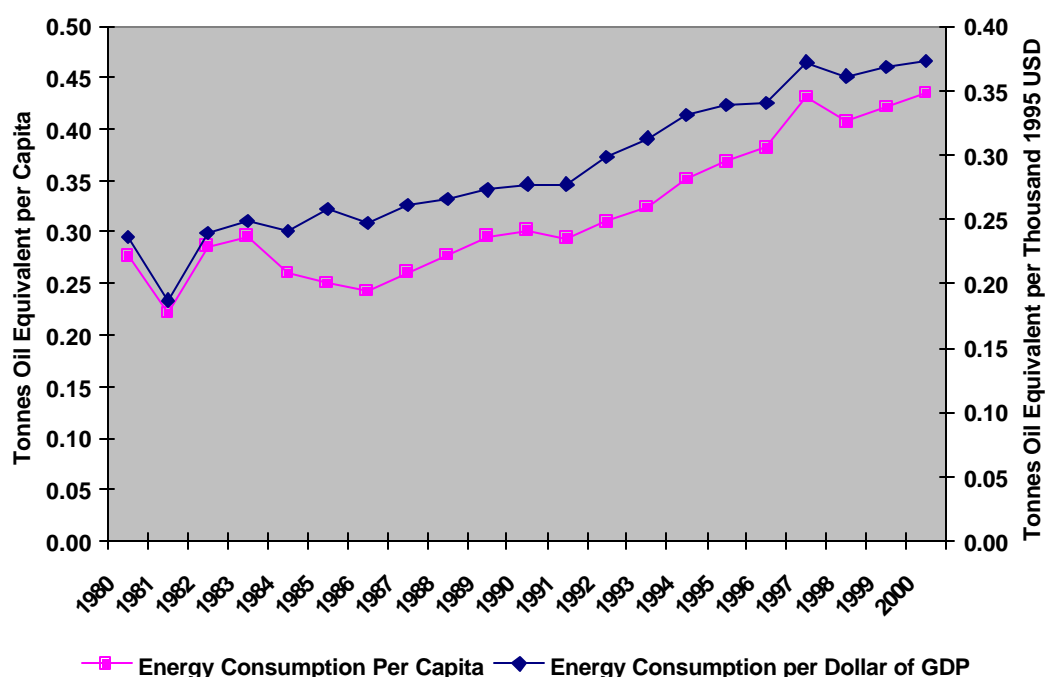
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# PHILIPPINES

## BACKGROUND

Between 1985 and 2000, the Philippines experienced average annual GDP growth of 3.5 percent, while energy consumption grew at an average rate of 6.1 percent and electricity demand grew at an average rate of 4.8 percent. Consequently, the economy's energy intensity (ratio of energy use to GDP) increased steadily by an average of 2.5 percent per year, while its electrical intensity (ratio of electricity use to GDP) increased more slowly at an average of 1.3 percent per year. Energy consumption per capita also saw a steady upward trend over most of the period.

**Figure 10 Energy Efficiency Indicators for Philippines, 1980-2000.**



Energy efficiency programmes in the Philippines are directed by the Department of Energy and guided by an Energy Plan that currently covers the period from 2002 through 2011. Energy efficiency efforts began with the passage of the Energy Conservation Law in the 1980s. They include dissemination of information on the benefits of efficient energy use and best practices, promotion of energy-efficient appliances, introduction of new energy efficient technologies, provision of expertise and technical assistance, and awards for successful conservation projects. Estimated savings from various programmes, as well as the public and private investment requirements that are anticipated pursuant to the programmes, are shown in the tables below.

**Table 6 Energy Savings Prospects in the Philippines (ktoe)**

Programme	1999	2000	2001	2002	2004	2011
Energy Management Services	57.8	57.8	491.0	519.8	577.6	924.2
Information and Education Campaign	0.0	14.4	14.4	14.4	14.4	0.0
Government Enercon Programme	0.0	0.0	14.4	28.9	28.9	28.9
System Loss Reduction	57.8	86.6	72.2	86.6	86.6	14.4
Heat Improvement of Power Plants	158.8	57.8	28.9	28.9	28.9	28.9
Efficiency Labels and Standards	72.2	57.8	101.1	130.0	144.4	144.4?
Demand-Side Management (DSM)	57.8	86.6	72.2	86.6	86.6	14.4
<b>Total</b>	<b>346.6</b>	<b>288.8</b>	<b>736.4</b>	<b>823.1</b>	<b>909.7</b>	<b>1140.8</b>

Source: Philippines DOE - Energy Plan (2002 -2011)

**Table 7 Energy Efficiency Investment Needs in the Philippines (Million Pesos)**

Programme	Public Investment	Private Sector Investment
Energy Management Services	165.3	88,278.3
Information and Education Campaign	36.0	--
Government Enercon Programme	1,167.4	--
System Loss Reduction	--	13,264.5
Heat Improvement of Power Plants	--	5,772.9
Efficiency Labels and Standards	16.0	--
Demand-Side Management (DSM)	--	357.7
<b>Total</b>	<b>1,384.7</b>	<b>109,058.1</b>

Source: Philippines DOE - Energy Plan (2002 - 2011)

## BUILDING SECTOR EFFICIENCY PROGRAMMES

### BUILDING ENERGY CODES

The Philippines instituted voluntary building energy efficiency standards in 1994 which have been incorporated in the national building code. The standards apply to offices, hotels, hospitals and shopping centres with a peak design energy use rate greater than 10 watts per square metre. They cover building shells, lighting, air conditioning equipment, boilers and hot water systems. Building plans are usually reviewed by local city governments prior to issuing construction permits.

### EFFICIENCY LABELS AND STANDARDS

The Philippines have had mandatory efficiency standards and labels for all air conditioners since 2002. For window-type air conditioners, voluntary labelling was introduced in 1992, followed by mandatory labelling in 1993 and minimum energy performance standards (MEPS) in 1994. These measures saved an estimated 113 GWh or 670,000 barrels oil equivalent in 2002. For split-type air conditioners, labelling became mandatory in 2001 and standards became mandatory in 2002. Air conditioning units with a cooling capacity below 12,000 kilojoules per hour must have an energy efficiency ratio (EER) of at least 9.1 kilojoules per hour of cooling per watt of energy input, and units with greater cooling capacity must have an EER of at least 8.6 as of 2002. By comparison, the required EER was just 8.3 for the smaller units and 7.8 for the larger units in 1997. So efficiency requirements for air conditioners were tightened by 10 percent over a 5-year period.

The Philippines have also had mandatory efficiency labels on refrigerators and freezers since 2000. Efficiency labels for compact fluorescent lamps (CFLs) and electromagnetic fluorescent lamp ballasts are currently voluntary but are scheduled to become mandatory at the start of 2004.

#### **ENERGY MANAGEMENT SERVICES**

Energy management services are designed to help commercial and industrial firms identify cost-saving energy efficiency measures. They include energy audits, financing for purchase of energy-efficient equipment, and information on energy use by different industrial firms. They also include the Partnership for Energy Responsive Eco-Zone (PEREZ) programme to facilitate voluntary monitoring and reporting of energy consumption and adoption of energy efficient technologies within special economic development areas. Private energy service companies (ESCOs) will assist in auditing facilities, putting energy saving measures in place, and providing guarantees for energy savings from these measures.

