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A Review and Evaluation of Vehicle Fuel Efficiency Labeling and Consumer Information Programs

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Abbreviations

AFV	Alternative fueled vehicle
APEC	Asia-Pacific Economic Cooperation
BEV	Battery electric vehicle
CNG	Compressed natural gas
CO_2	Carbon dioxide
EECA	New Zealand Energy Efficiency and Conservation Authority
EGEE&C	Expert Group on Energy Efficiency & Conservation
EPA	U.S. Environmental Protection Agency
EWG	Energy Working Group of Asia-Pacific Economic Cooperation
FCV	Fuel cell vehicle
ICCT	International Council on Clean Transportation
LCV	Light-commercial vehicle
LowCVP	Low Carbon Vehicle Partnership
LPG	Liquefied petroleum gas
LT	Light-truck
MPG_e	Miles per gallon equivalent
NEDC	New European Driving Cycle
NHTSA	National Highway Transportation Safety Administration
OEM	Original equipment manufacturer
PHEV	Plug-in hybrid electric vehicles
PV	Passenger vehicle
VFEL	Vehicle fuel efficiency labeling
WLTP	Worldwide Harmonized Light Vehicles Test procedure

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1. Executive summary

Vehicle Fuel Efficiency Labelling (VFEL) is one of a suite of measures designed to improve the fuel efficiency of transport fleets that have been introduced by various economies throughout the world since 1978. The principle behind VFEL is to raise consciousness in the general public about transport fuel efficiency, it being presumed that properly informed consumers will be more likely to purchase vehicles that are fuel efficient. This, in theory, will mobilise market forces to improve the energy efficiency of the transport sector, realising economic and environmental benefits.

Amongst the 21 economies comprising the Asia-Pacific Economic Cooperation (APEC), 12 have implemented a VFEL program, and a thirteenth, Thailand, was due to unroll its own program in October 2015. Figure ES1 represents schematically the state of VFEL programs globally and in APEC economies. As can readily be seen, APEC economies operate 56% of the global vehicle fleet.

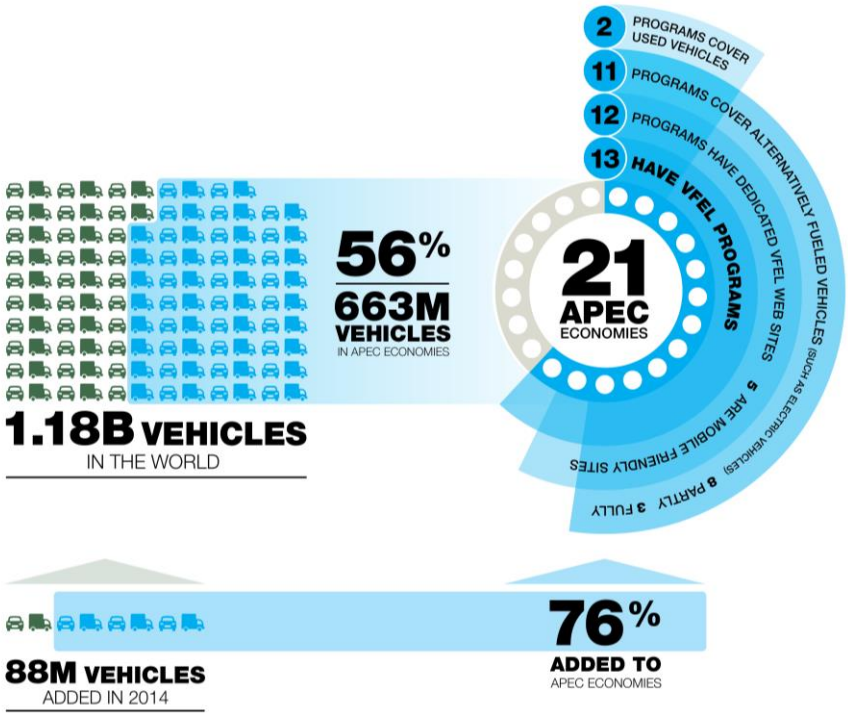


Figure ES 1. Overview of vehicle fuel efficiency labeling program in APEC economies[1].

Yet although some programs have been in place for close to two decades, there has never been any comprehensive effort made to evaluate the effectiveness of vehicle

[1] Vehicle population and sales data come from OICA at http://www.oica.net/category/vehicles-in-use/.

fuel efficiency labelling across a wide range of economies. APEC has accordingly commissioned this report to address this gap.

The report is based on desk-based research into the literature concerning VFEL and a survey of 18 economies (13 of which are members of APEC). The aim was to identify components of VFEL, and best practice within each component. These findings were then used to evaluate existing VFEL programs in order to highlight areas in which individual programs met or fell short of best practice. It is suggested that these findings will provide a sound basis to inform the establishment of new programs or improve existing programs.

Six program elements were identified from a literature review and survey of VFEL experts in the various economies and are listed in Figure ES2.

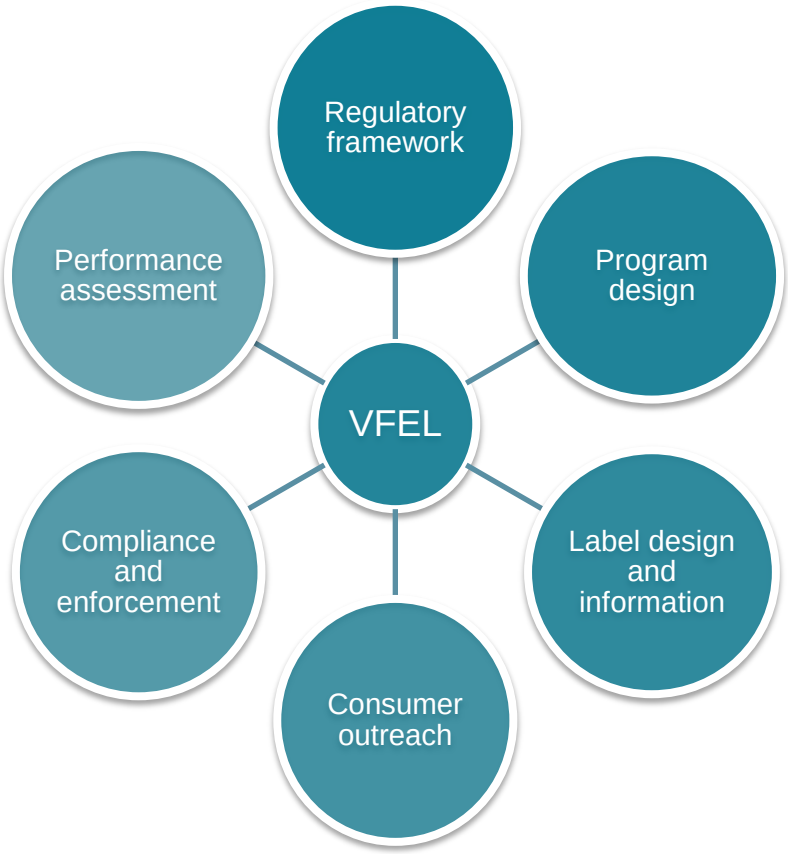


Figure ES 2. Six key elements of vehicle fuel efficiency labeling programs.

These elements were further broken down to yield a list of sixteen VFEL components, and an attempt was made to identify best practice within each of these areas. The list of components and associated best practices are represented below (Figure ES3).

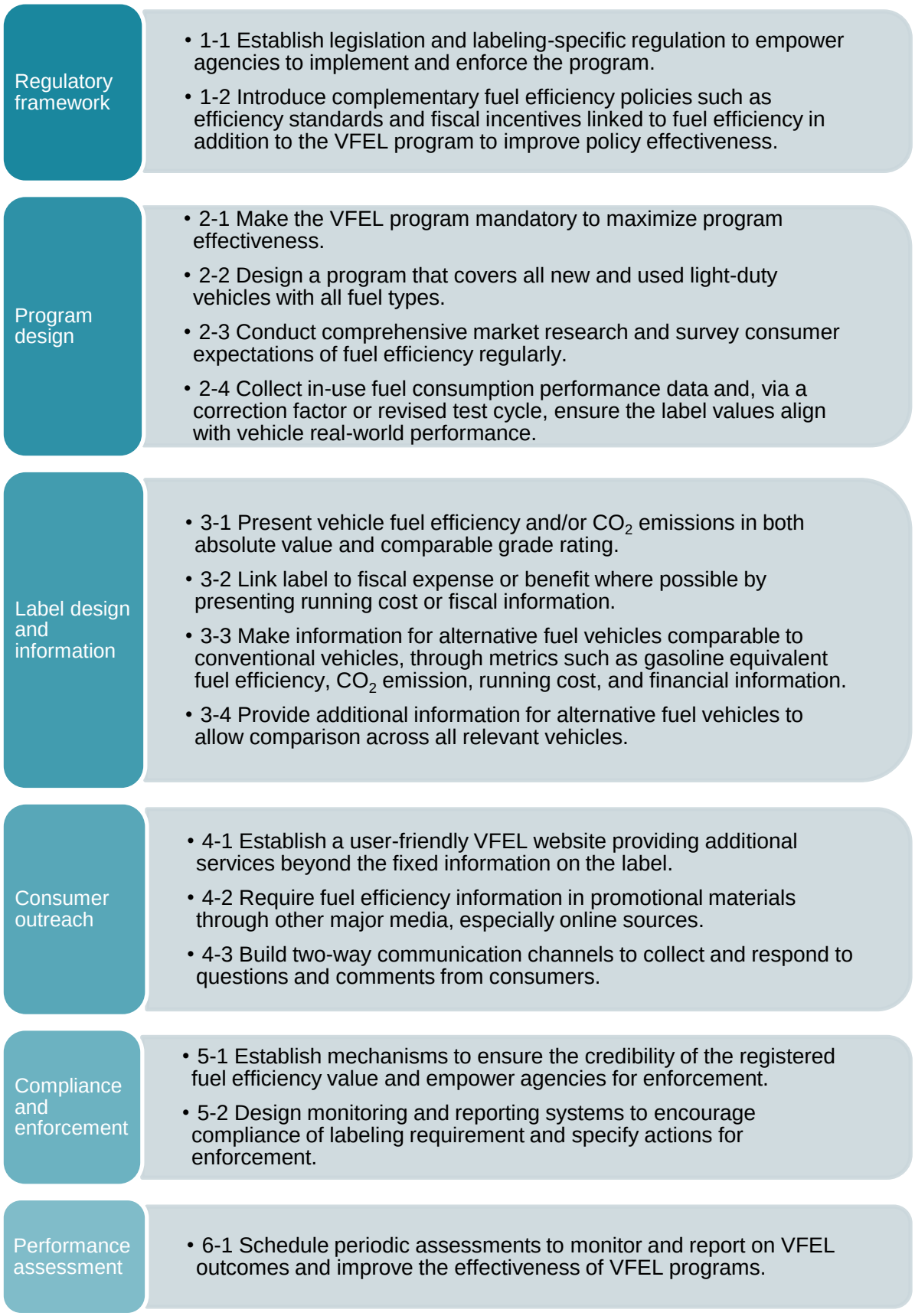


Figure ES 3. Best practices of vehicle fuel efficiency labeling programs under six program elements.

When the effectiveness of VFEL programs was evaluated based upon their conformity to the identified best practices, it was found that all economies are doing well on at least a few components, but there is also room for improvement in every case. The programs in three APEC economies (US, New Zealand, and Korea) and three non-APEC economies (UK, Germany, and Brazil) meet the greatest number of best practice recommendations.

In broad terms, the VFEL programs in this study proved to be effective in: providing legal and regulatory support; understanding the market and consumer; mandating VFEL requirements, and presenting understandable label information.

The most common shortcomings were: the lack of effort to align label values with vehicle real-world performance; the facility to fit vehicles with advanced technologies into the parameters of the program, and regular monitoring once the programs are established.

It is concluded that the ongoing sharing of information on VFEL programs — in establishing mutually compatible vehicle information databases and a platform for economies to share experiences in VFEL development and implementation — would be highly beneficial to APEC member economies. The findings of this report are a first step in this process.

2. Introduction

2.1. Purpose of the report

APEC member economies account for approximately 57% of global GDP and 76% of global vehicles sales. The expansion of vehicle populations is pressuring governments around the world to improve vehicle efficiency and reduce greenhouse gas (GHG) emissions. Due to the fast development of technologies, similar vehicles can be significantly different in fuel efficiency. In addition to the free competition in the market, policymakers can lead the vehicle market to a more efficient fleet through appropriate regulations.

Vehicle fuel efficiency standards and labeling are complementary policy strategies to reduce on-road vehicle energy consumption and GHG emissions in APEC member economies. Tightening of fuel efficiency standards in major vehicle markets drives penetration of technologies that reduce vehicle fuel consumption and provide a supply-push of more efficient vehicles. The aim of VFEL is to provide vehicle fuel efficiency information to consumers in a manner that increases demand for more fuel-efficient vehicles and creates a strong demand-pull.

Even though VFEL is implemented in many parts of the world, there is very limited information on how well these programs are working and how they could be improved. Few analyses have attempted comprehensive reviews of implementation, compliance, and effectiveness of VFEL across APEC as well as non-APEC economies. In order to fill this research gap, APEC in conjunction with the New Zealand Energy Efficiency and Conservation Authority (EECA), has commissioned the International Council on Clean Transportation (ICCT) to conduct a detailed review of VFEL programs in APEC and non-APEC economies.

The aim is to evaluate these programs and enable economies to improve or set up their own programs based on best practices. An improved understanding of programs in place and under development will provide a framework to analyze and summarize considerations and best practices for practitioners in APEC member economies to develop or improve VFEL policies. Additionally it will facilitate alignment of VFEL policies across markets, which in turn will aid regional trade of fuel-efficient vehicles. As APEC member economies introduce or revise their VFEL programs according to best practices, consumers will be empowered to make informed decisions and influenced to purchase more efficient vehicles, thereby increasing demand for more efficient vehicles, leading to fuel savings and therefore reducing CO_2 emissions from burning fossil fuels.

Compared to most studies that investigate and discuss different aspects of VFEL or studies that delve deeply into VFEL of one economy, this report is the most

comprehensive latest study on VFEL program development worldwide. It goes beyond providing profiles of 18 VFEL programs and conducts a comparison across programs to come up with best practices that policymakers and practitioners can use for policy development and revision. It also covers a wide variety of light-duty vehicles, including examples of alternative fuel vehicles such as battery electric vehicles and plug-in hybrid electric vehicles, and lays out the scope for improvement on that front.

2.2. Definitions and scope

VFEL programs have many interrelated aspects. These include vehicle fuel efficiency labeling as well as the associated consumer information campaign by government, uptake of the program by industry, and consideration of fuel economy by customers. The “fuel efficiency label” refers to information that is displayed about the vehicle in the showroom or online. It contains the official fuel consumption and/or official specific emission of CO_2 as measured on a standardized test cycle. The label may also contain other relevant information for a vehicle model based on typical driver scenarios. The label is displayed prominently on the vehicle or on a stand by the vehicle in the showroom.

The VFEL programs discussed in this report are applicable to passenger cars, light-trucks, and light-commercial vehicles with all types of fuel (gasoline, diesel, LPG, CNG, hydrogen, electricity). For the purposes of this report, alternative fueled vehicles (AFVs) include vehicles fully or mostly fueled by natural gas, LPG, ethanol, hydrogen and electricity. Heavy-duty vehicles are not covered in this report.

2.3. Research approach

This report is based on a thorough review of VFEL programs in 18 identified economies. The following three approaches were used to gather information to inform this report:

- Desk-research on VFEL literature and regulations.
- Survey of VFEL experts in the different economies.
- Expert workshop.

2.3.1. Desk-research on VFEL literature and regulations

A desktop review was conducted on regulation documents and government project reports on existing VFEL programs worldwide. These were retrieved online or from relevant contacts within APEC and non-APEC economies.

2.3.2. Survey of VFEL experts in the different economies

A survey was sent to relevant experts and stakeholders from across the range of economies to capture the insights and experiences worldwide in the design and implementation of effective VFEL programs.

With the assistance of the secretariat of APEC's Expert Group on Energy Efficiency & Conservation, experts working in the field of VFEL were identified in APEC and non-APEC economies. These included government and research institution staff involved in the development and management of vehicle labeling or fuel efficiency policies, auto clubs, consumer associations, and other nonprofit organizations that are familiar with vehicle labeling programs.

The survey was conducted online from December 21, 2014, to April 28, 2015, via SoGoSurvey (an online survey interface). Thirty-five complete responses from 24 economies (including the European Union) were received. Thirty-one responses were received prior to February 13, 2015, and were used in the production of the interim report presented at a workshop with APEC/non-APEC participants on March 24, 2015, in Singapore; see below for further details. The responding economies included 18 APEC economies and 6 non-APEC economies as shown in Table 1.

Table 1. Organizations/agencies of survey participants

	Government/research agency	Others
Australia	Department of Infrastructure and Regional Development	
Canada	Natural Resources Canada	
Korea	Korea Energy Management Corporation (KEMC)	
Malaysia	Malaysia Automotive Institute (MAI)	Universiti Tenaga Nasional
New Zealand	Energy Efficiency and Conservation Authority (EECA)	
Mexico	National Commission for the Efficient Use of Energy (CONUEE)	
Singapore	Land Transport Authority	
Thailand	Department of Alternative Energy Development and Efficiency	Asia Pacific Energy Research Center
US	Environmental Protection Agency (Office of Transportation and Air Quality); Department of Energy (Fuel Economy Information Program); Oak Ridge National Laboratory	
China	China Automotive Technology and Research Center (CATARC)	
Chile	Vehicle Control Center and Certification; Ministry of Energy	
The Philippines		Clean Air Asia
Russia	Ministry of Transport (NIIAT)	United Nations Development Program Russia
Viet Nam	Viet Nam Register - Ministry of Transport	

Japan	Ministry of Land Infrastructure Transport and Tourism (MLIT)	Japan Automobile Federation (JAF)
Chinese Taipei	Industrial Technology Research Institute	
Hong Kong, China	Electrical and Mechanical Services Department, the Government of the HKSAR	
Peru	Ministry of Environment	
EU	EU Commission	EU Consumer Organization (BEUC)
Austria	Austria Tech	
Brazil	National Institute of Metrology, Standardization, and Industrial Quality (INMETRO)	Greenpeace Brazil Instituto de Energia e Meio Ambiente (IEMA)
Germany		Federation of German Consumer Organizations (VZBV)
UK	Department for Transport	Low Carbon Vehicle Partnership (LowCVP)
The Netherlands	Netherlands Ministry for Infrastructure and Environment	

The majority of the survey participants were from government agencies. Most respondents were deeply involved in the VFEL development and implementation in each economy and all are familiar with vehicle fuel efficiency issues. As a result the coverage of issues related to VFEL programs is quite comprehensive.

2.3.3. Expert workshop

A project workshop was organized and held in Singapore, on March 24, 2015, in conjunction with the 45th APEC Expert Group on Energy Efficiency & Conservation (EGEE&C) meeting, to present the interim results and to bring together key experts. The workshop provided an opportunity for economy representatives to present key aspects regarding their VFEL program, and share lessons learned focusing on the best practices of VFEL programs[2]. Forty-two people participated in the workshop.

The interim results were provided in the form of an interim report, produced based on the literature review and survey responses.

This final report incorporates the desktop research on VFEL programs and combines it with the information and feedback from that workshop and reviews from relevant stakeholders.

[2] Presentations from the workshop including video are available on the workshop page. http://www.egeec.apec.org/egee-and-c-reports-to-ewg/apec-vehicle-fuel-efficiency-labelling-workshop-/

2.4. VFEL program evaluation methodology:

In theory program performance should be assessed along two dimensions: (1) the impact of VFEL programs on increasing consumer awareness and purchasing behavior, and (2) observed changes in new vehicle fuel efficiency/CO_2 emissions (when taking other interventions that might be in place into consideration).

However, as will be discussed in Section 5, due to lack of information, consistent ex-ante and ex-post evaluation of changes in fuel consumption or consumer purchasing behavior is not feasible.

Therefore, it was necessary to utilize an alternative evaluation methodology to determine the relative effectiveness of VFEL programs.

a) Considering the literature review, and survey responses, six elements of VFEL programs have been identified. Elements comprise the regulatory framework, program design, label design and information, consumer outreach, compliance and enforcement, and performance assessment. The elements are defined in detail in Section 4.3.
b) The six elements were divided further into 16 components of VFEL programs. The 16 components are listed in Section 5 (Table 9) and explained in more detail in Section 6.
c) For each component, best practice recommendations were defined in Section 6, based on the range of features of the various VFEL programs under study. In addition, criteria were identified to differentiate between best practice, and less than best practice.
d) The performance of each VFEL program was then assessed against the identified criteria, in order to determine to what degree a program meets best practice.

2.5. Structure of this report

The report is structured as follows:

Section 3 covers existing academic research on efficiency labeling for vehicles.

Section 4 provides an overview of the features of the investigated VFEL programs. This is followed by a cross economy comparison of VFEL programs across six program elements: the legislative and regulatory framework; program design; label design and information, consumer outreach, compliance and enforcement, and performance assessment. Additional information is provided on the differing objectives of VFEL programs, the costs of VFEL programs, and key barriers to establishing or improving VFEL programs.

Section 5 discusses the constraints when evaluating VFEL programs, then outlines the approach used for this project and report – assessing the performance of VFEL programs against best practice recommendations.

Section 6 outlines the rationale for what constitutes best practice, across 16 components.

Section 7 summarizes the identified best practices, outlines quantifiable criteria for assessing best practice, and evaluates the performance of VFEL programs against these criteria.

Section 8 provides potential actions for APEC economies and the APEC Energy Working Group to assist in the improvement of existing VFEL programs.

3. Review of VFEL-related studies

Vehicle fuel efficiency labeling has generated increasing interest in the past decade with more systematic studies from both academic and government sources since 2008. In this section, we briefly review studies addressing different aspects of a VFEL program including consumer behavior in vehicle purchasing decisions, label effectiveness, labels for AFVs, as well as accuracy of the fuel efficiency value displayed on the label.

3.1. Consumer behavior in vehicle purchasing decision

A number of studies have found that while consumers value fuel efficiency as an increasingly important element, fuel efficiency labels have limited direct impact on consumer purchase decisions (Esposito, 2014; Grünig, Skinner, Kong, & Boteler, 2010; Ipsos New Zealand, 2014; Codagnone, Bogliacino, & Veltri, 2013). These studies reveal that consumers in the market for a new car tend to make their purchase decisions in two steps. In the first step, the consumer selects a specific type of vehicle to purchase (e.g., a small car or an SUV). In the second step, the customer filters the choices available by applying major criteria, which often include reliability, safety, comfort and price (Grünig et al., 2010; Esposito, 2014). Fuel consumption is often a secondary criterion behind many others, but consumers also indicate environmental impact as a potential determinant (Esposito, 2014).

In the UK, running costs, fuel economy, performance, safety, styling, image, brand and reliability are all under consideration in the second step of selection (Lane and Potter, 2007). Consumers in Malaysia claimed that initial purchase price is still the major concern, especially for lower income households (Zainudin et al., 2014). A New Zealand survey found that fuel consumption is among top importance factors to consumers right after price and reliability and around 80% of car buyers rated fuel consumption as important (Ipsos New Zealand, 2014). An EU study found that while consumers affirm that fuel consumption is an important feature, they have a relatively poor understanding of fuel economy and the real-world costs associated with vehicle use, and that fuel economy is generally not strongly considered as part of the purchase decision (Grünig et al., 2010).

Consumer expectation about future fuel prices is an important factor, noted by various studies (Greene, 2010). Due to the impact of loss aversion and the uncertainty of future fuel savings, consumers usually discount the fuel economy benefit (Greene et al., 2013; Greene et al., 2008). A study found no households analyzed their fuel costs in a systematic way in their vehicle purchases (Turrentine & Kurani, 2007). One strategy to address consumer misconception of the fuel savings is to supply information on the “total cost of ownership,” a metric which accounts for the purchase price, the cost of the fuel, and other costs over the ownership period,

and show it on those labels to better assist consumers in car selection (Dumortier et al., 2015). Although the total cost of ownership would present a purely economic rationale for purchase, it is possibly limited by a lack of information, including the price of carbon. To incentivize more efficient vehicles or reduce CO_2 emissions, some studies show consumer interest in running cost, which is usually refueling cost (Esposito, 2014; PRR, Inc., 2010a). However, consumer value for fuel economy sometimes is more than cost saving, as social norm will influence consumers' environmental behavior at the same time (Turrentine & Kurani, 2007; Schultz et al., 2007).

3.2. Effectiveness of fuel efficiency label

The effectiveness of a label is influenced by the way that information is presented and how well the consumer can absorb and act on it (Thøgersen, 2002). A number of studies observe that the label effectiveness will increase when consumers can compare motor vehicles in same category on a fair and equitable basis (Mahlia, Tohno & Tezuka, 2013; PRR, Inc., 2010a; Esposito, 2014). As label designs are getting more complicated, consumers might already be overwhelmed with information and misinterpret the displayed information. Therefore, finding an appropriate balance between sufficient information and label attractiveness to consumers is always essential for policymakers.

Incentive programs appear to work well when introduced alongside fuel efficiency labels in inducing consumers to purchase energy efficient and clean cars (Mahlia, Tohno & Tezuka, 2013). The labeling programs can make the incentive programs more visible to consumers during the purchasing process. Policymakers need to choose the elements and format of fiscal information that can have greatest impact on consumers. For example, presenting lost savings in fuel can exploit the loss aversion bias[3] that consumers may have (Codagnone et al., 2013). Incentives directly monetize the benefits for the customer (Mueller & Haan, 2009). Additionally, since initial price may play a more important role in making a purchase decision, labeling strategies that prominently display taxes or incentives are more likely to motivate consumers in adopting more fuel-efficient cars (Mueller & Haan, 2009).

For the evaluation of labeling effectiveness, most studies gather self-reported attitude and future intentions. This may bias results. Studies found gaps between intention and the actual purchase behavior (Ipsos New Zealand, 2014). In the US, surveys of what people intend to do with their next vehicle purchase found that fuel economy ranked in the top three or so factors, however, in surveys of recent vehicle purchasers, fuel economy usually ranked 10 to 20 of the factors that actually

[3] Loss aversion refers to people's tendency to strongly prefer avoiding losses to acquiring gains (Kahneman & Tversky, 1992).

influenced their purchase decision. The distinction between buyer intent and actual behavior reflects the potential inaccuracy of surveys and the bias of the respondents that filled out the survey.

3.3. Integration of alternative fueled vehicles in existing VFEL programs

Various studies have tried to evaluate the label design for alternative fueled vehicles (AFVs) including electric drive vehicles. In an EPA focus group research in 2010, participants were aware of electric vehicles that were coming on the market (PRR, Inc., 2010b). In the LowCVP survey (Esposito, 2014), consumers' top concerns on EVs include the maximum driving range on one charge and the length of time for a full charge. The UK LowCVP also underscores the significant value of their latest research study on fuel economy labels in informing the creation of aspects of the latest EV and PHEV labels, which would better meet consumer needs and assist them in making decisions (Esposito, 2014). In a survey in the EU, whereas only about 1.9% of the respondents possess either a hybrid or an electric vehicle, almost 33% of them say they will buy electric or hybrid vehicle as their next car (Codagnone et al., 2013).

In the EU, some stakeholders proposed to represent the "well-to-wheel" emissions on electric vehicles labels – taking into account upstream emissions including from electricity generation, rather than only have the direct vehicle in-use emissions accounted for (Brannigan, Skinner, Gibson, & Kay, 2011). However, this approach will not allow direct comparison between EVs and conventional vehicles, which show only tank-to-wheel emissions. In order to make them comparable, some studies recommended adopting a label format for EVs similar to that of conventional vehicles, as well as representing fuel economy in terms of "mpg equivalent," in addition to "Wh/km" or "kWh/100km" that were most frequently used.

3.4. Accuracy of the fuel efficiency value on the label

The choice of vehicle test procedure is an important step in designing equitable and accurate vehicle fuel economy labels. However, some studies have found problems with the accuracy of fuel consumption and emissions information (Kadijk and Ligterink, 2012 ; Transportation & Environment, 2014).

A recent study by ICCT found that in European countries, the divergence between the results from emissions laboratory testing (the so-called "type-approval" process) and that from on-road testing is increasing, from less than 10% in 2001 to around 25% in 2011 (Mock, Tietge, et al., 2014). There are likely multiple reasons resulting in the growing divergence, including increasing application of fuel-saving technologies that show a higher benefit in the type-approval tests than under real-

world driving conditions, increasing exploitation of flexibilities in the type-approval procedure, the tolerances and flexibilities in road load determination procedure and chassis dynamometer testing, and changing external factors (e.g., auxiliary electrical devices, air conditioning units) (Tietge et al., 2015). The key issue is to explore solutions that minimize the differences and guarantee the credibility of fuel economy and emission values on vehicle labels. For example, the EU is going to adopt a more dynamic and tightened test procedure, i.e., the Worldwide Harmonized Light Vehicles Test Procedure (WLTP), which is expected to result in more realistic values (Mock, Kühlwein, et al., 2014). Japan has also agreed to adopt the WLTP for its fuel efficiency standards (Mock, German, Bandivadekar, & Ligterink, 2013).

4. Overview and comparison of VFEL and consumer information programs

This section provides an overview of the features of the VFEL programs investigated and a comparison of these VFEL programs across six program elements: the legislative and regulatory framework; program design; label design and information, consumer outreach, compliance and enforcement, and performance assessment. Additional information is also provided on the costs of VFEL programs, and key barriers to establishing or improving these programs.

4.1. Overview of VFEL programs

Out of 21 APEC members, 12 have already implemented a VFEL program as shown in Table 2 and Thailand has developed a VFEL program that will phase in from October 2015 and come into fully effect in 2016. Five APEC economies – Malaysia, Russia, the Philippines, Peru, and Mexico – are developing or are planning to develop VFEL programs.

Besides APEC members, this report also reviews VFEL programs in Brazil and four European economies (Austria, Germany, the Netherlands and the UK) to provide a more global perspective.

Table 2. Economies investigated in this report

APEC members	Survey Response	Non-APEC regions	Survey Response
APEC members with a VFEL program		**Non-APEC economies with a VFEL program**	
Australia	√	Austria	√
Canada	√	Brazil	√
Chile	√	Germany	√
China	√	The Netherlands	√
Hong Kong, China	√	The United Kingdom	√
Japan	√	The European Union*	√
Republic of Korea	√		
New Zealand	√		
Singapore	√		
US	√		
Viet Nam	√		
Chinese Taipei	√		
Thailand (from 2016)	√		

APEC members	Survey Response	Non-APEC regions	Survey Response
APEC members without a VFEL program			
Brunei Darussalam			
Indonesia	√		
Malaysia	√		
Mexico	√		
Papua New Guinea			
Peru	√		
The Philippines	√		
Russia	√		

* The European Union VFEL program sets certain minimum requirements that member states must implement. Member states can add additional provisions in the regulation.

Of the various APEC VFEL programs, the US and Korea have the longest running programs, whereas Chile and Viet Nam have just begun implementation as shown in Figure 1. Outside of APEC, the UK has had the longest running labeling program, having begun at the same time as the US program in 1978. The average age of all programs is 14.5 years, with a median age of less than 12 years. All VFEL programs except those in Canada, Hong Kong, China and Brazil are mandatory. A snapshot of the different VFEL programs is shown in Table 3.

