Asia-Pacific
Economic Cooperation

PEER REVIEW ON ENERGY EFFICIENCY IN CHINESE TAIPEI

Final Report

5 November 2010

Report for the APEC Energy Working Group

CONTENTS

PREFACE

According to the guidelines for the APEC Peer Review on Energy Efficiency (PREE), the objectives of the PREE, endorsed by APEC leaders at their 2007 meeting are to:

- share information on energy efficiency performance as well as on policies and measures for improving energy efficiency
- provide opportunities for learning from the experience of other economies and for broadening the network among energy efficiency policy experts
- explore how energy efficiency goals on an overall and/or sectoral basis and action plans could be effectively formulated in each economy under review, taking into account the range of possible strategies that could be used, according to the circumstances of each economy
- monitor progress towards attaining energy efficiency goals on an overall and/or sectoral basis and implementing action plans, if such goals and action plans have been already formulated at the time of the review
- provide recommendations for voluntary implementation on how implementation of action plans could be improved with a view to achieving energy efficiency goals.

Two activities are undertaken as part of the PREE:

a) **Peer Reviews** of volunteer member economies

b) The **Compendium** of energy efficiency policies of APEC member economies based on either the APEC voluntary PREE or energy efficiency aspects of the IEA Energy Policy Review.

This report presents the results of a peer review of energy efficiency policies conducted in Chinese Taipei. Chinese Taipei volunteered to undertake a peer review.

The primary accountability for each peer review is shared by the economy being reviewed and the Review Team. The peer review in Chinese Taipei was conducted by a team of nine experts (see Appendix A) who visited Chinese Taipei from 22 to 27 August 2010.

During the visit, the Review Team had comprehensive discussions on energy efficiency with representatives and experts from government departments and private and state companies (see Appendix B). The Review Team wishes to thank all the presenters and others that spent time with the team for discussions, especially the representatives of the Ministry of Economic Affairs who organised the event.

EXECUTIVE SUMMARY

There is a strong commitment to energy efficiency and conservation (EE&C) in Chinese Taipei, extending from the highest level of government (the Executive Yuan) to the general public. This is reflected by the implementation of energy efficiency policies and measures that reflect international best practice. The recommendations made in this report are intended to help improve a system that is in very good order.

The Review Team was pleased to note that there is a strong history of government engagement with businesses and the public on energy efficiency and conservation issues. This leadership element is critical to ensure further progress is made on energy efficiency in Chinese Taipei.

In January 2010, the Executive Yuan established the Committee on Energy Conservation and GHG Emission Reduction to enhance cooperation among ministries. In May 2010, under the supervision of the committee, relevant ministries worked together to build up the Master Plan on Energy Conservation and GHG Emission Reductions. While there is strong political leadership in this area, there are limited human and financial resources available to achieve all that should/could be done. There is also a need to enhance the interaction across all levels of government to ensure that policies and programs are fully implemented.

Chinese Taipei has a robust framework of policies, programs, laws and action plans for promoting EE&C that clearly align the objectives of improving EE&C with the broader economic and energy goals of economic growth, economic productivity, energy security and the de-carbonisation of the economy. However, the Review Team considers that what is really lacking for Chinese Taipei is an overarching "strategy" for EE&C that would specify accountabilities for agencies to achieve certain actions by certain dates, link the outcomes in the existing framework and its key elements with the operational programs and potentially other existing or to be developed "action plans".

The Executive Yuan has recently stated bold targets for decreasing energy intensity, annual energy efficiency improvement and reducing overall carbon emissions. These targets are for the economy as a whole. The Review Team consider that there would be considerable value in specifying targets for energy intensity or efficiency improvements in specific sectors of the economy and potentially also sub-sectors. As part of these efforts, appropriate indicators should also be developed to monitor and assess the progress of policies and measures.

A key observation of the Review Team is that the price of energy in Chinese Taipei (particularly electricity) is very low and arguably "too low" to provide an adequate incentive for households, businesses and industry to use it more efficiently. In order to achieve energy efficiency improvement (and the stated energy targets) an economy-wide pricing instrument needs to be introduced into the Chinese Taipei energy system in a timely manner in order to move towards internalising the costs of energy use, production and transmission in the economy.

Chinese Taipei has many organisations involved in the collection and analysis of energy related data. The introduction of a single organisation or authority will help to streamline and simplify data collection and monitoring efforts. Further, the creation of a single exchange platform can help reduce overlap in data collection and analysis work and could potentially reduce database management costs for each organisation.

The commercial and residential sectors have strong potential for energy efficiency improvement. The BOE has recognised this and has determined that restraining the growth of consumption in these two

sectors (and the transport sector) are its second highest priority as stated in the Strategic Promotion of Energy Conservation Policy in the economy. It is recommended that a study comparing codes, or at least common sections of codes, to other economies with similar climate and infrastructure conditions should be performed and that a clear and transparent process for improving the codes on a regular basis be developed.

Energy use in the transport sector in Chinese Taipei is relatively low with respect to its population and economic development. Chinese Taipei has put in place excellent strategies, plans, and actions for the development of mass public transportation systems. However, the modal share of public transportation is relatively low. The Review Team believes that Chinese Taipei should consider the use of pricing mechanisms to discourage the use of inefficient transportation modes, while concurrently promoting the use of efficient transportation.

The framework for research, development and demonstration (RD&D) in Chinese Taipei is well established. It is recommended that the government continues to work with industry to achieve technology development goals, particularly for technologies that have strong future potential but are currently unable to attract the required investment. The government can encourage greater investment by removing some of the financial risks involved with investing in R&D by increasing the range of incentives available.

RECOMMENDATIONS

Institutional Context

Recommendation 1 *The level of government office which is responsible for policies to promote energy efficiency and energy conservation should be heightened and the staff and budget for energy efficiency and energy conservation should be expanded.*

Recommendation 2 *Coordination among relevant government agencies at the economy-wide level and at the local level should be enhanced in order to maximise energy savings across the various regions in the economy.*

Energy Efficiency Goals, Targets and Strategy

Recommendation 3 *Acknowledge in energy policy documents the "trade-offs" that will likely need to be made between achieving energy efficiency and other energy goals* (MOEA to lead).

Recommendation 4 *Ensure that there is no confusion between the use of the concepts of "energy intensity" and "energy efficiency" in energy policy documents and public statements* (MOEA to lead).

Recommendation 5 *Ensure that the economy-wide targets are underscored by analysis that clearly shows the scale and timing of the technological and behavioural changes necessary to achieve them (MOEA to lead).*

Recommendation 6 *Develop, in consultation with stakeholders, specific energy intensity and/or energy efficiency targets for sectors and sub-sectors of the economy (MOEA to lead).*

Recommendation 7 *Consider developing a target, preferably for an absolute reduction (or "plateau") in energy use in the Chinese Taipei economy to supplement current energy intensity and energy efficiency targets (MOEA to lead).*

Recommendation 8 *Fast track the design and implementation of a pricing instrument to internalise the externality costs of energy use and production. For example, an energy or carbon tax or emissions trading scheme (MOEA to lead).*

Recommendation 9 *Develop a comprehensive energy efficiency and conservation "strategy" for Chinese Taipei in consultation with stakeholders (MOEA to lead).*

Recommendation 10 *Establish an ongoing requirement for an economy-wide energy efficiency and conservation strategy (MOEA to lead).*

Energy data collection and monitoring

Recommendation 11 *To establish a "Chinese Taipei Data and Information Centre", which is focused on energy data collection and monitoring.*

Industry Sector

Recommendation 12 *Chinese Taipei should continue to collect information on global best practices for policies and measures and recent technology development related to energy efficiency improvement. BOE and relevant agencies should deploy appropriate policies and measures and technologies in the economy.*

Recommendation 13 *Chinese Taipei should continuously encourage large energy users to report future plans for energy efficiency efforts reflecting recommendations from on-site audits and follow up their achievements.*

Electricity Sector

Recommendation 14 *The government needs to adjust the electricity price to meet present electricity generation costs. Once this has been achieved, they should implement existing fuel adjustment clauses, established in January 2009, that adjust electricity prices seasonally.*

Recommendation 15 *The BOE and Taipower should consider energy efficiency in the overall power supply to set appropriate incentives and reasonable purchase and sales tariffs for cogeneration, such as a dynamic purchasing price based on Taipower's generation cost.*

Recommendation 16 *As part of the long-term power resource planning, new unit building costs and end-user efficiency improvement costs should be analysed using cost-benefit analysis.*

Commercial and Residential Sector

Recommendation 17 *Perform a "comparative study" of the stringency levels of Chinese Taipei's code to other similar economies with similar climate conditions and building infrastructure.*

Recommendation 18 *Create a "performance" building energy code for residential construction.*

Recommendation 19 *Conduct a study on code compliance to ensure (1) that green building criteria contained in the building codes are met during post construction review/approval and (2) that a high level of compliance is achieved.*

Recommendation 20 *Include major renovations and promote "passive" design features.*

Recommendation 21 *Promote "cool roofs" as a major component of codes and as part of the Eco-Cities program.*

Recommendation 22 *Building energy codes should be revised and increased every 2 years.*

Recommendation 23 *Enact regulations to make building labels mandatory for both the residential and commercial building sectors.*