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#### **INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES**

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##### **HEAT RATE IMPROVEMENT FOR ELECTRIC POWER PLANTS**

Improvement in the operational capability of old thermal, coal and diesel power plants is a continuing endeavour to increase plant availability, increase plant output, improve operational efficiency, extend plant life, and reduce operating costs. The main objective is to bring the actual performance of all generating units close to their optimum levels. Competitive markets will quickly evolve in a restructured power sector. This will put pressures on power plant operators to reduce costs through operational efficiency programmes.

##### **SYSTEMS LOSS REDUCTION FOR ELECTRIC UTILITIES**

This programme supports Republic Act 7832, which seeks to address electricity waste due to system losses in electricity distribution. The Electric Power Industry Reform Act (EPIRA), or RA 9136, has amended the ceiling on the recoverable rate of system losses as prescribed in RA 7832. The ceiling, to be determined by the Energy Regulatory Commission (ERC), shall be based on load density, sales mix, services cost, delivery voltage and other technical considerations. Private utilities and electric cooperatives are assisted in lowering system losses through technical system review and evaluation, system load balancing, thermal scanning of lines, and equipment load management.

##### **DEMAND-SIDE MANAGEMENT**

There is an ongoing initiative to review, amend and improve the regulatory framework for demand-side management that was established in 1996. The review is needed due to the uncertainties, challenges and opportunities associated with liberalisation of the power industry. To date, the national DSM programme has remained in the pre-implementation stage. If implemented, the DSM efforts will be targeted at building and industrial sectors as well as government properties.

##### **INFORMATION AND EDUCATION ON POWER CONSERVATION**

The Power Conservation and Demand Management (Power Patrol) programme is the principal means of providing information and education to the residential, commercial, and industrial sectors on how to conserve electricity and reduce peak power demand. The programme is conducted mainly through seminars and workshops and is expected to be self-sustaining by 2007. Initial efforts are to be focused on commercial and industrial firms in economic development zones.

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## TRANSPORTATION SECTOR EFFICIENCY PROGRAMMES

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### INFORMATION AND EDUCATION ON ENERGY EFFICIENCY IN TRANSPORT

The Fuel Conservation and Efficiency in Road Transport (Road Transport Patrol) programme is aimed at drivers, operators, vehicle and fleet owners, transport groups and associations. It disseminates information on operation and maintenance practices that can lower fuel consumption. It should thereby help to reduce oil imports and environmental emissions.

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## PUBLIC SECTOR EFFICIENCY PROGRAMMES

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### REDUCTION OF ENERGY USE IN PUBLIC BUILDINGS

Launched in December 2000, the “Enercon” programme requires all government agencies, bureaus and offices to reduce their annual electricity and fuel consumption by at least 10 percent, with monthly reports to be submitted to DOE. The “Energy Efficient Best Practices Awards in Government” were established to recognise agencies that achieve this objective. In addition, DOE has established a Government Energy Management Programme in 2002 to reduce government energy use and expenditure by implementing energy efficient technologies and practices in all government facilities. DOE is collaborating with other government agencies to help integrate energy efficiency objectives into policies for mass housing and the construction of public school buildings. DOE will also attempt to make its buildings showcases of energy efficiency in order to stimulate energy efficiency efforts by other agencies and the public in general.

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## SUMMARY

The Department of Energy’s energy efficiency programmes have triggered successful results and hope to achieve better results in the future. Collaboration with other government agencies, businesses and consumers is an essential component for ensuring programme success.

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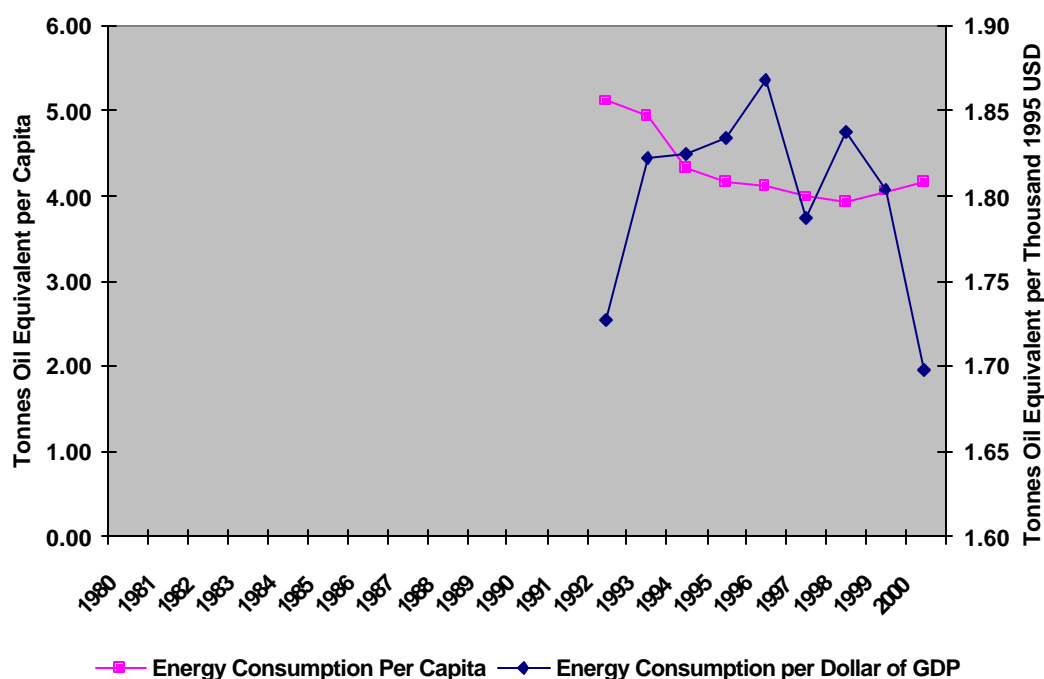
# RUSSIA

## BACKGROUND

Russia has a higher energy intensity (ratio of energy use to GDP) than any other APEC economy. This elevated energy intensity is supported by low domestic energy prices and lack of incentives for energy savings. Domestic energy prices and tariffs are typically equivalent to only 35 percent to 40 percent of energy production costs, with the remainder covered by direct and indirect subsidies. At these prices, energy costs account for only 3 to 4 percent of total expenditures for households and 6 to 8 percent of production costs for industry.

However, between 1995 and 2000, Russia's GDP grew at an average annual rate of 1.2 percent, while its energy consumption declined at an average rate of 0.4 percent and its electricity demand declined at an average rate of 0.3 percent. Consequently, its energy intensity (ratio of energy use to GDP) and electrical intensity (ratio of electricity use to GDP) have both declined markedly at average annual rates of 1.6 percent and 1.5 percent, respectively, over the period.

**Figure 11 Energy Efficiency Indicators for Russia, 1980-2000.**



Russia's energy strategy aims to reduce energy intensity by 50 to 60 percent by the year 2020, or about 2 ½ percent per annum, coming roughly half through structural shifts and half through energy efficiency improvements. It is estimated that the technical potential for energy savings amounts to 40 to 48 percent of today's energy consumption, divided evenly between energy industry, other industry, and other sectors, and that about one-fifth of the technical potential is cost-effective at current domestic fuel prices.