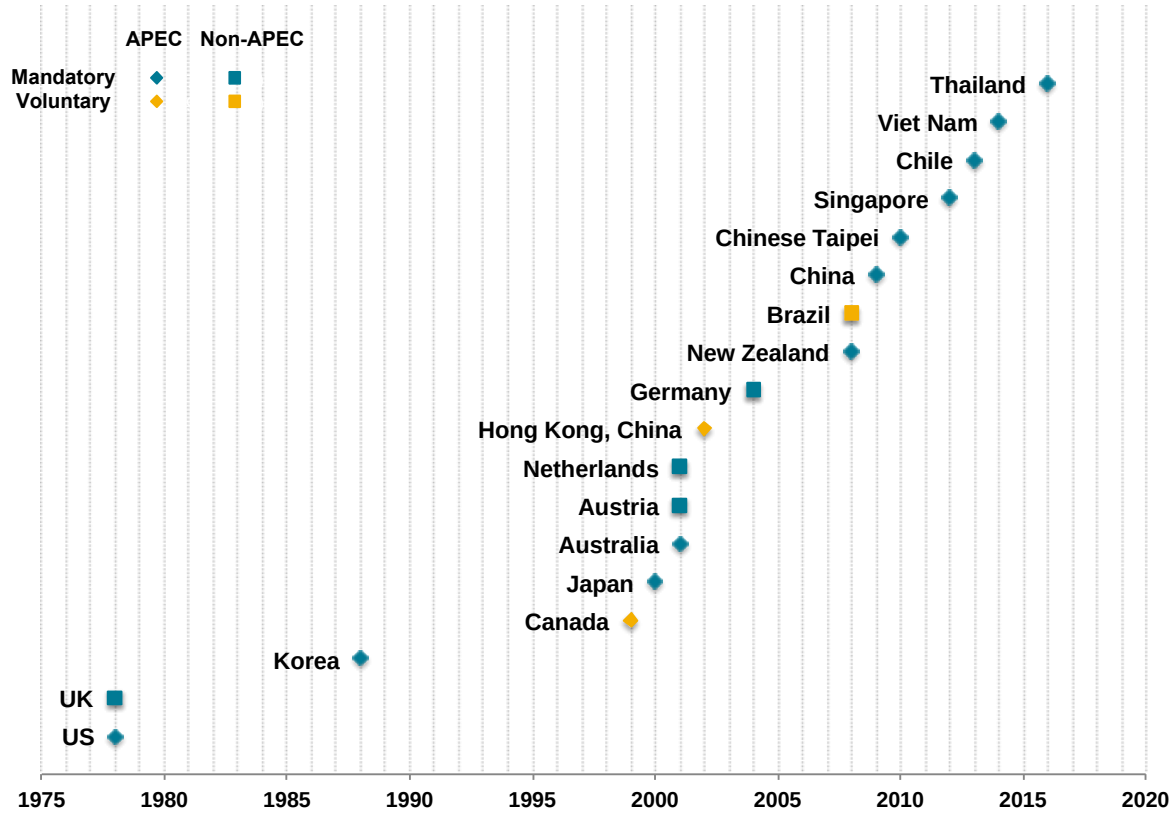


Figure 1. **Year of implementation of VFEL programs in APEC and selected non-APEC economies.**

Table 3. Summary of VFEL programs

Economy	Start/ Update	Vehicle category	Mandatory / voluntary	Used cars	Alternative Fuel Vehicles (AFVs) [1]	Supporting Legislation/Act	Administrative agency	Display Requirement	Driving cycles	Fuel efficiency display	CO_2 emission display	Assess-ment
Australia	2001/ 2008	PV, LT	Mandatory	No	Yes	Motor Vehicle Standards Act 1989	Department of Infrastructure and Regional Development	On vehicle	NEDC[2]	Absolute (l/100km)	Absolute	No
Canada	1999	PV, LT	Voluntary	No	Yes	The Energy Efficiency Act - Canada	Natural Resource Canada	On vehicle, at showroom	US 5-cycle	Absolute (l/100km) & efficiency range by class	Absolute & rating (1-10)	No
Chile	2013	PV	Mandatory	No	Partly	Presidential decree NO. 61	Ministry of Energy; Ministry of Transport; Ministry of Environment	On vehicle, at showroom, promotional material	NEDC	Absolute (km/l)	Absolute	No
China	2009	PV, LCV	Mandatory	No	Partly	Energy Saving Law	Ministry of Industry and Information Technology; China Automotive and Technology Research Center	On vehicle	NEDC	Absolute (l/100km)	/	Yes (internal)
Hong Kong, China	2002	PV	Voluntary	No	No	Energy Efficiency (applicant labeling) Act	Electrical and Mechanical Services Department	On vehicle, at showroom	Japan 10-15 mode, NEDC, US 2-cycle	Absolute (l/100km)	/	No
Chinese Taipei	2010	PV, LT	Mandatory	No	No	Energy Administration Act	Industrial Technology Research Institute	On vehicle, at showroom, promotional material	US 2-cycle +NEDC (before 2016); NEDC (after 2016)	Absolute (l/100km) & relative class rating (1-6)	/	Yes (internal)
Japan	2000	PV, LCV, HDV	Mandatory	No	Partly	Act Concerning the Rational Use of Energy	Ministry of land infrastructure transport and tourism	On vehicle, at showroom, online information	Japan JC08 mode	/	/	No
Korea	1988/ 2015	PV, LT	Mandatory	No	Partly	Rational Energy Utilization Act	Ministry of Trade, Industry and Energy; Korea Energy Management Corporation	On vehicle, at showroom, online information, promotional material	US 5-cycle	Absolute (km/l) & rating (1-5)	Absolute	No
New Zealand	2008	PV, LCV	Mandatory (new & used)/ Voluntary (AFVs)	Yes	Partly	Energy Efficiency and Conservation Act 2001	Energy Efficiency and Conservation Authority	On vehicle, at showroom, online information, promotional material	Vehicles built to standards in US, EU, Japan, and Australia	Absolute (l/100km) & rating (1/2-6 stars)	/	Yes (public)
Singapore	2012	PV, LCV	Mandatory	No	Partly	Energy Conservation Act	Land Transport Authority	On vehicle	NEDC	Absolute (l/100km) & efficiency range	Absolute & CO_2 emission range	No
Thailand	2016	PV, LT	Mandatory	No	Partly	Consumer Protection Act	Ministry of Industry, the Ministry of Finance	On vehicle	NEDC	Absolute (l/100km)	Absolute & CO_2	No
US	1978/ 2013	PV, LT	Mandatory (new)/ Voluntary (used)	Yes	Yes	Energy Policy and Conservation Act Energy Independence and Security Act	Department of Energy, Environmental Protection Agency	On vehicle, online information, promotional material	US 5-cycle	Absolute (mpg) & rating (1-10) & efficiency range by class	Absolute & Rating (1-10)	Yes (public)
Viet Nam	2014	PV	Mandatory	No	Partly	Law of energy consumption efficiency and saving	Viet Nam Register - Ministry of Transport	On vehicle, at showroom, online information, promotional material	NEDC	Absolute (l/100km)	/	Yes (internal)

Economy	Start/ Update	Vehicle category	Mandatory / voluntary	Used cars	Alternative Fuel Vehicles (AFVs) [1]	Supporting Legislation/Act	Administrative agency	Display Requirement	Driving cycles	Fuel efficiency display	CO_2 emission display	Assess-ment
Austria	2001	PV	Mandatory	No	Partly	Passenger Car Consumer Information Act - car VIG, Federal Law Gazette I No. 26/2001	Federal Ministry of Agriculture, Forestry, Environment and Water Management	On vehicle, at showroom, online information, promotional material	NEDC	Absolute (l/100km)	Absolute & rating (A+ to G),	No
Brazil	2007/ 2009	PV, LT	Voluntary	No	Partly	LAW N°10295/2001 - Energy Efficiency Law	The National Institute of Metrology, Standardization and Industrial Quality	On vehicle, at showroom, online information, promotional material	US 2-cycle	Absolute (km/l) and fuel efficiency scale (A to E)	Absolute	Yes (internal)
Germany	2004	PV	Mandatory	No	Yes	EU Directive 1999/94/EC	The German Energy Agency	At showroom, online information, promotional material	NEDC	Absolute (l/100km)	Absolute & relative class rating (A+ to G)	No
Netherlands	2001	PV	Mandatory	No	Partly	Netherlands Energy Saving Act; EU Directive 1999/94/EC	Netherlands Type Approval Authority	On vehicle, at showroom	NEDC	Absolute (l/100km) & rating (A to G)	Absolute	Yes (internal)
UK	1978/ 2005	PV	Mandatory (new)/ Voluntary (used)	Yes	Yes	EU Directive 1999/94/EC	Department for Transport and Vehicle Certification Agency	On vehicle, at showroom, promotional material	NEDC	Absolute l/100km)	Rating (A-M)	Yes (public)

1. AFVs here refer to vehicles using alternative fuels other than gasoline or diesel, primarily including four types of fuels: electricity, hydrogen, natural gas (including biogas), and ethanol. In this column, “Yes” means AFVs in this economy covers all previously mentioned AFVs available in the market; “Partly” means the economy only covers some AFVs available in the market.
2. NEDC is inter-changeable with UN ECE R101 in this report. For detailed information on test cycles, refer to Appendix A.

4.2. Objectives of vehicle fuel efficiency labeling (VFEL) programs

A number of different objectives of VFEL programs were identified as a result of the literature review and analysis of existing programs:

- Improve consumer information disclosure
- Improve recognition of clean vehicles
- Reduce petroleum consumption and improve energy security
- Improve vehicle fleet fuel economy
- Reduce CO_2 emissions from vehicles
- Push the market uptake of alternative fuel vehicles

These objectives are obviously not mutually exclusive. The first two objectives have direct impact on consumers while the last four objectives represent the broad outcomes from the change of vehicle fleet that may result from having implemented a VFEL program. Though all objectives are interrelated to some extent, each economy views the importance and priorities of these goals differently in its own context.

As part of the VFEL survey, respondents were asked about the importance of each objective on a 1 to 10 scale. Figure 2 summarizes the responses. The blue bar reflects the percentage of survey participants who value the objective as more important (Rate 6-10 out of 10) while the gray bar is the percentage of responses who value the objective as less important (Rate 1-5). Several conclusions are drawn as follows:

- On average, all objectives were deemed important by the survey participants.
- Improving vehicle fleet fuel efficiency and improving consumer information disclosure were rated most important.
- Compared to other objectives, the importance of the uptake of alternative fuel vehicles varied significantly across economies.

In addition, some objectives are rated as highly important by some respondents but are not listed in the survey, such as encouraging manufacturers to produce and supply more efficient vehicles (competitiveness), and pushing the market uptake of efficiency technologies on conventional vehicles.

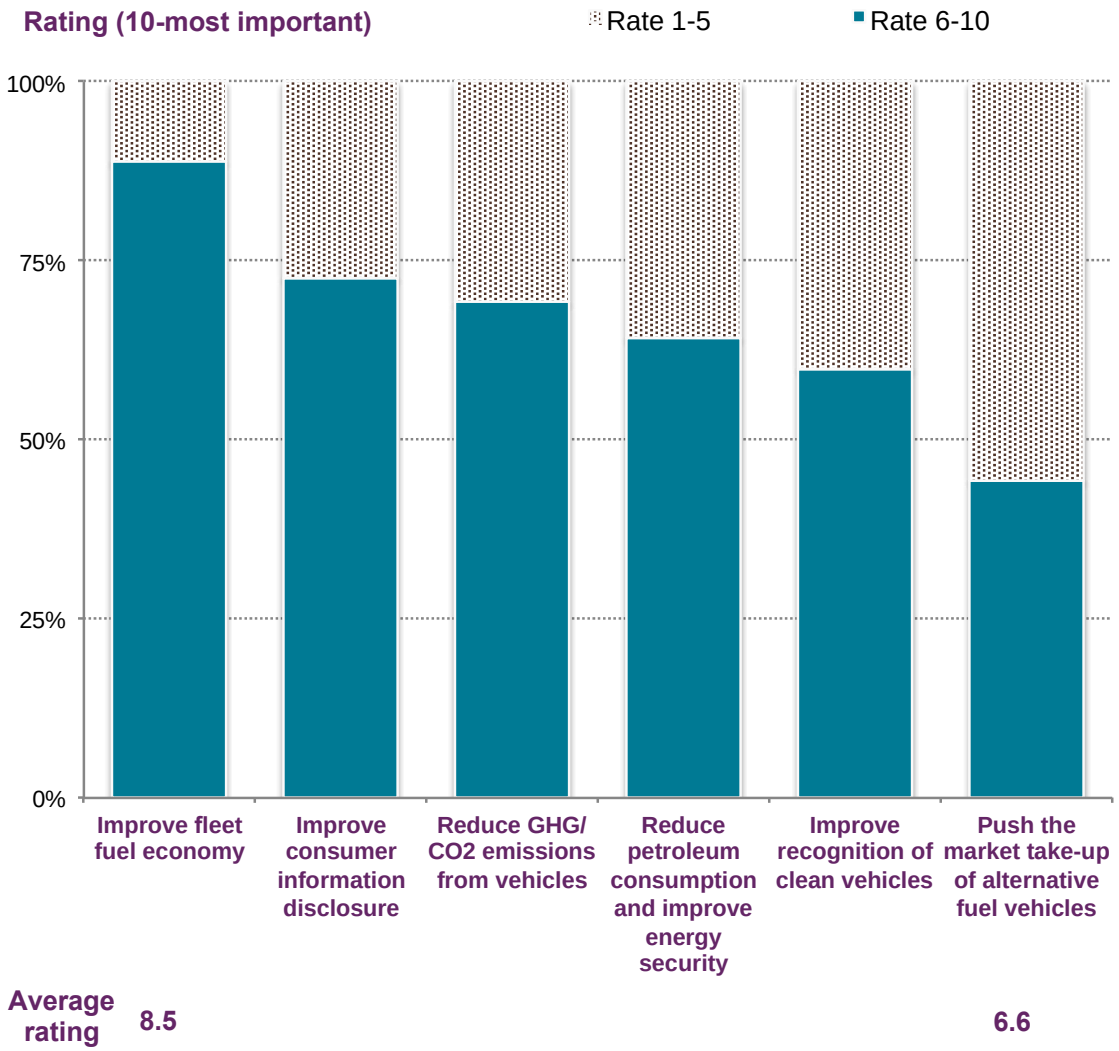


Figure 2. **VFEL program objectives ranked by importance (economies with or without VFEL program).**

More importantly, a VFEL program can be an enabler for other fuel economy programs. On one hand, a VFEL program provides an opportunity and platform where regulatory agencies can establish a mechanism for fuel economy reporting and collecting fuel economy data. It is the foundation of fuel economy standards and other relevant fiscal policies. On the other hand, when there are fuel economy standards and fiscal policies in place, a VFEL program complements those policies by making the information more accessible to consumers, therefore maximizing their impact.

4.3. Comparison of VFEL programs

The following list provides the definitions used for the six elements that were used to look at all of the VFEL programs investigated. The sub-sections after this provide the results of this analysis:

1. **Regulatory framework.** The regulatory framework includes the legislation, regulations, and technical documents that support the establishment and operation of the VFEL programs. The legislative framework empowers regulatory agencies to carry out the VFEL program.

2. **Program design**. Program design includes the framework adopted to develop and design the program and the primary characteristics of the VFEL program design, such as the timeline and coverage.

3. **Label design and information**. Label design and information includes all information that is required to appear on the label as well as the layout, color, and font used to present label information, which aims to effectively deliver information to consumers.

4. **Consumer outreach**. Consumer outreach includes the approaches and channels that an economy uses to promote the VFEL program. It increases awareness of the VFEL program among consumers and therefore improves the understanding of fuel efficiency and enhances its impact on vehicle purchasing decisions.

5. **Compliance and enforcement**. The actions taken by the regulatory agencies to encourage and ensure the implementation of the program accurately follows the policy requirements to realize the expected benefit in the real world.

6. **Performance assessment**. Performance assessment is the evaluation of the program once it is in place. It is used to assess the real outcome of the program and enable further improvement.

4.3.1. Regulatory framework

Most VFEL programs have been established under an existing legislative framework related to energy or fuel efficiency, while others have been developed based on consumer information disclosure legislation. For example, the Austrian program is based on the Passenger Car Consumer Information Act, while the upcoming Thai program is based on the Consumer Protection Act. Even for economies that do not have a VFEL program, there are legal statutes in place that allow establishment of a VFEL program. For example, Indonesia has the Presidential Regulation on National

Energy Policy and Russia has Federal Law about Energy Saving and Improvement of Energy Efficiency, Protection of Consumers Rights, and Protection of Atmospheric Air.

Within the overarching legislation, economies establish a specific regulation and technical documentation regarding vehicle labeling defining the responsible agencies and specification of the VFEL programs. The specific regulations usually either focus exclusively on the vehicle fuel economy label (i.e., Korea, Australia) or combine with fuel economy standards, if any (i.e., Chinese Taipei). The regulatory documents usually include many administrative and technical details, including the scope and definitions, test procedures, label requirements, and enforcement and penalties.

The EU Directive 1999/94/EC requires its 28 member states to ensure that consumers have access to information on fuel consumption and CO_2 emissions of new vehicles, and specifies certain minimum requirements with respect to label design and marketing materials. Individual member states' labeling programs, such as those in UK and the Netherlands, often go beyond the minimum requirements of the directive and can include requirements for AFVs or used vehicles.

Looking at the broader vehicle fuel economy policy portfolio, VFEL is just one of many policy instruments available to increase fuel efficiency of new vehicles and encourage the purchase of fuel-efficient vehicles. As shown in Figure 3, economies often use a combination of standards, fiscal instruments and other tools (such as mandatory alternative fuel vehicle sales targets) in addition to VFEL programs to achieve the overall vehicle fuel efficiency goal, but VFEL programs are one of the policy tools most commonly used. Some survey participants encouraged an explicit linkage between label fuel efficiency values and vehicle taxes, while others deemed VFEL programs as a cornerstone for developing further fuel efficiency related policies.

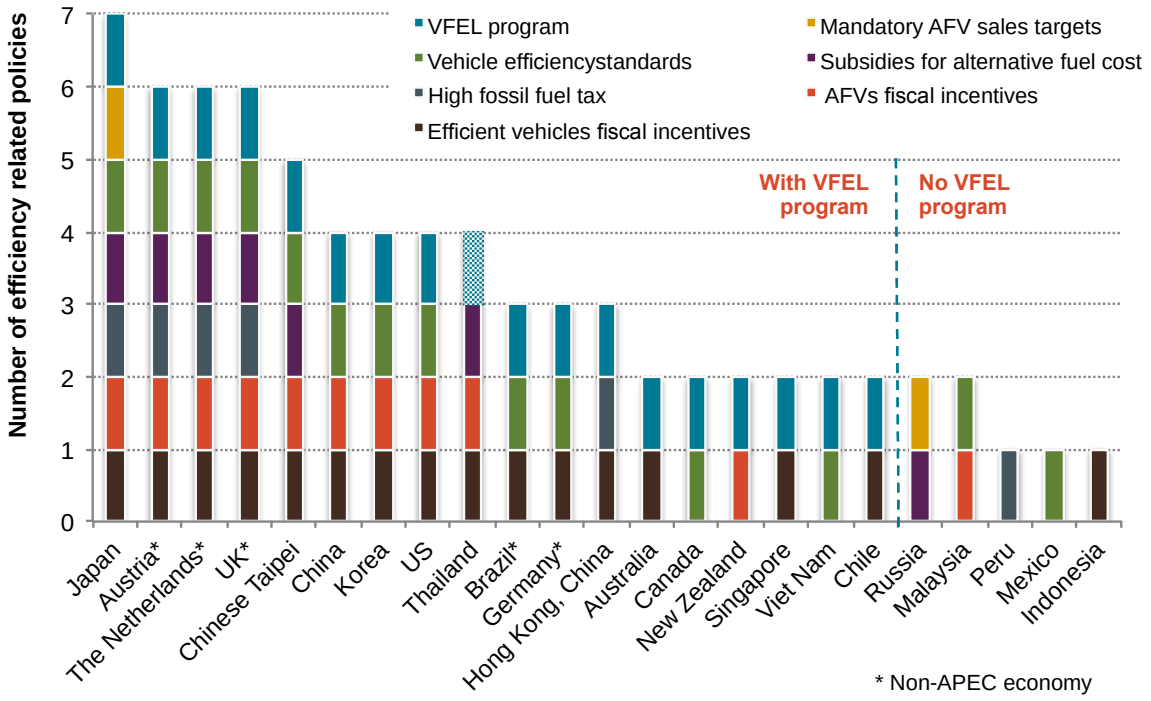


Figure 3. **Implementation of fuel efficiency related policies by economy.**

4.3.2. Program design

VFEL programs apply broadly to passenger vehicles (PV), light-trucks (LT), and light-commercial vehicles (LCV). Note that the definitions of these three categories vary by region. For example, the gross vehicle weight threshold to separate light vehicles from medium/heavy vehicles is 3500 kg in the EU, China, Japan, and Korea versus 3856 kg (8500 lb) in the US, Canada, Mexico, and Brazil. The requirements for maximum numbers of seats are also different. Unlike other economies, the US categorizes four-wheel drive SUVs and passenger vans as LT rather than PV. These differences in categorization do not affect the cross comparison of VFEL programs in this study.

Currently, 15 of the investigated VFEL programs are mandatory for most, if not all, regulated vehicles. In Canada and Hong Kong China (APEC) and Brazil (non-APEC), participation in their labeling programs is voluntary. Some economies have voluntary requirements for certain types of vehicles. For example, New Zealand's VFEL program is mandatory for new and used conventional vehicles, but voluntary for electric vehicles. The US VFEL program is mandatory for new vehicles but voluntary for used vehicles on the second-hand market.

Most APEC VFEL programs include both passenger and light-commercial vehicles, except those in Hong Kong, China, Chile, and Viet Nam that cover passenger cars

only. Among investigated non-APEC economies, Brazil's labeling program applies to both passenger vehicles and light-commercial vehicles while the labeling in Germany, the UK, Netherlands, and Austria is targeted at passenger vehicles only.

Not all vehicles in each segment are within the scope of the programs. Most VFEL programs (15 out of 18) incorporate at least some types of AFVs. For example, the programs in China, Chile, and Thailand include PHEVs; Brazil's program includes CNG and flex-fuel vehicles. However, only four VFEL programs studied for this report include vehicles with all types of fuels.

While most VFEL programs focus solely on new vehicles, some also cover used vehicles. In this context there are two different applications: (i) used vehicles that were previously sold new in the respective economy, and (ii) used vehicles that are imported from another economy.

As an example of the first application (refer i above), the UK encourages voluntary labeling for used vehicles that were previously sold new in the UK. The UK uses the same labels for all applicable vehicles.

New Zealand requires vehicle fuel efficiency labeling on both used vehicles that were previously sold new and used vehicles that are imported from another economy (refer i and ii above). New Zealand uses the same label design but without the fuel economy value shown in l/100km in the case of used imports (see Figure 4, left). The requirement to display a label for all used vehicles applies to commercial sales (e.g., via a vehicle dealership) as well as private sales that are conducted online (e.g., via an auction website)[4]. Figure 5 illustrates how the label is displayed in the case of a private sale on an auction site.

In the US the label is voluntary for used vehicles that were previously sold new (refer i above). The used vehicle label is simplified and differs in some aspects from the label that applies to new vehicles. For example, the labels for used vehicles (see Figure 4, right) do not provide the "Fuel Economy & Greenhouse Gas Rating" that is included on new vehicle labels.

The reason for this is that the threshold of the Fuel Economy & Greenhouse Gas Rating (see example in Appendix B) is based on data from the most recent complete model year and will be different each year. Two models produced in 2010 and 2015 with the same 110 g/km may rank differently because the average GHG emission levels have improved between 2010 and 2015. Therefore, ranking a used vehicle based on either current average level of emissions or the emission level of the year that the vehicle was produced may be misleading to consumers. In addition, the US

[4] There is no requirement to display a label if a private sale is not conducted online.

EPA believes that a vehicle's fuel economy changes very little over a typical 15-year life with proper maintenance, thus it displays the original fuel economy estimate for a used vehicle's average gas mileage (EPA, 2015). Dealers and sellers can easily download the labels from an official website and place them on the vehicles they sell.

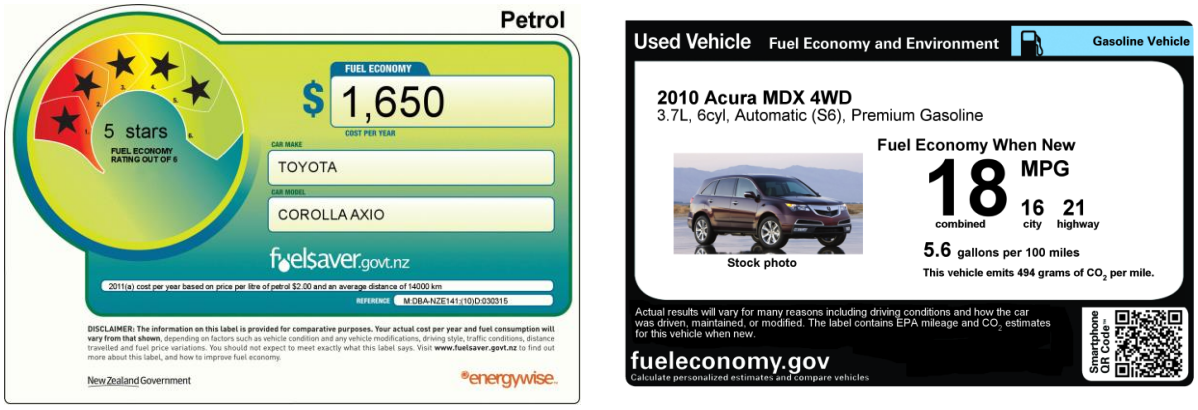


Figure 4. **Fuel economy labels for used vehicles in New Zealand (used vehicles imported from another economy, left) and the US (used vehicles that were previously sold new, right).**

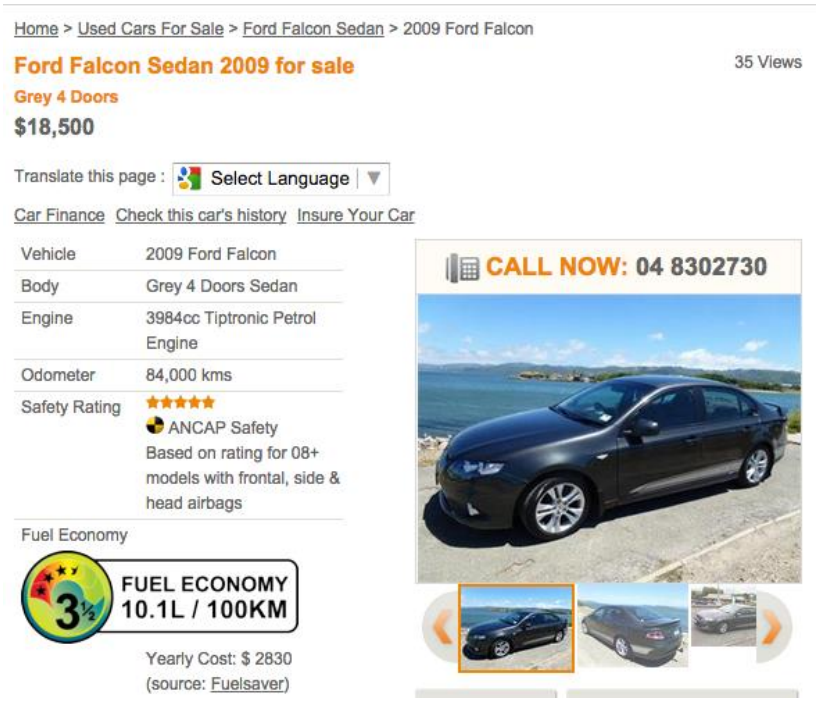


Figure 5. **An example of the use of fuel economy labels for used vehicles, for sale privately, on the New Zealand auction site www.trademe.co.nz**

In terms of the display of the label information, the physical vehicle fuel efficiency labels are affixed to vehicle models at the point of sale and are also displayed in the showroom, providing official information for potential car buyers. They are removed after purchase. Some APEC members, including Chile, Chinese Taipei, Japan, Korea, US, and Viet Nam, also mandate display of label fuel economy information on promotional materials either in print or online.

Some regulatory agencies conduct consumer research for the labeling program development. For example, Viet Nam spent $50,000 on a survey project before program implementation. The US EPA conducted extensive consumer research to redesign its fuel economy label in 2006 and 2011. During the development of the new label that was rolled out in 2013, EPA and NHTSA conducted comprehensive research, including a literature review, focus-group discussions and expert-panel consultations. There was also an internal design review upon the release of the proposed regulation. One of the main findings was that consumers prefer to have information on refueling costs included on the label (PRR, Inc., 2010a).

The EU also has conducted a number of consumer behavior-relevant studies. They have found consumers to be in favor of providing comparisons in terms of stars, letters or numbers, rather than detailed technical information (Grünig et al., 2010).

Some economies referred to other economies' experience when developing their programs. For example, Singapore gained experience from the EU, US, and Japan; Chinese Taipei and Chile referred to the US and EU VFEL programs; China and Brazil referred to the US VFEL program.

Experience from existing VFEL programs sometimes provides inspiration for VFEL programs under development. This suggests that sharing program information with other economies is essential for improving these programs worldwide.

4.3.3. Label design and information

Label design differs widely across the programs. Some economies, such as Australia, Canada, Chinese Taipei, and Hong Kong China, align the vehicle label design with the energy efficiency label for appliances (e.g., refrigerators) to raise recognition of the vehicle label.

In terms of the information shown on the label, there are some commonalities across economies. Figure 6 shows the frequency of usage of different types of information displayed on labels in 18 economies. A detailed overview of all labels used in each economy is included in Appendix B.

More labels present vehicle fuel consumption/economy information than CO_2 emission value. Most of the economies choose to display vehicle fuel consumption in l/100km or gallon/mile, but some economies also display fuel economy in km/l or miles per gallon, depending on familiarity of consumers with a particular metric. For economies that use test procedures simulating typical urban or highway driving routines, the labels typically show a combined fuel economy value based upon a pre-determined weighting while some show fuel efficiency values under urban and

highway test cycles separately in addition to a combined value. Japan is the only economy that does not show fuel economy or a CO_2 emission value on the label. It provides an incentive label for vehicles that exceed efficiency standards by indicating the percentage of overachievement of their fuel efficiency standards.

There is other information that is not required as often as the vehicle fuel efficiency performance, but is picked up by some economies, such as fuel cost and fiscal incentive information. In addition to showing the labeling website, some labels show a QR code that can lead consumers using portable devices directly to a relevant website.

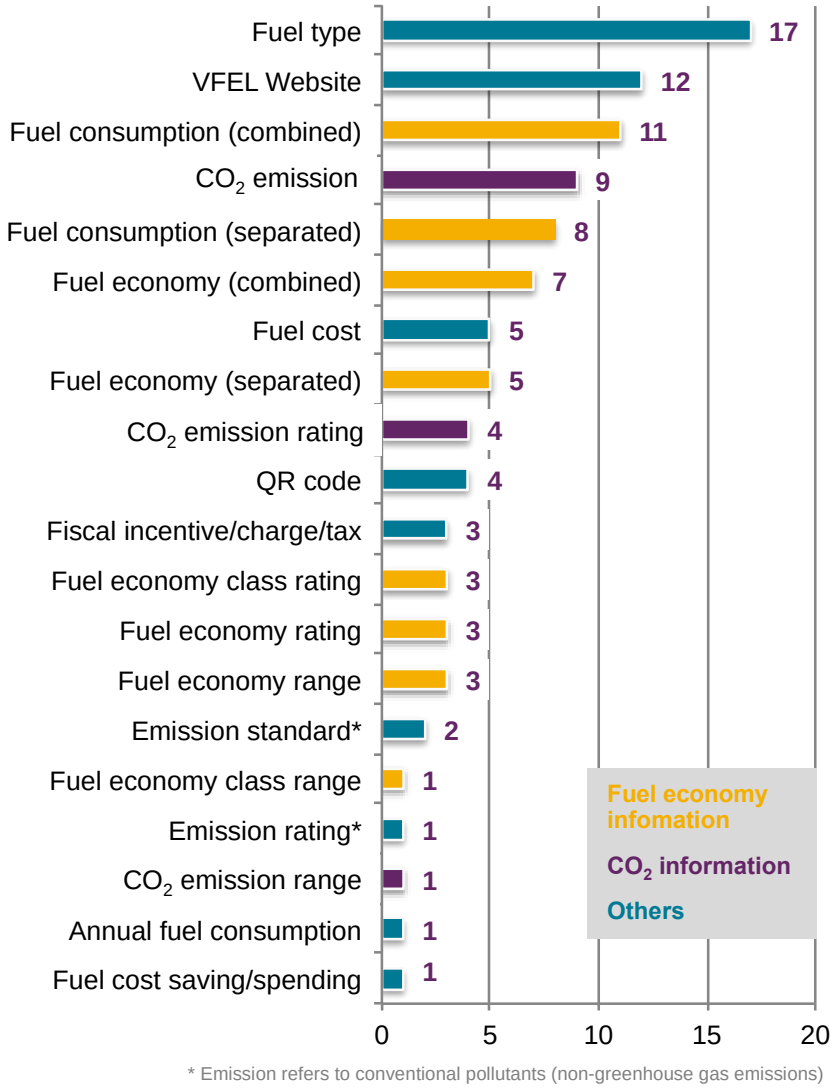


Figure 6. **Frequency of usage of information on different labels in 18 economies.**

For labels that apply to AFVs, the information requirement is usually different from conventional vehicles. Table 4 summarizes the approaches that different labels use that allow consumers to compare AFVs and conventional vehicles.