Recommendation 24 *The Government should lead by example. i.e. demonstrate "net-zero energy buildings" and challenge the private sector to match/exceed agency goals/targets.*

Recommendation 25 *Under the Eco-Cities program, have a special focus on municipal water utilities to reduce water loss and decrease energy use.*

Recommendation 26 *Develop a Low Income Residential Retrofit Program.*

Transportation Sector

Recommendation 27 *Chinese Taipei should set a sub-target for energy consumption in the transportation sector in relation to the economy-wide energy intensity target, and regularly monitor the progress towards this sub-target.*

Recommendation 28 *Chinese Taipei should summarise best practices from cities with high modal share of mass public transportation, including lower car usage, and deploy economy-wide.*

Recommendation 29 *Chinese Taipei should develop a holistic pricing structure for the whole passenger transport system in order to discourage the use of inefficient transportation modes and vehicles.*

Recommendation 30 *Chinese Taipei should use targeted marketing to promote and encourage organisations and individuals to adopt efficient transportation modes and travel behaviours (e.g. personalised travel planning, workplace travel planning, eco-driving).*

Appliances and Equipment

Recommendation 31 *Chinese Taipei should extend its MEPS and labelling program to other appliances and equipment in accordance with technical and economic assessment viability and technology reality, including commercial and industrial equipment.*

Recommendation 32 *Revise MEPS for low voltage three phase squirrel-cage induction motors.*

Recommendation 33 *Chinese Taipei should promote and provide incentives for manufacturers, importers and end users to produce and procure appliances labelled as Class 1 to achieve highest efficiency.*

Education and Energy Efficiency Related Research and Development

Recommendation 34 *An Energy Technology Roadmap should be developed in conjunction with the energy efficiency strategy to create a common understanding of the technologies and R&D required to achieve stated energy efficiency goals. The roadmap should consider a portfolio approach including a mix of short term, low risk innovation and longer term, higher risk projects.*

Recommendation 35 *Chinese Taipei should continue to work with industry in research and development and to accelerate the commercialisation and deployment of energy efficient technology.*

PART 1: BACKGROUND INFORMATION

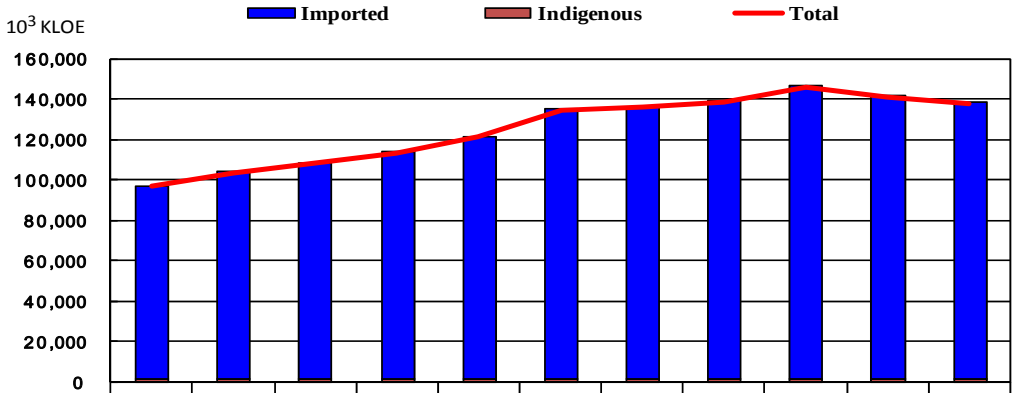
The background information contained in this report has been contributed by Chinese Taipei. This information is intended to provide some context to the recommendations of the Review Team. The first section discusses the trends in Chinese Taipei's energy supply and consumption. The second section provides information on Chinese Taipei's energy efficiency institutions, current policies and objectives and energy efficiency programs.

1. STATISTICS, FORECASTS AND TRENDS IN ENERGY CONSUMPTION

1.1. Trends in Energy Supply

Chinese Taipei has limited indigenous energy resources and, as a result, is highly dependent on imported energy. In 2009, 99.4% of total energy supply was imported. Most of the energy supply is fossil fuel, with renewable energy accounting for only 0.4% of the total energy supply.

Total primary energy supply (TPES) was 138.06 x 10^3 kilolitres of oil equivalent (kLOE) in 2009 as shown in **Figure 1**. TPES increased by 42.6% over the past decade, which is equivalent to an average annual growth rate of 3.6%. Indigenous energy supply decreased because of declining natural gas production and hydro power generation. As seen in **Figure 2**, the energy supply mix did not change significantly over the past decade. Petroleum was the major energy source, accounting for 51.8% of TPES in 2009. However, energy supply from renewables other than hydro power has been increasing sharply.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Imported	95,407	102,536	107,033	112,375	120,287	133,686	134,959	137,891	145,157	140,340	137,183
Indigenous	1,427	1,272	1,365	1,191	1,165	1,154	1,006	955	959	912	875
Total	96,834	103,808	108,397	113,566	121,452	134,840	135,966	138,846	146,116	141,251	138,058

Figure 1 Primary energy supply trends

As shown in **Figure 2**, Chinese Taipei is highly dependent on fossil energy (coal, oil and gas). Fossil fuels accounted for 91% of TPES in 2009. 78% of Chinese Taipei's electricity supply is generated using fossil fuels, with generation from coal-fired plants accounting for 52% of total generation.

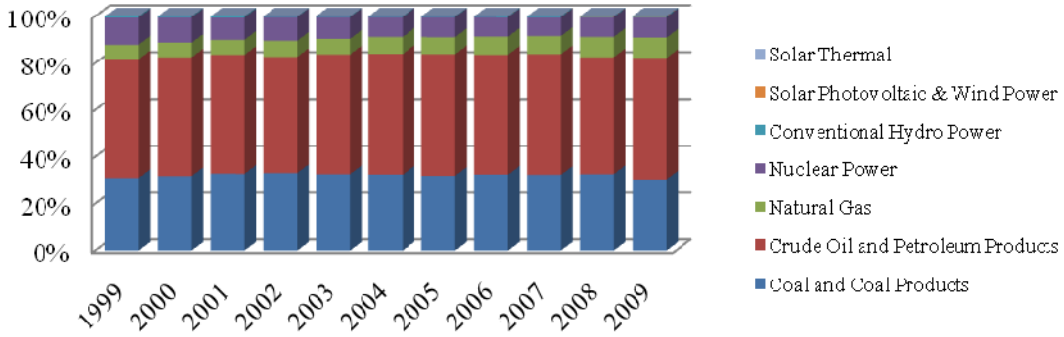


Figure 2 Primary energy supply (by energy form)

1.2. Trends in Energy Consumption

Figure 3 shows the trends in Chinese Taipei's energy consumption. It can be seen that domestic energy consumption grew considerably over the past decade, from 84.65 x 10^3 kLOE in 1999 to 113.09 x 10^3 kLOE in 2009. This represents an average annual growth rate of 2.9%. Over the same period, growth in real GDP was 3.4%. As shown in **Figure 4**, Chinese Taipei's energy intensity has improved, declining by 1.7% a year between 2001 and 2009.