Russia's "Energy Efficient Economy" programme aims to achieve 100 Mtoe of energy savings between 2002 and 2005 compared to a business as usual scenario, with average annual savings of 25 Mtoe or roughly 6 percent of total final energy consumption in 2000 (which was 420 Mtoe). Savings on energy bills over the four-year period are estimated to total 143 billion roubles or



roughly US\$5 billion. The programme includes elements for residential buildings, federal buildings, energy-intensive industry, energy-producing industry, agriculture and transport. The federal budget is to fund 20 percent of the programme costs, with the remainder raised by local authorities and utilities. The current programme follows on an Energy Conservation in Russia programme for 1998 through 2005 that achieved energy savings of 5.5 Mtoe or 1.4 percent of total final energy consumption in 1998 (which was 394 Mtoe). The earlier programme reached only 40 percent of its savings target, in part because the federal government contributed only 1 percent of the funding. Investment in energy conservation is expected to total between US\$50 billion and US\$70 billion over the period from 2001 through 2020, with contributions coming from regional energy efficiency funds, federal and local budgets, energy tariff revenues and private investors.

Energy efficiency programmes in Russia are implemented by the Department for Energy Savings and State Energy Supervision, which has 75 regional sub-departments and a staff of some 8,000. To facilitate implementation of energy efficiency measures, amendments to federal legislation have been proposed, including reduction in taxes and customs fees and inclusion of energy efficiency expenditures (especially for energy audits) in the corporate production costs that are deducted from revenues in calculating taxable income. The following legal, administrative and economic measures for stimulating energy efficiency are anticipated:

- Amendments to the technical regulation law, specifying energy end-use standards;
- Regular energy audits in enterprises, mandatory for the public sector;
- Economic and fiscal incentives for energy efficiency projects;
- Efficiency outreach programmes for households;
- Development of energy efficiency databases;
- Training of personnel to install energy-efficiency measures;
- Government support and promotion of energy service companies (ESCOs).

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## **BUILDING SECTOR EFFICIENCY PROGRAMMES**

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### **BUILDING CODES**

Building codes for energy efficiency in public and residential buildings have been enacted in thirteen regions of the Russian Federation. These regional codes provide the same energy efficiency effect in designed buildings as the federal building codes, but offer more flexibility in terms of building design, selection of building envelopes and engineering equipment, and making use of local building materials and locally manufactured products. Through measures such as gradual improvement of building codes, supervision and licensing of new buildings in urban areas, more effective maintenance of central heating and power distribution networks, and seasonal and daily load management, it is anticipated that energy savings of 4.5 percent will be achieved, cutting residential energy bills by 14 billion roubles (US\$ 500 million).

### **APPLIANCE EFFICIENCY STANDARDS**

Russia has mandatory energy performance standards for a broad range of household appliances including room and central air conditioners, refrigerators, stoves and ovens, dishwashers, clothes washers, televisions and electric water heaters. There are also mandatory efficiency standards for office equipment including computers, monitors and printers. The energy efficiency standards are set by the State Committee of the Russian Federation for Standardisation and Meteorology (GOST). However, there are no labelling requirements for any appliances.

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## INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES

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### OPERATIONAL IMPROVEMENTS IN ENERGY PRODUCTION

Energy saving technologies may cut Russia's natural gas consumption by 40 to 60 Bcm. Gazprom has estimated that the cost of saving 1 Bcm of gas would be less than half the cost of finding the same amount of gas in new deposits. Energy- and resource-saving technologies saved Gazprom some 2 billion roubles (US\$63 million) in 2002. Gazprom is cooperating with defense companies to develop and introduce new technologies for drilling, pumping and heat utilisation.

Other energy producers have also reduced on-site energy use and losses by introducing new technologies and equipment. For example, crude oil producers planned to reduce technological loss by 30 percent (2 Mt in 2000 – 0.6 percent of production); refineries to increase refining degree (30 Mt) and cut own energy use ratio from 10.4 percent in 2001 to 7.9 percent in 2005.

In the Sakhalin power sector, an energy management programme has been instituted for 2002 through 2015. Goals are to reduce primary fuel use in power generation from 452 gce to 300 gce per kWh, achieve cumulative fuel economy of 3.7 Mt to 4.8 Mt coal equivalent, reduce transmission losses by 42.6 GWh, reduce carbon dioxide emissions by 3.9 Mt or 25 percent, and stabilise electricity prices at 2001 levels. Overall savings on energy bills and maintenance are estimated at US\$472 million, against programme costs of US\$357 million. Financing is to come from federal and regional budgets, the Sakhalinenergo power company, private investors, and bank loans. The project is being monitored by the Sakhalin energy conservation and supervision agency.

### REGIONAL ENERGY EFFICIENCY DEMONSTRATIONS

Establishment of regional energy efficiency demonstration zones has proven to be an effective policy tool. The United Nations Economic Commission for Europe (UNECE), European Bank for Reconstruction and Development (EBRD) and the Global Environment Facility (GEF) have supported this activity along with federal and regional governments. During the 1990s, fourteen regions established special energy efficiency agencies and funds, promoting pilot projects and demonstration zones. The Sakhalin programme described above is an example.

### ENERGY EFFICIENCY IN ENERGY-INTENSIVE INDUSTRY

Energy saving projects focus on energy intensive industries such as basic metals, chemicals, construction materials, wooden products, pulp and paper, and food processing. The focus is on retrofitting general-purpose industrial equipment such as motors, boilers and industrial heating systems with more energy-efficient technologies. Project investments are usually paid back in less than three years, and it is estimated that 8.7 Mtoe will be saved annually in 2002-2005, equivalent to 5.8 percent of final total energy consumption in 2000.

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## TRANSPORTATION SECTOR EFFICIENCY PROGRAMMES

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### TRANSPORT ENERGY TARGETS

Russia's government set a 3 percent energy saving target for the transport sector. The target will be achieved mainly by introducing competition, new equipment and better maintenance on the federal rail system which accounts for about 10 percent of total energy consumption in transport. Although road transport accounts for about 70 percent of energy use in transport, there is no deliberate policy to make road transport more efficient, except for some minor improvements in federal transport organisations. The stock of road vehicles is old, and its fuel economy is poor.

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**PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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**REDUCTION OF ENERGY USE IN PUBLIC BUILDINGS**

To reduce energy expenditures, the government has adopted mandatory efficiency standards in federal buildings. Energy consumption in these buildings is targeted to decline by 14 to 16 percent by 2005 compared to 2000, with total energy savings of 3.2 Mtoe in 2002-2005 and 5.8 Mtoe in 2006-2010. The corresponding cut in government energy bills should amount to 500 million roubles (US\$17 million) in 2002-2005 and 3.1 billion roubles (US\$100 million) in 2006-2010.

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**SUMMARY**

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Several issues are important for successful energy efficiency policy implementation in Russia:

- legislative and governmental support for energy conservation activity,
- gradual elimination of energy subsidies,
- development of markets for energy-efficient equipment,
- establishment of new financial mechanisms and schemes,
- international cooperation, standardisation and certification,
- greater private business involvement (ESCO), and
- public awareness of energy efficiency opportunities.