Table 4. Alternative fueled vehicle labels in investigated economies

Economies	Information compared to conventional vehicles	Applied AFV type	Approaches to compare with conventional vehicles	Special information for AFVs
Australia	Different	BEV, PHEV, LPG, CNG	Combined fuel consumption (l/100km), CO_2 absolute value	Energy consumption (Wh/km), driving range (km)
Canada	Different	BEV, PHEV FCV, CNG, flex-fuel, dual fuel	MPGe, CO_2 rating and absolute value, smog rating, annual fuel cost	Energy consumption (kWh/100km), driving range (km)
Chile	Same	PHEV	Fuel economy (km/l), CO_2 absolute value	None
China	Same	PHEV	Fuel consumption (l/100km)	None
Hong Kong, China	None	None	None	None
Chinese Taipei	None	None	None	None
Japan	Same	LPG	Percentage of overachievement compared to fuel economy standard	None
Korea	Different	BEV, LPG, Bi-fuel	For BEV: None For other AFVs: km/l, CO_2 absolute value	Fuel type, electricity efficiency (km/kWh), fuel cell efficiency (km/kg), driving range (km)
New Zealand	Different	BEV, PHEV, LPG	Fuel efficiency rating and absolute value, fuel cost (NZ$/km)	Driving range (km), energy consumption (kWh/100 km)
Singapore	Same	BEV	CO_2 rating and absolute value, CO_2 emissions base rebate/surcharge	None
Thailand	Same	PHEV, E85	Combined fuel economy value (L/100 km, km/L) and scale bar, CO_2 absolute value, standard	None
US	Different	BEV, PHEV, CNG, flex-fuel (E85), fuel cell	MPGe, CO_2 rating and absolute value, smog rating, annual fuel cost, fuel savings over 5 years	Driving range (km)
Viet Nam	Same	LPG, CNG	l/100km	m^3/100km (for CNG)
Austria	Different	BEV, PHEV, CNG	l/100 km, CO_2 rating and absolute value, annual fuel cost (euros)	Energy consumption (kWh/100km)
Brazil	Different	CNG, Ethanol	CO_2 rating and absolute value, l/km (for ethanol)	km/m^3 (for CNG)
Germany	Different	BEV, PHEV, LPG, CNG, flex-fuel	l/100 km, CO_2 absolute value	Energy consumption (kWh/100km), kg/100 km (CNG)

Netherlands	Same	LPG, CNG, PHEV	l/100 km, CO_2 absolute value and rating	None
UK	Different (electric drives) Same (other AFVs)	BEV, PHEV, LPG, CNG	CO_2 rating and absolute value, fuel cost (pounds for 12,000 miles), vehicle excise duty	Energy efficiency (mi/kWh), driving range of a full charge (for electric drives)

The CO_2 rating, CO_2 absolute value and equivalent fuel economy (MPGe) are the top three metrics used by APEC members for AFVs. The UK includes an annual rate of vehicle excise tax, which varies depending on the CO_2 emission level. Singapore shows the fiscal incentives and penalty based on the CO_2 emissions on the label.

Other information commonly offered on AFV labels includes vehicle range, recharging time and in-use cost savings compared to a conventional vehicle. In particular, the in-use cost savings are important for battery electric vehicles (BEV) and plug-in hybrid vehicles (PHEV) because those savings help to compensate for the typically higher upfront cost compared to conventional vehicles. Seven labels display additional or different information for AFVs compared to conventional vehicles. For example, Australia's BEV label provides combined test energy consumption in Wh/km, instead of urban and extra urban fuel consumption for gasoline vehicles. Also, the CO_2 emissions value, which is rated at zero for BEVs, comes with an explanatory footnote on upstream power plant CO_2 emissions (Figure 7).

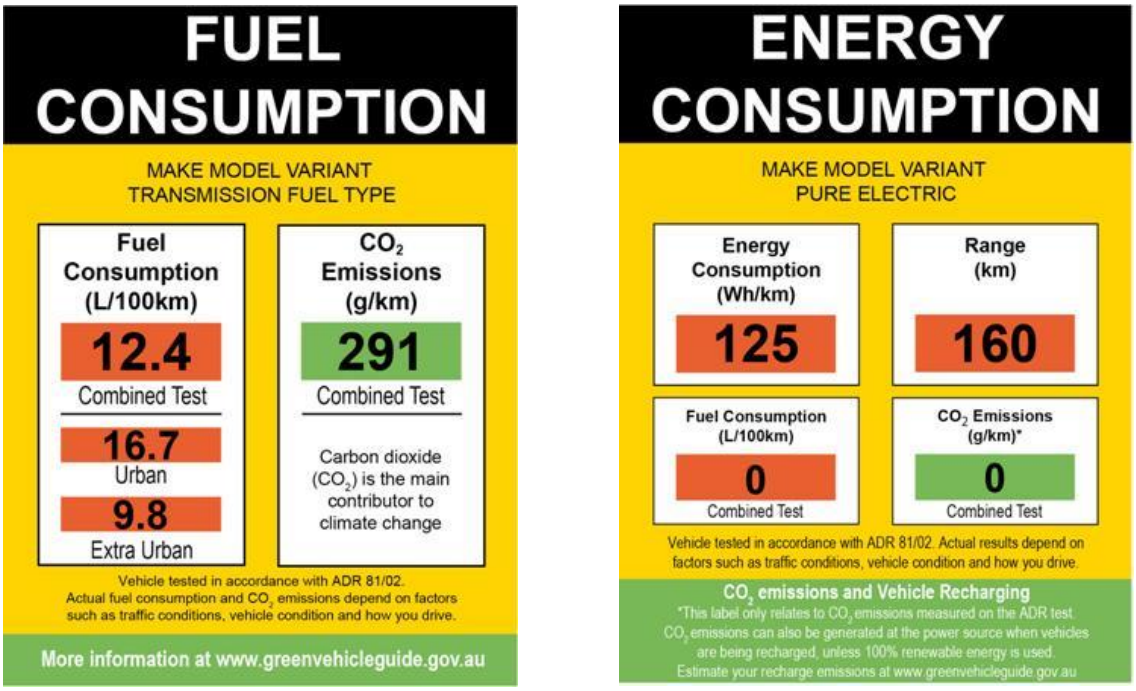


Figure 7. Fuel efficiency label for conventional vehicles (left) and BEVs (right) in Australia.

In terms of the test procedures required to test the fuel economy-related value, the current test cycles used for European and US regulations – the New European Driving Cycle (NEDC) and US federal test procedures – are the most commonly used testing procedures for measuring fuel consumption.

Economies that introduce vehicles tested to different cycles either require vehicles to be tested under the same cycle, or, to economize at the cost of accuracy, adopt an algorithm to convert the test results to the reference test cycle. Chinese Taipei used to allow results from both NEDC and US 2-cycle tests, but after 2016 vehicles will have to provide data on the NEDC only. Because roughly half of automobiles sold in New Zealand are imported as used vehicles, the New Zealand government developed an algorithm to convert fuel efficiency information from different test cycles into a common star-rating. Before Korea switched to the US 5-cycle, an algorithm was used to convert the old test cycle (i.e., US 2-cycle) to the new test cycle. The National Institute on Ecology and Climate Change in Mexico faces a similar issue in comparing fuel economy data for vehicles tested on the US and European cycles, although this problem should be resolved as vehicles will be certified to US 2-cycle tests for fuel efficiency standards in the future. As indicated in Table 5, the NEDC is by far the dominant test cycle among APEC members.

Table 5. Test cycles adopted by different economies for fuel efficiency/CO_2 emission label information

Test Cycle	Adopted By
NEDC	Australia, Chile, China, Chinese Taipei, Singapore, Viet Nam, Austria, Germany, Netherlands, UK, Thailand
US 2-cycle	Brazil, Chinese Taipei
US 5-cycle	US, Canada, Korea
JC08	Japan
Japan 10-15 mode	Hong Kong China

Note:
1. New Zealand accepts vehicles tested to US, EU, and Japanese standards.
2. Descriptive test cycle information can be found in Appendix A, Table 21 and Table 22.

4.3.4. Consumer outreach

Many economies understand that consumer outreach is an essential element of a VFEL program for raising the profile of the program and increasing VFEL influence on purchase decisions. Placing the label prominently on the car at the point of purchase is no longer the only tactic for raising awareness among consumers.

Eleven out of 18 VFEL programs reviewed for this report have developed guidebooks for consumers, which introduce the VFEL program and/or provide specific vehicle fuel efficiency information. Some programs distribute hard copies at

dealerships or other venues easily accessed by consumers, while some economies make the guidebook available online.

Any consumer outreach strategy is likely to be more effective if it uses a multimedia approach as the Internet and social media have increasingly gained importance, while the importance of more traditional channels such as television, radio and paper publications has declined. For example, according to a 2014 New Zealand survey, the Internet was in the top three sources for consumers' research about new cars, and 27% people bought their cars online (Ipsos New Zealand, 2014).

Most VFEL programs have dedicated websites offering fuel economy and labeling-related information, and around 40% offer sites that are accessible from mobile devices. Mexico, which does not have an active labeling program, does have a consumer information website where fuel efficiency information is available. Ideally, these websites should help consumers learn about the label program, find fuel economy and CO_2 emission information, and enable a comparison between different vehicle models.

Studying the existing VFEL websites, eight main features are identified:

a) Fuel efficiency/VFEL program introduction;
b) Label/energy guide explanation;
c) Specific vehicle model information;
d) Comparison among different vehicle models;
e) Fuel cost calculations;
f) Fiscal incentive information;
g) Real-world fuel consumption reports;
h) Efficient driving suggestions.

Table 6 lists the functions of websites of all labeling programs investigated in this report. It shows that the functions of VFEL websites are varied, with some providing more complementary information and services while some are simple with limited functions. Some economies have invested more to make their websites understandable and interactive with consumers.

Table 6. Consumer outreach strategies

Economies*	Mobile friendly	Website feature								Opportunity for consumer comments through
		a	b	c	d	e	f	g	h	
Australia	No		√	√	√	√	√			Website (email)
Canada	Yes		√	√		√			√	Email/letter/telephone
Chile	Yes	√	√	√	√	√			√	Website (email)
China	No	√		√			√		√	
Hong Kong, China	No			√						
Chinese Taipei	No	√	√	√	√		√			Website (email)
Japan	No			√			√			
Korea	Yes	√	√	√		√				
New Zealand	Yes	√	√	√	√	√	√		√	Email, telephone
Singapore	No	√	√							Website
US	Yes	√	√	√	√	√	√	√	√	Email, online data login
Viet Nam	No									Website (email)
Austria	No			√	√		√		√	
Brazil	Yes	√		√		√	√		√	Email, phone, website service
Germany	No	√	√			√		√	√	
Netherlands	No	√	√	√				√		
UK	NA	√	√			√				Email, letter

* Thailand's labeling website will be available in December 2015.

Two-thirds of VFEL websites allow consumer comments through various approaches, such as by email, telephone, letter, and website forms. New Zealand and Brazil both reported they use that feedback, especially complaints and program suggestions, to help improve the program over time. The US website includes a portal where consumers can report the actual fuel economy of their vehicles in real driving conditions[5].

Figure 8 shows how survey participants see the importance of various consumer outreach actions. The two most important actions are establishing a VFEL website enabled for mobile devices and maximizing the use of VFEL information in promotional material and through other public media. Advertising in print and dealership training programs are considered the least important among the survey participants.

[5] See https://www.fueleconomy.gov/mpg/MPG.do?action=garage

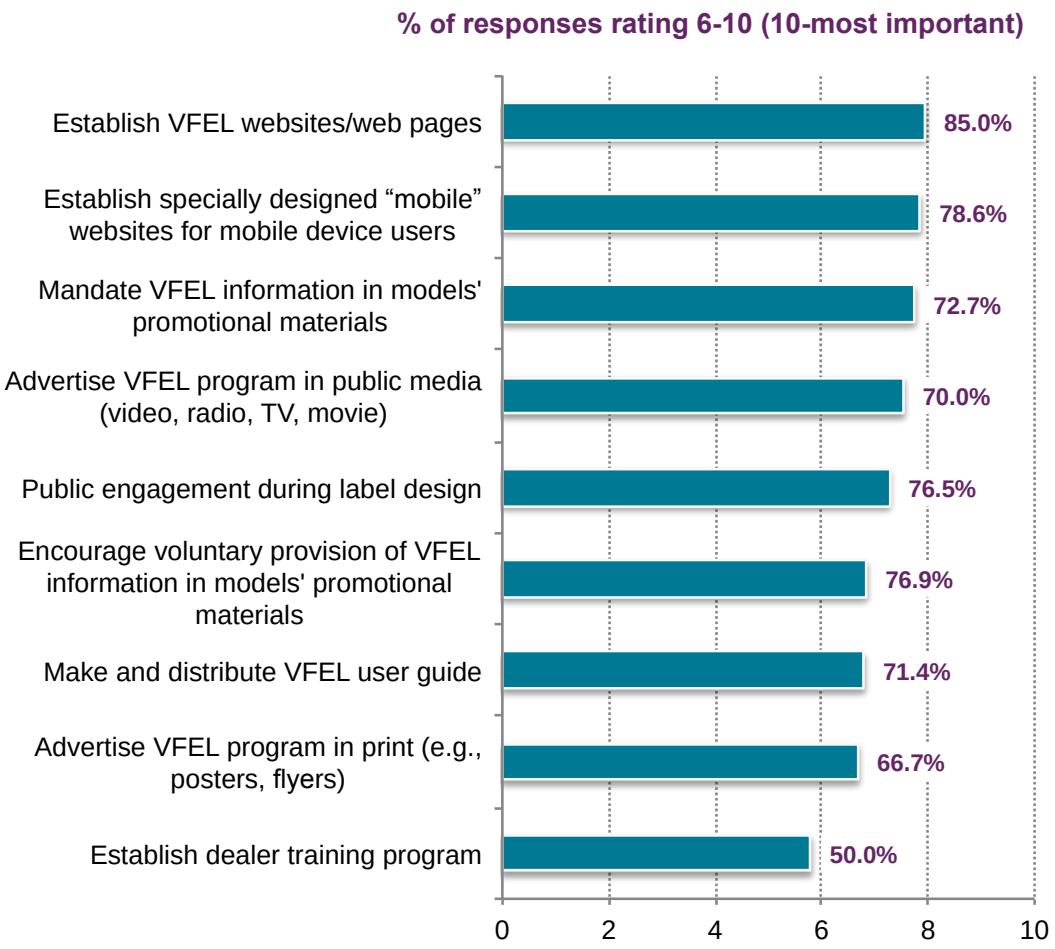


Figure 8. **Importance of consumer outreach activities.**

4.3.5. Compliance and enforcement

A strong compliance and enforcement program is essential for earning and maintaining consumers' trust in a VFEL program and creating a level playing field for the vehicle manufacturers. There are primarily two levels of enforcement related to VFEL programs. One is ensuring manufacturers have followed the established procedures in creating the certified value. The other is encouraging and ensuring that labels are displayed as required.

4.3.5.1. Ensure that manufacturers follow testing procedures

Because vehicle efficiency testing is conducted either by manufacturers or independent test organizations, it is necessary to conduct label verification to guard against fraudulent information and cheating. In the US, manufacturers self-test and report to the EPA. The EPA typically reviews results and conducts tests in its own

laboratory for a sample of 10% to 15% of the models sold. Other economies conduct conformity tests with various sample sizes. Table 7 provides information on how other APEC members and non-members verify vehicle fuel consumption values.

Table 7. Label information verification methods

Economies	Test Procedure Verification
Australia	Yes, assess manufacturer's auditing procedure and test samples if not satisfied with the auditing procedure
Canada	Yes, conformity test, sample size is not specified
Chile	Yes, methods are not specified
China	Random checks by responsible agency
Chinese Taipei	Conformity test of sample size <5
Korea	Conformity test of sample size >15
New Zealand	Documentation audits for new cars and comparison with international databases
Singapore	Conformity test by accredited independent test laboratories
US	Conformity test of sample size >15 (or 10% to 15%)
Viet Nam	Conformity test of sample size <5
Brazil	Electronic audits of the input data, conformity test with sample size >15, by accredited laboratories

For all economies that verify manufacturer reported fuel efficiency, regardless of sample size, an independent verification test is a must in order to make sure the test result is credible. In fact, the enforcement of manufacturer testing goes even beyond confirmatory testing investigated in the survey. For example, the EPA has requirements for coastdown testing and conducts confirmation testing of the coastdown results. There are also requirements for tires installed on the test vehicles that need to be verified. Such practices are not captured in this report.

4.3.5.2. Encourage and ensure that labels are displayed as required

Enforcement is to make sure there is a label on the vehicle or in other required materials and the provided information is correct. Most economies focus on checking the former by conducting showroom or advertising material inspections assuming that manufacturers or dealers will not take risks to present fake values on the label (Table 8). For example, in New Zealand, at least 200 dealers are visited throughout the year. As of June 2015, compliance with VFEL regulations by car dealers stood at 95% for new vehicles, and 91% for used vehicles. This is significantly higher than at the beginning of the program in 2008[6]. Many economies also conduct periodic inspections of showrooms/dealerships to verify fuel economy labels are being displayed. Among non-APEC economies, the UK conducts unannounced showroom

[6] Personal communication, Eddie Thompson, Manager Efficient Products, EECA, 31/07/2015

visits, also known as “mystery shopping,” by local enforcement agencies. Only Germany has specified the penalty if noncompliance is identified.

Notwithstanding the above focus on enforcement, another factor to consider is making it easy to comply (Thompson, 2015). By making it easy to comply with any regulatory requirements, relevant enforcement activities, which can be costly, can be reduced. For example, this could include making it easy for showrooms/dealerships to get labels for their vehicles (e.g., via an official website) and increasing awareness of VFEL programs among dealers.

Table 8. Measurements of label inspections or verification

Economies	Inspection measures
Canada	Compliance study, biannual, representative sample of new vehicles
Chile	Compliance observation, frequency unspecified, sample vehicles at point of sale
Chinese Taipei	Audit periodically, frequency and sample size unspecified
Korea	Compliance inspection and showroom visits, frequency unspecified, promotional materials and websites
New Zealand	Dealer visits, annual, sample size > 200
Singapore	Showroom visits, annual, sample size unspecified
US	A fine of up to $1,000 per vehicle if the sticker is missing, and other fees and penalties are authorized if the sticker is altered illegally
Viet Nam	Random surveillance, frequency and sample size unspecified
Austria	Compare label value to vehicle type approval result
Germany	Compare label value to vehicle type approval result, frequency and sample size unspecified, fine up to 50,000 euros if not using the right information sheets
Netherland	Compare label value to vehicle type approval result, frequency and sample size unspecified
UK	Unannounced showroom visits, compare label value to vehicle type approval result, frequency and sample size unspecified
Brazil	On-site verifications, frequency and sample size unspecified

4.3.6. Performance assessment

Regular performance assessments of VFEL programs can be used to improve program effectiveness as an overarching goal. APEC members Chile, China, Chinese Taipei, the US, New Zealand and Viet Nam and the non-APEC economies of Brazil, the Netherlands and UK reported at least some form of VFEL program assessment. The most popular assessment methods reported are questionnaires/surveys, face-to-face interviews and focus groups (Figure 9). Other methods include mystery shopping and studies to identify fuel savings attributable to VFEL programs.

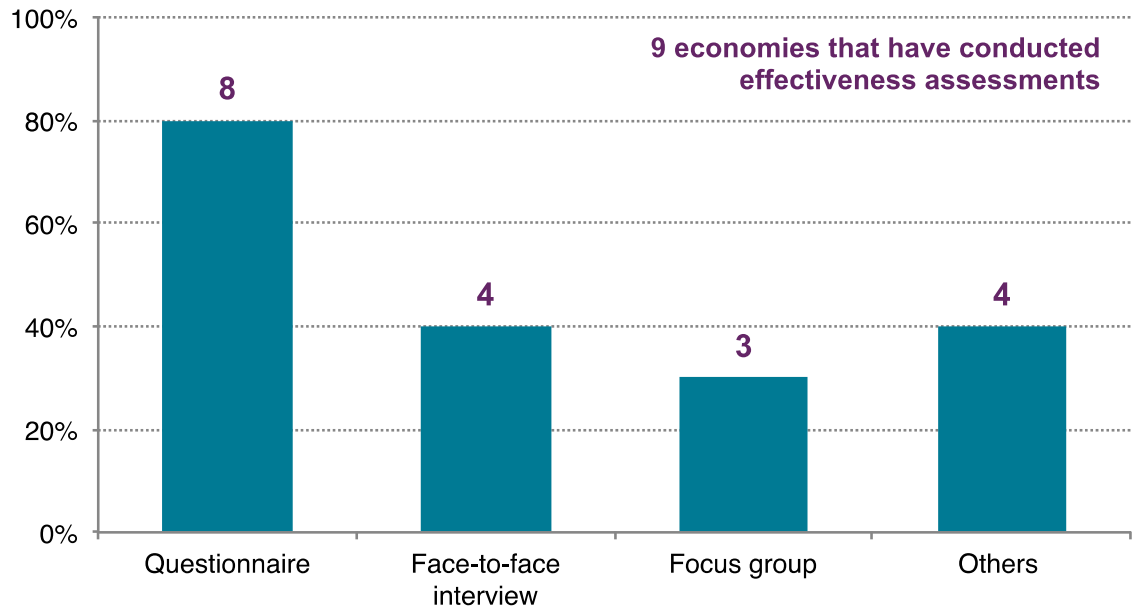


Figure 9. **Methods used for effectiveness assessments of VFEL programs in nine economies.**

Survey results indicate that the influence of fuel efficiency in a purchase decision is the most important criterion that survey participants intend to use to measure the effectiveness of the VFEL program, followed by the overall awareness of the VFEL program (Figure 10).

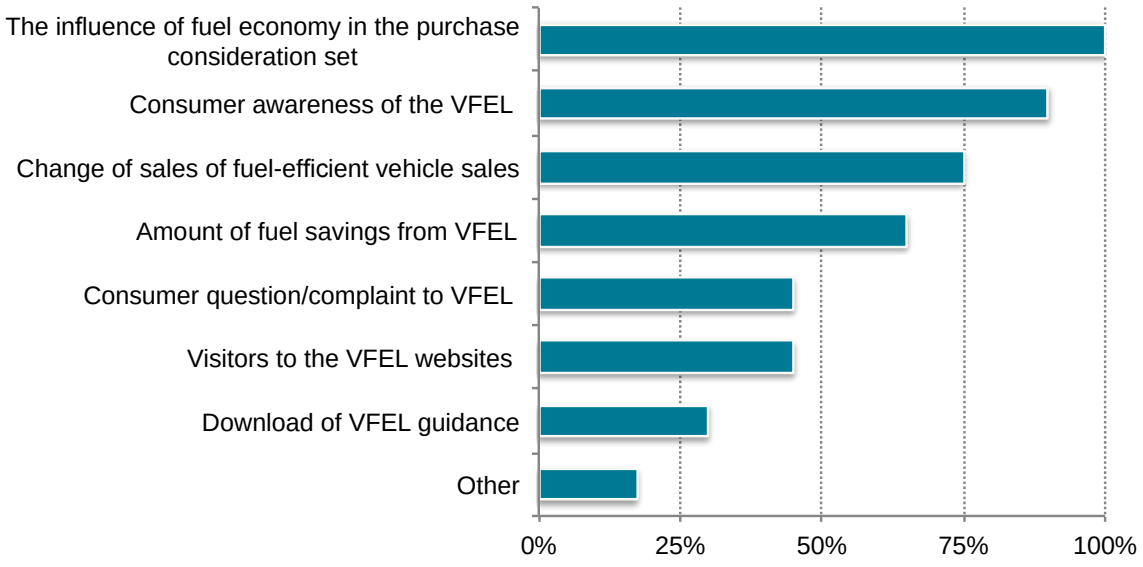


Figure 10. **Percentage of survey respondents intending to use the indicator for effectiveness assessment.**

For some voluntary programs, participation of vehicle manufacturers, importers, and sales agents, and the level of advertising on TV and radio are also seen as indicators of program effectiveness. The US also counts the media stories mentioning the main website of the program at www.fueleconomy.gov.

Survey respondents also highlighted the difficulty in tracking changes in consumer preferences, and estimating the impact of labeling programs, in particular separating the effect of VFEL programs from other policies, especially fiscal instruments. Thus, the impact of VFEL on sales of more fuel efficient vehicles or on fuel savings is difficult to estimate. An assessment of the VFEL programs in the EU came to a similar conclusion (Brannigan et al., 2011).

4.4. Cost of running VFEL programs

With regard to the costs of operating a program, whether under the umbrella of either legislation and/or regulations, the survey gathered data on VFEL program staff and budgets in different economies. Among 10 economies that responded to the survey question, six reported fewer than five full-time equivalent staff while four economies reported five to 10 full-time equivalent staff working on VFEL programs. Five economies that disclose their budget range have annual budgets of less than $50,000, while four economies report an annual budget between $50,000 and $500,000[7].

However, the scope of work that the staff and budget cover varies significantly across economies. For example, Chile's VFEL program budget is spent primarily on fuel economy testing[8] and the promotion, maintenance and improvement of the VFEL webpage. The UK budget includes personnel costs as well as the maintenance of a database of fuel economy and emission data obtained from car manufactures and the production of an annual guide for car buyers. The New Zealand budget includes personnel, marketing and communications, website maintenance and compliance activities. In addition to personnel, marketing and testing, establishment of a VFEL program incurs additional costs, which are further explained below.

Program budgets are harder to estimate when a number of government agencies are involved, and when VFEL activities are one of a range of activities carried out by the program staff. In the US, the cost of the labeling program for the EPA Office of Transportation and Air Quality are not accounted for as a separate line item, because the same staff also engage in fuel economy standards and emissions testing programs. The US VFEL program is a shared responsibility of the

[7] One economy provided staffing information but not budget range.
[8] Chile has its own testing lab to determine the fuel economy of vehicles.

Environmental Protection Agency, Department of Transportation, and Department of Energy, so no consolidated VFEL program budget is available.

With regard to the costs of establishing such a program as opposed to operating it, no direct information is available. However, a research study from New Zealand in 2012 considered how much money was spent on researching, drafting, developing and then passing laws and regulations through the New Zealand Parliament. The study showed a new act can cost from $1.3 million to $4 million, with an average of $2.3 million, while a regulation was estimated to cost around $344,500 (Wilson, Nghiem, Foster, Cobiac, & Blakely, 2012). The average cost per page of legislation was estimated at $29,250. While costs in other jurisdictions may differ significantly, it shows that legislation and regulations do not come free. Indeed, there may be significant costs not only in relation to the development of a regulatory framework, but there may also be costs associated with understanding the market to ensure the program is fit for purpose.

4.5. Key barriers to establishing or improving VFEL programs

Survey participants from non-VFEL economies think highly of the benefit of VFEL programs. The average rating of the benefit of a VFEL program is 8.4 on a scale of 10. Yet, these economies do not have VFEL programs, and survey participants identified key barriers as:

- Lack of legal/regulatory support
- Lack of resources for VFEL program development
- Lack of resources for VFEL implementation
- Lack of information to prove the effectiveness of the VFEL program
- Opposition from stakeholders, mostly vehicle manufacturers

Additional challenges were highlighted in the survey responses and workshop discussion, such as how to generate political will to establish a VFEL program, how to raise public awareness and gain consumer acceptance, and how to access and/or develop technical support for the implementation of the program (e.g., testing in the laboratory).

Participants in the survey and the VFEL workshop also identified barriers to improving existing VFEL programs, including:

- Lack of funding for the expansion of the program
- Resistance from vehicle manufacturers
- Lack of public education on fuel efficiency
- Difficulties in getting real-world fuel efficiency data to verify the label value (i.e., reflect real performance)
- Lack of complementary incentive programs to enhance VFEL effectiveness
- Lack of local regulatory control (in EU)
- Difficulties turning voluntary programs into mandatory programs.

5. VFEL evaluation considerations

Based on the objectives of VFEL programs, the effectiveness of VFEL programs could be tested along two dimensions: (1) the impact of VFEL programs on increasing consumer awareness and purchasing behavior, and (2) observed changes in new vehicle fuel efficiency/CO_2 emissions (when taking other interventions that might be in place into consideration).

Some survey participants indicated that regular assessment of VFEL programs is effective in monitoring and measuring changes in public awareness of the labeling program and its subsequent impact on consumers' car buying choices.

Nevertheless, out of the 13 APEC economies with VFEL programs, only six have conducted such an assessment. Moreover, the frequency of and approach to evaluation varies across different economies. For example, the US assessed its VFEL program before each revision. New Zealand conducts an assessment every year while several other economies conduct assessments infrequently; normally these are for internal use only.

The methodology of evaluation also varies. For example, New Zealand carried out quantitative analysis of VFEL impact on consumers based on an in-depth market investigation while the EU conducted qualitative analysis of program effectiveness and enforcement by relying on input from stakeholders. As a result, the effectiveness of VFEL programs cannot be easily compared across economies using self-assessment results, even though such assessments are useful for evaluating each program individually.

Evaluating the impact of VFEL programs and comparing the performance of different VFEL programs is further complicated by the fact that the impact of VFEL on fleet fuel efficiency cannot easily be isolated from other policies, such as CO_2 emission/fuel efficiency standards and vehicle/fuel tax policies and business as usual improvements in the fleet.

Figure 11 plots the changes in average new car CO_2 emission levels compared to 2005 levels for different economies. It appears that most economies that have implemented VFEL programs have experienced a dramatic CO_2 emission decrease since 2005. However, the economies with VFEL programs usually have other fuel efficiency-related policies in place as well. Therefore, Figure 11 also shows the number of fuel efficiency related policy instruments implemented in each economy, including vehicle efficiency standards, high fossil fuel taxes, efficient vehicle fiscal incentives, mandatory alternative fuel vehicle sales targets, alternative fuel subsidies, and alternative fuel vehicle fiscal incentives. Notably, economies using a combination of different policy instruments are more likely to have achieved larger CO_2 emission reductions.