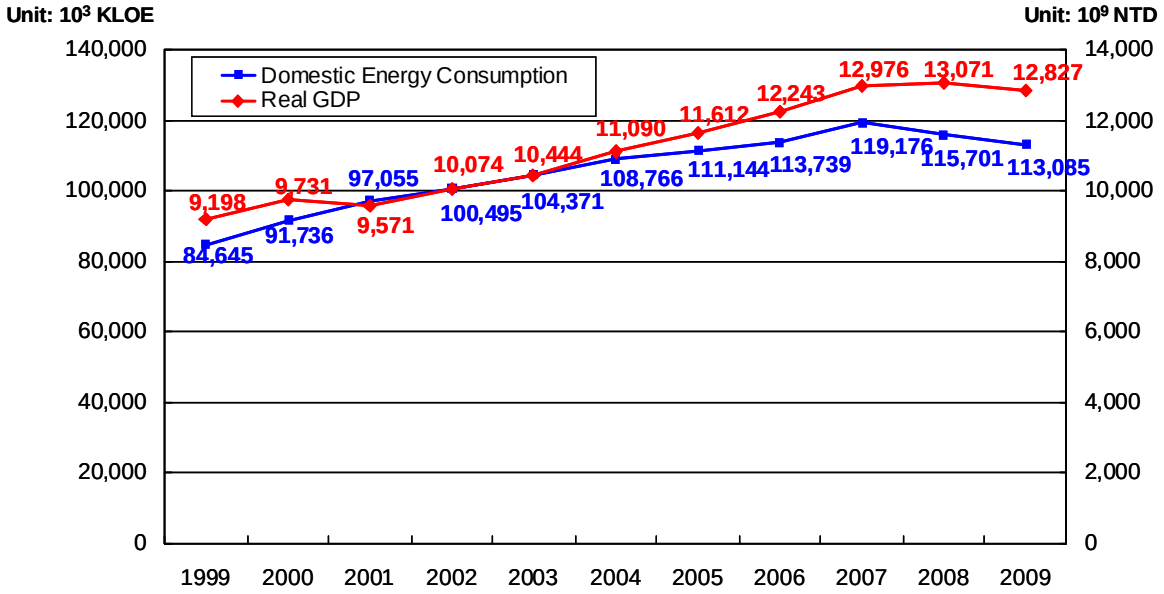


Figure 3 Domestic energy consumption and real GDP

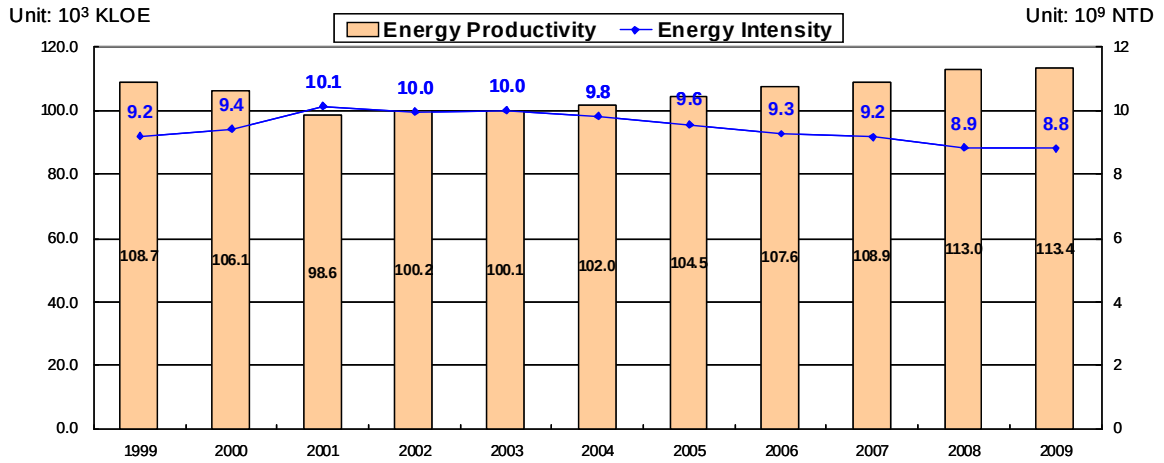


Figure 4 Energy productivity and intensity

Although domestic energy consumption has been growing, the energy mix has been relatively stable as shown in **Figure 5**. Over the past decade and in 2009, electricity, petroleum products, and coal and coal products were the three major fuels consumed. When classified by sector, as shown in **Figure 6**,

the industry sector is the major energy consuming sector. Its share in domestic energy consumption grew from 43.9% in 1999 to 52.5% in 2009. The share of the transportation sector declined to 13.2% in 2009 from 16.8% in 1999.

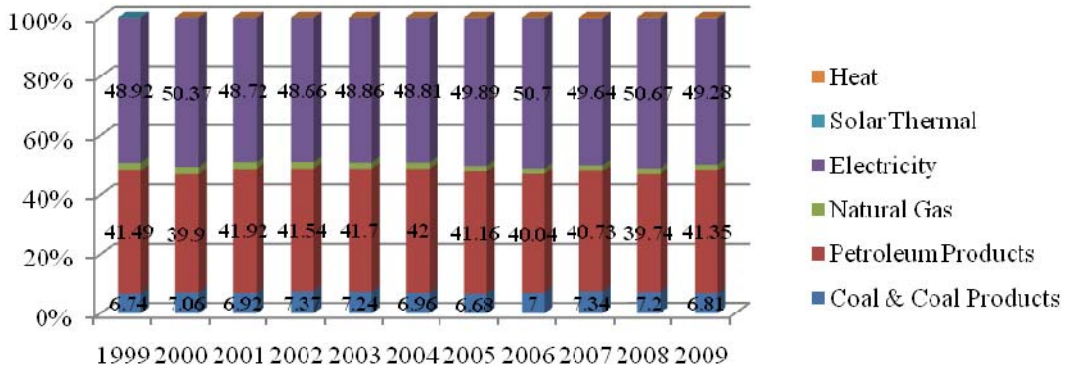


Figure 5 Domestic energy consumption (by energy form)

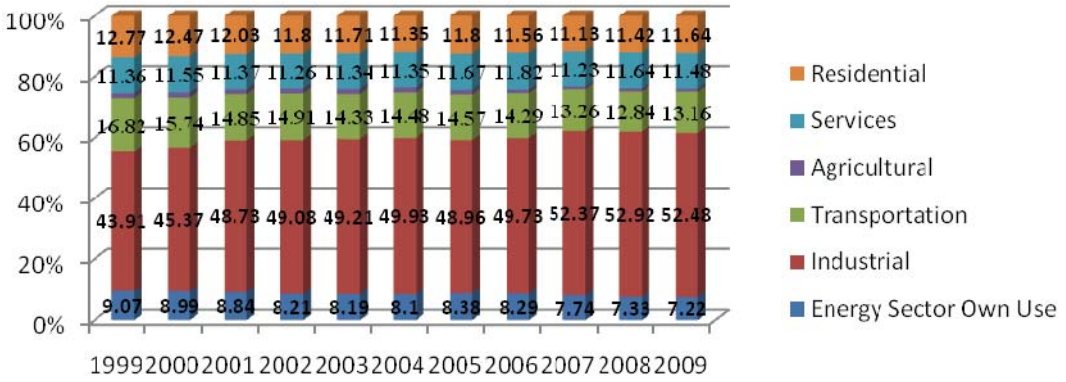


Figure 6 Domestic energy consumption (by sector)

Energy consumption in the manufacturing industry, including energy sector own use, accounted for around 60% of domestic energy consumption in 2008. Within the sector, chemical materials, basic metal, and electronic parts were the largest energy consuming industries (**Figure 7**). **Figure 8** shows that the increase in energy consumption in manufacturing was mainly caused by increased production after 2002. Improved energy efficiency and changes in industrial structure were also observed.

Energy intensive industries accounted for 36.3% of domestic energy consumption in 2008. **Figure 9** shows that energy consumption in these sectors has increased over the past decade, particularly in the chemical material industry. As illustrated in **Figure 10**, this growth was mainly caused by increased production after 2002. Energy efficiency declined between 2000-2001 and 2007-2008 because of the growth in chemical material production capacity.