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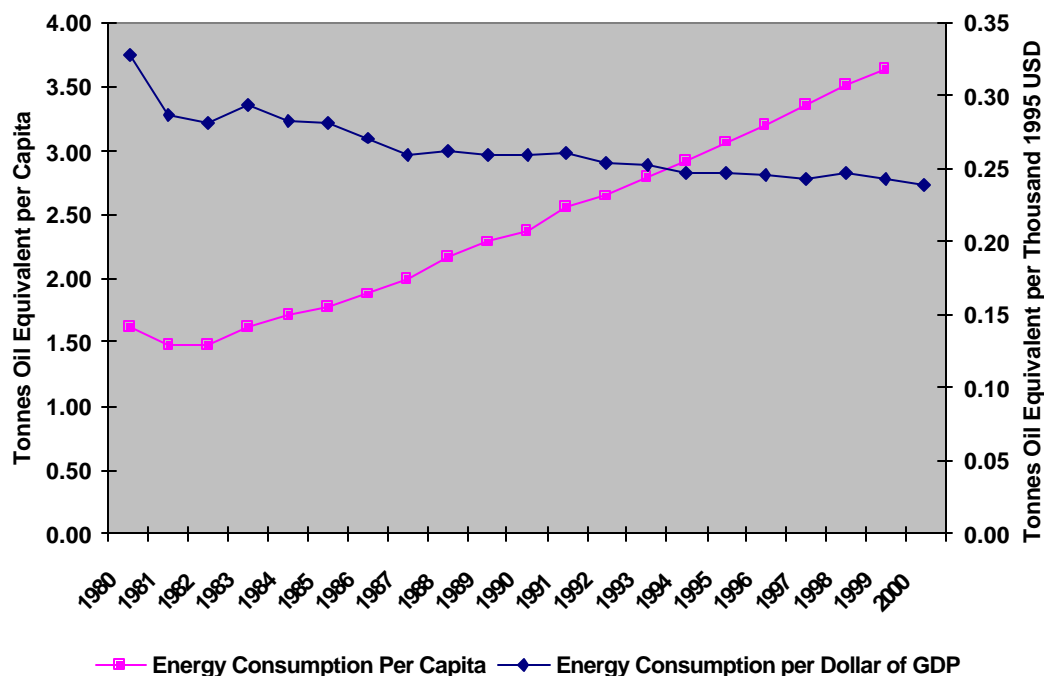
# CHINESE TAIPEI

## BACKGROUND

Energy efficiency programmes in Chinese Taipei are overseen by the Energy Commission (EC) in the Ministry of Economic Affairs. Energy efficiency is seen as a major component of energy policy since 96 percent of the economy's energy comes from outside and domestic energy resources are few. The programmes are focused on building codes and appliance standards in the buildings sector and on financial incentives, equipment standards and energy audits in the industrial sector.

From 1985 through 2000, Chinese Taipei's GDP grew at an average annual rate of 7.3 percent, while its energy consumption grew at an average rate of 6.2 percent and its electricity demand grew at an average rate of 8.5 percent. Consequently, the economy's energy intensity (ratio of energy use to GDP) declined by 1.1 percent per year, while its electrical intensity (ratio of electricity use to GDP) increased by 1.1 percent per year. Energy use per capita has meanwhile grown steadily. Energy efficiency programmes aim to yield sufficient energy savings so that the economy's energy intensity in 2020 falls to 28 percent below its energy intensity in 2000.

**Figure 12 Energy Efficiency Indicators for Chinese Taipei, 1980-2000.**



## BUILDING SECTOR EFFICIENCY PROGRAMMES

### BUILDING CODES

The energy-saving design code specifies energy consumption requirements for six classes of buildings. A building design and construction chapter of regulations on building technology was issued in 1995. It specified the maximum energy consumption per unit of floor space for office buildings, department stores, shopping centres and hotels. Revised regulations issued in 1997 added hospitals and residential buildings to the list. Energy consumption indexes for building

envelopes and air-conditioning systems, together with building inspection and testing systems and energy audit programmes, are used to measure progress toward energy efficiency. The energy performance of buildings is monitored by the Construction and Planning Agency of the Ministry of Interior and by the Energy Commission of the Ministry of Economic Affairs.

#### **APPLIANCE EFFICIENCY STANDARDS AND LABELS**

Most appliances in Chinese Taipei are subject to mandatory minimum energy performance standards (MEPS). These include room air conditioners, fans, fluorescent lamps, refrigerators and refrigerator-freezers, and electric water heaters. MEPS also apply to office equipment such as computers, monitors, printers, photocopiers, and fax machines. For some appliances, MEPS have been in effect for more than 25 years. Implementation of efficiency standards for electrical appliances has resulted in an average annual peak load power savings of 130 MW. Companies manufacturing or importing energy utilisation equipment must comply with them.

There is voluntary efficiency labelling for all the appliances that are subject to minimum energy performance standards (MEPS), as well as for freezers, televisions and clothes washers and dryers. Labels certify that products are 10 percent to 30 percent more efficient than required by the MEPS. In addition, highly efficient office equipment is eligible to receive an Energy Star label. By raising consumer brand awareness, such labels should encourage the manufacture of efficient equipment.

#### **DEMAND-SIDE MANAGEMENT**

Concrete measures for DSM implementation were adopted that include providing incentives to lower peak load, installing remote load control for central air conditioning systems, promoting the utilisation of energy-efficient lighting and ice-storage air conditioners. Energy service companies (ESCOs) were established to implement these measures. ESCOs provide energy-saving related services to enterprises, including technical consulting, inspection and diagnosis, planning and designing, new engineering solutions and technology transfer to small and medium-sized enterprises (SMEs). Through measures that shift on-peak energy usage to off-peak hours, 4,387 MW had been clipped from peak load by the end of 2001.

#### **APPLIANCE TECHNOLOGY DEVELOPMENT**

An advanced energy-efficient refrigerator has been developed through cooperation between the Energy and Resources Laboratory of the Industrial Technology Research Institute and Kolin Company, a local manufacturer. Its energy factor in 1999 was 23 percent higher than that of a baseline model in 1997. The energy-efficiency strategies applied to the advanced model include high efficiency compressor, vacuum insulation panel (VIP), high leak-protected gasket, and photoelectric automatic defrosting sensing system. A second phase of technology development aims at improving refrigerator efficiency by another 30 to 40 percent. The Energy and Resources Laboratory also works to raise the efficiency of other appliances such as lamps and air conditioners.

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### **INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES**

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#### **EQUIPMENT EFFICIENCY STANDARDS AND LABELS**

Mandatory energy efficiency standards have been established for motors, boilers, transformers, water chillers and heating, ventilation and air conditioning (HVAC) systems. An authorised agency or technician must test each piece of equipment to ensure that the standards are met before the equipment can be imported or sold. Typically, the standards call for energy efficiency of 5 percent to 25 percent greater than that of average products in service. There is also a voluntary labelling programme in place for transformers, but not for other industrial equipment.

### **FINANCIAL INCENTIVES FOR ENERGY-EFFICIENT EQUIPMENT**

Under Article 6 of the Statute for Upgrading Industries, industrial firms that invest in new and clean energy utilisation equipment and energy conservation equipment may receive investment tax credits of 5 percent to 20 percent of the cost of such equipment against their income. Two-year accelerated depreciation is applicable to the remainder of expenditure for such equipment, as well as to related research and development, experimentation, and quality inspection. Companies may also receive low-interest loans for the purchase of such equipment. Energy conservation equipment includes equipment for cogeneration, process energy conservation, general-purpose energy conservation, energy recycling, energy conservation monitoring, and peak load shifting, as well as any fixed assets that are installed or upgraded specifically for energy conservation purposes. Corporations received NT\$467 million in tax credits on conservation equipment from 1995 through 2001 and claimed NT\$11.2 billion in accelerated depreciation on such equipment from 1991 through 2001. NT\$10.9 billion of investment in energy-conservation equipment received low-interest loans from 1994 through 2001.