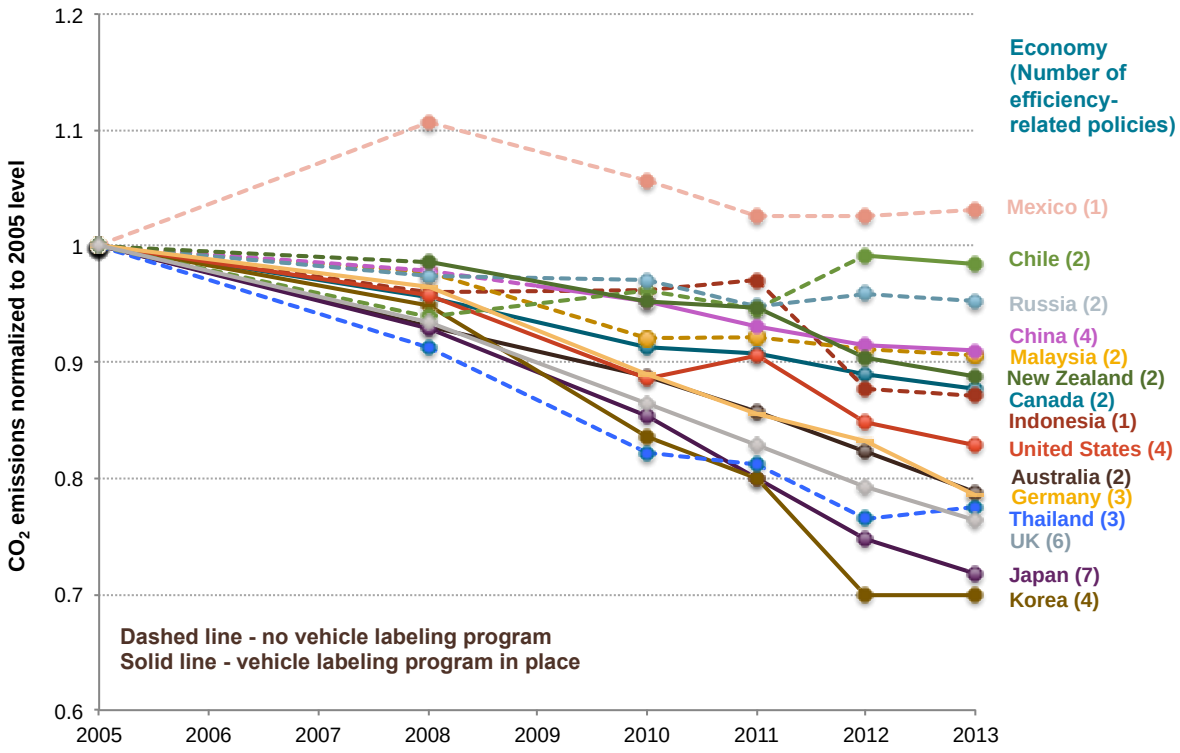


Figure 11. **New passenger car fleet average CO_2 emissions compared to 2005 level and implementation of VFEL program in various economies.**

Data from GFEI (2014) and ICCT (2015).

There have been some attempts to estimate the influence of VFEL programs independent of other policy instruments. For instance, New Zealand estimated the impact of its VFEL program based on the change in fuel consumption trend before and after the introduction of the VFEL program in 2008 (Campbell & Williamson, 2007). Such assessments are complicated by the fact that economies that have VFEL programs on average have implemented more efficiency related policies than economies that do not have VFEL programs, as shown in Figure 11.

Perhaps, this should not be surprising, as energy efficiency labeling programs have tended to precede efficiency standards in some cases (e.g., Brazil). Economies that started to manage vehicle fuel efficiency over the past five years, such as Brazil, Viet Nam, Chile, and Malaysia, have introduced or plan to introduce VFEL programs ahead of the establishment of fuel efficiency standards. In addition, not all economies have a long enough trend of monitoring new vehicle fuel efficiency/CO_2 emissions, and in some cases, the labeling programs have opened the doors to do such monitoring. Therefore, an ex-ante and ex-post evaluation of changes in fuel consumption is not sufficient to determine the relative effectiveness of VFEL programs.

For the purposes of this report, we have broken down various VFEL programs into their key elements, and identified key indicators and relevant best practices under

each element based on the survey responses and real-world experience. The effectiveness of a VFEL program is evaluated based on the performance of the program across this broad range of indicators.

The six key elements for VFEL programs from the designing and implementation to compliance and monitoring were discussed in Section 4. A total of 16 components were developed covering the six key elements of VFEL programs as shown in Table 9. A detailed explanation of each indicator and evaluation of various VFEL programs for each follows in the next section.

Table 9. Key components under six key elements of VFEL programs

1. Regulatory framework	
Key component 1	Legislative/regulatory support
Key component 2	Other fuel efficiency related policies
2. Program design	
Key component 3	Mandatory VFEL requirement
Key component 4	Broad coverage of the VFEL program
Key component 5	Understanding the market
Key component 6	Accurate fuel efficiency/CO_2 emissions data that reflect vehicle real-world performance
3. Label design and information	
Key component 7	Understandable fuel efficiency/CO_2 emissions information
Key component 8	Indication of running cost or financial penalties/rewards
Key component 9	Comparable information for AFVs
Key component 10	Specialized information for advanced technologies
4. Consumer outreach	
Key component 11	User-friendly website provides VFEL information
Key component 12	Mandatory fuel efficiency information in promotional materials through other media
Key component 13	Direct communication channel with consumers
5. Compliance and enforcement	
Key component 14	Audits of vehicle fuel efficiency/CO_2 emissions test
Key component 15	Encouraging and ensuring compliance with labeling requirements
6. Performance assessment	
Key component 16	Periodic VFEL effectiveness assessment

6. Defining best practice by component

6.1. Regulatory framework

6.1.1. Component 1: Legislative/regulatory support

Appropriate legislative and/or regulatory authority to formulate and implement a VFEL program is fundamental to the success of any VFEL program. Legislation grants government entities the authority to carry out a VFEL program while regulations specify the detailed requirements and responsible implementing bodies.

According to the survey and practices across economies, the development of VFEL programs can build on legislation in three policy areas: law focusing on energy conservation and efficiency (e.g., the Energy Conservation and Policy Act in the US), law focusing on consumer information or protection (e.g., the Passenger Car Consumer Information Act in Austria), or law more narrowly tailored focusing only on vehicle efficiency (e.g., the Motor Vehicle Standards Act in Australia). Under the legislative framework, governments have regulations that specify requirements of VFEL programs. The regulation can either focus exclusively on vehicle fuel economy labeling, or vehicle fuel economy labeling may be embedded within regulations covering other policy aspects. For example, Chinese Taipei covers VFEL under regulations focusing on fuel economy standards and vehicle inspection.

Regulatory documents include administrative and technical details to carry out the VFEL programs. A list of common contents includes, but is not limited to, the following:

- Scope of the regulation
- Vehicle definition and classification
- Responsible stakeholders
- Test methodology
- Requirements for testing facilities and laboratories
- Label design and format
- Displayed label information
- Manufacturer report format
- Compliance and inspection
- Penalty for noncompliance

The development of detailed regulations requires extensive and in-depth research by the regulatory agencies to ensure the document is technically sound and feasible to implement. Because the market sizes and program histories vary widely within APEC, no specific program staffing or budget estimates can be made (Wilson et al.,

2012). Each economy needs to determine how to allocate or organize a budget so it is sufficient to cover the establishment, implementation, and enforcement of the VFEL programs.

Best practice 1-1: Establish legislation and labeling specific regulation to empower agencies to implement and enforce the program.

6.1.2. Component 2: Other fuel efficiency related policies

A number of policies have been adopted worldwide to improve vehicle fuel efficiency, including mandatory fuel efficiency standards, fiscal policies, and production requirements for manufacturers of low CO_2 emission vehicles. These policies are complementary to each other and work together with VFEL programs to create a demand pull and a supply push for higher fuel efficiency vehicles. For example, fleet average vehicle efficiency/CO_2 standards and mandatory AFV sales targets incentivize manufacturers to produce and sell more efficient vehicles or AFVs. Taxes and fiscal incentives linked to vehicle efficiency send a clear price signal to both manufacturers and consumers for favoring efficient vehicles. Fuel efficiency labeling can facilitate or even set the foundation for development of such policies as it collects vehicle fuel efficiency information upon which other policies, such as fuel efficiency standards or vehicle tax and incentives, can be based.

Even when other fuel efficiency policies are already in place, labeling programs enable other programs to function better by making it easier to link policies to vehicle efficiency level. Therefore, a comprehensive policy portfolio with a combination of labeling program and other fuel efficiency policies is more likely to improve fleet fuel efficiency.

Figure 12 summarizes the feedback from the survey participants on the relative importance of each fuel efficiency related policy instrument in enhancing VFEL programs. The responses show a general agreement on the importance of vehicle efficiency/CO_2 emissions standards, possibly due to the fact that mandatory fuel efficiency standards level the playing field and encourage all manufacturers to deploy fuel efficiency enhancing technologies. The survey also found that fiscal incentives for efficient vehicles and AFVs are also quite important, followed by fuel taxation. A higher fossil fuel tax was ranked higher in the survey than an alternative fuel subsidy and mandatory target for AFV sales, but only a few regions have adopted the last two policies.

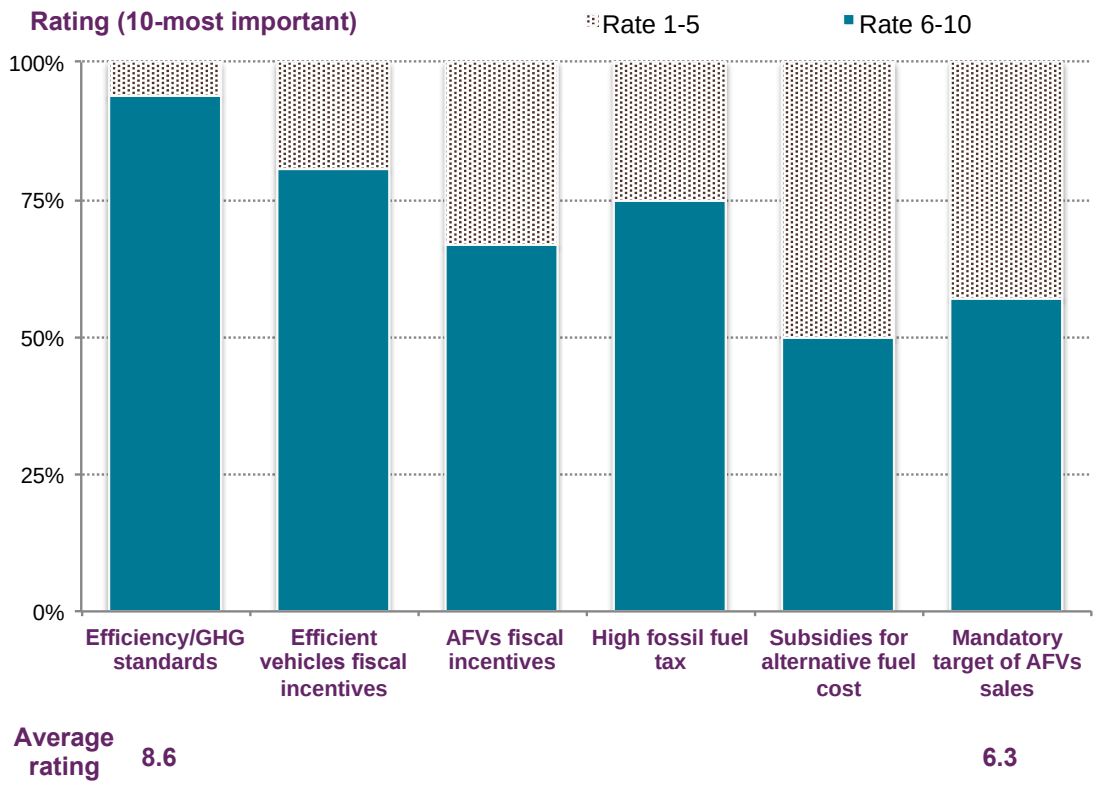


Figure 12. **Summary of respondents' ratings on the importance of supporting fuel efficiency policies in enhancing VFEL program.**

As discussed in Section 5, economies that implement VFEL programs appear more likely to have other fuel efficiency related policies. Please also refer to Figure 3 (page 33), which lists the fuel efficiency policy implementation status for different economies. Because labeling programs and other fuel efficiency policies are complementary, as a rule the more policies supporting fuel-efficient vehicles, the better the outcome a VFEL program can potentially achieve due to the positive synergy among various policies.

Best practice 1-2: Introduce complementary fuel efficiency policies such as efficiency standards and fiscal incentives linked to fuel efficiency in addition to vehicle fuel economy labeling to improve policy effectiveness.

6.2. Program design

6.2.1. Component 3: Mandatory VFEL requirement

As a general principle, a mandatory VFEL program is likely to have a larger influence than a voluntary program. The observed participation ratios of voluntary VFEL programs are generally low.

For instance, the participation rate in Canada is only 43% (Beeby, 2013) while only two OEMs publish their model information in Hong Kong, China[9]. In Brazil, only around one or two models of some OEMs participated in the labeling program in 2014 (INMETRO, 2014). However, under the Inovar-Auto program (Facanha, 2013), manufacturers have a strong incentive to participate in the labeling program fully by 2017 to avoid higher tax rates. Given the potential low participation ratio of voluntary VFEL programs, mandatory VFEL requirements for all targeted vehicles will be more effective.

A mandatory VFEL program ensures universal coverage so consumers can compare fuel efficiency information for all vehicles covered by the program during the purchase process. An economy may choose to start with a voluntary program if there are key barriers preventing mandatory coverage. A voluntary program allows for a soft introduction of the VFEL program that provides sufficient time for industry adoption while enabling regulatory agencies to gain experience and adjust policy where needed. However, a voluntary program cannot ensure that information is available for every vehicle and, as a result, may turn off consumers who cannot find information for the types of vehicles they want to purchase. Especially for VFEL programs that require fiscal related information on the label, vehicles showing lower or even negative fiscal benefit are less likely to participate in a voluntary program. Therefore, it can be useful to set a cutoff point when a voluntary VFEL program transitions to being mandatory. For example, Thailand will introduce its voluntary VFEL program in October 2015 and switch to mandatory requirements beginning in January 2016.

Best practice 2-1: Make the VFEL program mandatory to maximize program effectiveness.

6.2.2. Component 4: Broad coverage of the VFEL program

The wider the scope of a VFEL program, the more consumers the program will impact. All 18 investigated VFEL programs cover passenger vehicles. Eleven of

[9] Information retrieved from Hong Kong voluntary energy efficiency labeling program: http://www.emsd.gov.hk/cgi-bin/emsdnew/eng/pee/eels_reg_car.cgi?sortBy=make (accessed on May 21, 2015)

these also cover light truck/light commercial vehicles as they have vehicle and engine sizes that are similar to passenger cars. Only one economy, Japan, covers heavy-duty vehicles (HDV). In the survey, many economies expressed interest in applying a VFEL program to HDVs, but have found it challenging due to the diversity in the design of HDVs and lack of suitable methods for fuel efficiency testing. To monitor HDV fuel efficiency, the European Commission is developing a tool that can simulate HDV fuel efficiency across different duty cycles, and this could play a role similar to labeling.[10]

As the use of AFVs is expanding in many parts of the world, a fuel efficiency label should be able to incorporate efficiency information for such vehicles. Because alternative fuel use may be measured in different units, showing the additional information about AFVs and making them comparable with conventional gasoline or diesel vehicles is important for many consumers. Four economies – the US, Canada, Australia, and Germany – fully cover all types of fuels with relevant test procedures and calculation methodologies. For example, as a PHEV includes a charge-depleting operation (like BEVs) and charge sustaining operation (like conventional hybrid vehicles), regulatory documents have specific guidance for combining the two operations for the final information on the labels. On the other hand, some economies entirely block AFVs by restricting the VFEL program to only gasoline or diesel vehicles, which limits the compatibility of the VFEL program with AFVs.

While most VFEL programs in this report are applicable only to new vehicles, New Zealand mandates VFEL for used vehicles, while the UK and US encourage voluntary labeling on used vehicles. Providing fuel efficiency information for used cars can have a positive impact on fuel efficiency of the vehicle fleet. It provides the opportunity for consumers to shift to more efficient models even in the second-hand vehicle market. That should lead to less demand for inefficient vehicles, and may result in their being taken out of the fleet earlier. Consumers buying new vehicles may pay more attention to fuel efficiency as it may affect vehicle value when they want to sell it. Note that applying VFEL on used vehicles is particularly important to economies where a significant portion of the vehicles sold are used vehicles imported from other jurisdictions.

One survey respondent expressed interest in applying VFEL to used vehicles. Another respondent expressed interest in providing fuel efficiency/CO_2 emissions information to rental car consumers at the time of booking. Requiring fuel efficiency information on rental cars can encourage consumers to rent more efficient cars, therefore incentivizing rental car companies to buy more efficient vehicles.

[10] See more details at: Reducing CO_2 emissions from heavy-duty vehicles, http://ec.europa.eu/clima/policies/transport/vehicles/heavy/index_en.htm

In general, to maximize the impact of a VFEL program it should cover all types of fuels consumed by light-duty vehicles, and it should apply to both new and used vehicles. Policymakers should prioritize the most influential market depending on the local market status. In the longer term, with appropriate design, the program can expand from LDVs to two-wheelers and even HDVs (see Table 10).

Table 10. Recommendation of VFEL scope

	Vehicle type	Fuel type	Sale type
Recommended scope	• Passenger vehicle • Light-truck • Light commercial vehicle	• Gasoline • Diesel • CNG • LPG • Fuel cell • Electricity	• New • Used
Possible program expansion	• Two-wheeled • Heavy-duty vehicles		• Rental

Best practice 2-2: Design a program that covers all new and used light-duty vehicles with all fuel types.

6.2.3. Component 5: Understanding the market

Even though energy and environmental benefits are the main driving factors behind fuel efficiency labeling, car buyers' decisions to purchase a particular vehicle are guided by many other factors besides fuel efficiency. Overly simple or complex labels that fail to communicate relevant messages to the consumer do not achieve their intended benefits. Thus, engaging the public during the design and revision of a VFEL program is important in identifying what efficiency related information is important to consumers and how they would like to receive this type of information.

Understanding car-purchase behavior assists in the development and implementation of VFEL programs. According to EPA (2011a) and Lane and Banks (2010), conducting market research is useful to:

- Understand consumers' vehicle buying process
- Identify the importance of fuel efficiency in consumers' purchase process
- Identify elements that incentivize consumers to purchase fuel efficient vehicles
- Identify efficiency related information that can be best understood by consumers
- Identify media and communication methods that are best accepted by consumers
- Obtain feedback on proposed label design

- Increase public participation in VFEL design while raising awareness of the program
- Establish consumer behavior and attitude baselines for future effectiveness assessment

There are a variety of methods used to carry out market-based consumer research, including literature reviews, focus groups, face-to-face interviews, surveys, and expert panels. Table 11 is a general comparison of different methods of conducting consumer research. Note that there are variations even within the same method. For example, the cost effectiveness of a method will vary depending on the use of Internet, telephone, mail or email to reach consumers and obtain their feedback. It should also be noted that these methods could be used in conjunction with each other, depending on the purpose of research. For instance, a literature review and survey can help identify the vehicle buying process and general pattern of consumer behavior; expert panels can help inform the initial development of the proposed label designs; focus groups and interviews can enable an in-depth analysis of consumers' reaction to, and preference for, information.

Table 11. Characteristics of different methods of collecting consumer information

	Comprehensiveness	Depth of insight	Representation	Accuracy	Speed	Cost effectiveness
Literature review	H	M	M	M	H	H
Focus groups	M	H	M	M	M	M
Interview	M	H	L	H	M	M
Survey	H	L	H	L	H	H
Expert panel	M	H	L	M	M	M
Key: H = High; M= Medium; L = Low						

Additionally, consumer attitudes on what constitutes effective information changes over time. Therefore, market-based research is recommended not only before the creation of a VFEL program, but also during revisions of existing programs, and at regular intervals in between. For the purpose of improving existing programs, collecting information from vehicle dealers is helpful as well in order to determine the effectiveness and uptake of the labels in dealerships, the utilization and usefulness of the label at the point of sale, the level of understanding of the label among consumers, and the level of interest in fuel efficiency as part of the purchasing process.

The EPA (2011a) commented that consumer research was valuable in helping to inform the redesign of its fuel economy label in 2006. The contribution of consumer research is more substantial with greater penetration of advanced technologies and changes in consumer behavior. New Zealand, UK, and Viet Nam invest substantially in consumer surveys for the development or improvement of their VFEL programs.

Consumer behavior research provides valuable feedback on consumer purchase decisions as well as preferences regarding different vehicle fuel economy label information.

Fourteen out of 17 economies with VFEL programs have engaged the public during label design in some capacity. The average rating of the importance of public engagement during label design was 7.3 on a scale of 10, with 10 being highly important, with 70% of respondents rating public engagement at 7 and above.

Best practice 2-3: Conduct comprehensive market research and survey consumer expectations of fuel efficiency regularly.

6.2.4. Component 6: Accurate fuel efficiency/CO_2 emissions data that reflects vehicle real-world performance

Displaying labels not only provides a common basis for fuel efficiency comparisons of individual vehicle models, but also displays the vehicle efficiency performance that the consumer could expect to achieve when driving. Large discrepancies between the label and real-world efficiency may erode the label credibility. Therefore, the fuel efficiency/CO_2 emissions data on the label should preferably come from tests that simulate real-world conditions.

It is a common practice to base the fuel efficiency data on the label on vehicle type approval results. All type approval tests are conducted under a stylized test cycle and fixed operating conditions. Because traffic, road, and weather conditions, vehicle maintenance practices and individual driving habits vary widely, it is understood that the actual fuel consumption experienced by vehicle users will vary from the label fuel consumption value.

Some survey responses and recent reports share a concern about the accuracy of fuel efficiency information on labels, especially as it relates to a growing divergence between label fuel economy and real-world fuel economy. A UK study indicates that consumers had trust in the reported fuel efficiency figures to use them for comparison purposes, but did not believe their representativeness of real-world fuel economy (Esposito, 2014). Some consumers, especially those with an urban commute, reported urban fuel consumption values 20% to 50% higher than the

combined value, thus the combined fuel economy posted on the label cannot best reflect the fuel economy in real driving.

A study in China concluded that real-world fuel consumption normalized to the NEDC test cycle, which is a cycle used for type approval, is nearly 30% higher on average compared to type-approval values for gasoline vehicles (Zhang et al., 2014). The discrepancy between real-world and test cycle for type approval is also an issue to be addressed in the EU. A series of reports from Mock et al. (2012), Mock et al. (2013), and Mock, Tietge, et al. (2014) found that the average discrepancy between type-approval and on-road CO_2 emissions has increased from around 8% in 2001 to nearly 38% in 2013. New Zealand indicated in the survey the growing unease about the lack of relevance of tested figures to real-world performance.

The importance of reducing the discrepancy between label fuel economies and on-road fuel economies cannot be overstated. Many survey respondents suggested adoption of advanced or supplemental driving cycles to improve fidelity of fuel efficiency label values.

There are two basic approaches to address label accuracy:

a) Establish correlation factors between the test cycles and in-use fuel economy. The EPA has used this approach to adjust test results since 1985, for example, using a certain percentage reduction for fuel efficiency under different test cycles and more recently replacing the older 2-cycle test with the 5-cycle test by adding supplementary test cycles to capture additional driving conditions. Korea, following the US experience, has also switched from the 2-cycle test to the 5-cycle test in its label requirement.
b) Establish test cycles and procedures that better represent in-use driving conditions. This approach is extremely difficult, as trip length, soak time (time between trips), ambient temperature, wind, rain, accessory use, cargo, and road grade all have significant impacts on fuel consumption, beyond the impacts of the driving cycle itself. For example, Japan introduced a JC08 test cycle to replace the previous 10-15 test cycle. The new Japanese cycle has both cold and warm start measurements and a top speed of 82 km/h, and on average results in an 8% lower fuel economy rating. The EU is currently working within the UNECE WP29 process to develop a World Light-duty Vehicle Test Procedure (WLTP), which will replace the NEDC by 2020. Japan has also committed to adoption of the new test cycle (ICCT, 2013). The WLTP is expected to reduce the gap between test and real-world fuel consumption data, but the gap is not expected to disappear.

In either case, robust in-use fuel efficiency data is necessary to create accurate label values. A thorough investigation would require (i) a representative sample of all

vehicles on the road, and (ii) leaving the data loggers on for a full year in order to capture seasonal variation in fuel economy and owner driving behavior (TÜV NORD Mobilität, 2013; Eastern Research Group, 2013). In practice, no economy has ever done this.

Another option is to allow consumers to input their actual fuel consumption on a VFEL website or database, similar to the MyMPG option on the US website www.fueleconomy.gov. This is not as accurate as testing, because there is likely to be a user bias in the type of customer who inputs data and it only provides fuel economy for snippets of in-use driving conditions. It also does not allow for analyses of factors that influence real-world fuel economy. But the average reported fuel consumption information balances the potential bias and the data can provide accurate trends over time on how the in-use shortfall is changing.

Best practice 2-4: Collect in-use fuel consumption performance data and, via a correction factor or revised test cycle, ensure the label values align with vehicle real-world performance.

6.3. Label design and information

Vehicle labels that are affixed to vehicles are the most common method used to disclose vehicle fuel efficiency information at the point of sale. A variant of this approach is to present vehicle information on a stand in the showroom, as practiced in most EU economies. Though the labeling information and design vary across different VFEL programs, label designs usually follow five main principles:

- Accurate information on key vehicle characteristics
- Clarity and readability of content
- Sufficient information, but not an overdose
- Simple, easy to understand language
- Appropriate font size and colors

Appendix B provides an overview of all labels and summary information for each economy with a VFEL program.

Based on worldwide practices, four components affecting effective presentation of information on the labels were identified.

6.3.1. Component 7: Understandable fuel efficiency/CO_2 emissions information

Fuel efficiency/CO_2 emissions information is the main information on the VFEL label. From the summary of label information in 18 economies, the fuel consumption or fuel economy is displayed more often than CO_2 emissions (see Figure 6, page 37). Fuel consumption and CO_2 emissions are more straightforward because the non-linear nature of fuel economy is problematic when used to compare fuel economy improvement level or fuel costs (EPA, 2011b; Esposito, 2014).

No matter which value is chosen to present on the label, it is better to show values under the same test cycle. An alternative approach is to create or adopt an algorithm to convert values from various test cycles to one test cycle, so that all vehicles can be compared.

The choice between presenting fuel economy (km/l or mpg) or fuel consumption (l/100km) or CO_2 emissions (gCO_2/km) information depends on consumers' familiarity with a metric as well as the legacy regulatory context in a given economy. For example, both the US and UK have found in their studies that fuel economy was the consumers' favored metric. Some labels represent fuel consumption under different driving conditions to help consumers understand vehicle efficiency under different driving patterns, such as city (or urban), and highway (extra-urban).

In addition to presenting the absolute fuel efficiency/CO_2 emissions level, some VFEL programs include a form of fuel efficiency/CO_2 emissions rating information on the label. Vehicle efficiency ratings make it easier for consumers to understand the relative efficiency of the vehicle. When rating information is shown, it can be on either an absolute basis or a relative basis. An absolute rating compares the efficiency of a given vehicle with the entire fleet regardless of its size, class, or type, such as in Korea, New Zealand, Singapore, the US, Thailand, the Netherlands, and UK. A relative rating compares vehicles within the same type or class or displacement range, such as in Chinese Taipei, Brazil, and Germany.

Each approach has pros and cons. A labeling program showing absolute ratings will encourage consumers to purchase the vehicle with the better fuel economy regardless of the size or other classification system. But vehicles in the same class may cluster at one part of the scale as their rating can be relatively similar. Thus, a buyer may perceive little difference between those vehicles.

A class-based rating system is helpful if the consumer has already decided the class of vehicle to purchase. In such a case, the label will help the consumer in selecting the vehicle closer to the best-in-class vehicle. Some consumer studies have reported that most consumers already know what vehicle category they are looking for when they decide to buy a new vehicle. Thus, consumers prefer a comparison of vehicles within the same category (ADAC, 2005).

On the other hand, a relative class rating neglects the higher fuel consumption of larger vehicles and may encourage manufacturers to manipulate the categorization system in order to get a better efficiency rating by upsizing the vehicle to just over the category borderline. Table 12 lists the detailed advantages and disadvantages of each approach.

Table 12. Advantages and disadvantages of presentation methods of fuel economy/CO_2 emissions

	Advantages	Disadvantages
Absolute value	• Simple to implement • Avoids defining rating grade thresholds • Well linked to fiscal measures • Encourages consumers to buy efficient vehicles • Encourages downsizing and small efficiency/emission improvement • Supports manufacturers' efforts to comply with CO_2 reduction targets	• Consumers may not be familiar with the metrics • Many customers have difficulty using numbers to compare vehicles and prefer rating systems
Absolute class rating	• Simple to implement • Easy for consumers to understand • Well linked to fiscal measures • Avoids defining categories by which vehicles will be grouped • Does not allow manufacturers to manipulate the rating • Encourages consumers to buy efficient vehicles • Encourages downsizing • Supports manufacturers' efforts to comply with CO_2 reduction targets	• Inconvenient for consumer to compare vehicles in the same class, as models may have similar ratings • Erodes differences between the ratings assigned to similar vehicles, e.g., small vehicles will tend to be clustered at the high end of the scale and large vehicles will tend to have low ratings
Relative class rating	• Enables comparison of vehicles with similar characteristics • Consumers often decide first on the vehicle category and wish to compare similar vehicles • Rewards vehicles that have high efficiency, regardless of their size • Manufacturers of executive and luxury class vehicles have an incentive to improve efficiency if their vehicles do not automatically fall into the worst classes	• Difficult to develop a consistent and fair method for relative comparison • Harder for consumers to understand • Could penalize certain vehicles, e.g., small vehicles with low absolute emissions • Gives no incentive for downsizing within the overall vehicles fleet • Manufacturers could manipulate by solely increasing weight in a weight-related system, changing vehicle characteristics to achieve a better rating • May not be directly linked with fiscal measures, which are linked to absolute emissions • Difficult to implement as there is not an agreed definition for vehicle classes

Source: adapted from ADAC (2005).

Among the 18 VFEL programs investigated in this report, 17 labels present fuel efficiency or CO_2 emission information as absolute values, 11 labels present rating levels. Eight labels present an absolute rating; four labels present a relative rating. More than half of the programs present absolute value and absolute rating value at the same time (Figure 13).

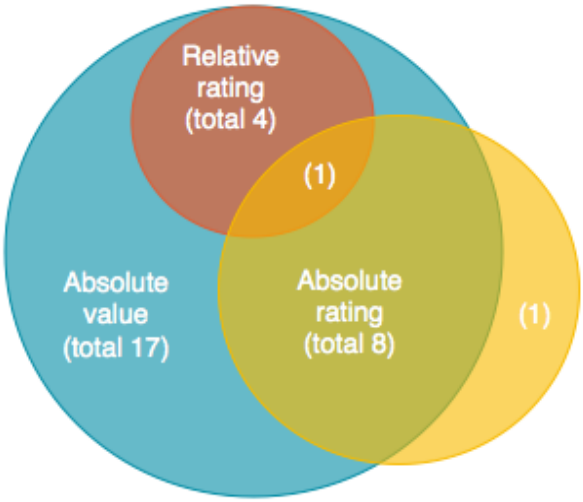


Figure 13. **Frequency of usage of absolute value and rating for fuel efficiency/CO_2 emission information[11].**

The efficiency/CO_2 emission ratings are often presented as different types of color-coded scales (Table 13). The threshold of each grade can be the absolute efficiency/CO_2 emission value (e.g., vehicles more efficient than 16 km/l are rated as grade 1 “best” in Korea) or the percentage difference compared to a reference value (e.g., vehicles emitting 37% less than the CO_2 emissions standards are rated as grade A+ “best” in Germany).

[11] Japan is the economy that shows only an absolute rating value on the label. The label is displayed only on vehicles that outperform the fuel efficiency standards.

Table 13. Types of color-coded scale

Type	Examples		Other economies
Letter scale	A to G in The Netherlands		Austria, UK, Germany, Brazil, Singapore
Numerical scale	1-5 in Korea		US, Chinese Taipei
Star scale	1-6 stars in New Zealand		

Depending on the type of rating (i.e., absolute or relative) and the thresholds of grade, a vehicle can end up with different ratings in different labeling systems. Table 14 shows the fuel efficiency rating of a 2015 Toyota Camry in various VFEL systems. The selected Toyota Camry has a 2500 cc displacement and CO_2 emissions of 134 g/km under NEDC and fuel economy of 17.8 km/l (41.9 mpg) under the US 2-cycle or 5.8 l/100km under NEDC.

In the absolute rating systems, the Toyota Camry is rated 1 (the best class) in Korea, while rated 8 out of 10 (best) in Canada and the US, and E (four levels below A, the best rating) in the UK.

In the relative rating systems, the Toyota Camry is rated the best in the class in Chinese Taipei and Brazil, while rated D (four levels below A+, the best rating) in Germany.

Whichever methodology is chosen, the regulators need to leave space for future vehicle efficiency improvements due to technological development to avoid more efficient vehicles clustering at the high end of the grading scale. Some labels show the range of efficiency/CO_2 emissions instead of clearly rating the vehicles, which avoids defining rating grade thresholds.