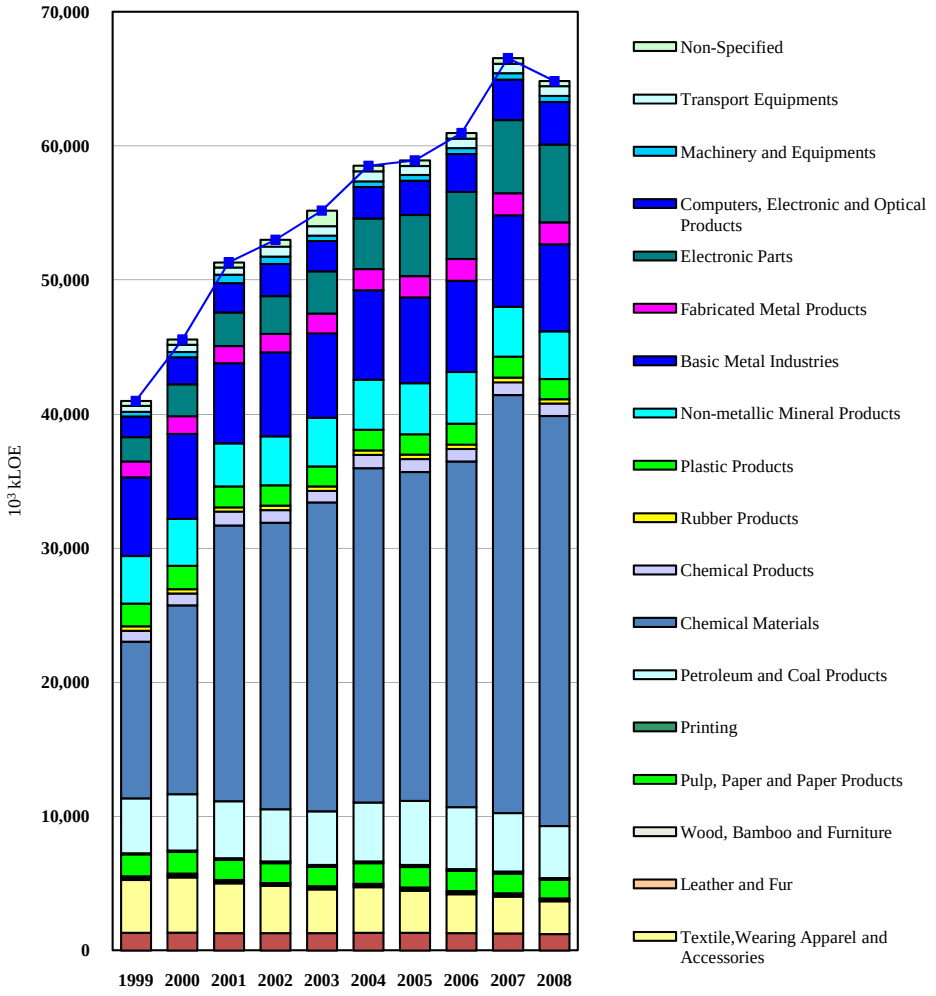


Figure 7 Energy consumption in the manufacturing industry

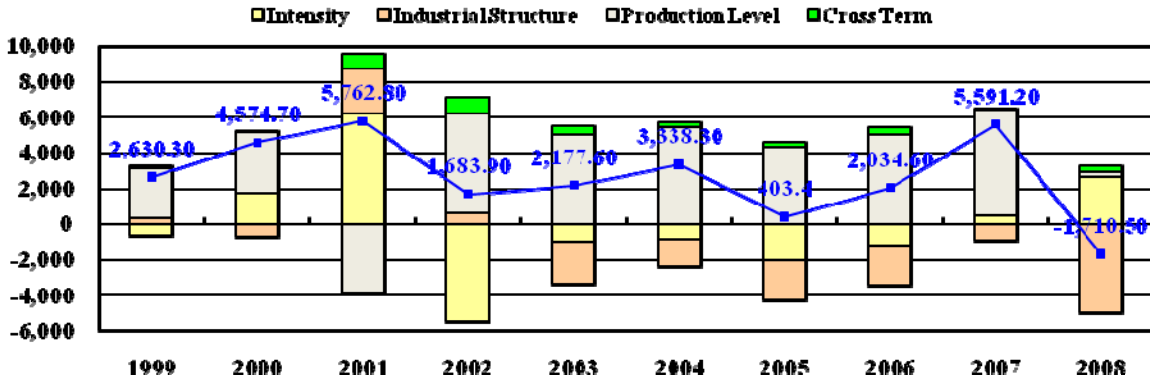


Figure 8 Energy consumption of manufacturing industry - factors analysis

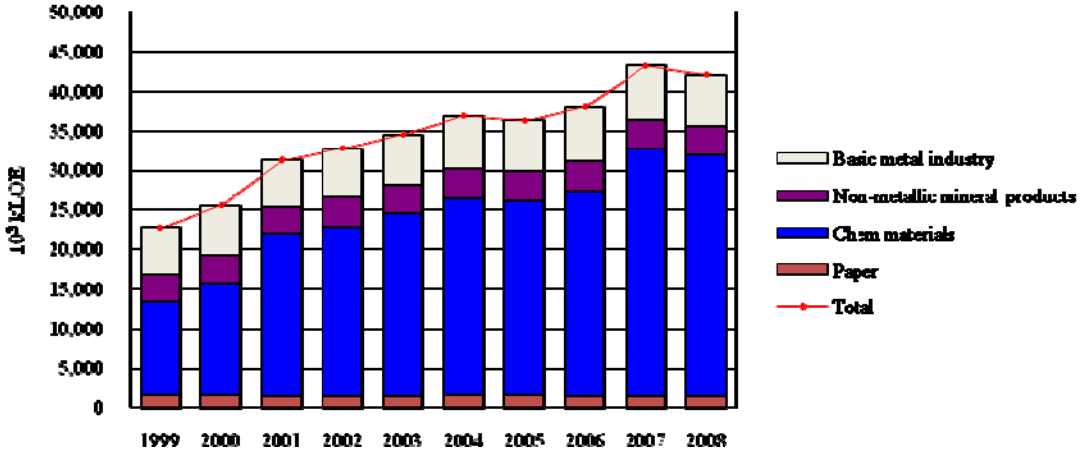


Figure 9 Energy consumption of energy intensive industries

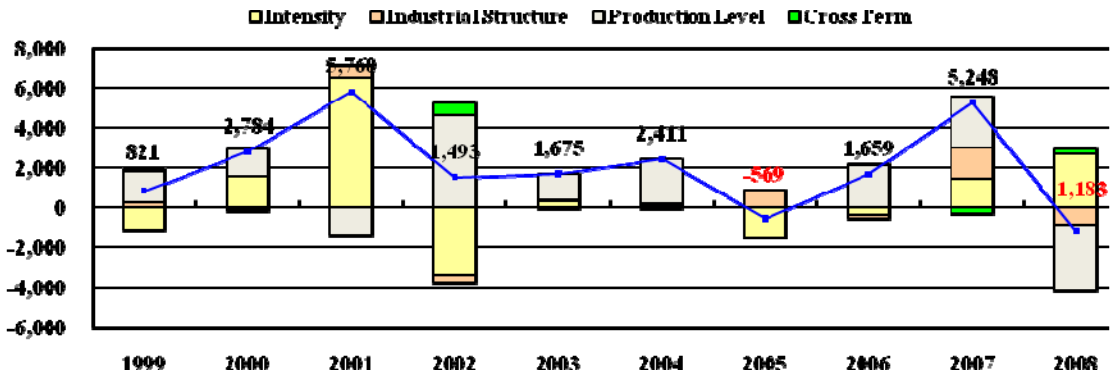


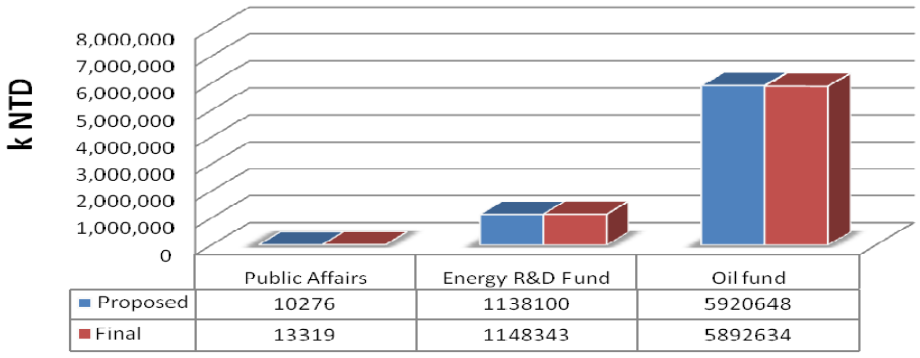
Figure 10 Energy consumption of energy intensive industries – factor analysis

2. ENERGY EFFICIENCY INSTITUTIONS, POLICIES AND MAJOR PROGRAMS

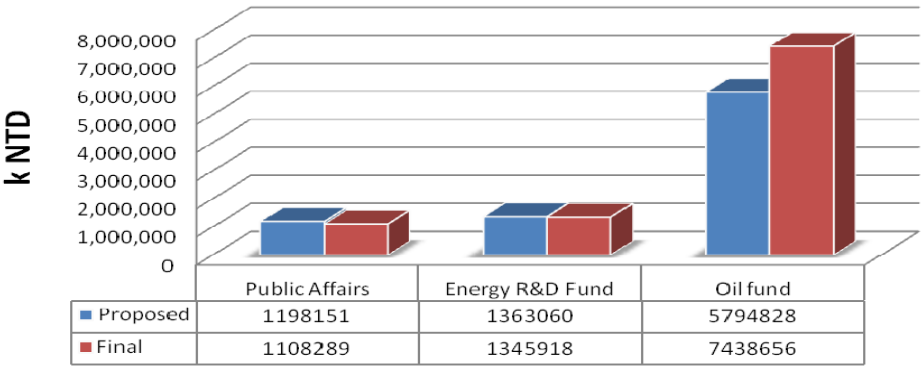
2.1. Institutional Framework

Bureau of Energy (BOE)

Chinese Taipei is a densely populated island with limited natural resources. Since energy plays a vital role in the economic development of Chinese Taipei, the government established the Energy Development Group in 1968 under the International Economic Cooperation and Development Council of the Executive Yuan. It was renamed as the "Energy Policy Deliberation Group" and became a subordinate under the Ministry of Economic Affairs (MOEA) in 1970 and Energy Commission under MOEA in November 1979. The most recent change was to rename the Energy Commission to the Bureau of Energy in July 2004 under the President's order. This was done to better formulate and implement energy policies such as the "Energy Management Law", "Electricity Act", "Petroleum Administration Act", "Regulations Governing Administration of Gas Utilities", and other energy-related regulations. In addition, the BOE guides the operations of energy enterprises and carries out tasks such as the evaluation of energy supply and demand, the establishment of an energy database system, the promotion of energy conservation programs, the implementation of research and development of energy technology, and the promotion of international energy cooperation.



(a) Anticipated revenue 2009



(b) Annual appropriation 2009

Figure 11 Annual budget overview 2009

As seen in **Figure 11**, the annual budget of BOE is comprised of three main parts: public affairs, the energy R&D fund and the oil fund. In 2009, the oil fund contributed the largest anticipated revenue and annual appropriation. Although BOE receives most of the research and administration energy budget, other Ministries and Departments such as the Department of Industrial Development (DOIT) and Atomic Energy Council (AEC) share the remainder of the total energy related research expenditure in Chinese Taipei. More detail can be found in the section dealing with energy efficiency programs.

Organisational Structure

The most recent organisational structure is shown in **Figure 12**. The BOE is governed by the MOEA under the Executive Yuan. It has four Divisions — the Planning Division, Petroleum and Gas Division, Electricity Division and Energy Technology Division. Each Division is composed of two to three Sectors as shown in **Figure 12**.