### **PROMOTION OF COMBINED HEAT AND POWER**

Conversion of waste heat into power is considered a high priority for raising the efficiency of energy use in Chinese Taipei. Tax deductions, favourable power purchase prices, and favourable natural gas prices are provided to encourage the installation of cogeneration systems. By the end of 2001, the installed capacity of combined heat and power systems had reached 5,435 MW.

### **ENERGY AUDITING**

The largest 1,384 energy-consuming firms account for 56 percent of all energy use in the industrial sector and must report their energy use annually. In addition, the top 100 energy-consuming firms are subject to on-site audits, which make use of a demonstration model that the Energy Commission developed for improving and managing energy conservation measures. Furthermore, there is an energy efficiency review and approval system for new factories.

Firms with low energy efficiency are required to improve within a certain period. If they fail to do so, they are subject to fines of NT\$15,000 to NT\$150,000 and presented with a new deadline for making improvements. If they fail to meet the new deadline, the fines can be doubled, and energy supplies to the firms can be limited or suspended for seven to thirty days. Progress is monitored through an energy efficiency index for major products of energy-intensive industries. The industrial auditing programmes are estimated to have resulted in savings of 660 GWh of electricity, 51,000 kilolitres of oil, and 103,000 tonnes of coal in 2001.

### **VOLUNTARY AGREEMENTS**

The iron and steel, chemical, cement, pulp and paper, and fibre industries are assisted in the formulation of voluntary energy-saving action plans. The government projects that energy savings of 1.9 million cubic metres oil equivalent will be achieved as a result of such voluntary road maps between 1997 and 2020. To help carry out the plans, as indicated above, industries can receive long-term, low-interest loans and investment tax credits when they upgrade and replace inefficient equipment and processes.

### **INDUSTRIAL TECHNOLOGY RESEARCH INSTITUTE**

Efficient energy use requires the development and application not only of technology but also of energy conservation expertise. The Industrial Technology Research Institute (ITRI) supports government and industry efforts to conserve mineral, water, land and ocean resources and to use these resources more rationally. Its work has focused largely on air conditioning, refrigeration, heat exchange, electro-technology, and combustion processes. Technological developments from its R&D efforts have been transferred to local industries through industrial cooperation and licensing to help conserve energy and upgrade productivity. In 1997, the Energy Conservation Services

Division was established to help industry achieve better energy-saving efficiency. It sponsored exhibitions and training programmes to disseminate ITRI's energy expertise to various industries.

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### **TRANSPORT SECTOR EFFICIENCY PROGRAMMES**

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Energy conservation measures in Chinese Taipei's transport sector include:

- Raising energy efficiency standards for cars, motorcycles and fishing boat engines;
- Construction of a high-speed railway system and mass rapid transit system;
- Development of intelligent transportation systems and management strategy; and
- Fuel tax collection at point of sale rather than at the point of vehicle purchase.

Vehicle fuel economy is regulated under the Energy Management Law. Fuel economy requirements for various types of vehicles are stated in terms of kilometres per litre of gasoline or diesel. Vehicles which meet the requirements in a given calendar year are issued a certificate of conformity and can be sold through the end of the following calendar year. Standards are gradually being tightened; for example, the standard for vehicles with engine displacement of 50 to 100 cc will be raised from 37 kilometres per litre to 42 kilometres per litre in 2004.

Before 2002, vehicle fuel tax was levied on each type of vehicle twice a year, regardless of the amount of fuel it consumed. For example, a gasoline truck with 2401 cc to 3000 cc of engine displacement paid NT\$6,300 every six months while a typical taxicab paid NT\$4,800. Now, however, fuel tax is based upon the amount of fuel consumed. For 98 octane lead-free gasoline, for example, the tax is NT\$6.83 per litre, representing a tax of roughly 50 percent on a base price of NT\$13.46 (so that together with 5 percent sales tax of NT\$1.01, the sales price is NT\$21.30). This will provide a much stronger incentive to purchase more fuel-efficient vehicles and drive them less.

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### **PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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#### **ENERGY RESEARCH AND DEVELOPMENT FUND**

Chinese Taipei has an energy research and development fund financed from 0.5 percent of operating revenues from the sale of petroleum products and electricity. Uses for the fund, as specified in the Energy Management Law, include developing energy, researching energy conservation technology, and training of energy conservation personnel. The fund aims to achieve a target of 28 percent in total energy savings by 2020. Means for achieving this target include:

- Development of energy technology;
- Peak-load shaving to improve the balance of electric power supply and demand;
- Information exchange on energy-efficient technologies; and
- Promotion of energy conservation among the public.

Research activities in the energy efficiency field include lighting energy conservation, power electronics, electricity monitoring, low-pollution combustion, refrigeration and air conditioning, heat recovery, chemical process technology, electric heating energy conservation technology, electric appliance energy efficiency management, industrial energy conservation management, DSM, vehicular energy-consumption standards management, building energy management, green building energy-saving technology, high-efficiency equipment production, industrial energy-efficiency-enhancing technology and innovative energy-saving product technology.

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## EDUCATION, TRAINING AND PUBLIC AWARENESS PROGRAMMES

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To intensify energy conservation education, teaching materials for schools at all levels were prepared. Various training programmes were conducted for energy management personnel, architects, air conditioning technicians and illumination designers. The Energy Commission's website has information on energy-saving practices for households, offices, and many kinds of appliances such as air conditioners, fans, lighting, refrigerators, computers, and copying machines. It also has information on energy efficiency standards, energy audits, energy-saving services, training programmes for energy professionals, and the industrial energy consumption index.

## ENERGY CONSERVATION TECHNICAL DEVELOPMENT CENTRE

To promote better energy management practices, the Energy Conservation Technical Development Centre (ETSC) carries out assignments on marketing, administration and planning, scientific management of heating energy, energy and environment, electrical and lighting equipment, refrigeration and air conditioning, and business development. ETSC's technical services are tailored to the capabilities, processes and facilities of individual customers. ETSC provides comprehensive services by integrating cooling, heating, electrical technologies and energy management. It offers performance guarantees for energy conservation measures it recommends. It also helps firms apply for governmental incentives on energy conservation equipment.

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## SUMMARY

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Chinese Taipei has a relatively strong set of energy efficiency programmes in place. In the buildings sector, these include limits on allowable energy consumption in commercial buildings as well as appliance standards and labels. For industry, programmes include equipment efficiency standards, financial incentives for investment in energy-efficient equipment, strict energy audits of large firms with fines for those that fail to improve their efficiency performance, and voluntary agreements to raise the energy efficiency of energy-intensive manufacturing processes. In the transport sector, there are substantial fuel taxes on vehicles, as well as vehicle efficiency standards. In concert, such programmes promise to improve the economy's energy efficiency significantly.