Table 14. 2015 Toyota Camry fuel efficiency rating in various VFEL system

Economies	Rating range	Toyota Camry Rating
Canada	CO_2 (1-10)	1 2 3 4 5 6 7 **8** 9 10 (best)
Chinese Taipei	Efficiency relative class rating (1-6)	(best) **1** 2 3 4 5 Class: 2400~3000 cc
Korea	Fuel efficiency (1-5)	(best) **1** 2 3 4 5
US	CO_2/efficiency (1-10)	1 2 3 4 5 6 7 **8** 9 10 (best)
Brazil	Fuel efficiency relative class rating (A to E)	(best) **A** B C D E (relative class) (best) A **B** C D E (absolute)
Germany	CO_2 relative class rating (A+ to G)	(best) A+ A B C **D** E F G
UK	CO_2 (A to M)	(best) A B C D **E** F G H I J K L M

In summary, there is widespread use of both absolute value and rating formats to enhance consumer understanding. The best decision on the presentation of label information including the format, metric, and rating type of fuel efficiency/CO_2 emissions information is contingent upon the conclusions of consumer research and the regulatory objective. As a default, showing the vehicle fuel efficiency/CO_2 emissions in both absolute value and comparable grade rating will help consumers best understand vehicle performance.

Best practice 3-1: Present vehicle fuel efficiency and/or CO_2 emissions in both absolute value and comparable grade rating.

6.3.2. Component 8: Indication of running cost or financial penalties/rewards

According to the survey, participants see fiscal penalties/rewards and fuel savings as important as fuel consumption (Figure 14). Linking the label to fiscal incentives was rated as the most important element in the survey to improve VFEL program effectiveness by influencing consumer purchase decisions.

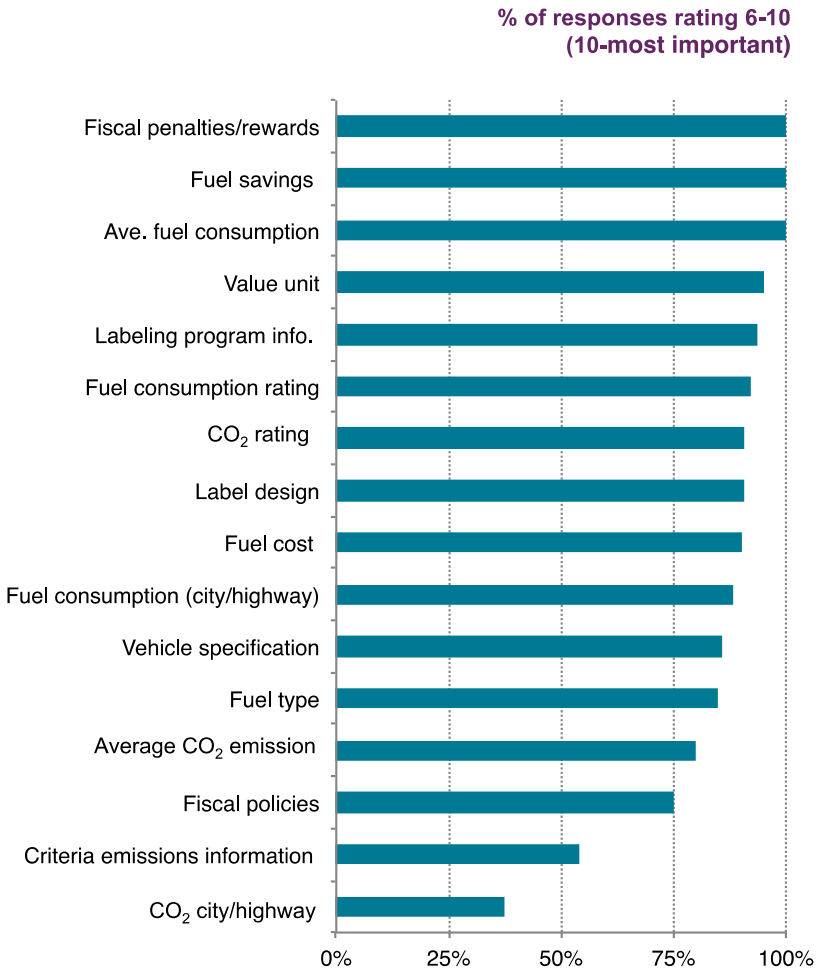


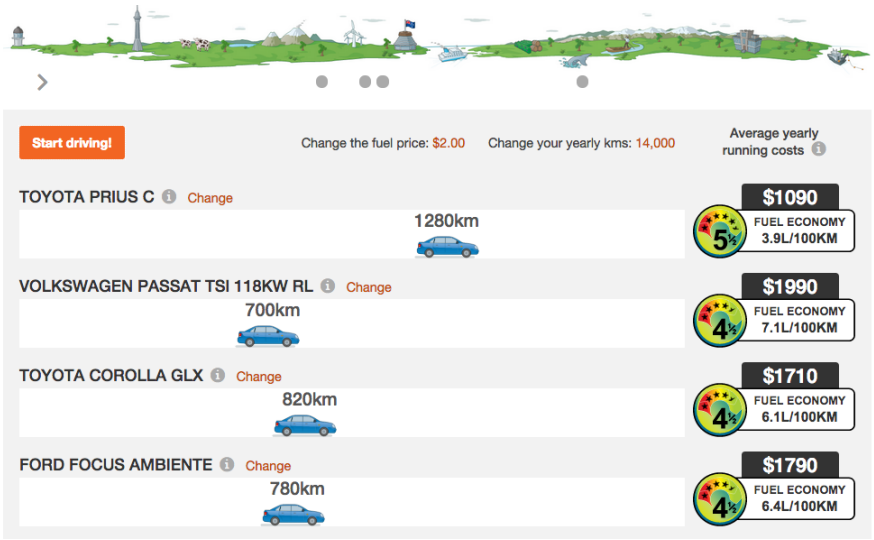
Figure 14. **Rating of the importance of elements in labeling design**

The running cost of the vehicle is one of the criteria in a consumer's purchase decision. To improve the connection between fuel efficiency and total cost of operation, presenting an estimate of refueling costs or savings has been identified as an important element to be incorporated in the label, especially for economies where fuel is relatively expensive. Refueling costs/savings are the major component of the vehicle operational costs, and highlight the monetary benefit (or cost) that a consumer will incur for buying a more (or less) efficient car.

There are several ways to present refueling cost, such as "total refueling cost," "cost savings" or "additional expenditure." Some economies, such as the US, use all three, while others use only some of them. The UK, for instance, discovered that consumers prefer to see information related to "cost savings" as opposed to "spending more" on the label as they perceive the latter negatively (Esposito, 2014). The period of calculated cost also varies across economies. Some places show cost over five years while some show only annual cost. One study suggests it

may be better to present monthly cost, which consumers are more likely to understand than a long term three-year cost (Esposito, 2014).

The presentation of refueling cost is, in general, easy for consumers to understand and comparable across different models. However, one potential issue is that the calculation of fuel cost is based on assumptions that may not reflect an individual consumer's actual usage of the car and fuel price fluctuations. This makes it important to allow consumers to find additional information beyond what is on the label and customize it to their own situations. Some economies, such as the US and New Zealand, provide a website with a fuel cost and savings calculator that enables consumers to put in annual driving mileage and fuel price to get a customized fuel cost (Figure 15).



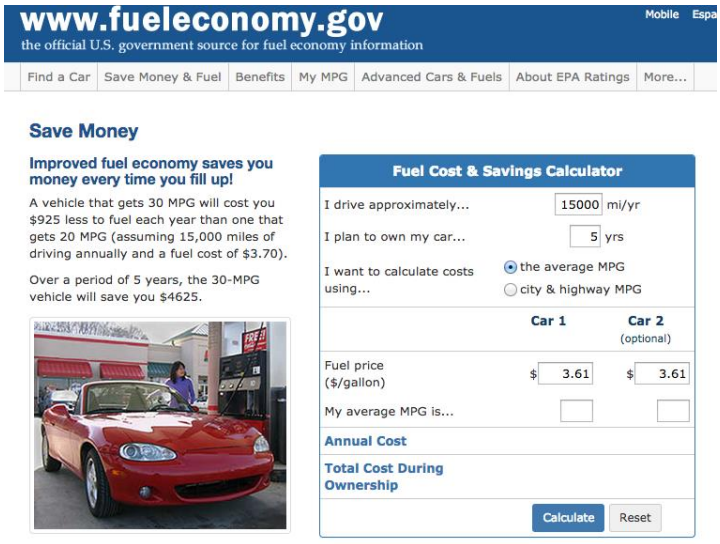


Figure 15. Snapshot of fuel cost and savings calculator on energywise.govt.nz in New Zealand (above) and fueleconomy.gov in the US (below).

If there are supporting fiscal policies that link to fuel efficiency or CO_2 emissions, presenting financial penalties/rewards will make the message more explicit. The incentive labels adopted by Japan are put on vehicles only if they are efficient enough to receive fiscal incentives. Singapore shows a color band indicating the fiscal reward or penalty applying to a vehicle depending on its CO_2 emission level (Figure 16).

As summarized under component 2 (Section 6.1.2), many economies with VFEL programs have relevant fiscal incentives to encourage fuel efficient vehicles, such as subsidies or tax reduction for efficient or alternative fuel vehicles, or high fossil fuel taxes or reduced alternative fuel prices. Showing the fiscal benefit from these policies on the label would highlight the cost advantage of efficient vehicles and thereby steer the purchase decision toward more sustainable vehicles.

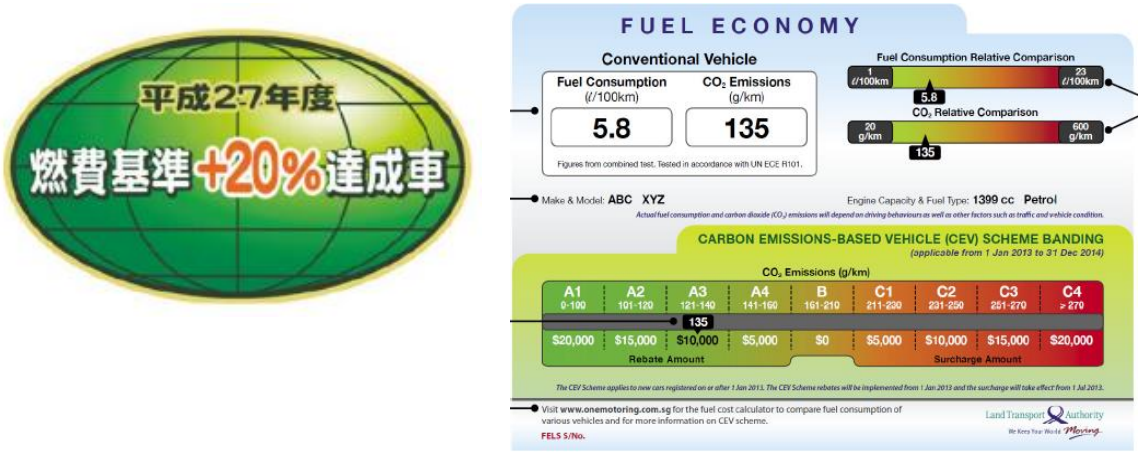


Figure 16. **Japan 2015 fiscal year fuel economy standards + 20% achieved (left) and Singapore label (right).**

Currently only six out of 17 labels in our investigation have cost-related information on the label. An EU study suggested mandating the inclusion of annual vehicle refueling cost information on the label and requiring member states to include information on relevant vehicle taxation rates on their labels (Brannigan et al., 2011).

Best practice 3-2: Link label to fiscal expense or benefit where possible by presenting running cost or fiscal information.

6.3.3. Component 9: Comparable information for AFVs

The last decade has seen growth in the diversity of fuel and powertrain options in the passenger vehicle market. The market share of AFVs including electric vehicles is presently small, but it is growing and is expected to garner a greater share in the coming decade. Due to relative unfamiliarity of AFVs, inclusion of these vehicles in a

VFEL program can help their uptake by emphasizing their potential economic and/or energy/environmental benefit compared to conventional vehicles. Thirteen of the 18 economies with VFEL programs include AFVs in their labeling program.

Figure 17 illustrates the rating results from the survey on the usefulness of including different types of information for AFVs. While the overall label design (color, font, information layout) was rated as the most important factor by 95% of survey respondents, opinion on the usefulness of other elements was quite varied. On average, more than 80% of survey respondents rate fuel consumption, fuel type, and refueling cost as important. Fuel economy information was rated more useful than information on CO_2 emissions. Refueling time/charging time and the additional running cost were rated as the least useful label information, even though AFVs may differ substantially from conventional vehicles in this respect. In addition to the elements listed on the survey, some respondents also highlighted the usefulness of conveying air pollutant emissions information for AFVs.

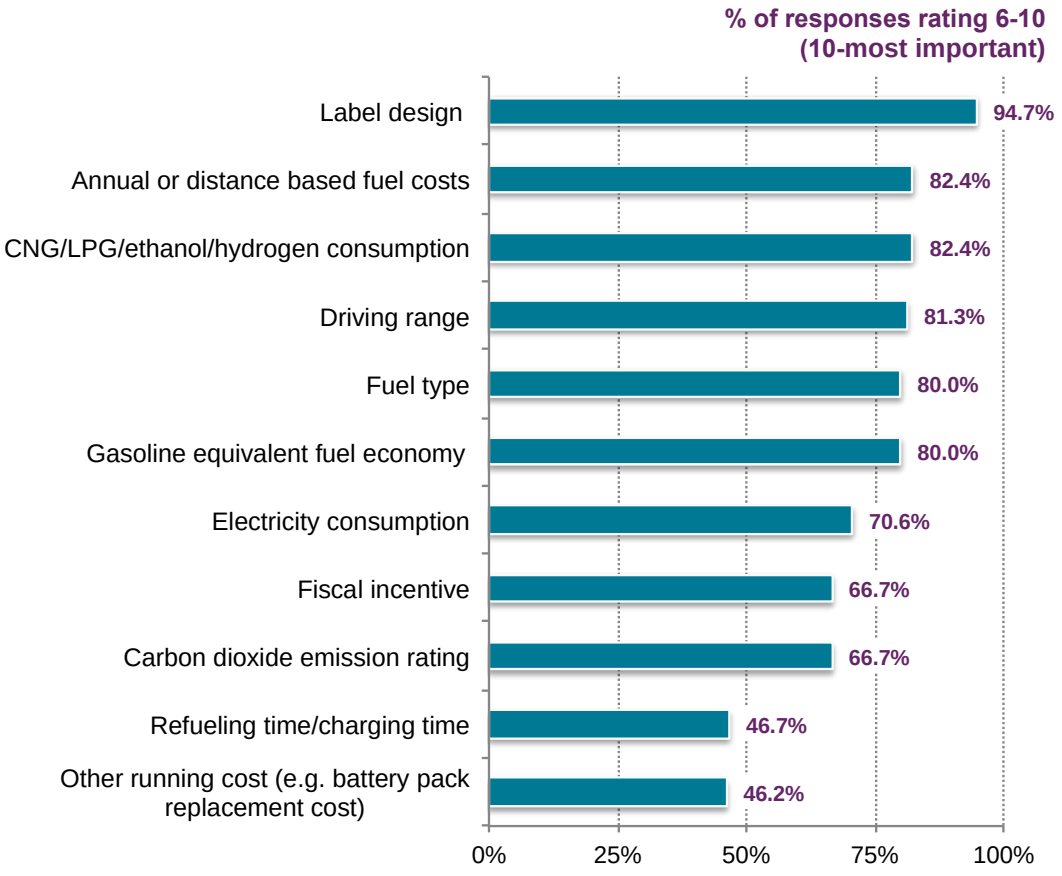


Figure 17. **Rating of the usefulness of label information for AFVs.**

A fundamental practice in AFV labeling is to present information that is comparable with conventional vehicles. Providing vehicle information that allows it to be compared with other vehicles in the model range is also helpful in highlighting the environmental or financial benefit of AFVs (Brannigan et al., 2011). The elements from Components 7 and 8 (i.e., understandable fuel efficiency/CO_2 emissions information and indication of running cost or financial penalties/rewards) are all applicable to both AFVs and conventional cars with some special considerations, including:

- Fuel efficiency/consumption equivalent
- CO_2 emissions
- Refueling cost
- Financial information

Fuel efficiency/consumption equivalent

Although different fuel sources have different characteristics, they can be converted to fuel efficiency equivalents based on energy content. For example, the US uses MPGe for all vehicles regardless of fuel type. The MPGe metric represents the number of miles the AFV can travel using a quantity of fuel with the same energy content as a gallon of gasoline. At least one study (Esposito, 2014) found that consumer unfamiliarity with newer vehicle types, such as plug-in hybrid vehicles, means they may not easily identify with the MPGe type numbers. For example, a 98 MPGe rating for a 2015 Chevrolet Volt in the US when operating solely using electric power may appear jarring to consumers not used to seeing such high fuel economy numbers. If such a concern is identified from consumer research during the development of a VFEL program, actions should be taken to help consumers to understand the underlying methods or assumptions to ensure acceptance of the numbers displayed.

In addition, there are some other energy metrics to make the fuel efficiency less fuel type dependent. However, consumers may not well understand the value. For example, Brazil uses MJ/100km as the metric for checking compliance with energy consumption requirements in its Inovar-Auto program[12] as most vehicles sold in Brazil are flexible fuel vehicles. Nevertheless, for labeling purposes, Brazil chose to use km/l because consumers are more familiar with those units.

[12] The Inovar-Auto program encourages manufacturers to improve fleet fuel consumption by providing strong tax incentives.

CO_2 emissions

The level of CO_2 emissions is straightforward and can be easily understood and compared by consumers. The advantage of CO_2 emissions is that they are easier to compare across different fuel types.

Energy consumption or CO_2 emissions displayed on vehicle labels typically refer to tank-to-wheel energy consumption. Therefore vehicles with zero tailpipe emissions, such as electric or fuel cell vehicles, have little incentive to compete on the upstream efficiency. In order to properly compare the energy and climate impacts of conventional and plug-in vehicles, it may be necessary to compare well-to-wheel emissions. A similar challenge exists when comparing flex-fuel or dual fuel vehicles with conventional vehicles. The advantages and disadvantages of both approaches are listed in Table 15. If upstream CO_2 emissions are included, then a clear system boundary and life-cycle analysis methodology must be established. A simpler alternative is to include indicative values for the carbon intensity of energy sources besides presenting the tailpipe emissions (Brannigan et al., 2011). But the effectiveness of this option depends on consumers' understanding of the concept of carbon intensity of fuels.

Table 15. Advantages and disadvantages of including life-cycle emissions on labels

	Advantage	Disadvantage
Tank-to-wheel emissions	• Easy to calculate • Comparable with conventional vehicles	• Neglects the upstream emissions (at the power plant and/or refineries) and emissions during vehicle manufacture and disposal
Well-to-wheel emissions	• Take full account of emissions, both upstream and tailpipe • Make emissions comparable across the fleet	• Greatly increases the complexity of the CO_2 calculations • System boundaries can induce errors • Adds confusion for consumers • Still does not incorporate manufacturing and disposal emissions (comprehensive life-cycle analysis is more complex than just well-to-wheel emissions)

Source: Brannigan et al., 2011.

Refueling cost

Refueling cost can help the consumer understand the trade-off between potential upfront cost of a more efficient vehicle and savings accruing over the lifetime of the vehicle. As shown in Figure 17 (page 72), survey respondents rate displaying fuel cost as second-highest. Similar to the problems identified in the label design, the calculation of refueling cost is based on many assumptions. Customized cost information could better meet consumers' desire for estimates that match their own situations.

Financial information

The presentation of financial incentives can demonstrate the benefits of choosing fuel efficient, low CO_2 emitting vehicles. Some regions provide significant subsidies in the form of tax credits or fuel subsidies to promote the uptake of AFVs. It is helpful for buyers to know if a model they are considering is eligible for any fiscal incentive that could reduce the total cost of ownership. From the survey, economies with strong fiscal incentives for the promotion of AFVs rated such policies highly important in enhancing their VFEL programs.

Best practice 3-3: Make information for alternative fuel vehicles comparable to conventional vehicles, through metrics such as gasoline equivalent fuel efficiency, CO_2 emission, running cost, and financial information.

6.3.4. Component 10: Specialized information for advanced technologies

Consumers also expressed interest in information for AFVs that is generally not applicable to conventional vehicles (EPA, 2011a; Esposito, 2014). Figure 18 shows some example labels for AFVs.

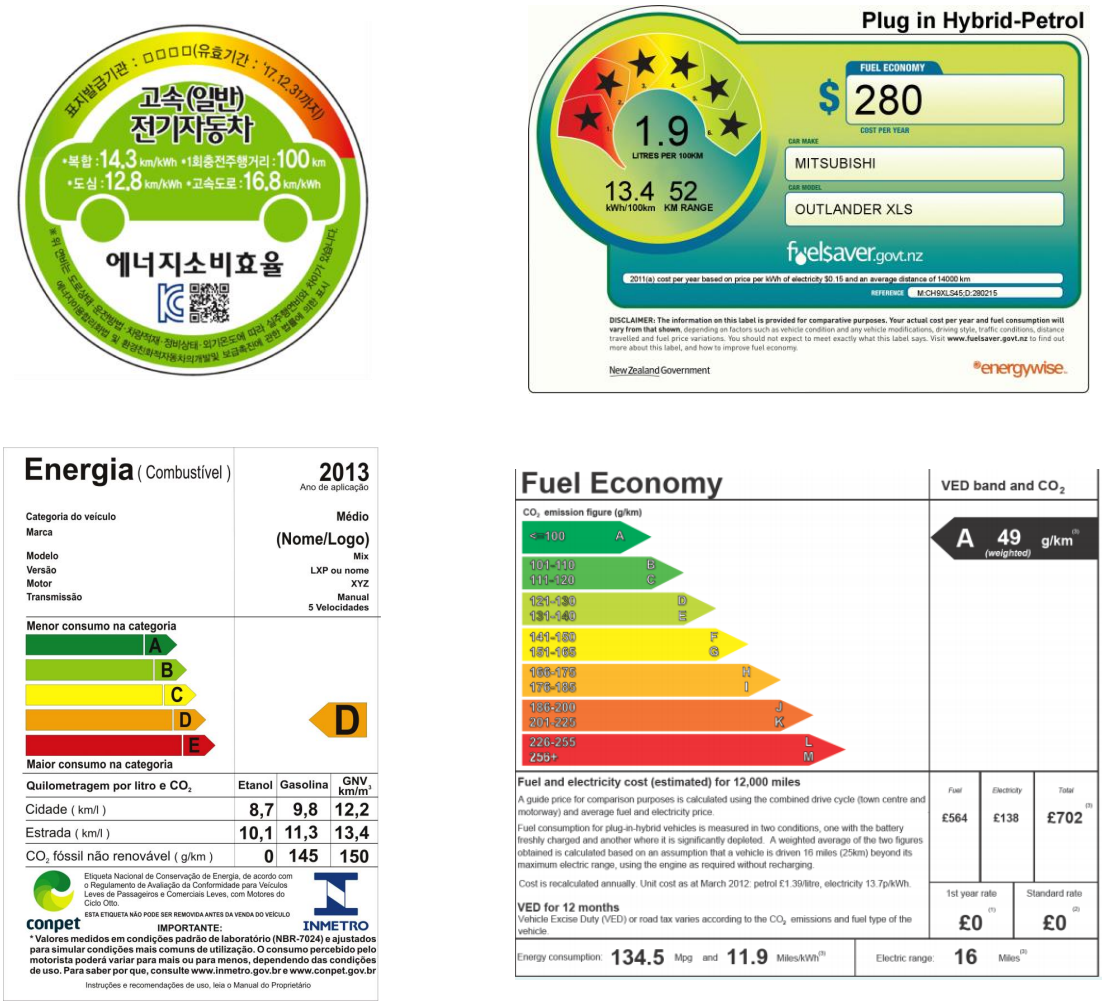


Figure 18. Example labels for alternative fuel vehicles (from top left: Korea, New Zealand, Brazil[13], UK).

Below is a list of additional data elements that are either included or are under discussion in some economies:

- Electricity consumption

Among economies presenting special label information for PHEVs and BEVs, kilowatt-hours (kWh)/100 miles or mile/kWh are common metrics used to reflect electricity consumption. The choice of metric is based on consumers' understanding of the issue. The US adopted kWh/100 miles, while the UK research found that a

[13] Tri-fuelled vehicles are available in Brazil, which can switch between CNG, ethanol and gasoline (a dual fuelled CNG vehicle which can also take ethanol instead of gasoline). The flexible fuel vehicle label from Brazil includes fuel consumption information when running on ethanol or compressed natural gas as well as gasoline.

preferred metric for electricity consumption was mile/kWh because consumers have a greater familiarity with miles per unit of energy consumed metrics (Esposito, 2014).

- Range

This element is especially applicable to all AFVs, including EVs, FCVs, and CNG vehicles. The maximum feasible travel distance between two refueling episodes can be a big concern for potential AFV customers. Range anxiety need not pertain only to electric vehicles, but also to other alternative fuels with less widespread refueling infrastructure (e.g., CNG). Note that the electric range of a plug-in electric vehicle may be compromised by use of air conditioning systems and it may be necessary to make this clear to consumers.

- Charge time

Charge time is only applicable to battery EVs, as plug-in hybrid electric vehicles can run on the engine when needed and the refueling time of other AFVs is similar or not much longer than the refueling time of gasoline and diesel. The amount of time to recharge is one of the major concerns of consumers with respect to EVs.

- Operational information for AFVs

Consumers also express an interest in knowing the location of public recharging points as well as battery durability (Esposito, 2014). These types of information are valuable for consumers but may be too detailed to show in the limited space on the label. Such information could be provided through additional material, such as the VFEL website or a mobile application.

Best practice 3-4: Provide additional information for alternative fuel vehicles to allow comparison across all relevant vehicles.

6.4. Consumer outreach

As the objective of the VFEL program is to provide information to consumers, extensive consumer outreach is essential in order to raise awareness about vehicle fuel efficiency, its impact, and how VFEL programs can assist consumers.

One study found that even though most buyers claim fuel efficiency is important to their purchase decision, only 60% of them rated VFEL as an influential information source (Ipsos New Zealand, 2014). This highlights the importance of outreach with regard to VFEL programs, because the buyer will not consider fuel economy information from the label if they are unaware of the label.

All VFEL programs require the labels to be displayed prominently on the vehicle or on a stand by the car in the showroom. This is to make sure that consumers can easily recognize the labels and use, or at least consider, the information while making the purchasing decision.

Nonetheless, the label is not the only way to provide information to consumers. Increasingly, potential buyers do their research on the Internet to help decide which vehicle to look at or test drive before stepping inside a showroom (Lane & Banks, 2010; Carroll et al., 2014). As a result, delivering information through various media is important for the success of a VFEL program. Figure 19 summarizes the relative importance of different consumer outreach approaches as rated by survey respondents.

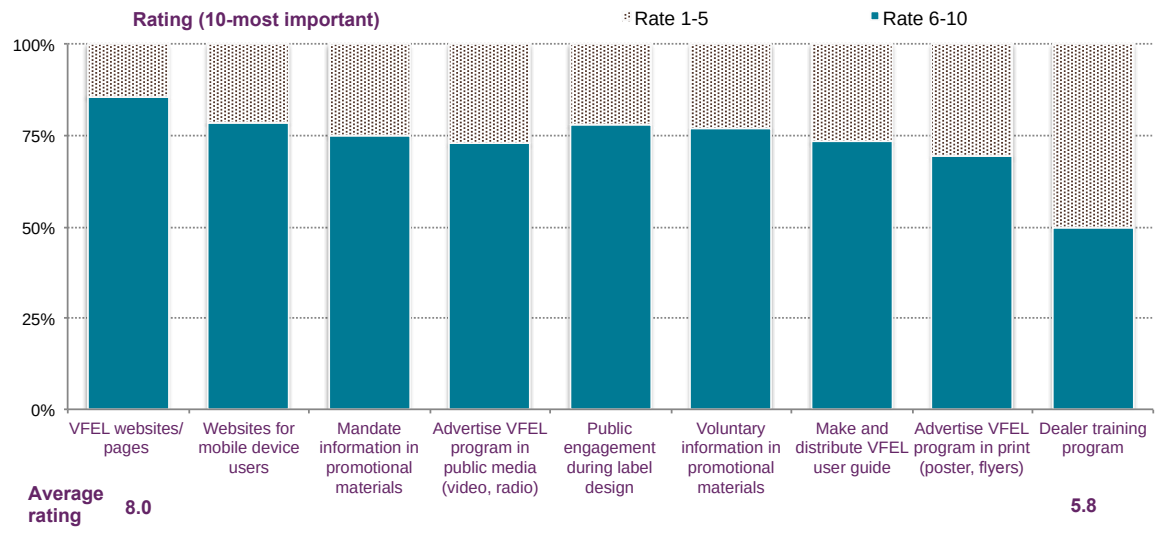


Figure 19. **Rating of the importance of consumer outreach strategy to VFEL program.**

As mobile handheld devices have become ubiquitous, a VFEL website that can be comfortably viewed on mobile as well as desktop devices should be a priority for an

effective VFEL program. Nearly 80% of survey participants rated this as the most important feature. Advertising VFEL programs through modern public media, such as video, radio and TV, received a better rating than traditional media, such as posters and flyers. One survey participant also brought up the rising role of social media in raising awareness of VFEL among potential consumers. Surprisingly, dealer training programs were not rated among the most important consumer outreach opportunities, suggesting that the opportunity to introduce information on the label at the point of sale may not be getting fully utilized.

Three components relating to the consumer outreach element are identified below:

6.4.1. Component 11: User-friendly website providing VFEL information

> "… with the easy availability of information on the Internet, it is important that digital forms of messaging be considered by regulators and promoters of fuel economy labeling programs. Smart phones and other devices are the future for these information based programs."
>
> -- A comment from the survey

A specialized VFEL website can provide all types of information related to the VFEL programs and vehicle fuel efficiency information. Because the information presented on the label is limited due to space considerations, a website enables consumers to explore more information beyond a piece of paper or sticker. Further, as discussed previously, an increasing number of consumers research vehicles on the Internet before visiting the showrooms. Therefore, providing consumers with a dedicated resource on vehicle fuel efficiency information is important.

For the purpose of this component, we define a specialized VFEL website as an official consumer facing website dedicated to providing vehicle fuel efficiency information, rather than a website that describes the regulatory structure of the VFEL program. A well designed VFEL dedicated website can:

- Provide up to date official information on vehicle fuel efficiency relevant to information that appears on the label; the website can be updated frequently with data for new type-approved vehicles.
- Go beyond the information on the label, including why fuel efficiency is important, how consumers can save money by not only choosing a more fuel efficient vehicle, but also by driving more efficiently and by maintaining their vehicle appropriately.
- Enable consumers to compare different vehicles and customize relevant label information based on their specific circumstances to determine the operating cost of the vehicle.

- Educate consumers about different vehicle technologies and explain how fuel efficiency is measured under test conditions.
- Increase public awareness of the VFEL program in general.
- Offer complimentary driving tips for drivers to improve fuel efficiency, such as efficient driving styles, appropriate tire pressure, and other factors that influence vehicle efficiency.
- Add an option for users to input their actual fuel consumption. This could help with Component 6: Accurate fuel efficiency/CO_2 emissions data that reflects vehicle real-world performance

Most of the 18 economies with VFEL make use of specialized VFEL websites (see Table 6, page 42). On one hand, a clear interface of the website is helpful to generate traffic. On the other hand, most labels provide links to the relevant website to enable consumers to find more VFEL information. A more recent approach is to provide QR codes on labels and promotional materials so that consumers can view supplementary information on their portable devices. Therefore, a website that can be viewed easily in portable devices, such as smartphones or tablets, has become an increasingly useful tool. There are six economies that have already established mobile versions of their VFEL websites (see Table 6), and Australia is developing one.

There is a great variety of information and services provided by different VFEL websites. Table 16 summarizes the main features and their functions. Some websites provide more interactive information that allows consumers to customize content to meet their needs, such as comparing information among different models, fuel cost calculations, and fiscal incentive information. These features are practical and likely to influence purchase decisions. There are other functions that websites can provide, such as providing a portal where consumers report real world fuel consumption and educating drivers about the benefits of a more efficient driving style.