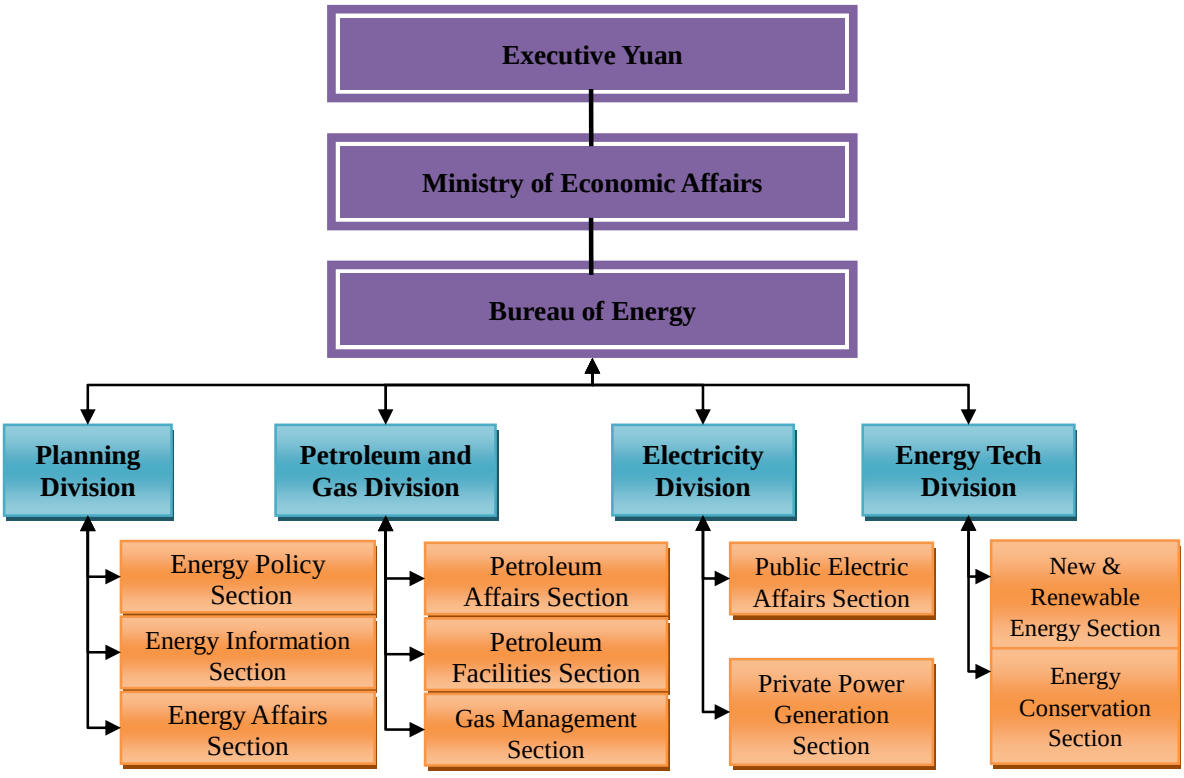


Figure 12 Administration structure of Bureau of Energy

Inter-Ministry Cooperation

To enhance cooperation among government ministries on energy and climate issues, the Executive Yuan established the "Committee on Energy Conservation and GHGs Emission Reduction" in January 2010. The Framework of Inter-Ministry Cooperation is shown in **Figure 13** where NSC is the National Science Council, PCC is the Public Construction Commission, MOE is the Ministry of Education, MOTC is the Ministry Of Transportation and Communications, MOFA is the Ministry of Foreign Affairs, GIO is

the Government Information Office and CEPD is the Council for Economic Planning and Development. This committee oversees the implementation of energy and climate action plans, and serves as a platform for inter-ministry energy and climate policy discussion.

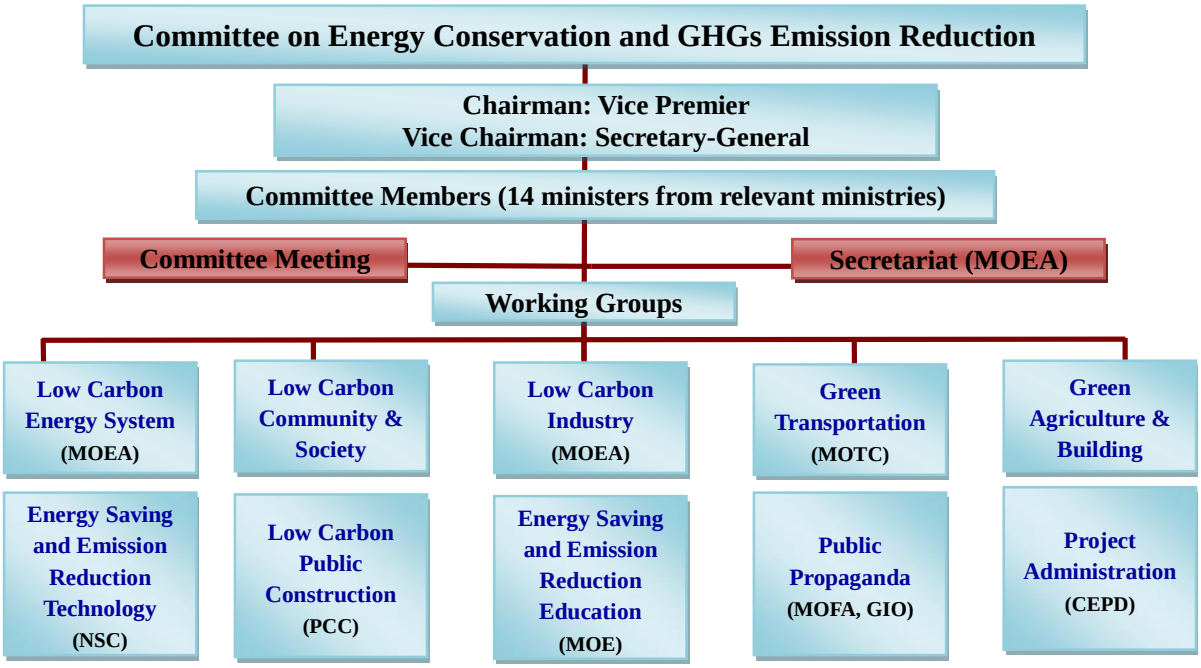


Figure 13 Framework for inter-ministry cooperation

2.2. Energy Efficiency Policy

Framework of Taiwan's Sustainable Energy Policy

Since President Ma Ying-Jeou took office in May 2008, the Legislative Yuan announced the 'Framework of Taiwan's Sustainable Energy Policy' which targeted the harmonic development of energy, economy and the environment, leading to '3 wins', together with '2 highs' (high efficiency and high value-added), and '2 lows' (low emissions and low dependency). His administration set a clear goal of improving energy efficiency by more than 2% a year, so that when compared with 2005, energy intensity will decrease by 20% by 2015. Supplemented by further technological breakthroughs and proper administrative measures, energy intensity will decrease by 50% by 2025.

I. Policy Objective: Win-Win-Win Solution for Energy, Environment and Economy

Sustainable energy development should balance the objectives of energy security, economic development and environment protection, and consider the need of future generations.

Chinese Taipei has insufficient natural resources to meet domestic demand, and is constrained by limited environmental carrying capacity. In order to create a win-win-win solution in energy, environment, and economy, sustainable energy policies should support the efficient use of limited energy resources, the development of clean energy, and the security of energy supply. Chinese Taipei's targets are:

1. Improving energy efficiency:

The goal is to improve energy efficiency by more than 2% a year, so that when compared with 2005, energy intensity will decrease by 20% by 2015. Supplemented by further technological breakthroughs and proper administrative measures, energy intensity will decrease by 50% by 2025.

2. Developing clean energy:

    1) Reduce economy-wide CO_2 emissions: return total emissions to 2008 levels between 2016-2020, and further reduce emissions to 2000 levels by 2025.
    2) Increase the share of low carbon energy in electricity generation from the current 40% to 55% in 2025.

3. Securing stable energy supply:

Build a secure energy supply system to meet economic development goals, such as 6% annual economic growth between 2008 and 2012, and USD 30,000 per capita income by 2015.

II. Policy Principles

The basic principles of a sustainable energy policy are to establish a high efficiency, high value-added, low emission, and low dependency energy consumption and supply system.

1. High efficiency: improve energy consumption and transformation efficiency.
2. High value-added: increase the value-added of energy consumption.
3. Low emission: adopt energy supply methods and consumption practices that ensure low carbon and low pollution.
4. Low dependence: decrease the dependence on fossil fuels and imported energy.

III. Strategy Framework

The strategy framework of sustainable energy policy is divided into two parts: cleaner energy supply and rationalised energy demand.

1. Cleaner Energy Supply: restructure the energy mix and improve energy efficiency.

    1) Develop carbon-free renewable energy. Effectively explore its power generating potential so that the share of renewable energy in the electricity system can reach 8% by 2025.
    2) Increase the utilisation of low-carbon natural gas, so that it can account for more than 25% of power generated in 2025.
    3) Increase energy supply diversity. Reconsider nuclear power as a no-carbon energy option.
    4) Accelerate the replacement of existing power generating units. Formulate a power plant efficiency improvement program that requires new units to utilise the best available technology.
    5) Introduce clean coal and CCS technologies through international cooperation to reduce the CO_2 emissions of the power generating system.
    6) Rationalise energy prices to reasonably reflect internal cost in the short run, as well as the external cost in the long run.

2. Rationalised Energy Demand: promote energy conservation schemes in various sectors.

1) Industrial sector:

a) Reform the industrial sector towards a high value-added, low energy intensive structure so that its carbon intensity can be reduced by more than 30% by 2025.
b) Allocate emission quotas and reduction duties to push the industry towards an energy-conserving and emission-reducing production and sales model.
c) Assist small and medium-sized enterprises to improve their emission reduction capacity. Establish incentive measures and administrative schemes to encourage the application of clean production technology.
d) Promote green energy industry, including energy conserving industries and renewable energy industries, to move towards a clean energy economy.