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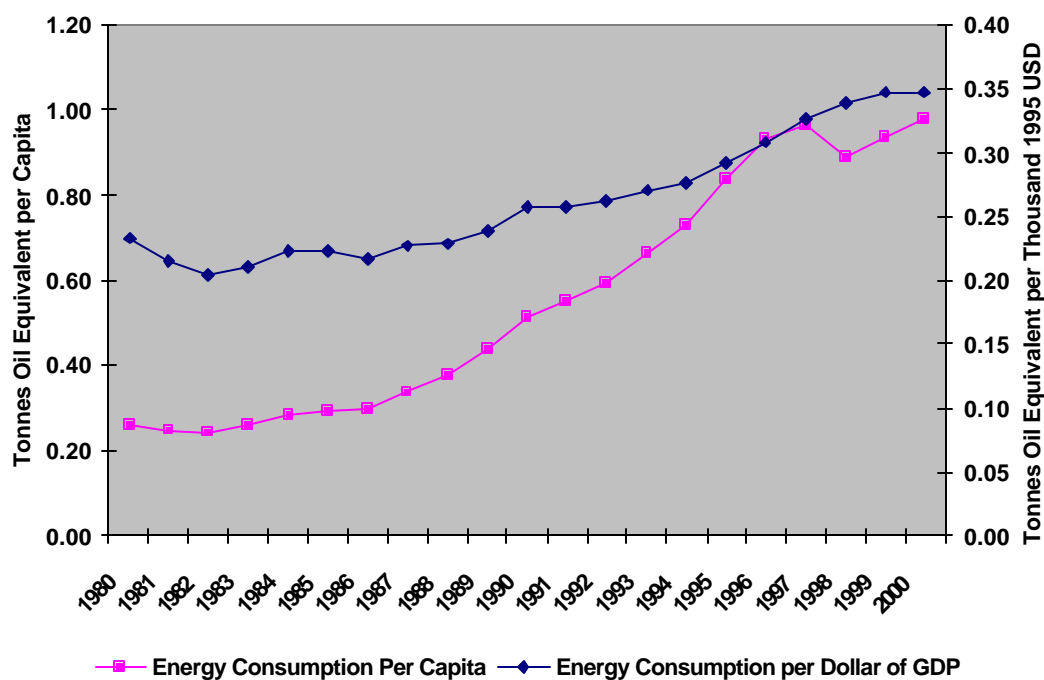
# THAILAND

## BACKGROUND

Energy efficiency programmes in Thailand are overseen by the Energy Policy and Planning Office (EPPO) and the Department of Alternative Energy Development and Efficiency (DAEDE) in the Ministry of Energy. These programmes are seen as vital to energy security since Thailand produced only 45 percent of its total energy needs domestically in 2000. Some are compulsory, such as those for efficient design of buildings and factories. Others are voluntary, such as demand-side management, efficiency labelling of refrigerators and air conditioners, and research and development of energy-efficient technologies. Still others are complementary, such as training in conservation methods and programmes for public awareness of energy conservation potential.

Between 1985 and 2000, Thailand's GDP grew at an average annual rate of 6.3 percent, while its energy consumption grew at an average rate of 9.5 percent and its electricity demand grew at an average rate of 10.4 percent annually. Consequently, its energy intensity (ratio of energy use to GDP) and electrical intensity (ratio of electricity use to GDP) have been increasing quite rapidly at average rates of 3.1 percent and 3.9 percent per annum respectively. Energy consumption per capita has also been increasing rapidly, except for a pause after the Asian financial crisis of 1997.

**Figure 13 Energy Efficiency Indicators for Thailand, 1980-2000.**



Energy efficiency programmes in Thailand, as well as renewable energy programmes, are supported through a levy on petroleum fuels. The levy is set by the National Energy Policy Council (NEPC), along with guidelines, criteria and conditions for programmes under the Energy Conservation Promotion Fund (Encon fund) that was established under the Energy Conservation Act of 1992. At present, the levy is 0.04 baht per litre on petroleum fuels such as gasoline, diesel and fuel oil (LPG is exempted). It generates revenue for the fund of some 1.5 billion baht (US\$36 million) per year. By 2000, the ENCON fund had accumulated 15 billion baht (US\$360 million).

Over the period from 1995 through 2001, the ENCON Fund provided some 11.7 billion baht of support for efficiency projects that were expected to return some 12.2 billion baht in savings over their lifetimes, as shown in the table below.

**Table 8 ENCON Fund Budgets and Savings Potentials**

	<b>Compulsory</b>	<b>Voluntary</b>	<b>Other</b>	<b>Total</b>
<b>ENCON Fund Budgets</b>				
Average per year (million baht)	464	446	549	1,459
Total disbursement (million baht)	3,713	3,567	4,394	11,674
<b>Electricity Savings Potential</b>				
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
<b>Fuel Savings Potential</b>				
Savings per year (million litres crude)		48		48
Savings over project life (M litres crude)		666		666
<b>Monetary Savings</b>				
Savings per year (million baht)	260	553		813
Savings over project life (million baht)	3,899	8,296		12,195
Avoided Investment (million baht)	2,181	664		2,844

Source: Energy Conservation Section, Energy Policy and Planning Office.

Note: Project lifetime estimates are for 5, 15 or 25 years depending on the type of equipment or technology used.

## BUILDING SECTOR EFFICIENCY PROGRAMMES

### BUILDING ENERGY CODES

Thailand has commercial building codes which apply to both new and existing structures with energy consumption rates above 1000 kW. The codes were initially voluntary when introduced in 1994 but were soon made mandatory in 1995 after the public and building professionals had become familiar with them. The codes include requirements for building shells, lighting, and air conditioning equipment. Existing buildings were given three years to improve building shells so that their rate of energy use is 55 watts or less per square metre for heating and cooling, while new buildings are required to use no more than 45 watts per square metre for these purposes. Failure to comply with the building codes is penalised through a surcharge on electricity bills.

### APPLIANCE LABELS

The Demand Side Management Office of the Electricity Generating Authority of Thailand (EGAT) has a programme for voluntary efficiency labelling of appliances. Appliances receive a comparative efficiency rating from 1 to 5. Refrigerators and freezers have been included in the programme since 1994, air conditioners since 1995, and lighting ballasts since 1996. There has also been a programme since 1994 under which highly efficient clothes washers, computers, lamps and motors, as well as refrigerators, air conditioners and ballasts, can be endorsed with a green label. Highly efficient electric motors have been able to receive a separate endorsement label since 1996.

Refrigerator labelling has perhaps been the most successful since most refrigerators are produced by just a few large manufacturers, all of which have accepted labelling. By 1997, over 2.7 million refrigerators had been labelled, reducing electrical energy demand by 297 GWh and peak demand by 39 MW. By 2001, energy savings from efficient refrigerators had increased to 849 GWh and peak demand reduction to 84 MW. There were also more than 200,000 labelled air conditioners in 1997, reducing energy demand by 196 GWh and peak demand by 12 MW. By 2001, efficient air conditioners had produced energy savings of 318 GWh and peak shaving of 84 MW.

### **BUILDING ENERGY AUDITS**

Thailand has had a programme for conducting energy efficiency audits of commercial buildings since 1997. By 2001, roughly 1,600 commercial buildings had received energy efficiency audits.

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### **INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES**

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#### **EFFICIENCY IN EXISTING INDUSTRIAL FACILITIES**

Owners of existing factories and buildings are encouraged to undertake energy efficiency measures through grants for energy audits and financial support for energy conservation planning and investment. These efforts were expected to reduce electricity demand by 3,832 GWh per year, saving industry 7.7 billion baht on its annual energy bills. They were also expected to reduce power demand by about 547 MW, delaying investment in power plant construction costing 24.6 billion baht. However, since only 98 of the 635 facilities audited in 2001 developed specific targets and plans for reducing their energy use, it is not clear whether these ambitious goals will be achieved. Some 2,500 factories received energy efficiency audits between 1997 and 2002.