Table 16. VFEL dedicated website features and function

	Features	Function
Basic information	• Fuel efficiency/VFEL introduction • Label/energy guide explanation • Specific vehicle model information	• Increase awareness and understanding of VFEL program
Customized information	• Comparison among different models • Fuel cost calculation • Fiscal incentive information	• Influence consumer purchase decision
Additional information	• Real-world fuel consumption reporting • Efficient driving suggestions	• Collect input from consumer and label information verification • Influence driving behavior

Best practice 4-1: Establish a user-friendly VFEL website providing additional services beyond the fixed information on the label.

6.4.2. Component 12: Mandatory fuel efficiency information in promotional materials through other media

The layout and application of the label is important, but other information tools are becoming increasingly more relevant. There are potential benefits of integrating the CO_2 and fuel efficiency information in formats that consumers are increasingly depending on for their car research. Several studies have identified the importance of electronic media in the car buying process. One UK study estimates that 50% to 80% of consumers carry out their car research online (Esposito, 2014). The market-based study of the EU also reflects the realities of the increasing use of electronic media (Carroll et al., 2014). Another study found that nearly 90% of consumers globally used the Internet to research vehicles in 2010 compared to 61% in 2005 (Capgemini, 2010).

Given the key role of the Internet, requiring the provision of fuel efficiency and CO_2 emission information in online promotional materials, including manufacturers' websites and major car dealership websites, can expose VFEL information to a much wider audience. As reflected in the survey responses, the Internet is seen as the most important media source. The EU is considering extending the definition of “promotional literature,” such as external electronic posters in public spaces that are visual, static, or dynamic.

Branigan, Skinner, Gibson, & Kay (2011) found that consumers do not view TV, radio, and other advertisements as important sources of information. The usefulness of a printed VFEL guidebook is disputable under the current circumstances. Eleven economies publish a consolidated VFEL guidebook, some of which are distributed at

dealerships, that provides detailed VFEL information guidance. At least three survey respondents commented that printed guidebooks are not cost-effective, and making electronic versions of the reports more easily available and accessible is likely to have a greater impact with lower cost. Table 17 summarizes different types of information channels for reaching consumers and their estimated popularity.

Table 17. Potential information channels to consumers

Type	Source
Media attracting most consumer interest	Label on car or stand in the showroom at the point of purchase Electronic posters online Printed or electronic promotional materials (e.g., newspaper, periodical magazine, catalogue)
Media attracting less consumer interest	TV Radio
Media impact diminishing	Printed VFEL guidebook

Depending on the purpose and space, the information required on promotional materials in print or online could be simplified or the same as the label requirement. Note that as the only economy that mandates label information for used vehicles, New Zealand established a system that enables vehicle fuel economy value and rating to be shown on websites where used vehicles are posted for sale (see example in Figure 5, page 35).

Best practice 4-2: Require fuel efficiency information in promotional materials through other major media, especially online sources.

6.4.3. Component 13: Direct communication channel with consumers

Collecting feedback from consumers could help to identify potential problems of program design, observe program effectiveness, and improve the program in the future. Ten of the 18 VFEL programs offer a feedback portal for consumers to submit comments. Based on survey responses, consumers usually provide their comments to overseers of VFEL programs or the responsible regulatory agency through an official website, email or phone number. Some programs respond to consumers directly through email or letter while some collect the feedback and address it internally or publish the feedback on the Internet.

Opening communication channels with consumers on the one hand can collect comments and feedback regarding the design and implementation of the VFEL program for future improvement. On the other hand, it also can field complaints that uncover issues or noncompliance. The regulatory agencies can take it as an opportunity to provide advice and guidance to consumers to better take advantage of the VFEL program while investigating potential noncompliance with the regulation.

Moreover, tracking public feedback can help to evaluate the awareness of the VFEL program among the general public.

Although many economies have claimed to have standard procedures to address consumers' comments and respond to their feedback, there is rarely any public record of the feedback and responses on the VFEL program, nor is any data on comments received available to present in this report.

Some experiences of communication with consumers are summarized from the practices across various economies:

- Provide communication channels that consumers have frequent and easy access to, including Internet customer service portal, email, toll-free phone, mail, etc.
- Establish a feedback management system that will track comments and feedback, assign a responsible department or contact to respond to consumers' comments and feedback, and notify consumers how they can expect to receive responses.
- Establish a standard procedure or guideline to investigate complaints, and if necessary, follow-up actions if noncompliance is discovered.
- Increase the transparency of communication by publishing comments received and responses from the agencies or providing information on frequent asked questions.

Using social media to increase two-way communication with consumers is another option to improve the popularity of VFEL programs among potential vehicle buyers. The US government's fueleconomy.gov website already provides links to social media, such as Facebook and Twitter, to increase public participation.

Best practice 4-3: Build two-way communication channels to collect and respond to questions and comments from consumers.

6.5. Compliance and enforcement

The compliance and enforcement of a VFEL program can be divided into two aspects: (i) whether the reported fuel efficiency data complies with the standard test procedures, and (ii) whether accurate information is provided to consumers in a conscientious manner.

6.5.1. Component 14: Audits of vehicle fuel efficiency/CO_2 emissions test data

The fuel efficiency/CO_2 emissions information is derived from type approval tests. In some economies, such as the EU, the government authority or a third party independent body conducts type approval tests of vehicles. In other economies, such as the US, the manufacturers conduct the type approval test and report the results to the government. In both cases, auditing is necessary to ensure the reliability of vehicle fuel efficiency results from type approval tests.

Government agencies should conduct confirmatory tests with either their own laboratories or through an independent contractor's laboratory. The confirmatory tests can target certain high-selling models and/or randomly select models. To ensure consistent enforcement with long-term effects, at least a predefined minimum number of samples should be chosen every year.

Twelve of the 18 economies surveyed conduct audits of fuel efficiency/CO_2 emissions type approval application data. The sample sizes vary. The US, Korea, and Brazil conduct testing for more than 15 sample models every year while the sample size of confirmatory tests in Chinese Taipei is less than five per year.

Regulators should make sure the fuel efficiency/CO_2 emissions data shown on the label or other promotional materials are tested under the same procedures and have always been sufficiently verified. For example, Viet Nam provides two options for fuel consumption information displayed on vehicle labels. One is a green label with government tested and fully certified fuel consumption, while the other is yellow displaying the information published by the manufacturers themselves. The inconsistency of data sources may reduce the credibility of a VFEL program in the long run in the absence of auditing, especially as most manufacturers choose to self-certify (VietBao, 2015; AutoVina, 2015).

The US is a good example of imposing serious penalties to increase manufacturers' noncompliance costs in case of noncompliance discovered by confirmatory testing. As implemented in the US, the regulatory agency should have the authority to mandate manufacturers recall the vehicles if they already have been sold and impose fiscal penalties depending on the impact of each case. Note that this ability to recall or impose fiscal penalties is associated with not only the confirmatory testing

discussed above, but also the other aspects of the US enforcement program, such as confirmatory coastdown testing and in-use testing.

With stringent enforcement, manufacturers are more likely to closely follow the regulations. In one of the highest profile civil cases related to vehicle fuel economy label value accuracy, automakers Hyundai and Kia agreed to pay $100 million in civil penalties for not properly following vehicle coastdown procedures, which resulted in an inflated fuel economy estimate on nearly a million cars sold in the US between 2012 and 2013. The presence of EPA audit testing was critical to discovering the violations (EPA, 2014).

Where such a strong auditing and compliance program is lacking, deviations from standardized test procedures could become a norm, and affect consumer perception of the quality of information they are receiving, as documented recently in China and the EU (He, 2014; Transportation & Environment, 2014).

Best practice 5-1: Establish mechanisms to ensure the credibility of the registered fuel efficiency value and empower agencies for enforcement.

6.5.2. Component 15: Encourage and ensure compliance of labeling requirement

In some economies, general consumer protection laws provide legal recourse to consumers against incorrect information. Nevertheless, it is usually the agencies' responsibility to encourage and ensure that fuel efficiency information on labels or other required media is being displayed in the correct manner, and that the information supplied on the label is accurate. Some agencies conduct random surveillance by visiting showrooms for label and printed materials, browsing online promotional pages, or monitoring other applicable media to find out whether fuel consumption information is available to consumers as required.

Making such inspections a regulatory requirement and setting minimum samples for random inspection can enhance the enforcement program. At present, the inspections in some economies are still random without particular frequency requirements, such as the UK, Viet Nam, China, Brazil, and Chile. Singapore and Chinese Taipei claim to have periodic inspection and visits to showrooms. New Zealand requires a minimum of 200 dealers to be visited each year across different locations in the economy and adopts compliance targets as one of the key performance indicators for its VFEL program. Canada is conducting biannual compliance studies on a representative sample of new vehicles sold in Canada.

Meanwhile, regulatory agencies can collaborate with manufacturers, dealers, and consumer associations to achieve the success of the program. Regulators can make

it easy to comply with the regulatory requirements, for example, by providing clear instruction and accessible label formats. Strong consumer associations also play a key role in monitoring compliance with VFEL requirements. This is complementary to government enforcement work. Information from these organizations or other individuals would be helpful in encouraging compliance. For example, BEUC, the European consumer association, indicated that there has been a clear lack of enforcement of the labeling requirements in member states (Carroll et al., 2014). Although the compliance ratio has increased significantly in the past decade, there remains a lot of room for improvement. The compliance ratios of information requirements in other media, such as promotional materials, are even lower.

In the case of noncompliance, the agencies should have a well developed and publicized process for ensuring that any errors are corrected, and that consumers have recourse if they received inaccurate information from manufactures or dealers. It may be necessary to have a legal challenge and/or impose fiscal penalties. Most economies have generic consumer protection laws that cover false or misleading information provided at the time of sale. But most economies do not have clear policies to penalize the violations of VFEL requirements. In Germany, the government authorities confirm whether the information required is displayed correctly, including fuel economy and emission data. If not, car traders can be fined up to 50,000 euros. However, the noncompliance penalties for promotional materials are only between 250 and 1000 euros, which is not significant enough to prevent violations (Carroll et al., 2014).

Best practice 5-2: Design monitoring and reporting systems to encourage compliance of labeling requirement and specify actions for enforcement.

6.6. Performance assessment

6.6.1. Component 16: Periodic VFEL effectiveness assessment

With a well-designed VFEL program, active consumer outreach, and strong enforcement, the overall effectiveness of VFEL programs can be assessed periodically to:

- Measure the compliance level of VFEL programs, and to identify means to enhance compliance
- Understand the consumer awareness and influence of the program in the real world. In other words, does the VFEL program alter the consumer's purchasing behavior?
- Learn lessons from the successes and challenges of existing programs, and modifying the programs accordingly
- Identify potential changes that will help improve VFEL programs overall

Different indicators have been adopted by different economies to evaluate the effectiveness of their VFEL programs. These indicators are categorized into three major methodologies: market-based research, direct data collection and analysis, and impact modeling. Table 18 summarizes the key direct and indirect measurements of VFEL effectiveness assessment and the level of difficulty of implementation. Compared to direct measurements, the indirect measurement may shed some light on the awareness or influence of the VFEL programs rather than reflecting their achievement of the program targets directly.

Table 18. Indicators of effectiveness

		Measurement of effectiveness	
		Direct	Indirect
Difficulty	Easy	• Compliance with VFEL requirements • Awareness of the VFEL program among consumers (e.g., New Zealand, Chile, UK)	• Visitor flow to the website • Consumer feedback on VFEL related issues (e.g., UK, EU, US)
	Medium	• Impact of vehicle efficiency on car buyers' purchasing behavior • Impact of label on car buyers' purchasing behavior (e.g., New Zealand, Chile, UK)	• An assessment of the gap between the fuel efficiency label values and actual in-use fuel economy
	Hard	• Fuel savings attributable to VFEL program • Improvement of new vehicle fleet fuel efficiency attributable to VFEL program (e.g., New Zealand)	• Increase of fuel efficient vehicle purchases attributable to VFEL program • Uptake of AFVs attributable to VFEL program
Note: research method		Market research	Data analysis / Modeling

Among the direct measurements, assessing consumer awareness of the labels, the importance of fuel economy in purchase decision making, and the impact of labels on car buyers' purchasing behavior are easier to investigate through market-based research that collects information from consumers and dealerships. The methods of market-based research are the same as listed under Table 11 (page 59).

As discussed previously in Section 5, it is difficult to isolate the influence of VFEL programs on fuel savings and fleet average fuel efficiency improvements from other fuel efficiency related policies, such as CO_2 standards and fuel efficiency related fiscal incentives. Thus, there are few attempts to evaluate VFEL program effectiveness using fuel savings and vehicle fleet fuel efficiency improvements. Moreover, some economies, such as the US, believe the implementation of the VFEL is more important in raising public awareness than in improving fleet fuel efficiency, which should be the main goal of fuel efficiency standards.

The indirect indicators cannot completely reflect the real outcome from any VFEL program as a whole, but the trend of these indicators can help to identify the effectiveness of some elements of the VFEL program. The easier approaches are tracking the VFEL website traffic, the number of consumer feedback/interactions, and estimating the real-world performance. VFEL programs do impact the sales of

efficient vehicles or AFVs, but it is challenging to estimate the empirical impact from VFEL programs alone.

VFEL program assessments can use a mix of various methods above. For example, effectiveness assessments in New Zealand adopted the following performance indicators:

- Percentage awareness of the VFEL/name/label/website with vehicle buyers
- Actual use of the website for comparing fuel economy between different makes and models of vehicles (compared to other commercial websites)
- Among vehicle buyers aware of the VFEL: the percentage of vehicle buyers' purchasing decisions that were influenced by the VFEL
- The rank of the importance of fuel efficiency among other purchasing criteria for vehicle buyers (e.g., price, reliability, fuel consumption, safety, brand/model, size, transmission, cost of running)

The practice of New Zealand as well as UK also indicates the importance of regular program evaluation to monitor the long-term effectiveness of VFEL program, and to summarize what works well and what doesn't. The results from assessment, especially those from market-based research, should help with the improvement of the program when necessary in the future.

Moreover, assessments from both New Zealand and the US found deviation between recent car buyers and intended car buyers, especially how they rated the importance of fuel consumption in their decision set. This survey result gap shows the necessity to find out what influenced the purchasers' actual purchase decision by picking recent buyers to get more accurate information.

Best practice 6-1: Schedule periodic assessments to monitor and report on VFEL outcomes and improve the effectiveness of VFEL programs.

7. Summary of best practice and evaluation of economies' VFEL programs

7.1. Best practices and criteria for evaluating vehicle fuel efficiency labeling programs

Below is a summary of the best practices of VFEL programs (Figure 20 below), as discussed in the previous section. It covers a variety of aspects of a VFEL program that policymakers can refer to when establishing a VFEL program from scratch or improving an existing VFEL program.

Based on Section 6, we have also identified the criteria to define to what degree an economy meets each best practice as in Table 19 below.

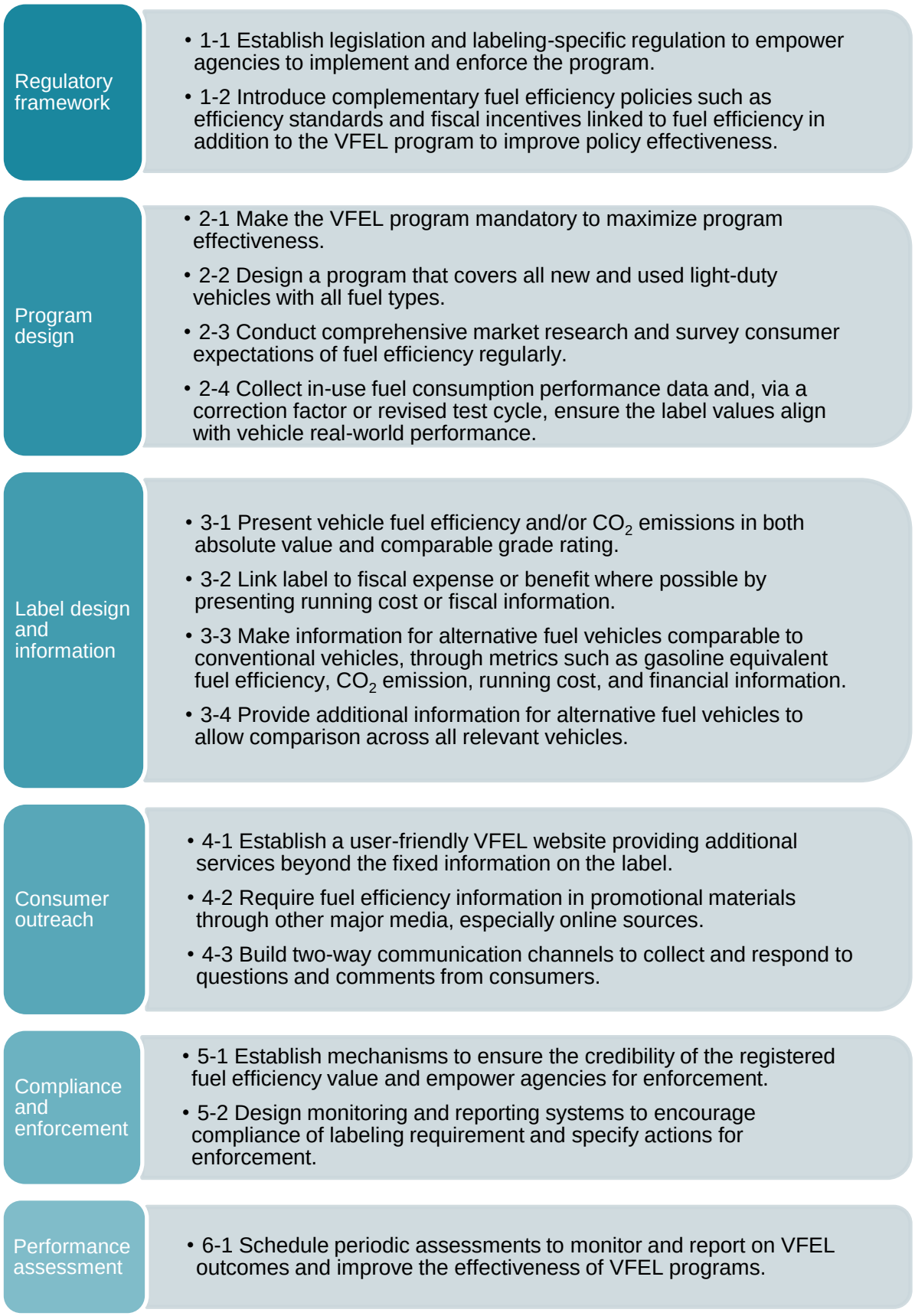


Figure 20. **Best practices of vehicle fuel efficiency labeling programs under the six key elements**

Table 19. Criteria to compare VFEL programs against best practices

Component	Follows best practice, or follows most best practices	Meets some best practices, some room for improvement	Follows few or none of the best practices, with room for improvement
1-1. Legislative/regulatory support	Clear law/regulation	Unspecific law/regulation regarding VFEL implementation and compliance details	Absence of law/regulation
1-2. Other fuel efficiency related policies	Number of other policies is more than 3	Number of other policies is 2-3	Number of other policies is less than 1
2-1. Mandatory VFEL requirement	All VFEL coverage is mandatory	Some VFEL is mandatory, some is voluntary	All VFEL coverage is voluntary
2-2. Broad coverage of the VFEL program	Coverage for all AFVs and used cars (imported and second-hand market) besides conventional vehicles	Coverage for some AFVs or used cars (imported or second-hand market) besides conventional vehicles	Coverage for new gasoline and diesel fuels only
2-3. Understanding the market	Conducted multiple market research	Conducted one market research	Didn't do market research
2-4. Accurate information that reflects vehicle real-world performance	Adjust official tested value to reflect real-world fuel efficiency	Regularly collect real-world fuel efficiency data	No action to verify or adjust label value
3-1. Understandable fuel efficiency/CO_2 emissions information	Present both absolute value and absolute/relative rating	Present both fuel efficiency and CO_2 emissions or present fuel efficiency value in two formats (e.g., different test cycle, different units)	Present only one value, either fuel efficiency or CO_2 emissions
3-2. Indication of running cost or financial penalties/rewards	Running cost or fiscal information in cost/cost saving format	Some fiscal information	No relevant fiscal information
3-3. Comparable information for AFVs	Present fuel efficiency equivalent/CO_2 emissions and cost related information	Present fuel efficiency equivalent/CO_2 emissions or cost related information only	No information
3-4. Specialized information for advanced technologies	Present two of the information characteristics: Electricity consumption/range/charge time/operation information of AFVs	Present one of the information characteristics: Electricity consumption/ range/charge time/operation information of AFVs	No information
4-1. User-friendly website providing VFEL information	More than 5 functions (Table 6)	3-4 functions	Less than 3 functions
4-2. Mandatory fuel efficiency information in other media	Required online and promotional material (Table 3)	Required on either of the sources	No requirement or only voluntary encouragement of other media
4-3. Direct communication channel with consumers	Multiple communication channels (Table 6)	At least one communication channel for consumers	No communication channel available for consumers
5-1. Audits of vehicle fuel efficiency/CO_2 emissions test	Require audit with large sample size (more than 15 vehicles) (Table 7)	Require audit, no specified sample size	No audit
5-2. Encourage and ensure label requirement compliance	Require audit with large sample size (Table 8)	Require audit, no specified frequency/sample size/penalty	No audit
6-1. Periodic VFEL effectiveness assessment	Periodic assessment	Assess at least once	No assessment

7.2. Evaluation of VFEL programs across APEC economies

Table 20 shows a summary of how different VFEL programs perform across all the components. For each component, performance is designated with coloured cells as follows:

- Green indicates that an economy follows the best practice, or follows most best practices
- Yellow indicates that an economy follows some best practices but with some room for improvement
- Red indicates that an economy follows only a few or none of the best practices, with significant room for improvement.

Note that care should be taken when considering overall program performance as some VFEL components are more important than others. For this reason, and due to differences in market conditions, some lack of comparable data, and the varying length of time VFEL programs have been in operation, no overall program ranking can be established.

Note also that the labeling program that is expected to take full effect on January 1st, 2016 in Thailand has not been evaluated, as the program has not yet commenced.

In general, all economies are doing well on at least a few components, but all economies evaluated here have potential for further improvement. The programs in three APEC economies (US, New Zealand, and Korea) and three non-APEC economy (UK, Germany, and Brazil) appear to be comprehensive with many of the key elements covered.

In broad terms, the VFEL programs in this study proved to be effective in: providing legal and regulatory support; understanding the market and consumer; mandating VFEL requirements, and presenting understandable label information.

The most common shortcomings were: the lack of effort to align label value with vehicle real-world performance; the facility to fit vehicles with advanced technologies into the parameters of the program, and regular monitoring once the programs are established.

At the APEC level, there is a lack of compatible databases to share vehicle information and a platform for economies to share experiences in VFEL development and implementation. For example, a number of economies require manufacturers or importers to report vehicle fuel efficiency and even carry out conformity tests. It could be advantageous in those cases to share relevant test data. This could help economies without sufficient vehicle fuel efficiency information or lead to better

coverage of vehicles being audited. Therefore, sharing successes and lessons learned with other economies will enable learning, offer mutual benefit, and achieve common progress in VFEL development. Areas for improved collaboration could include sharing vehicle fuel efficiency data, test methodologies, methodologies for market research, experience in compliance and enforcement, and methodologies for evaluating outcomes.

The detailed information related to the VFEL program in each economy may be limited due to the constraint of resources, but the evaluation shed some lights on the average level of implementation of VFEL programs across economies. As the program budget and staffing depend on the agency functions in one economy, including the direction of the plan and actions undertaken, there is a lack of specific guidance for budget development in this report. In general, the evaluation provides a framework that policymakers or researchers can refer to when evaluating an individual program in depth. The best practices serve as guidance for economies intending to establish a new VFEL program, or aiming to improve an existing one.

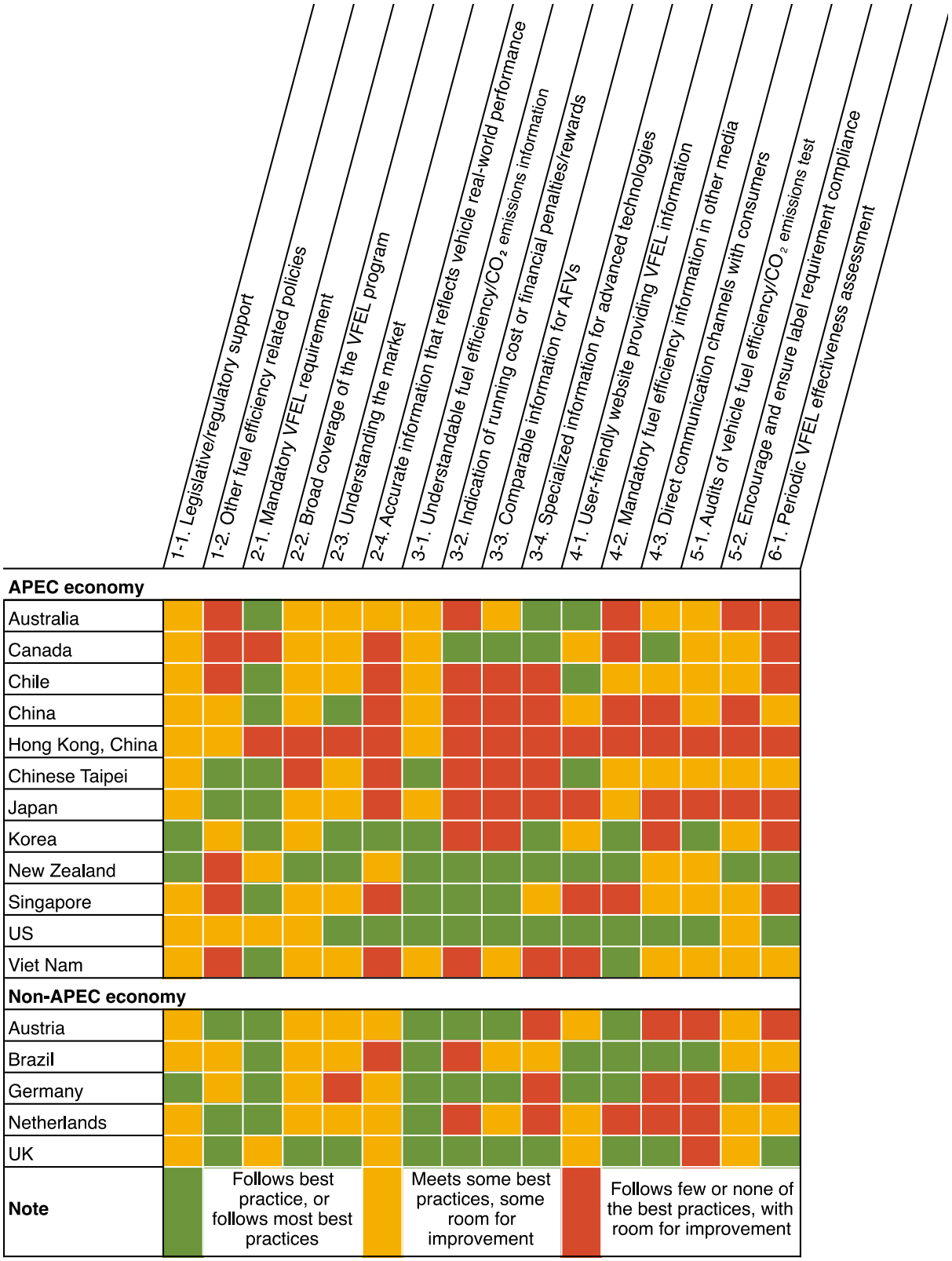


Table 20. Evaluation of VFEL programs in APEC and non-APEC economies

8. Action plan

Based on the summarized best practices and the evaluation of VFEL programs of APEC economies, this paper recommends some actions for APEC economies and the APEC Energy Working Group or other relevant working groups within APEC.

At APEC economy level

APEC economies without VFEL programs should:

- Identify and empower government agencies that should be responsible for the development and implementation of a VFEL program.
- Improve regulatory agencies' technical and management capacity to prepare for the development and introduction of a VFEL program.
- Allocate a budget for VFEL program development and implementation.
- Consult stakeholders (e.g., vehicle manufacturers and consumers) and the general public on the introduction of a VFEL program.
- Establish the legislation, if necessary, regulation, and technical specification detailing requirements of a VFEL program.
- Collect vehicle fuel efficiency related information from vehicle dealers' and manufacturers' associations, and encourage manufacturers to voluntarily disclose fuel economy information.
- Conduct relevant market research to better understand their existing fleet.
- Develop and design a VFEL program and label requirement based on suggested best practices.
- Establish a compliance and enforcement mechanism to monitor, evaluate and improve the program.
- Introduce other fuel efficiency policies, such as fuel economy/CO_2 emissions standards, vehicle tax or incentive based on fuel economy, etc., to maximize the collective impact of the all fuel efficiency policies.

APEC economies with an existing VFEL program should:

- Regularly monitor the existing VFEL program, including but not limited to staff and budget allocation, marketing activity/effectiveness (e.g., VFEL website use), and compliance status.
- Benchmark the existing VFEL program against best practices and identify opportunities for potential improvement in terms of program scope, label/information design and requirements, consumer outreach, implementation and enforcement, etc.
- Carry out regular program evaluation to ensure policymakers understand what elements of the program are/are not working properly and why.

- Revise the VFEL program as necessary and require periodic review and revision of the VFEL program.
- Develop other fuel efficiency policies, such as fuel economy/CO_2 emissions standards, vehicle tax or incentives based on fuel economy, etc., to maximize the collective impact of the all fuel efficiency policies.

At APEC level

The Energy Working Group and its sub-fora should work in cooperation with the Transportation Working Group and Subcommittee on Standards and Conformance, where relevant, to:

- Promote the establishment of an online platform and/or network of practitioners to enable ongoing information sharing on VFEL programs.
- Promote and support capacity building initiatives (e.g., workshops) to encourage region-wide adoption of best practices, particularly for economies with no current program in place.
- Promote regional coordination and share information on test procedures, methods to align results from different test cycles, test data (e.g., to create national fuel consumption databases), labeling metrics, and compliance regimes, in order to reduce barriers to trade in fuel efficient vehicles.
- Track adoption of, and progress under, VFEL programs across the APEC region annually, and provide a progress report in five years. This work could potentially be incorporated into an existing, and broader, initiative: the APEC's Peer Review on Energy Efficiency (PREE) initiative led by the Asia-Pacific Energy Research Center (APERC).