2) Transportation sector:

a) Provide a convenient mass transportation system to reduce the usage of private vehicles.
b) Construct an intelligent transportation system to provide instant traffic information and enhance traffic management capacity.
c) Build a user-oriented and green-oriented municipal transportation environment.
d) Raise the fuel efficiency standard for private vehicles by 25% in 2015.

3) Residential and commercial sector:

a) Improve urban planning, as well as promote forestation in urban areas to create a low carbon city.
b) Promote low carbon and energy conserving green architecture through energy conserving design of building facades and air-conditioning systems.
c) Raise appliance efficiency standards by 10% to 70% in 2011. Further raise the efficiency standards in 2015 to promote high efficiency products.
d) Promote energy conserving lighting solutions. Replace conventional lighting devices with high efficiency products.

4) Public sector:

a) Reduce the energy use of government agencies and schools by 7% in 2015.
b) Integrate the carbon neutral concept into policy planning. Adopt precaution, alert, and selection principles in carbon administration.

5) The general public:

a) Promote the public emission reduction movement by encouraging the public to reduce their CO_2 footprint by one kilogram per day.
b) Promote emission reduction from the Chinese Taipei Government through municipal governments, enterprises, and communities to develop low-carbon consumption habits and build a low-carbon and recycling society.

3. Provide a comprehensive regulatory framework and relevant mechanisms:

1) Regulatory framework:

a) Facilitate the legislation of the “Greenhouse Gas Emissions Reduction Act” to substantially build emission reduction capacity and enforce reduction measures.
b) Facilitate the legislation of the “Renewable Energy Development Act” to develop clean energy.

c) Draft and legislate the “Regulations on Energy Tax” to reflect the external cost of energy consumption.
d) Amend the “Energy Management Act” to effectively promote energy saving measures.

2) Supplementary mechanisms:

a) Establish a fair, efficient, and open energy market by deregulating the energy sector, reducing market entry barriers, and providing high quality energy services.
b) Design a carbon emissions trading scheme and establish carbon funds to help the industry receive emission quotas through various emission reduction programs. Participate in international emission reduction mechanisms to increase Chinese Taipei’s emission capacity.
c) Increase the annual energy research budget within the next four years from NTD 5 billion to NTD 10 billon.
d) Promote energy conservation and emission reduction education.

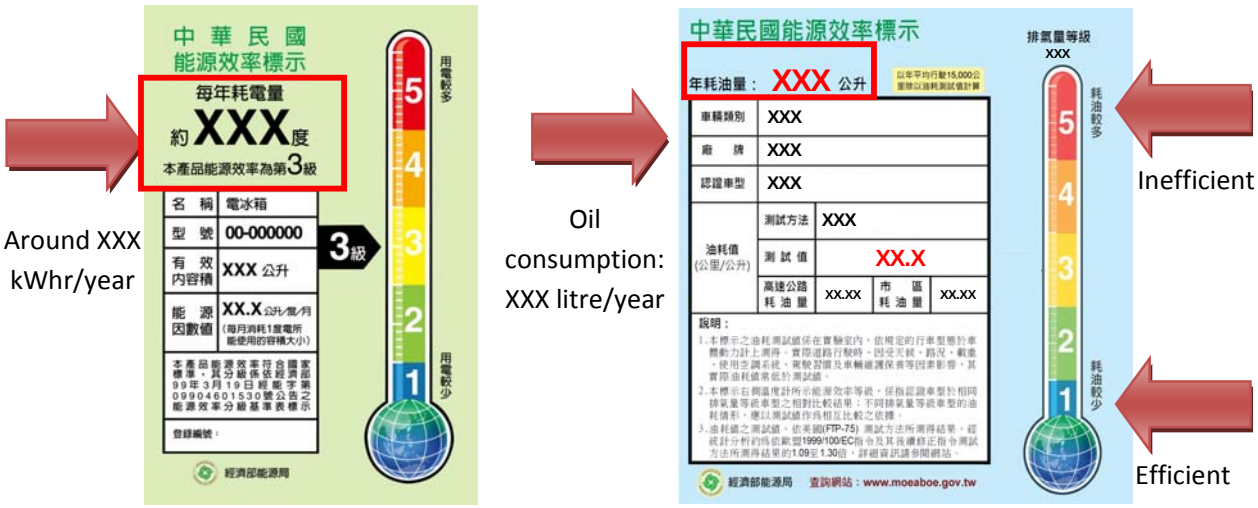
IV. Follow-up work

1. Government agencies should formulate concrete action plans in accordance with the framework. Quantitative objectives should be established for each task to measure its performance and facilitate implementation.
2. Carbon reduction targets should be clearly set in all action plans.
3. Monitoring and follow-up mechanisms should be built to regularly review the effectiveness and performances of the action plans.

Energy Management Law

The amendment to the Energy Management Law became effective on 8 July 2009. Articles 8, 9, 11, 12, 14 and 15 underwent an important amendment regarding energy efficiency retrofits. The amendment mainly focused on the sales ban on inefficient products. In addition, the amendment required that all large energy users report to authorities and obtain permits before building and/or operating otherwise they would incur a fine. Companies manufacturing or importing vehicles are required to meet energy efficiency standards set by the central competent authority and the energy consumption and efficiency of the vehicles should be clearly labelled. Vehicles failing to meet these requirements shall not be imported or sold in Chinese Taipei.

In order to implement articles 14 and 15 of the amended Energy Management Law, the BOE will plan for and promote the mandatory labelling program for home appliances, lighting equipments and gas burning devices over the next five years to encourage the uptake of efficient products. Labelling on air conditioners, refrigerators, automobiles and motorcycles have been in force since 1 July 2010. The label uses a five level ranking scheme and is depicted in **Figure 14**. To implement article 8, the BOE promotes non-leakage air conditioners and bans the use of incandescent lighting in seven key service industries which includes 13,891 business units. In addition, the BOE encourages service industries to sign a voluntary agreement for energy conservation and to set an energy-saving goal to reduce energy consumption by 5-10% compared with the current level.



(a) Refrigerator energy efficiency label **(b) Automobile Energy Efficiency Label**

Figure 14 Efficiency labels

Petroleum Administration Act

The management of the local petroleum market was strengthened through the promulgation of the Petroleum Administration Act on 11 October 2001. This law works to quell the illegal import, sale, and production of petroleum products while easing regulations on oil imports, thereby allowing all varieties of petroleum products to be imported into Chinese Taipei.

Renewable Energy Development Plan

Chinese Taipei is deeply aware of the importance of renewable energy. Acknowledging that forming a long-term solid and stable legal framework is the key to success, Chinese Taipei has actively promoted the legislation of the Renewable Energy Development Act since 2002. After seven years of efforts, the Act passed the legislative procedure of the Legislative Yuan on 12 June 2009, and was promulgated on 8 July 2009 by President Ma Ying-Jeou. The Act covers the breakthrough of market competition and installation barriers for renewables. The internalisation of externalities of traditional energy under the Act further enhances the competitive advantage of renewables.

Under this Act, a target of 6,500 MW to 10,000 MW for renewable energy power capacity, including new-renewable technologies, has been set. Power utilities and co-generators with certain capacity are obliged to pay a fee to the Renewable Energy Fund for every kWh of electricity that they produce from non-renewable energy resources. This payment can be reflected in their electricity sales price. Electricity generated from renewable energy power generation equipment must be integrated and purchased by power utility operating power grids where the equipment is located. Feed-in tariffs for all kinds of renewable electricity will be adopted, which will be decided by an expert committee and will be reviewed every year. Renewable power technologies that are in their early stage of development and possess future potential are entitled to demonstration incentives. Thermal utilisation of renewable energy will also be subsidised.

Future Legislation Plans

Chinese Taipei is facilitating the legislation of the "Greenhouse Gas Emissions Reduction Act", "Environmental Education Act" and the "Energy Tax Bill" to substantially build emission reduction capacity and enforce reduction measures.

3. ENERGY EFFICIENCY PROGRAMS

In order to reach these goals, Chinese Taipei provides a comprehensive regulatory framework and relevant mechanisms.

Energy Research Budget

The total energy related research budget in 2008 was around NTD 3,600 million. The budget allocation is shown in **Figure 15** where BOE represents the Bureau of Energy, COA the Council of Agriculture, DOIT the Department of Industrial Development, IDB the Industry Development Bureau, AEC the Atomic Energy Council, IOT the Institute of Transportation, NSC the National Science Council and "Others" is comprised of the State-owned Enterprise Commission (5.79 million NTD), Taipei County (2.8 million NTD) and the Research, Development and Evaluation Commission (0.3 million NTD). According to the "Framework of Taiwan's Sustainable Energy Policy" announced in 2009, Chinese Taipei plans to increase the energy research budget from NTD 5 billion a year to NTD 10 billion a year within the next four years.