#### **EFFICIENCY IN NEW INDUSTRIAL FACILITIES**

Owners of factories and buildings which are under construction or still being designed can apply for financial assistance to implement energy conservation measures that are required by law. It was hoped that efficiency assistance for facilities under construction might yield savings of 14 GWh of energy and 35 million baht per year. But so far, only one facility under this project has requested financial assistance from the ENCON Fund, accounting for 1.3 million baht.

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### **PUBLIC SECTOR EFFICIENCY PROGRAMMES**

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#### **ENERGY EFFICIENCY IN GOVERNMENT BUILDINGS**

Targets have been set for reducing energy consumption in government buildings, and over 400 buildings have met these targets. Nearly 600 government buildings received energy efficiency audits between 1997 and 2001. It is expected that savings from government conservation efforts may amount to some 138 GWh and 346 million baht per year. Power demand would then be reduced by some 52 MW, avoiding power plant investment requirements of some 2.3 billion baht.

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### **EDUCATION, TRAINING AND PUBLIC AWARENESS PROGRAMMES**

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#### **HUMAN RESOURCES DEVELOPMENT**

Thailand has many activities to develop professionals with skills and knowledge in the energy efficiency field. These include the development of energy conservation curricula and teaching materials for schools, research grants, scholarships, training, and financial support for educational institutes or universities to provide courses related to energy conservation.

#### **PUBLIC AWARENESS**

Public awareness campaigns aim to change consumer attitudes about energy use, inducing more energy-efficient behaviour. The government believes that the general public has recognised the benefits of energy conservation and learned simple ways to reduce energy consumption in daily life.

#### **TECHNOLOGY DEVELOPMENT**

Thailand has many projects to develop and demonstrate new energy efficiency technologies, as well as to improve and disseminate existing energy efficiency technologies. The Encon Fund has

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provided 525 million baht in grants for 59 research and development projects. Some recent projects have related to the 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.

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#### SUMMARY

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Thailand has achieved significant energy and monetary savings through energy efficiency programmes. These have notably included building codes, energy labels on some household appliances, and efficiency requirements for energy-intensive industry. However, most of the economy's efficiency efforts have been voluntary, and their impact has therefore been limited.

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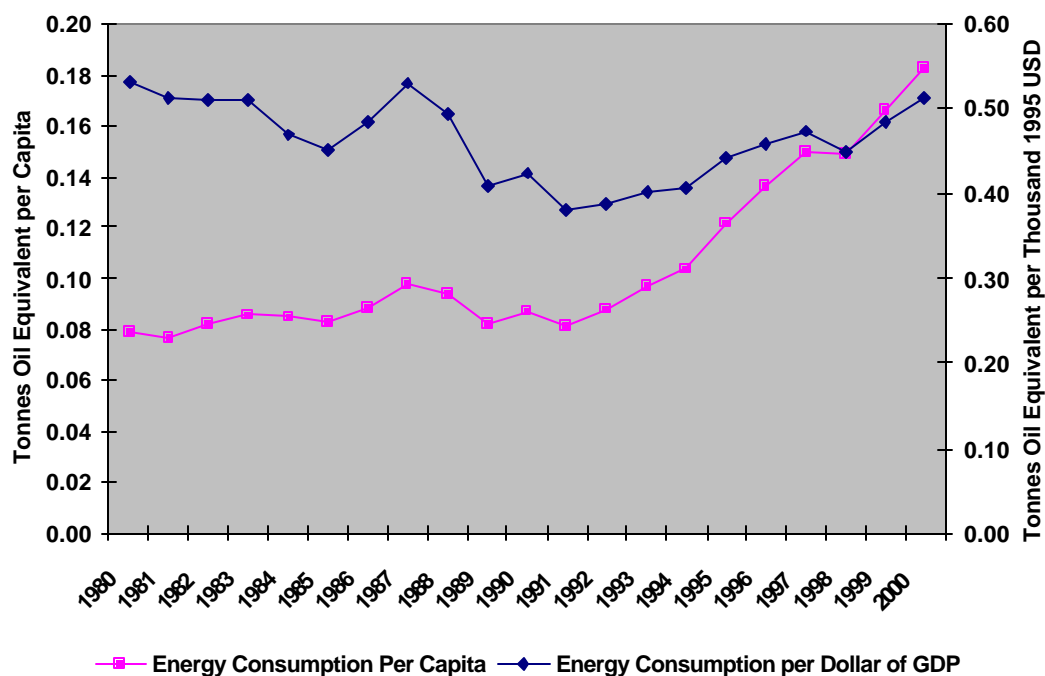
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# VIET NAM

## BACKGROUND

From 1985 through 2000, Viet Nam's GDP grew at an average annual rate of 6.5 percent, while its energy consumption grew at an average rate of 7.4 percent and its electricity demand grew at an average rate of 12.4 percent. As a result, the economy's energy intensity (ratio of energy use to GDP) increased at a modest pace of 0.9 percent per year on average, while its electrical intensity (ratio of electricity use to GDP) increased at a very rapid pace of 5.5 percent per year. Energy consumption per capita, while fairly flat in the 1980s, grew quite fast during the 1990s. Resulting investment requirements have been enormous, making energy efficiency an important priority.

**Figure 14** Energy Efficiency Indicators for Vietnam, 1980-2000.



Viet Nam's first energy conservation and efficiency programme was launched in 1995 by the Ministry of Science Technology and Environment (MOSTE). The programme includes short-term, medium-term and long-term measures. Short term measures include no-cost and low-cost measures such as enhancing awareness, improving housekeeping, and conducting small repairs and upgrades, with estimated energy savings potential of 12 to 18 percent. Medium-term measures, with an estimated payback period of less than three years, could yield savings of 18 to 21 percent of total industrial energy consumption. Long-term measures, with payback periods longer than three years, could save an additional 30 to 37 percent of total industrial energy consumption.

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## BUILDING SECTOR EFFICIENCY PROGRAMMES

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### APPLIANCE EFFICIENCY LABELS AND STANDARDS

Viet Nam's government plans to develop energy efficiency labels and standards for dishwashers, clothes washers and dryers, refrigerators and freezers, air conditioners, lighting, and rice cookers. National technical standards are prepared and submitted by the Standards, Measurement and Quality Office and ratified by Minister of Ministry of Science and Technology. As input to the national standards, sectoral standards are developed by technical committees in specific industries. Sectoral standards have already been drafted for incandescent light bulbs, linear fluorescent lamps, ballasts and electric motors. They are being circulated for public review before submission to the government for approval as national standards. Other standards for refrigerators, freezers, rice cookers, televisions, and air conditioners will be developed in the near future.