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Appendix A: Test cycles

Table 21. Descriptive information for test cycles (FTP 75, HWFET, NEDC, JC08, WLTC)

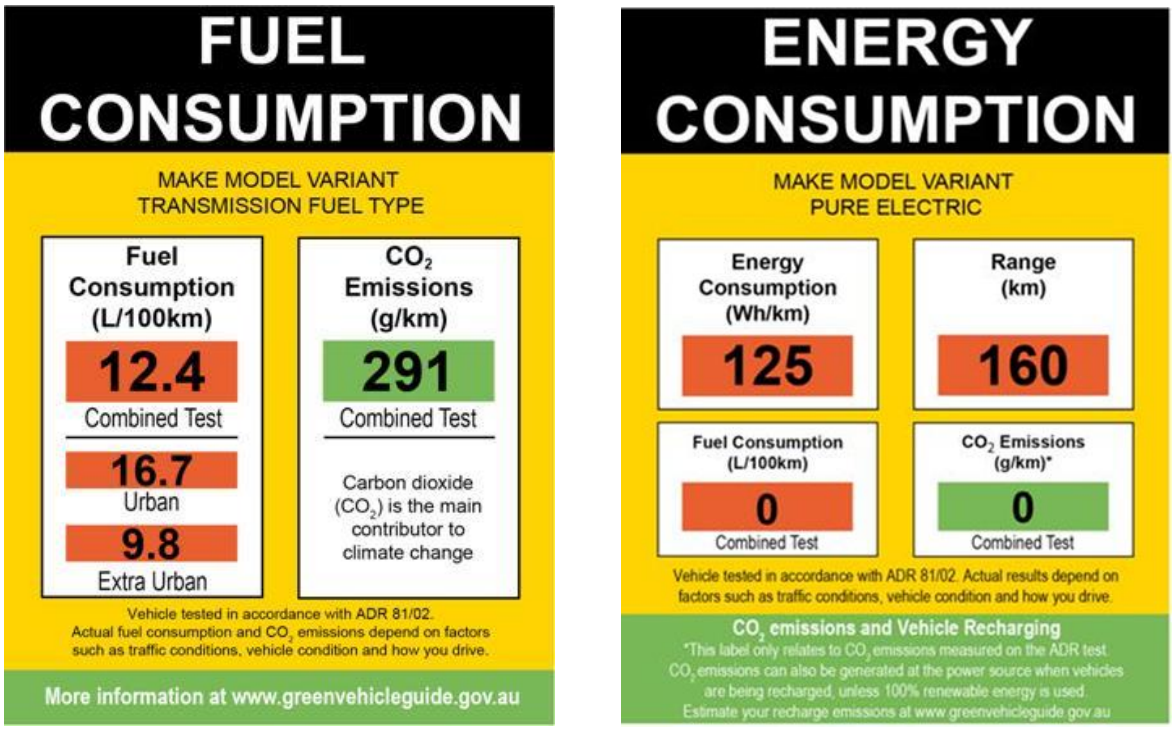
	Units	FTP75 weighted	HWFET	NEDC	JC08	WLTC
Start condition		43% cold / 57% hot	hot	cold	25% cold / 75% hot	cold
Duration	s	1369	765	1180	1204	1800
Distance	km	11.99	16.51	11.03	8.17	23.27
Mean velocity	km/h	31.5	77.7	33.6	24.4	46.5
Max. velocity	km/h	91.2	96.4	120	81.6	131.3
Stop phases		18	2	14	12	9
Durations						
Stop	s	241	4	280	346	226
Constant driving	s	109	126	475	21	66
Acceleration	s	544	338	247	432	789
Deceleration	s	475	297	178	405	719
Shares						
Stop		17.60%	0.50%	23.70%	28.70%	12.60%
Constant driving		8.00%	16.50%	40.30%	1.70%	3.70%
Acceleration		39.70%	44.20%	20.90%	35.90%	43.80%
Deceleration		34.70%	38.80%	15.10%	33.60%	39.90%
Mean positive acceleration	m/s^2	0.5	0.19	0.59	0.42	0.41
Max. positive acceleration	m/s^2	1.48	1.43	1.04	1.69	1.67
Mean positive 'vel * acc' (acceleration phases)	m^2/s^3	3.86	3.45	4.97	3.34	4.54
Mean positive 'vel * acc' (whole cycle)	m^2/s^3	1.53	1.52	1.04	1.2	1.99
Max. positive 'vel * acc'	m^2/s^3	19.19	15.17	9.22	11.6	21.01
Mean deceleration	m/s^2	-0.58	-0.22	-0.82	-0.45	-0.45
Min. deceleration	m/s^2	-1.48	-1.48	-1.39	-1.19	-1.5
1. The US 2-cycle testing includes the Federal test procedure (FTP) and the highway fuel economy dynamometer procedure (HWFET)						
2. The US 5-cycle means the FTP75, HwFET, US06, SC03 and cold temperature FTP tests (UDDS)						
3. NEDC is interchangeable with UN ECE R101						

Table 22. Descriptive information for test cycles (US06, SC03, FTP cold)

	Units	US06	SC03	UDDS (FTP cold)
Start condition		hot	hot	cold
Duration	s	596	596	1369
Distance	km	12.8	5.8	12.07
Mean velocity	km/h	77.9	34.8	31.5
Max. velocity	km/h	129.2	88.2	91.25

Appendix B: Economy VFEL program factsheet

Australia



(a) (b)

Figure 21. (a) Fuel consumption label for conventional vehicles; (b) Energy consumption label for BEVs and PHEVs.

VFEL program	
Introduced year	2001
Latest update	2008
Regulation type	Mandatory
Applicable vehicle	Passenger car, light truck
Legal framework	Motor Vehicle Standards Act 1989
Administrative agency	Department of Infrastructure and Regional Development
Main label information	• Fuel economy value (l/100km) • CO_2 emissions value (g/km)
Test cycle	NEDC (interchangeable with UN ECE R101)

Alternative fuel vehicle	
Applicable vehicle	BEV, PHEV, LPG, CNG
Main label information	• Energy consumption (Wh/km) (BEV/PHEV only) • Estimated range when fully charged (km) (BEV/PHEV only) • Fuel consumption value (l/100km) • CO_2 emissions value (g/km)
Note	Battery electric and plug-in hybrid vehicles have Energy Consumption label in place of the Fuel Consumption Label applied to conventional vehicles and LPG/CNG vehicles

Consumer information	
Webpage	www.greenvehicleguide.gov.au
Webpage feature	• Label/energy guide explanation • Specific vehicle model information • Comparison among different models • Fuel cost calculation • Fiscal incentive information
Label/fuel efficiency information display	Label affixed to the vehicle model, at the point of sale and can be removed after the purchase
Consumer outreach	Allow consumer comments through website
Note	Lightweight car, hybrid, and electric vehicles are excluded from the scope of fuel economy grade

Compliance and enforcement	
Verification of fuel economy value	Competent authority will assess manufacturers' auditing procedure to ensure conformity of vehicle type approval CO_2 emissions. Authority will test three samples if it is not satisfied with manufacturer's auditing procedure.
Monitor label/information display	N/A

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs

Canada

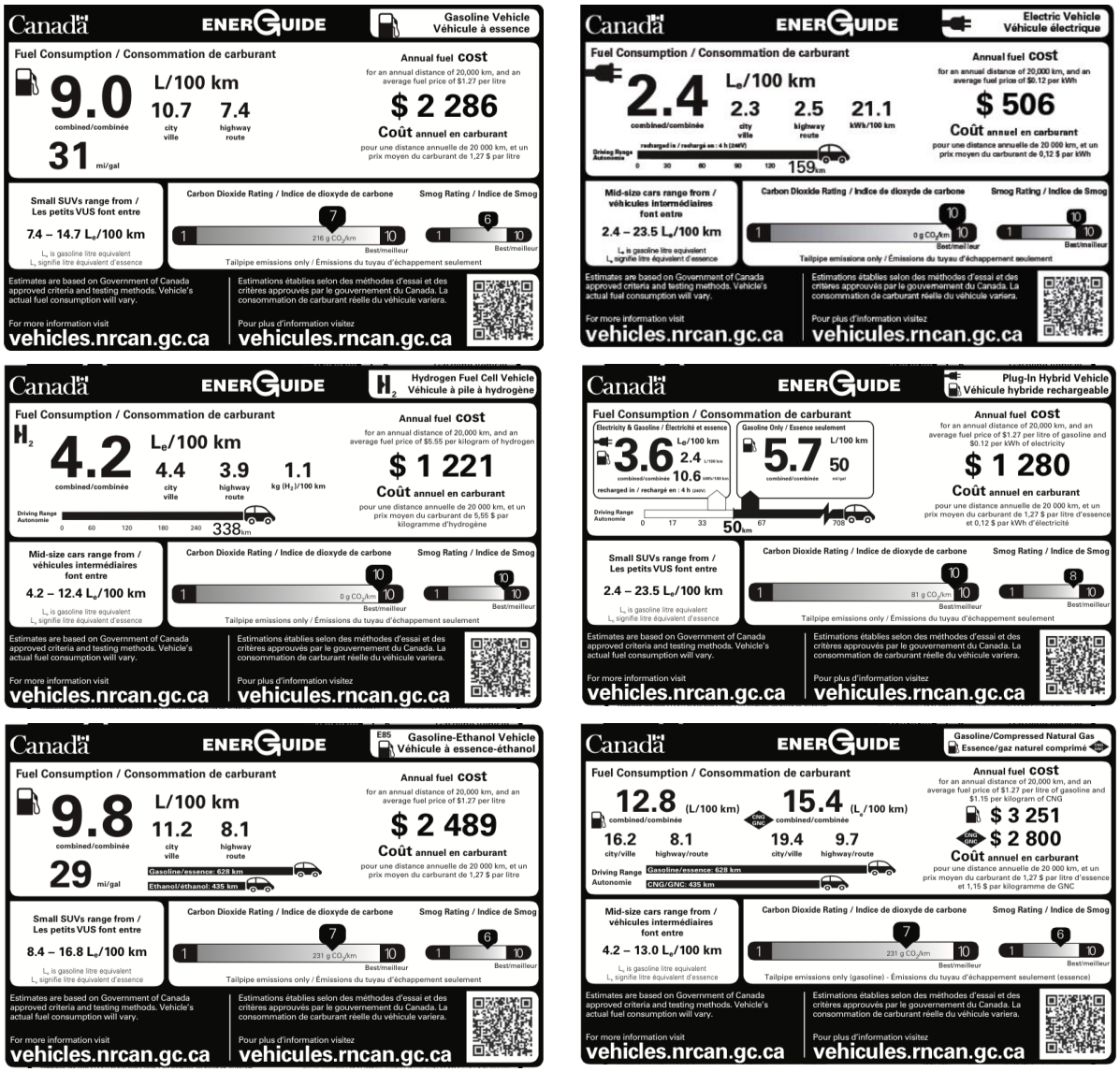


Figure 22. New EnerGuide label for vehicles (will be used beginning in 2016).

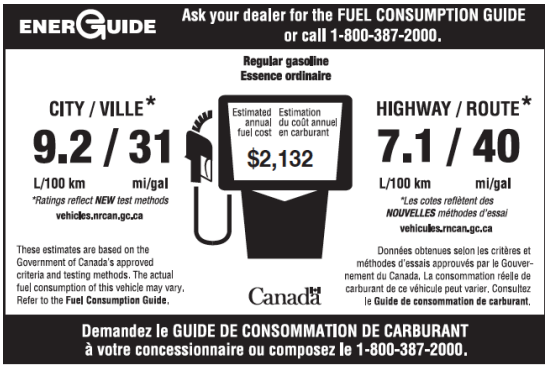


Figure 23. Old EnerGuide Label for vehicles (used before 2016).

VFEL program	
Introduced year	1999
Regulation type	Voluntary
Applicable vehicle	Passenger car, light truck, medium duty
Legal framework	The Energy Efficiency Act
Administrative agency	Natural Resource Canada
Main label information	• Vehicle fuel economy of same class (liter equivalent/100 km) • Fuel economy (l/100km, mi/gallon) • Estimated annual fuel cost (Canadian Dollar) • CO_2 absolute value and rating (g/km, 1-10 numerical rating) • Smog rating (1-10 numerical rating)
Test cycle	US 5-cycle
Note	• Beginning with 2016 model year vehicles, a redesigned EnerGuide label will be affixed to new light-duty vehicles. • The information in this table is based on new labels for 2016

Alternative fuel vehicle	
Applicable vehicle	BEV, PHEV (Blended & Series), fuel cell, CNG, flex-fuel, dual fuel (gasoline/CNG)
Main label information	• Energy consumption (kWh/100km) (BEV/PHEV only) • Estimated range when fully charged (km) (BEV/PHEV only) • Fuel consumption value (l/100km)

Consumer information	
Webpage	http://www.nrcan.gc.ca/energy/transportation/personal/7469
Webpage feature	• Label/energy guide explanation • Specific vehicle model information • Fuel cost calculation • Efficient driving suggestions • Mobile user friendly
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Fuel efficiency information in the showroom
Consumer outreach	Allow consumer comments through website/letter/telephone

Compliance and enforcement	
Verification of fuel economy value	Canada makes use of the extensive compliance program in the United States
Monitor label/information display	Compliance study, biannual, representative sample of new vehicles

Supporting fuel efficiency related policies:

- Vehicle efficiency/CO_2 standards

Chile

Figure 24. Fuel economy label for Chile.

VFEL program	
Introduced year	2013
Regulation type	Mandatory
Applicable vehicle	Passenger car
Publication agency	Ministry of Energy; Ministry of Transport; Ministry of Environment
Consumer outreach agency	Ministry of Energy - Chilean Energy Efficiency Agency
Label information verification agency	Centro de Control y Certificación Vehicular (3CV)
Main label information	• Fuel economy (km/l) • CO_2 emissions (g/km)
Test cycle	NEDC
Note	Chile is the only economy with emissions standards (for conventional pollutants) displayed on the label

Alternative fuel vehicle	
Applicable vehicle	PHEV
Main label information	Same label design with same information requirements

Consumer information	
Webpage	http://www.consumovehicular.cl/
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Specific vehicle model information • Comparison among different models • Fuel cost calculation • Efficient driving suggestions • Mobile user friendly
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Label stand at the showroom, in promotional materials about the vehicle
Consumer outreach	Allow consumer comments through website

Compliance and enforcement	
Verification of fuel economy value	N/A
Monitor label/information display	Observation at the point of sale, frequency unspecified

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs

China

Figure 25. Fuel economy label for China.

VFEL program	
Introduced year	2009
Regulation type	Mandatory
Applicable vehicle	Passenger car, light commercial vehicle
Publication agency	Ministry of Industry and Information Technology (MIIT)
Verification agency	China Automotive and Technology Research Center
Main label information	• Fuel economy value (l/100km) • Fuel type • Fuel economy standard target value of the model
Test cycle	NEDC
Note	An online tool is available for looking up fuel efficiency labels for specific cars for sale in China

Alternative fuel vehicle	
Applicable vehicle	PHEV
Main label information	Same label design with same information requirements

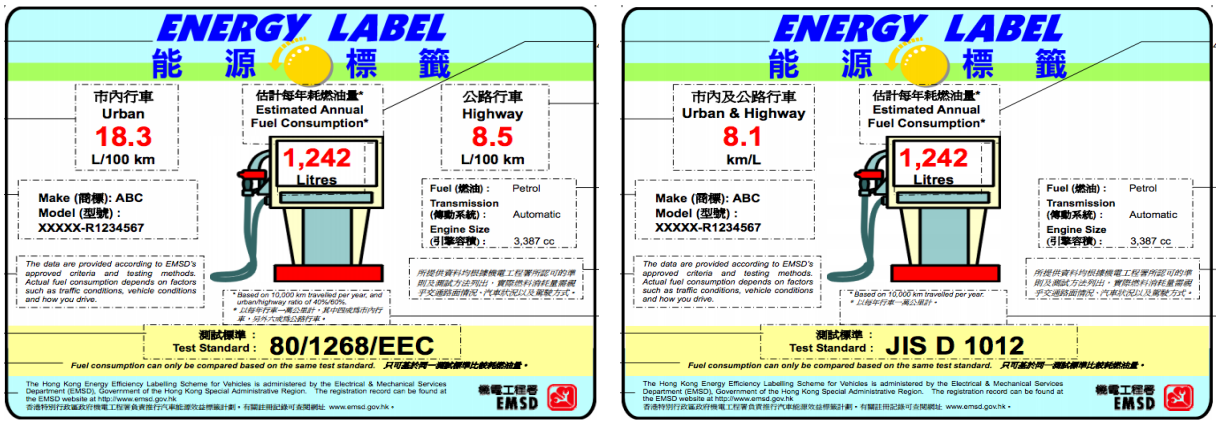
Consumer information	
Webpage	http://chinaafc.miit.gov.cn/
Webpage feature	• Fuel efficiency/VFEL program introduction • Specific vehicle model information • Fiscal incentive information • Efficient driving suggestion
Label/fuel efficiency information display	At the point of sale, affixed to the vehicle model, can be removed after the purchase

Compliance and enforcement	
Verification of fuel economy value	Random check by MIIT
Monitor label/information display	N/A

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards

Hong Kong, China



(a) (b)

Figure 26. Fuel economy label for Hong Kong, China – (a) European Standard; (b) Japanese Standard.

VFEL program	
Introduced year	2002
Regulation type	Voluntary
Applicable vehicle	Passenger car
Publication agency	Electrical and Mechanical Services Department (EMSD)
Main label information	• Fuel economy value (l/100km) • Estimated annual fuel consumption (liters) • Test standards
Test cycle	Japan 10-15 mode; NEDC; US Combined
Note	• Currently no label available for alternative fueled vehicles • Slightly different label design for vehicle under European and US standard • The participation in the voluntary program is low

Consumer information	
Webpage	http://www.emsd.gov.hk/cgi-bin/emsdnew/eng/pee/eels_reg_car.cgi?sortBy=num
Webpage feature	Specific vehicle model information
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Label stand at the showroom

Compliance and enforcement	
Monitor label/information display	N/A

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- High fossil fuel tax

Chinese Taipei

Figure 27. Vehicle fuel economy label for Chinese Taipei.

VFEL program	
Introduced year	2010
Regulation type	Mandatory
Applicable vehicle	Passenger car, light truck
Legal framework	Energy Administration Act
Administrative agency	Industrial Technology Research Institute
Main label information	• Estimated annual fuel consumption (liters) • Fuel consumption rating by class (numerical rating 1-5) • Fuel consumption value (km/L) • Website information
Test cycle	• US 2-cycle or NEDC (before 2016) • NEDC (after 2016)

Consumer information	
Webpage	http://web3.moeaboe.gov.tw/ECW/populace/content/wfrmStatistics.aspx?type=5&menu_id=1303
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Specific vehicle model information • Comparison among different models • Fiscal incentive information
Consumer outreach	Allow consumer comments through website
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Label stand at the showroom, in promotional materials about the vehicle

Compliance and enforcement	
Verification of fuel economy value	Test whether the vehicle could meet 92% of the energy efficient label listed values (less than 5 models a year)
Monitor label/information display	N/A

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards

Japan

(a) (b)

Figure 28. **Incentive labels for Japan – (a) 2015 fiscal year fuel economy standards achieved; (b) 2015 fiscal year fuel economy standards + 20% achieved).**

VFEL program	
Introduced year	2000
Regulation type	Mandatory
Applicable vehicle	Passenger car, light commercial vehicle, heavy duty vehicles (trucks and buses)
Legal framework	Act Concerning the Rational Use of Energy
Administrative agency	Ministry of Land, Infrastructure, Transport and Tourism (MLIT)
Main label information	Achievement of fuel consumption standards
Test cycle	Japan JC08

Alternative fuel vehicle	
Applicable Vehicle	LPG
Main Label Information	Same label design with same information requirement

Consumer information	
Webpage	http://www.mlit.go.jp/jidosha/jidosha_fr10_000013.html
Webpage feature	• Specific vehicle model information • Fiscal incentive information
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Label stand at the showroom • Online vehicle information for Internet sales

Compliance and enforcement	
Verification of fuel economy value	Verification of Conformity process
Monitor label/information display	N/A

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards
- High fossil fuel tax
- Mandatory AFV sale targets

Korea

Figure 29. Korean fuel efficiency label for conventional vehicles.

Figure 30. Korean fuel efficiency label for other AFVs.

Figure 31. Korean fuel efficiency label for EVs.

GRADE	1	2	3	4	5
~2011 (FTP-75)	≥15	14.9~12.8	12.7~10.6	10.5~8.4	≤8.3
2012~ (US Combined Mode adjusted)	≥16	15.9~13.8	13.7~11.6	11.5~9.4	≤9.3
Label					

Figure 32. Label format (conventional vehicles) under different grades (values in km/l).

VFEL program	
Introduced year	1992
Latest update	2015
Regulation type	Mandatory
Applicable vehicle	Passenger car, light truck and minivan
Legal framework	Rational Energy Utilization Act
Regulation agency	Ministry of Trade, Industry and Energy
Implementation agency	Korea Energy Management Corporation
Main label information	• Fuel economy grade (numerical rating 1-5) • Fuel economy value (km/l) • CO_2 emissions value (g/km)
Test cycle	US 5-cycle
Note	Lightweight cars, hybrid, and electric vehicles are excluded from the scope of fuel economy grade

Alternative fuel vehicle	
Applicable vehicle	BEV, LPG, Bi-fuel
Main label information	• Fuel type • City/Highway electricity efficiency (km/kWh) • Electricity drive range (km) • City/Highway fuel cell efficiency (km/kg)
Note	• LPG vehicle efficiency is converted to km/l with same label as general vehicles • PHEV fuel efficiency has two fuel efficiency values, electricity fuel efficiency and gasoline fuel efficiency

Consumer information	
Webpage	http://bpms.kemco.or.kr/transport_2012/main/
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Specific vehicle model information • Fuel cost calculation • Mobile user friendly
Label/fuel efficiency information display	• Label affixed on window glass at the point of sale and permanently • Fuel efficiency information in the showroom, website, and promotion materials

Compliance and enforcement	
Verification of label information	Audits fuel efficiency test of more than 15 samples every year
Monitor label/information display	Visit showroom, inspect information online and in promotional materials

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards

New Zealand

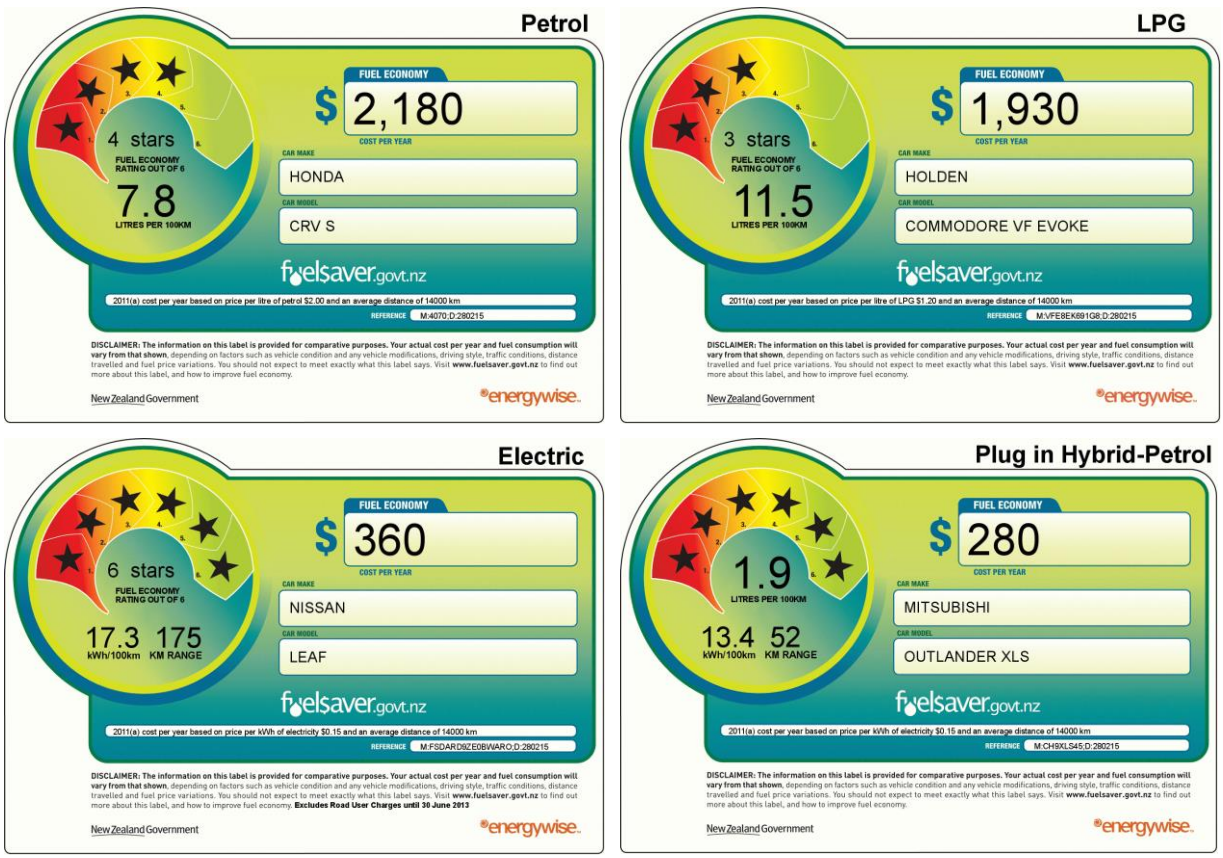


Figure 33. **Fuel economy labels for new vehicles in New Zealand (including petrol, LPG, electric and plug in hybrid electric vehicles).**

Figure 34. **Fuel economy labels for used vehicles imported from overseas (e.g., Japan).**

Figure 35. **Fuel economy labels for used vehicles previously sold new in New Zealand.**

VFEL program	
Introduced year	2008
Regulation type	Mandatory for new and used light vehicles; Voluntary for electric light vehicles
Applicable vehicle	Passenger car, light truck, light commercial vehicle; used light vehicle
Legal framework	• Energy Efficiency and Conservation Act 2001 • Energy Efficiency (Vehicle Fuel Economy Labeling) Regulations 2007
Administrative agency	Energy Efficiency and Conservation Authority (EECA)
Main label information	• Fuel economy rating (½-6 stars, interval: ½ star) • Estimated annual fuel cost (NZD) • Fuel consumption (l/100km)
Test cycle	• US city cycle, US 2-cycle, US 5-cycle • NEDC • Japan 10-15 mode, JC08 mode
Note	New Zealand accepts vehicles built to standards in four jurisdictions (US, EU, JAPAN, Australia).

Alternative fuel vehicle	
Applicable vehicle	BEV, PHEV, LPG
Main Features	Fuel economy (kWh/100 km) Driving range (km)

Consumer information	
Webpage	• https://www.energywise.govt.nz/energy-labels/vehicle-fuel-economy-labels/ • https://www.eeca.govt.nz/content/vehicle-fuel-economy-labels
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Specific vehicle model information • Comparison among different models • Fuel cost calculation • Fiscal incentive information • Efficient driving suggestion • Mobile user friendly
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model and shown on website • Fuel efficiency information in the showroom and promotion materials (voluntary)

Compliance and enforcement	
Verification of label information	• Only has audits for new vehicles; verification for others relies on international checking. • EECA compares its database with international databases to ensure alignment on fuel consumption figures
Monitor label/information display	• Minimum 200 dealers are visited each year, generally carrying out inspections somewhere in the economy each month • Compliance targets are also Key Performance Indicators for EECA

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs

Singapore

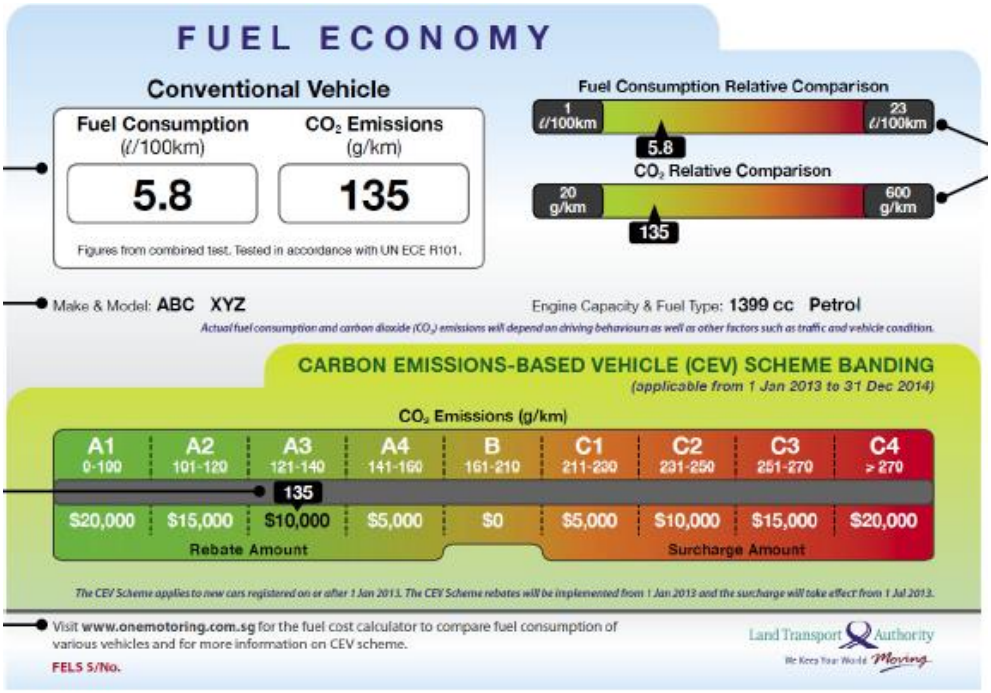


Figure 36. **Vehicle fuel economy labels in Singapore.**

VFEL program	
Introduced year	2012
Regulation type	Mandatory
Applicable vehicle	Passenger car, light commercial vehicles
Legal framework	Energy Conservation Act
Administrative agency	Land Transport Authority
Main label information	• Fuel consumption (l/100km) • CO_2 emissions value (g/km) • CO_2 emissions grade • CO_2 emissions base rebate/surcharge
Test cycle	NEDC

Alternative fuel vehicle	
Applicable vehicle	BEV
Main label information	Same label design with same information requirement

Consumer information	
Webpage	http://www.onemotoring.com.sg/publish/onemotoring/en/lta_information_guidelines/buy_a_new_vehicle/fuel_economy_.html
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation
Label/fuel efficiency information display	At the point of sale, affixed to the vehicle model, can be removed after the purchase.
Consumer outreach	Allow consumer comments through website

Compliance and enforcement	
Verification of label information	Test reports from accredited independent test laboratories
Monitor label/information display	Checks are conducted periodically by visiting the various showrooms, annual, sample size unspecified

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs

Thailand

Figure 37. Vehicle fuel efficiency label for Thailand.

VFEL program	
Introduced year	2016
Regulation type	Mandatory
Applicable vehicle	Passenger car, light trucks
Administrative agency	Ministry of Finance, Ministry of Industry
Main label information	• Manufacture/Vehicle data • Fuel economy value (l/100km) • CO_2 emissions value (g/km) • Test cycle/standard
Test cycle	N/A

Alternative fuel vehicle	
Applicable vehicle	PHEV, E85
Main information	Same design with same information requirements

Consumer information	
Webpage	http://www.car.go.th/Home
Label/fuel efficiency information display	• On vehicle at point of sale

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs

United States

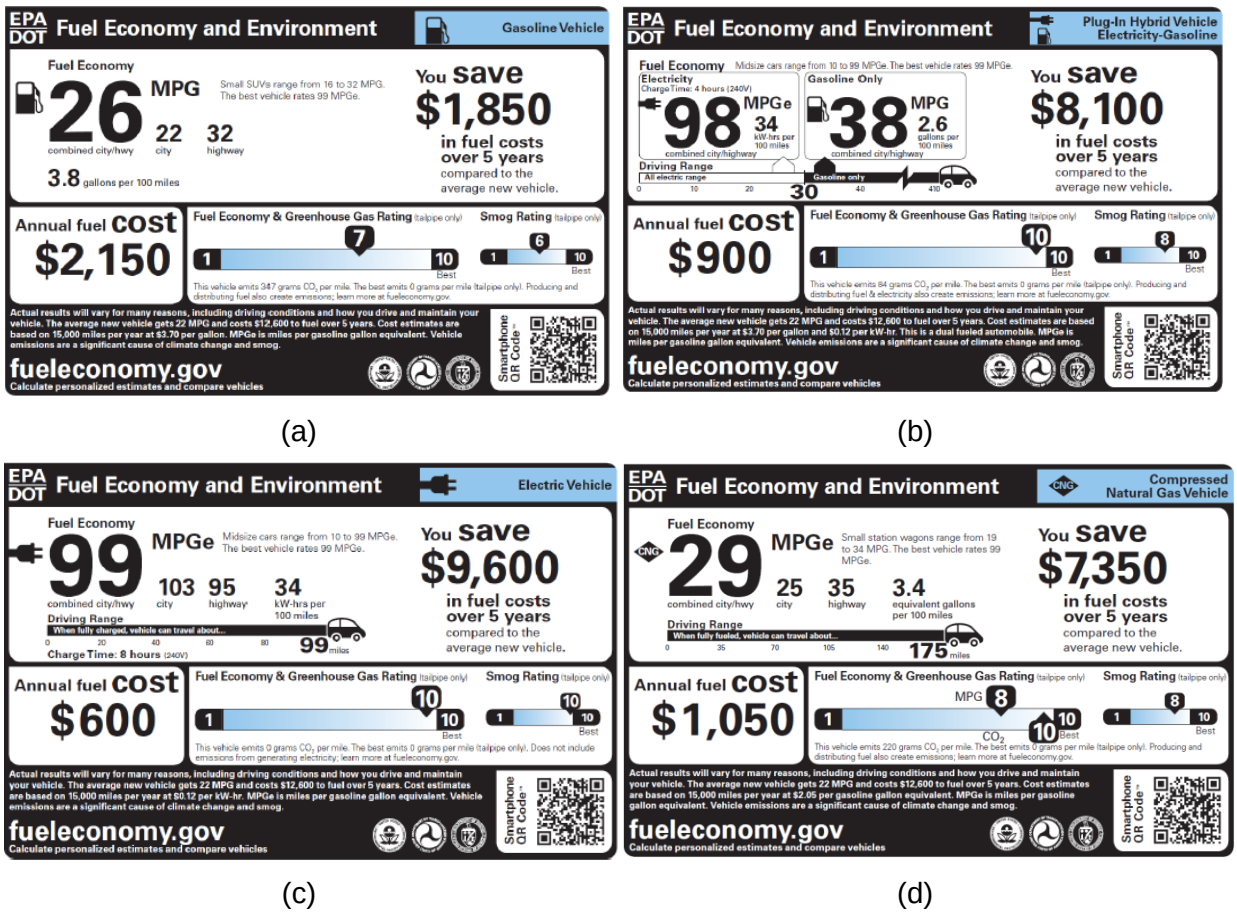


Figure 38. US fuel efficiency label – (a) diesel vehicle; (b) PHEV; (c) EV; (d) CNG.