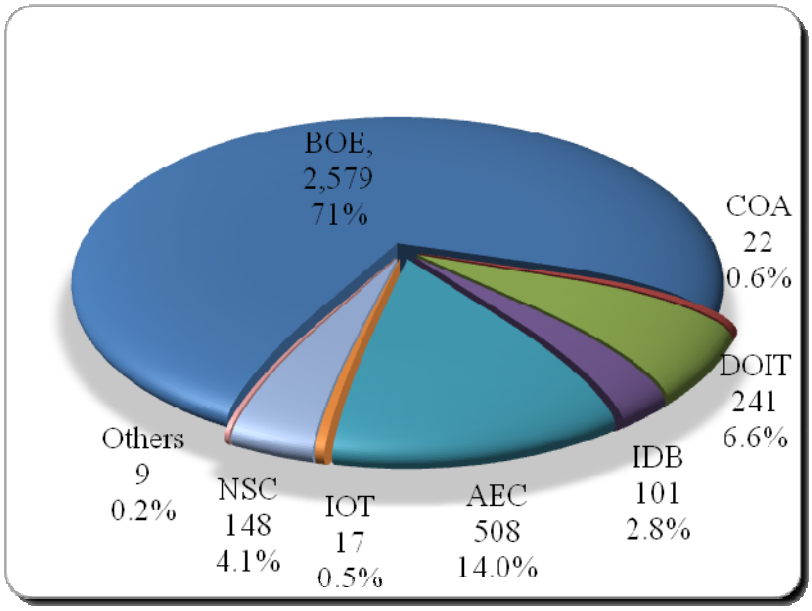


Figure 15 Allocation of energy related research budget in 2008. Total: 3,627 million NTD.

Source: National Science and Technology Program-Energy

The government of Chinese Taipei has invested heavily in energy research and development since the 1990s. During the 1990s, investment was around NTD 100 million a year. The amount of investment has increased gradually because of industry structural reform. However, compared with the major economies, the scale of energy technology R&D in Chinese Taipei is still relatively small.

Public Participation and Education

Public Participation in the Policy Making Process: National Energy Conference

- Facing the challenges of global climate change and the scarcity of energy resources, Chinese Taipei hosted the "2009 National Energy Conference" to gather opinions from the public
- The opinion collection process included an issue survey task force meeting, 3 pre-symposium sessions, 16 divisional meetings and preliminary meetings, and 12 groups and joint sessions, and other general sessions.

Energy Conservation and Emission Reduction Education and Campaign:

- Energy Administrators: training courses, teaching materials, online courses for energy personnel
- School Energy Education: projects to promote energy education in elementary, junior and senior high schools
- Publicity and Information Campaigns: through media, websites.

Incentive Mechanisms

- Tax Exemptions: tax exemptions and accelerated depreciation on capital expenditure, sales tax reduction on electric cars
- Low Interest Loans: subsidies to banks
- Incentive Payments: for the purchase of efficient appliances
- Electricity Bill Discount: discounts given to residential and school users who consume less electricity than the previous year.

Major Programs

National Energy Conference

Chinese Taipei held a National Energy Conference in 1998, 2005 and 2009. When the MOEA held the first National Energy Conference in 1998, tangible GHG reduction goals and schedules were successfully established. For example, it was decided that total energy consumption in 2020 should be reduced by 28% compared with 1997 and the amount of GHG emissions in 2025 should be equal to the total amount emitted in 2000.

When the Kyoto Protocol took effect, the MOEA organised the second National Energy Conference in 2005 in order to respond to the Protocol as well as to reflect on the achievements made since the first conference and what action plans could be amended as a result of a different industry structure. During the second National Energy Conference several important conclusions were made: (1) to stabilise the energy supply; (2) to decrease energy intensity by as much as 22-27% by 2025 compared with 2005. (3) to further liberalise the energy market; (4) to aim for the harmony of the 3Es – Economic Growth, Environmental Protection and Energy Security; (5) to strengthen energy research and (6) to continue energy education in the education and public sectors.

In 2009, the third National Energy Conference was held. Four main topics were discussed and the accompanying conclusions are listed below:

1. Sustainable Development and Energy Security

    1) Reduce CO_2 emissions to 2000 levels by 2025 and to 2008 levels during 2016 to 2020

2) Promulgate sustainable energy basic laws
3) Build up demonstration sites for utilising renewable energy
4) Create low-carbon communities and cities
5) Prioritise significant investment for green energy industry and low energy intensive industry.

2. Energy Management and Increased Efficiency

1) Promote eco-friendly industrial parks
2) New buildings should comply with green building codes
3) Promote a labelling scheme for buildings
4) Embed the concept of Carbon Neutral into the government decision system
5) Pass GHG mitigation Laws in the near future.

3. Price Signals and Market liberalisation

1) Rationalise electricity prices
2) Create a feed-in tariff mechanism
3) Create an Advanced Metering Infrastructure and Management platform
4) Add price incentives to lower electricity demand and consumption
5) Create energy users' purchasing options
6) Liberalise the electricity market.

4. Energy Technology and Industry Development

1) Focus on the research of new energy, renewables and energy-saving technology
2) Promote the "National Science and Technology Program-Energy" and "New Energy Flagship Program" (it was renamed as the "Green Energy Sunrise Program" in late 2009)
3) Focus on the promotion and support of green industries that have reached significant economic scale
4) Help industry development of wind power, biomass, hydrogen, fuel cells, energy information and communication technology (EICT) and electric vehicles (EV)
5) Accomplish 100 thousand Building Integrated Photovoltaics (BIPV) within three years
6) Promote energy education in schools and strengthen.

Sustainable Energy Policy Action Plans-16 Integrated Flagship programs

According to the conclusions at the National Energy Conference held in 2009, the "Sustainable Energy Policy Action Plans" were proposed by related ministries with the focus on 16 integrated flagship programs. The Integrated Flagship programs are listed below：

Legal System	1. Sustainable Energy Basic Law 2. Environmental impact assessment on "Energy Development Guidelines" 3. National Greenhouse Gas Emission Reduction Law and Energy Tax Bill
Energy Structure	4. Long-term Electricity Load Forecast and Power Development Planning 5. Electricity Market Liberalization Project 6. Advanced Metering Infrastructure (AMI) 7. Renewable Energy Multiplication Project 8. Evaluation on Reasonable Use of Nuclear Energy
Industry Structure	9. Low-carbon Industries Program 10. Green Energy Industry Program
Infrastructure	11. Green Transportation Program

Building	12. Low-carbon City Program 13. Green Building and Eco-City Promotion Program 14. Energy Price Rationalization Project
Energy Technology	15. National Energy Program 16. Energy Technological Talent Development Project

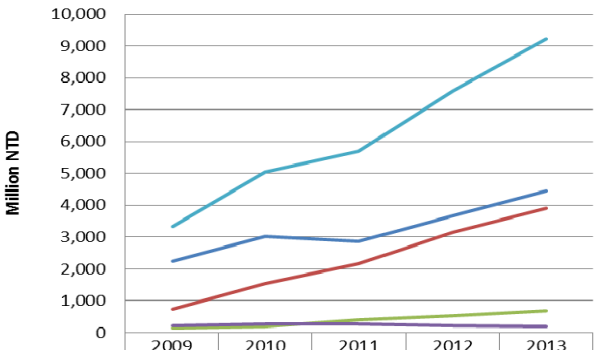
Green Energy Sunrise Program

The Green Energy Sunrise Program was announced by the Executive Yuan in 2009. By following the conclusions made at the third National Energy Conference, this program aimed to promote seven focused green industries in Chinese Taipei: photovoltaic (PV), LED, wind power, biomass, hydrogen and fuel cells, energy information and communication technology (EICT) and electric vehicles (EV). In order to accelerate market penetration and increase the competency of local industry, this program set out five promotion strategies: (1) technology innovation; (2) focused investment on the seven industries mentioned; (3) creating a friendly investment environment; (4) enlarge local market scale and (5) speed up the exportation scale and enlarge the trading framework with China.

The Green Energy Sunrise Program started in 2009 and will end in 2012. During this time, the government will invest nearly NTD 37 billion in this program and it is expected to draw more than NTD 200 billion from the private sector. The program is expected to create 110 thousand green jobs.

National Science and Technology Program-Energy (NEP)

The NEP was granted by the NSC in 2009. The program is proposed and mainly led by local research-intensive universities such as the National Taiwan University, National Cheng Kung University and National Central University. The other main bodies are the Atomic Energy Council and Taiwan Power Company. As seen in **Figure 16**, the program started in 2009 with NTD 3,402 million which increased nearly threefold within five years.



	2009	2010	2011	2012	2013
New Energy Technologies	2,252.90	3,029.90	2,854.00	3,670.00	4,451.00
Energy Saving and Carbon Reduction	732.2	1,550.10	2,157.50	3,159.00	3,908.00
Talents Cultivation	135.8	191.9	408	526	674
Energy Strategies	221.1	273.3	283	226	191
Total	3,342.00	5,045.20	5,702.50	7,581.00	9,224.00

Figure 16 Budget allocation of the National Science and Technology Program-Energy

Source: National Science and Technology Program-Energy

Four major areas are:

Area 1	Area 2	Area 3	Area 4
New Energy Technologies	**Energy Saving and Carbon Reduction**	**Talents Cultivation**	**Energy Strategies**
• Solar Thermal Energy • Solar Electric Energy • Wind Power Generation • Bio-energy • Ocean Energy • Hydrogen System • Nuclear Power Engineering • Geo-energy • Energy Storage Technology	• Clean coal, carbon capture and storage technology • Refrigeration and air conditioning • Energy saving buildings • Traffic and transportation • Industrial energy saving • Illumination and appliances • Afforestation and carbon reduction • Smart grid • Advanced meter infrastructure	• Strengthen fundamental research in science education • Deepen energy awareness and education in schools • Deepen energy awareness in the general public • Establish technology standards and product applications	• Energy Policy • Energy Saving and Carbon Reduction • New & Clean Energy • Energy Management • Energy Industry

Masterplan on Energy Conservation and GHGs Emission Reduction

In May 2010, under the supervision of the Committee on Energy Conservation and GHGs Emission Reduction, relevant ministries worked together to build up the "Masterplan on Energy Conservation and GHGs Emission Reduction". The master plan is composed of 10 landmark programs and 35 projects, which cover all aspects of Chinese Taipei's energy and climate policies.