### DEMAND-SIDE MANAGEMENT

The demand-side management (DSM) effort to reduce the rate of growth in electricity demand, which is described in detail in the section on industrial efficiency programmes below, includes several measures to limit average and peak electricity use in buildings:

- *Direct load control:* To limit heating and air conditioning loads in commercial buildings, 2000 customers will be offered an annual incentive payment of US\$25 to accept direct load controls. The average load controlled will be 10kW per receiver, and the duration of load control will average 15 minutes during two peak hours. Generation load is expected to be reduced by 3.1 MW for this pilot project.
- *Compact Fluorescent Lamps (CFLs),* using 20 percent less energy than incandescent lamps while producing the same amount of light, can reduce lighting's 30 percent contribution to Viet Nam's peak load. To encourage use of CFLs, Electricity of Vietnam (EVN) offers an incentive of US\$1.50 in the first year, US\$1.00 in the second year, and US\$0.60 in the third year to replace conventional light bulbs with CFLs. It also guarantees CFLs for one year. These incentives will help cope with barriers of high initial cost and lack of awareness of CFL benefits. It is expected that 1 million CFLs will be installed, reducing peak load by 33.4 MW, saving 39.0 GWh per year, and reducing carbon dioxide emissions by 46,700 tonnes per year.
- *Thin Fluorescent Tube Lamps (FTL)* can reduce energy requirements for lighting by 10 percent. The programme will arrange with manufacturers to supply 6 million FTLs over two years. This would reduce peak load by 14.4 MW, save 25.2 GWh of energy per year, and reduce carbon dioxide emissions by 30,300 tonnes per year.

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## INDUSTRIAL SECTOR EFFICIENCY PROGRAMMES

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### FINANCIAL INCENTIVES

Several tax incentives for energy-efficient equipment are being implemented in Viet Nam:

- New projects can receive a complete exemption from tax on profits during the first two years of operation and a 50 percent exemption during the next two years.
- New projects can also receive preferential income tax rates of 15 percent, 20 percent or 25 percent in lieu of the normal income tax rate of 30 percent.
- Energy-efficient technology for power plants, electrical networks and solar energy use may be fully exempted from income tax in the first year of their operation and receive a 50 percent exemption during the next two years on income gained.

- Energy-efficient equipment and materials for construction of high-technology zones or high-technology projects can be exempted from import tariffs.

It is expected that these tax incentives will induce energy-intensive industries to take advantage of cost-effective opportunities for investment in energy-efficient equipment. For example:

- In the *cement* industry, which accounts for 17 percent of total industrial energy use, air quenching coolers can increase efficiency by 7 percent with a payback of 10 years, and waste heat can be recovered to use for local power generation.
- In the *ceramics* industry, where kilns use 90 per cent of the energy, short-term measures can reduce energy use by 15 to 20 percent, while replacement of inefficient coal-fired kilns with new gas-fired kilns that are insulated by ceramic fiber can reduce energy use by half; two such kilns were installed in 1999.
- In the *steel* industry, which accounts for 8 percent of total industrial energy consumption, efficiency measures can reduce energy use by 11 percent with payback periods ranging from 4 to 9 years.
- In the *pulp and paper* industry, which consumes 5 percent of energy and 8 percent of electricity used by industry, potential energy savings are around 10 percent.
- In various subsectors, the efficiency of coal-fired boilers could be raised from a range of 50 to 65 percent to a range of 65 to 75 percent, while the efficiency of oil-fired boilers could be raised from a range of 60 to 70 percent to a range of 70 to 80 percent, potentially saving 53 million litres of oil and 137,000 tonnes of coal.

#### DEMAND-SIDE MANAGEMENT

In a business-as-usual scenario, Viet Nam's electricity use is expected to increase eight-fold from 9,000 GWh in 1994 to 75,000 GWh in 2010, with peak demand increasing nearly ~~ix~~-fold from 2,000 MW in 1994 to over 14,000 MW in 2010. The electricity sector would then require more than 15,000 MW of new capacity at a cost of US\$23.5 billion. Demand-side management (DSM) programmes could reduce these requirements, and thereby reduce the cost of providing electricity, through a mix of energy efficiency strategies to reduce kilowatt-hours of energy consumption and load management measures to reduce kilowatts of peak demand. An assessment of efficiency potential in 1997 showed that nearly 1,100 MW of generation capacity and 5,000 GWh of annual electricity saving could be achieved by the year 2010, reducing electricity consumption by 6.8 percent and peak demand by 7.6 percent, with net benefits of US\$800 million. Load management, together with commercial building, lighting, and motors standards, accounted for nearly US\$670 million (NPV) of the estimated potential net benefits.

Viet Nam's DSM programme is being carried out in three phases:

- *Phase 1 (2000-2002)*: Build the capacity for DSM planning and programme development, improving local data collection, developing an energy efficiency pilot programme at Electricity of Vietnam (EVN), enhancing EVN's load management and energy audit capability, establishing equipment standards for lighting and motors, and developing energy-efficient building codes for commercial buildings.
- *Phase 2 (2003-2005)*: Expand load management capability to all power companies, develop an industrial energy audit programme, and establish energy standards for electrical equipment and buildings, reducing peak load by 120 MW, annual electricity use by 64 GWh, and annual carbon dioxide emissions by 77,000 tonnes.
- *Phase 3 (2005-2010)*: Transfer full responsibility for DSM programmes to all power companies, establish DSM planning as an element of integrated resource planning and identify additional technical or financial assistance programmes that might be required to implement energy efficiency in state-owned industrial enterprises.

To achieve the DSM programme objectives, in addition to measures that have been noted in the section on building efficiency programmes above, steps have been taken in the industrial sector to expand the application of time-of-use (TOU) tariffs. To help flatten electricity loads, time-of-use tariffs were set up with peak rates between 18:00 and 22:00, off-peak rates from 4:00 to 18:00, and low-load rates from 22:00 to 4:00. By June 2002, 6,800 industrial customers had applied the TOU tariff, shaving the system peak by about 250 MW. By 2005, 6,000 TOU meters will be installed for customers with an average load of 100 kilowatts each, reducing peak by another 69.7 MW.

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## TRANSPORTATION SECTOR EFFICIENCY PROGRAMMES

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### FISCAL INCENTIVES FOR PUBLIC TRANSPORTATION

Public transportation in Viet Nam is underdeveloped and meets only 5 percent of travel demand. Yet motorcycles and other forms of private transportation are already choking major roads in large cities while raising oil import requirements. Thus, the government has established a goal to increase the share of public transport to 30 percent of travel demand in large cities. This is to be accomplished mainly by promoting bus enterprises with fixed routes and frequent and dependable service. Specific measures to promote bus transport include:

- Exemption from import tax and excise tax on buses for public transportation;
- Exemption from tax on capital investment;
- Exemption from parking fees, tolls, registration fees and license fees;
- Provision of free land for bus stations and bus stops.

The incentives for public transportation are to be financed through higher tariffs on imported cars and motorbikes. In addition several measures have been implemented to discourage excessive use of private transportation and improve the traffic safety:

- Taxation of cars and motorcycles by their size and capacity;
- Increased taxes on gasoline and diesel fuel in some cases;
- Compulsory insurance for motorcycles;
- Parking fee on public roads and walk ways.

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## SUMMARY

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Viet Nam has a fairly broad set of measures in place to promote energy efficiency. There are numerous financial incentives for the installation of energy-efficient equipment by industry. There is an active demand-side management programme to limit growth in electric capacity requirements. There are taxes on vehicles and fuel, as well as incentives for expanding bus service, to promote energy-efficient transport. If efficiency labels and standards are approved for household appliances, Viet Nam will have a substantive efficiency programme in every major energy-consuming sector.

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