VFEL program	
Introduced year	1978
Latest update	2013
Regulation type	• Mandatory (PV, LT) • Voluntary (used vehicle)
Applicable vehicle	Passenger car, light truck; Used vehicles
Legal framework	Energy Independence and Security Act
Administrative agency	US (EERE), EPA (OTAQ) and NHTSA
Main label information	• Fuel economy & greenhouse gas (numerical 1-10) • Smog rating (numerical 1-10) • Fuel economy (L/100km, mi/gallon) • Estimated annual fuel cost (USD) • Estimated fuel savings over 5 years (USD)
Test cycle	US 5-cycle (US 2 cycles + SC03+US06+Cold UDDS test cycle)

Alternative fuel vehicle	
Applicable vehicle	BEV, PHEV, fuel cell, CNG, flex-fuel (E85)
Main Label Information	• Fuel economy (MPGe, kWh/100 miles) • Driving range (miles) • The best vehicle fuel economy rate • Annual fuel cost • Money saved over 5 years

Consumer information	
Webpage	http://www.epa.gov/fueleconomy/
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Specific vehicle model information • Comparison among different models • Fuel cost calculation • Fiscal incentive information • Real-world fuel consumption report • Efficient driving suggestions • Mobile user friendly
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Fuel efficiency information in the showroom, website, and promotion materials
Consumer outreach	Allow consumer comments through website

Compliance and enforcement	
Verification of label information	Audits fuel efficiency test of more than 15 samples every year
Monitor label/information display	A fine of up to $1,000 per vehicle if the sticker is missing, and other fees and penalties are authorized if the sticker is altered illegally

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards

Viet Nam

Figure 39. Fuel economy label certified by registers for Viet Nam.

Figure 40. Manufacturer-claimed fuel economy label for Viet Nam.

VFEL program	
Introduced year	2014
Regulation type	Mandatory
Applicable vehicle	Passenger car (up to 7 seats)
Legal framework	Law of energy consumption efficiency and saving
Administrative agency	Viet Nam Register - Ministry of Transport
Main label information	• Include vehicle maker and model • Fuel economy (l/100km)
Test cycle	NEDC

Alternative fuel vehicle	
Applicable vehicle	LPG, CNG
Main Label information	Same design and same information requirement

Consumer information	
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Fuel efficiency information in the showroom, website, and promotion materials

Compliance and enforcement	
Verification of label information	Annually sample test (<5 units) by vehicle type (can be combined with emissions test)
Monitor label/information display	Random surveillance, frequency and sample size unspecified

Supporting fuel efficiency related policies:

- Vehicle efficiency/CO_2 standards

Austria

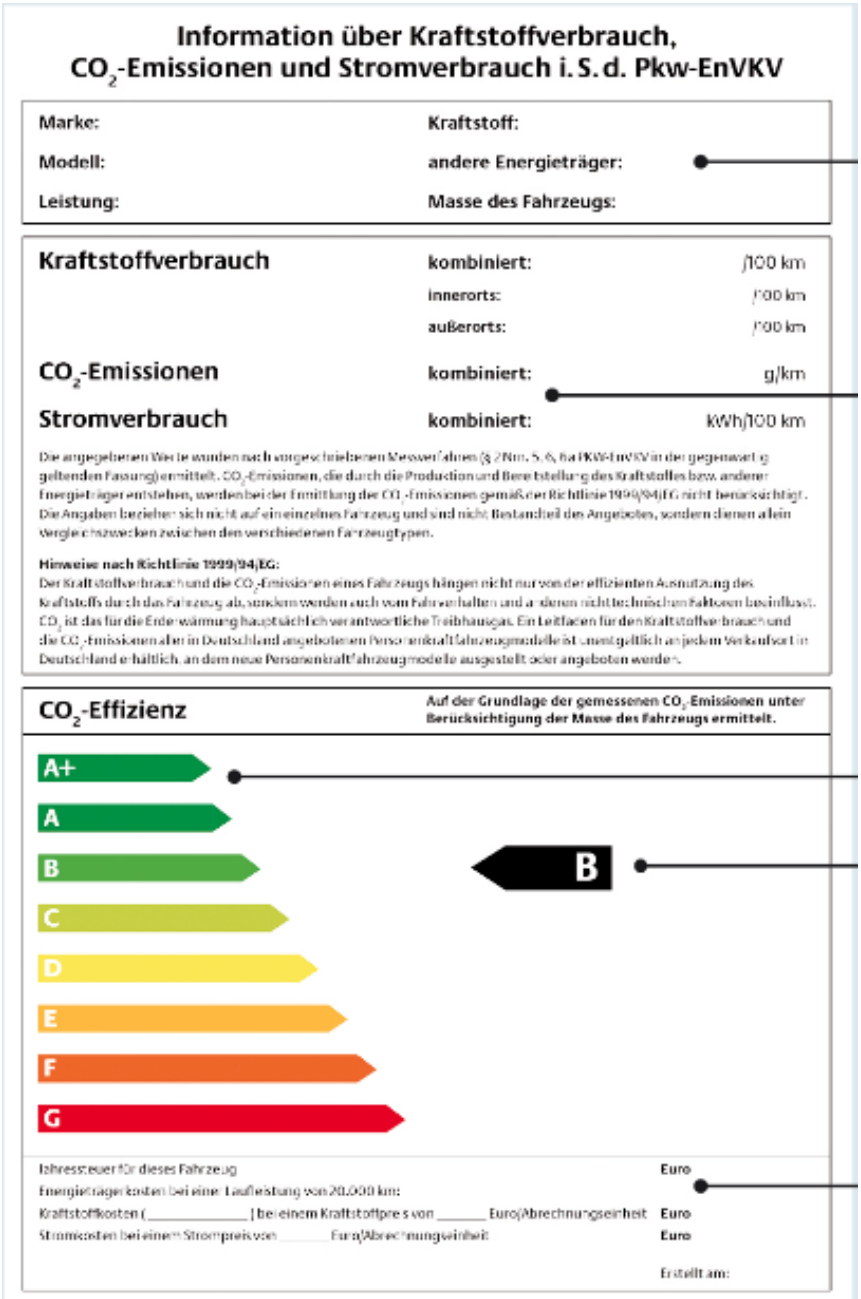


Figure 41. **Vehicle fuel economy label for Austria.**

VFEL program	
Introduced year	2001
Regulation type	Mandatory
Applicable vehicle	Passenger car
Legal framework	Passenger Car Consumer Information Act
Administrative agency	Federal Ministry of Agriculture, Forestry, Environment and Water Management
Main label information	• CO_2 emissions class (A+ to G, A+ is the best) • Fuel economy (l/100km) • CO_2 emissions (g/km) • Fuel cost (EUR)
Test cycle	New European Driving Cycle (NEDC)
Note	This design is also applicable to AFVs

Alternative fuel vehicle	
Applicable vehicle	BEV, PHEV, CNG
Main Label Information	• Energy consumption for BEVs and PHEVs (kWh/100km) • Consumption of natural gas (kg/100 km)

Consumer information	
Webpage	http://www.autoverbrauch.at/
Webpage feature	• Specific vehicle model information • Comparison among different models • Fiscal incentive information • Efficient driving suggestion
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Fuel efficiency information in the showroom, website, and promotion materials

Compliance and enforcement	
Verification of label information	Labeling information follows the type-approvals results as per the NEDC
Monitor label /information display	N/A

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards
- High fossil fuel tax

Brazil

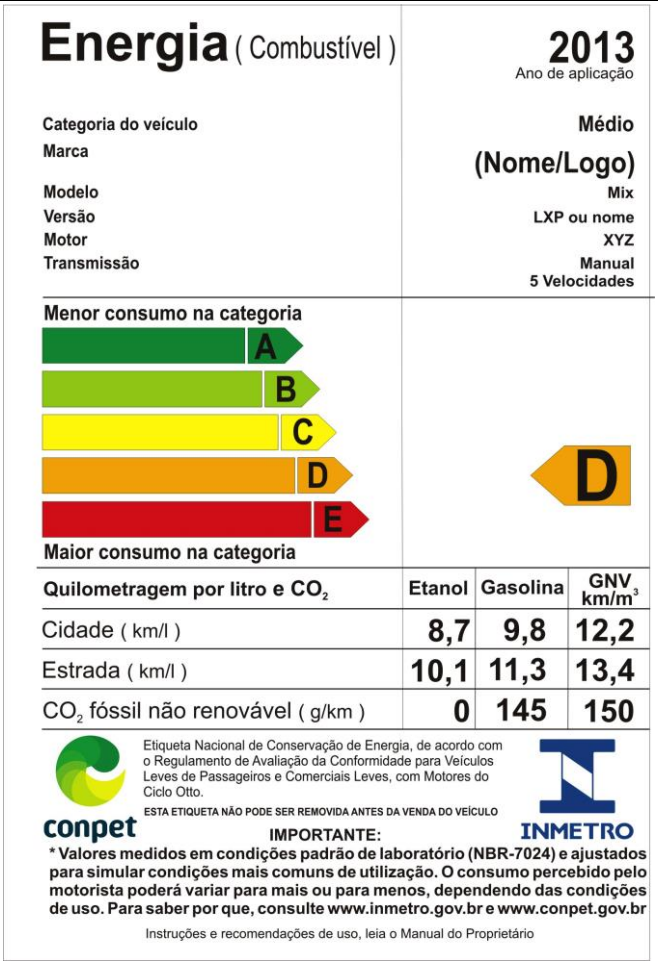


Figure 42. Vehicle fuel economy label for Brazil.

VFEL program	
Introduced year	2007
Latest update	2009
Regulation type	Voluntary
Applicable vehicle	Passenger car, light truck
Administrative agency	Inmetro and CONPET/PETROBRAS
Main label information	• Fuel consumption rating (A to E, A is most efficient) • CO_2 emissions (g/ km) • Fuel consumption (km/l)
Test cycle	US 2-cycle

Alternative fuel vehicle	
Applicable vehicle	CNG, Ethanol
Main Label Information	• Fuel consumption (l/100km for ethanol) • Fuel consumption (km/m^3 for CNG)

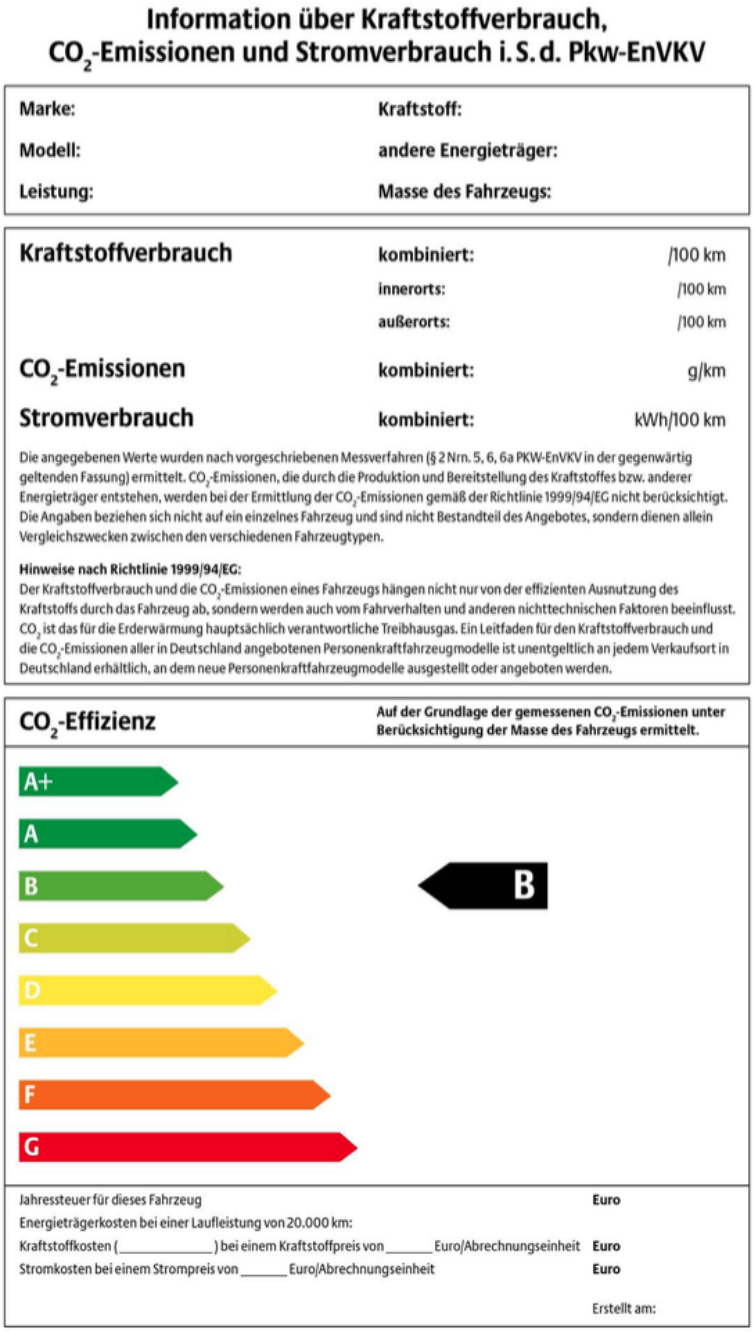
Consumer information	
Webpage	• http://www.inmetro.gov.br/consumidor/tabelas_pbe_veicular.asp • http://pbeveicular.petrobras.com.br/TabelaConsumo.aspx
Webpage feature	• Fuel efficiency/VFEL program introduction • Specific vehicle model information • Fuel cost calculation • Fiscal incentive information • Efficient driving suggestions • Mobile device friendly, allow consumer comments
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Fuel efficiency information in the showroom, website, and promotion materials

Compliance and enforcement	
Verification of label information	• A sample of the production models (>15) is selected every year to be retested by INMETRO's accredited laboratories network • Electronic audits of the input data, as well as throughout the national territory through the supervisory agents
Monitor label/information display	Field verification

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards

Germany



Information über Kraftstoffverbrauch, CO_2-Emissionen und Stromverbrauch i. S. d. Pkw-EnVKV

Marke:	**Kraftstoff:**
Modell:	**andere Energieträger:**
Leistung:	**Masse des Fahrzeugs:**

Kraftstoffverbrauch	**kombiniert:**	/100 km
	innerorts:	/100 km
	außerorts:	/100 km
CO_2-Emissionen	**kombiniert:**	g/km
Stromverbrauch	**kombiniert:**	kWh/100 km

Die angegebenen Werte wurden nach vorgeschriebenen Messverfahren (§ 2 Nrn. 5, 6, 6a PKW-EnVKV in der gegenwärtig geltenden Fassung) ermittelt. CO_2-Emissionen, die durch die Produktion und Bereitstellung des Kraftstoffes bzw. anderer Energieträger entstehen, werden bei der Ermittlung der CO_2-Emissionen gemäß der Richtlinie 1999/94/EG nicht berücksichtigt. Die Angaben beziehen sich nicht auf ein einzelnes Fahrzeug und sind nicht Bestandteil des Angebotes, sondern dienen allein Vergleichszwecken zwischen den verschiedenen Fahrzeugtypen.

Hinweise nach Richtlinie 1999/94/EG:
Der Kraftstoffverbrauch und die CO_2-Emissionen eines Fahrzeugs hängen nicht nur von der effizienten Ausnutzung des Kraftstoffs durch das Fahrzeug ab, sondern werden auch vom Fahrverhalten und anderen nichttechnischen Faktoren beeinflusst. CO_2 ist das für die Erderwärmung hauptsächlich verantwortliche Treibhausgas. Ein Leitfaden für den Kraftstoffverbrauch und die CO_2-Emissionen aller in Deutschland angebotenen Personenkraftfahrzeugmodelle ist unentgeltlich an jedem Verkaufsort in Deutschland erhältlich, an dem neue Personenkraftfahrzeugmodelle ausgestellt oder angeboten werden.

CO_2-Effizienz — **Auf der Grundlage der gemessenen CO_2-Emissionen unter Berücksichtigung der Masse des Fahrzeugs ermittelt.**

Jahressteuer für dieses Fahrzeug	**Euro**
Energieträgerkosten bei einer Laufleistung von 20.000 km:	
Kraftstoffkosten (_____) bei einem Kraftstoffpreis von _____ Euro/Abrechnungseinheit	**Euro**
Stromkosten bei einem Strompreis von _____ Euro/Abrechnungseinheit	**Euro**
	Erstellt am:

Figure 43. Vehicle fuel efficiency label for Germany.

VFEL program	
Introduced year	2004
Regulation type	Mandatory
Applicable vehicle	Passenger car
Administrative agency	Deutsche Energie-Agentur (DENA)
Main label information	• CO_2 emissions grade (A+ to G, A+ is the best) • Fuel economy value (l/100km) • CO_2 emissions value (g/km) • Fuel cost (EUR)
Test cycle	NEDC

Alternative fuel vehicle	
Applicable vehicle	BEV, PHEV, LPG, natural gas, flex-fuel
Main information	• Energy consumption (kWh/100 km for electric) • Fuel consumption (kg/100 km for natural gas)

Consumer information	
Webpage	http://www.pkw-label.de/
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Fuel cost calculation • Real world fuel consumption report • Efficient driving suggestion
Label/fuel efficiency information display	Label in the showroom, website, and promotional materials

Compliance and enforcement	
Monitor label/information display	Use fine up to 50,000 euros if not using the right information labels
Monitor label/information display	N/A

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards

Netherlands

Figure 44. **Vehicle fuel economy label for The Netherlands.**

VFEL program	
Introduced year	2001
Regulation type	Mandatory
Applicable vehicle	Passenger car
Legal framework	Netherlands Energy Saving Act
Administrative agency	Netherland Type Approval Authority (RDW)
Main label information	• Fuel economy grade (A-G, A is the best) • Fuel economy value (l/100km, km/l) • CO_2 emissions value (g/km)
Test cycle	NEDC

Alternative fuel vehicle	
Applicable vehicle	PHEV, LPG, CNG
Main information	• CO_2 emissions value (g/km) • CO_2 emissions rating
	• Fuel economy value (l/100km, km/l)

Consumer information	
Webpage	https://www.rdw.nl/Particulier/Paginas/Zuinig-en-milieuvriendelijk-voertuig-kopen.aspx?path=Portal/Particulier/Auto/Kopen
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Specific vehicle model information • Real world fuel consumption report
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Label stand at the showroom

Compliance and enforcement	
Verification of label information	No, fuel economy data is taken over from the Information document of the European Type Approval Procedure
Monitor label/information display	Inspection is done by the Inspection Leefomgeving en Transport, frequency and sample size unspecified

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards
- High fossil fuel tax

United Kingdom

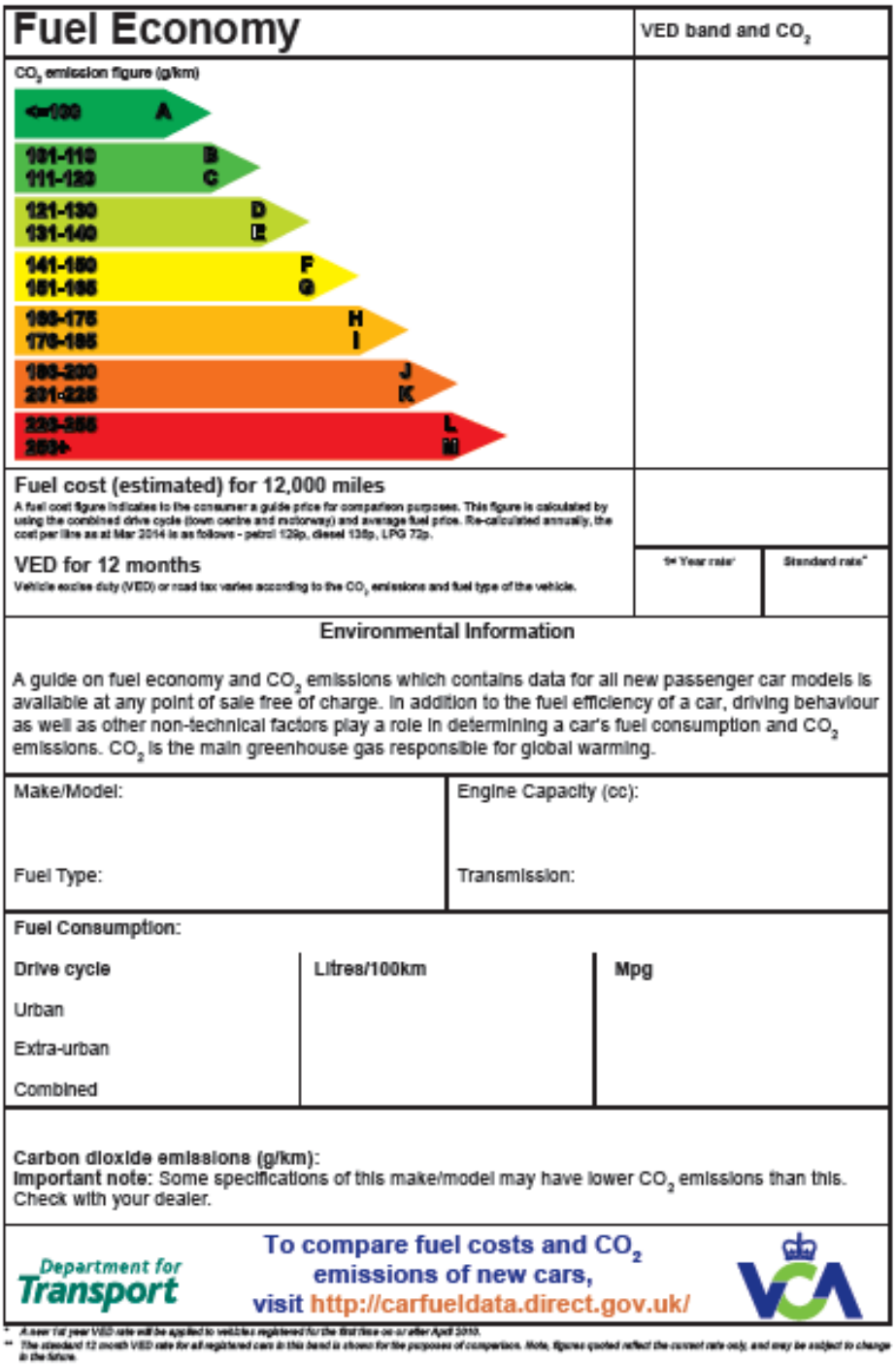


Figure 45. **Vehicle fuel economy label for UK (for conventional vehicles)**

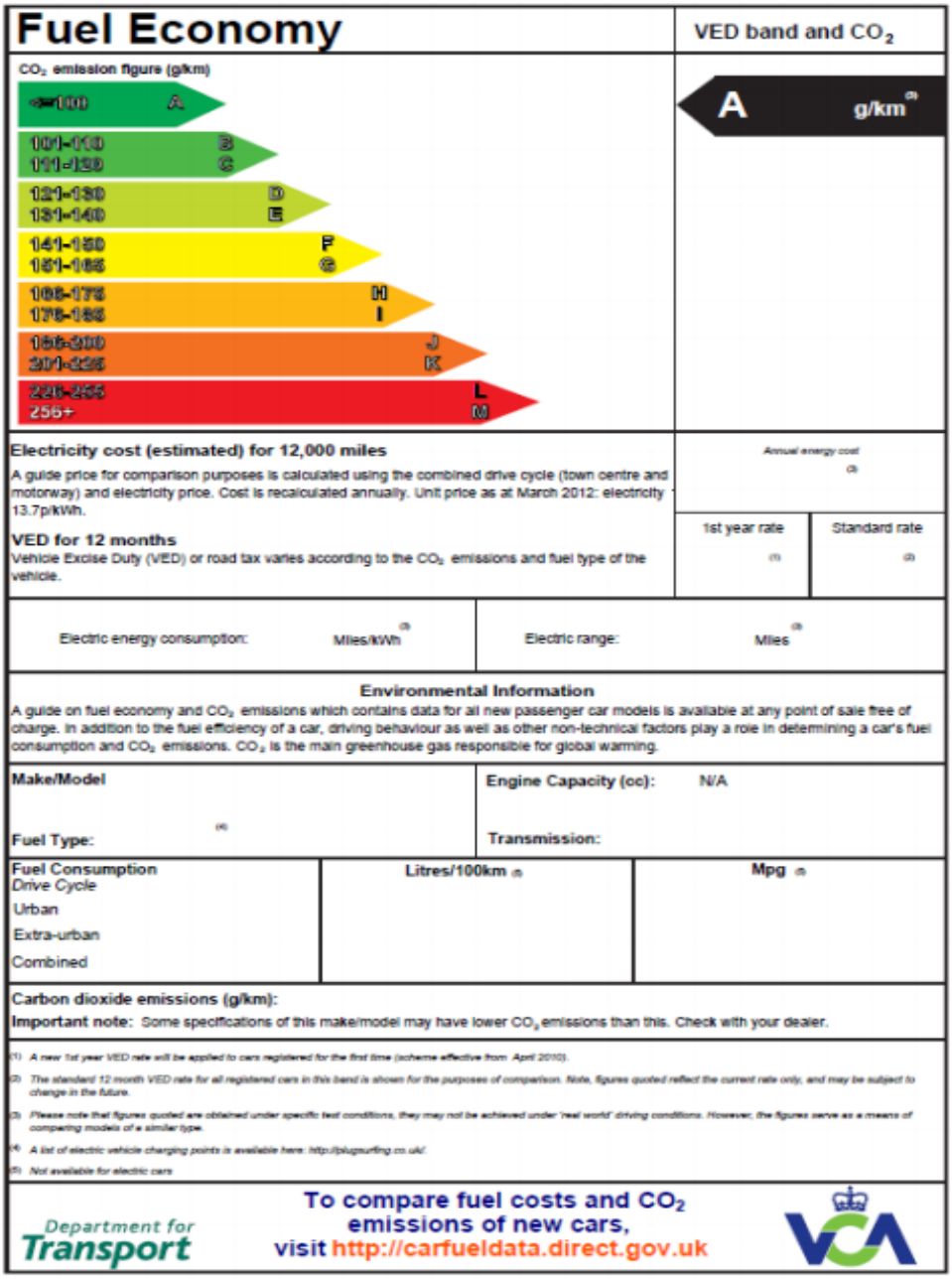


Figure 46. **Vehicle fuel economy label for UK (for EVs).**

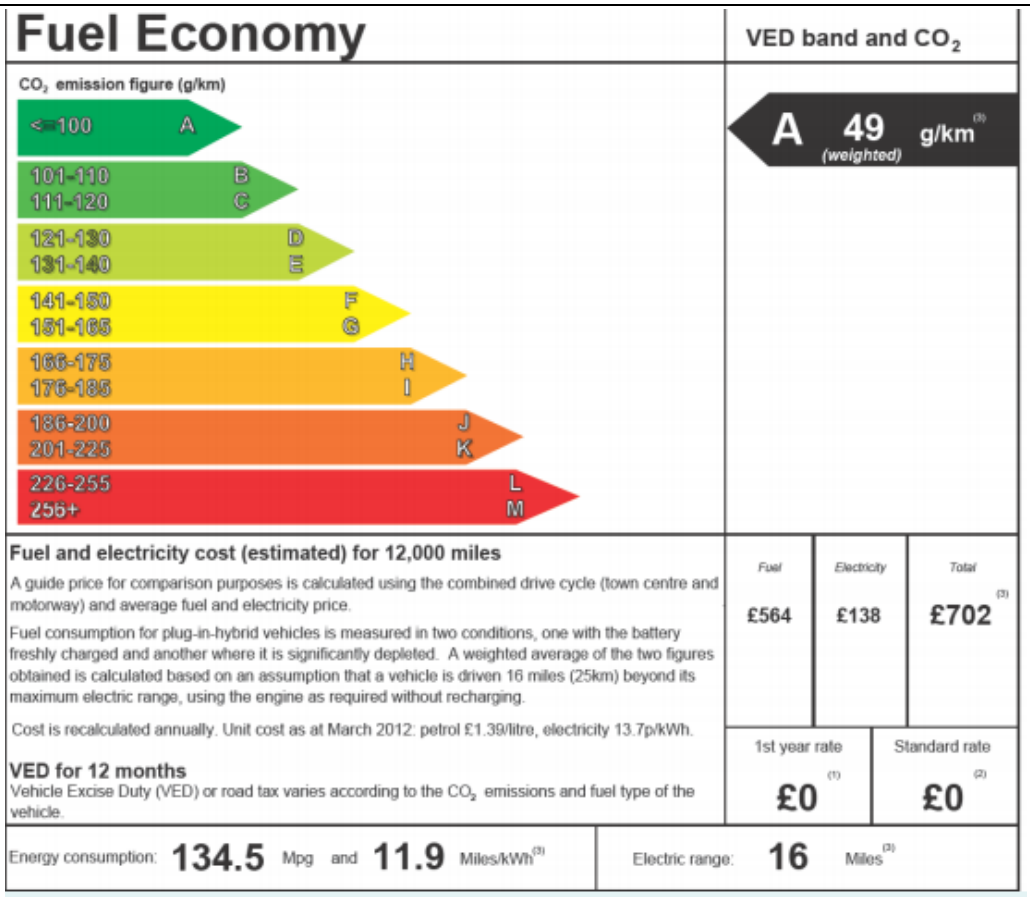


Figure 47. **Vehicle fuel economy label for UK (for PHEVs)**

VFEL program	
Introduced year	1978
Latest update	2005
Regulation type	Mandatory (new cars) Voluntary (used cars)
Applicable vehicle	Passenger car; used car
Legal framework	EU Directive 1999/94/EC
Administrative agency	Department for Transport and Vehicle Certification Agency
Main label information	• CO_2 emissions grade (A-M), with grade range • Fuel economy value (l/100km, MPG) • CO_2 value (g/km) • Estimated annual fuel cost (British Pound)
Test cycle	NEDC

Alternative fuel vehicle	
Applicable vehicle	BEV, PHEV, CNG, LPG
Main label information	• Electricity range (miles) • Energy consumption (km/kWh)

Consumer information	
Webpage	http://www.dft.gov.uk/vca/fcb/fuel-consumption-labelling.asp
Webpage feature	• Fuel efficiency/VFEL program introduction • Label/energy guide explanation • Fuel cost calculation
Label/fuel efficiency information display	• At the point of sale, affixed to the vehicle model, can be removed after the purchase • Fuel efficiency information in the showroom, website, and promotion materials

Compliance and enforcement	
Verification of label information	• Vehicle Certification Agency: select sample from the promotional literature • Local weights and measures authorities: visit dealers and check posters, labels and availability of guidebooks
Monitor label/information display	Official legal enforcement is random checks in showrooms by local Trading Standards consumer protection bodies

Supporting fuel efficiency related policies:

- Tax/fee reduction or subsidies to efficient vehicles/AFVs
- Vehicle efficiency/CO_2 standards
- High fossil fuel tax