The masterplan will be implemented through action plans proposed by ministries. These action plans will be merged into the "Sustainable Energy Policy Action Plans", and their implementation and targets will be regularly reviewed together with other action plans under the supervision of the Council for Economic Planning and Development.

EE Merits and Awards

Since 1994, Chinese Taipei has initiated a series of energy efficiency awards and expositions every year for local industry, the residential/commercial sectors and the public sector. So far 288 companies and 109 schools have won prizes and 56 expositions have been held. These are expected to encourage energy efficiency improvements from all aspects and provide an opportunity to exchange best practices. Registration and public nomination start early each year and is followed by a competition stage. Eventually, ten winners (five outstanding and five merits) in five different categories — Industry I, II, III,

residential/commercial I and II — will be awarded with certificates and prizes. Their achievement will be reported and can be downloaded online. As a result, they can gain greater exposure and public reputation in return, which is considered to be a great internal learning opportunity for Chinese Taipei.

Promotion of the Energy Management Program

In order to organise the energy management program to encourage consumers to purchase highly energy efficient products, the BOE uses four promotion means — media; activities; publications and a website to disseminate information on the voluntary labelling program, the mandatory ranking labelling program and the minimum energy performance standards (MEPS) program. The contents of these means are listed in **Table 1**.

The Energy Conservation Label Rebate Program

Program Rationale

As part of the "Economy Prospering Program" of the Executive Yuan, this rebate program achieved carbon emissions reductions, energy savings and prosperity by rewarding consumers that purchased air conditioners, refrigerators and clothes washers certified with Energy Conservation Labelling.

Program Objective

The six-month sales of air conditioners, refrigerators and clothes washers certified with Energy Conservation Labelling increased from 122 thousand units to 265 thousand units, with total sales totalling around NTD 9 billion. Annual energy consumption saved equalled 41.6 million kWh while CO_2 emissions were reduced by 26 thousand tonnes.

Duration

The program ran from 1 October 2008 to 31 March 2009. However, consumers were allowed to apply until 30 April 2009.

Promotion means

Detailed information was advertised via media and posters. An official website and a call centre were also established to provide counselling services to consumers.

Achievement

The number of qualified rebate applications was 269,962 and the cumulative rebate amount was NTD 539,924,000. The total sales for rebate products increased by 59.5% compared with the same period of last year.

Table 1 Promotion means and content

Promotion means	Contents description	
Media	• Articles in newspapers and magazines • Promotional films • News briefs	• Advertisements in periodicals • Radio and Television broadcastings.
Activities	• Electronic labelling product channel store campaign • Energy labelling car show	• Energy Resources and Environmental Protection Exhibitions • Energy Conservation Show

	•	• Energy labelling product Promotion worked with local government
Publication	• Energy Label News • Energy Conservation Tips for Home Appliances • Energy Conservation Label posters	• Energy Conservation Public Service Announcements • Energy Conservation Label Seasonal journal
Website	• On line e-Shopping mall • E-newsletter	• Labelling product database • Member Database • Study List for Children

4. CONCLUSION

Chinese Taipei has very limited natural resources; therefore economic growth relies greatly on the stable importation of energy and the efficiency with which it is consumed. In the late 1960s, Chinese Taipei established a designated government department to administrate energy related affairs. Because energy is important to economic growth and affects environmental sustainability, the administration has developed vertical and horizontal links to cooperate with the Executive Yuan and other Ministries and create other synergies.

Chinese Taipei has announced a sustainable development framework which includes commitments on the volume of energy savings, energy efficiency enhancement and carbon reduction. A series of statutory reforms and amendments were also undertaken, such as mandatory registration for large energy users and the sales ban on inefficient products. A Labelling scheme has also been implemented for certain products to ensure growth in the market for efficient home appliances.

In addition to legislation, Chinese Taipei has also initiated programs to promote energy efficiency improvement. The National Energy Congress has been a bridge between the public and private sectors since 1998. Via the Congress, solid and tangible conclusions have been reached through bilateral agreements which have paved the way for greener future development in Chinese Taipei. The NEP, led by the NSC, is expected to bring about the technology breakthrough required in both current energy technology and those with high market potential. The program will also develop specialists in the field of green energy that can provide sound advice in the future. To promote the growth of green industry, the government created the Flagship Program and the Sunrise Program to help local industry become clean and green. The government also provides incentives such as tax exemptions and preferential procurement to further accelerate market penetration.

With the measures implemented, the energy intensity of Chinese Taipei decreased gradually over the last decade from 10.1 to 8.8 (103 kLOE/109 NTD) which is equivalent to 1.7% a year. While the global financial crisis hindered real GDP growth, domestic energy consumption kept decreasing because of the successful implementation of these measures. It is expected that the declining trend will accelerate following the latest regulation amendments and the change in industry structure toward value added high technology. Hence the ambitious goal of reducing energy intensity by up to 20% by 2015 and 50% by 2025 is achievable.

PART 2: REVIEW TEAM REPORT

This part of the report presents the Review Team's conclusions and recommendations about energy efficiency policies and programs in Chinese Taipei.

1. INSTITUTIONAL CONTEXT

1.1. Critique

Political leadership at a high-level and sufficient expert staff at a working-level are essential for effective policy making and implementation to promote energy efficiency and conservation. The Review Team believes that the establishment of the "Committee on Energy Conservation and GHGs Emission Reduction" illustrates Chinese Taipei's strong political leadership. However, the Review Team found that there is limited staff and budget within the "Energy Conservation Section" in the "Energy Technology Division" in the BOE. Therefore, the Review Team believes that the high-level leadership of the committee should be supported by a greater number of staff and budget resources.

Achieving improved energy efficiency requires very close coordination among relevant government agencies at the economy-wide level and the local level. While the Review Team appreciates that communication has been occurring in some cases (e.g. in the case of promoting public transportation and enforcing Building Energy Codes), it found that closer coordination among relevant government agencies at the economy-wide level and local level would lead to more effective and efficient policy implementation in other cases (e.g. In the case of Green Transportation and Low Carbon Public Construction).

1.2. Recommendations

Recommendation 1 *The level of government office which is responsible for policies to promote energy efficiency and energy conservation should be heightened and the staff and budget for energy efficiency and energy conservation should be expanded.*

Greater inter-ministerial cooperation, through the development of sector-level goals, strategies and roadmaps, will help to maximise energy savings in an integrated manner as the results of various action plans in each sector can be reviewed in a consistent manner (e.g. the Convenient Rail Transport Network Project led by MOTC and the Vehicle Fuel Economy Improvement Project led by MOEA).

Recommendation 2 *Coordination among relevant government agencies at the economy-wide level and at the local level should be enhanced in order to maximise energy savings across the various regions in the economy.*

More cooperation between the Chinese Taipei government and local governments will lead to the maximisation of energy savings from some projects (e.g. the Low Carbon Community Demonstration Project, the Low Carbon City Demonstration Project and the Low Carbon Island Demonstration Project).

2. ENERGY EFFICIENCY GOALS, TARGETS AND STRATEGY

2.1. Critique

Goals

The Review Team is pleased to see that the "sustainable energy policy framework" for Chinese Taipei clearly aligns the objectives of improving energy efficiency and energy conservation with the broader economic and energy goals of economic growth, economic productivity, energy security and the de-carbonisation of the economy. In the Review Team's opinion this overall suite of integrated energy and economic goals compares well to that found in other growing APEC market economies at this time.

The Review Team also considers that the emphasis placed on energy security in the energy policy framework is appropriate given Chinese Taipei's current high dependency on imported stocks of oil.

Similarly the emphasis placed on de-carbonisation of the economy in the energy policy framework is also very appropriate given Chinese Taipei's participation in international climate change agreements (Kyoto Protocol) and the relatively high proportion of carbon intensive industrial production that presently contributes to Chinese Taipei's GDP.

However, while the energy policy framework clearly sets out high level goals for the management of the Chinese Taipei energy system, it does not state some of the "trade-offs" that may be required between these goals. For example, some level of environmental impact may need to be accepted to advance energy supply or transmission improvements (even those involving low carbon technologies) or the achievement of energy security may come at the expense of the increasing cost of energy supply (if it means that additional energy supply will ultimately need to be paid for by the end consumer). Another example is that more energy efficient equipment may cost more to purchase in the short term (impacting on "energy affordability"), but it will provide longer term paybacks (energy cost reductions) to households and productivity gains to businesses.

A key "trade off" that the Review Team does not see explained in the energy policy framework is the possibility of mutually achieving strong economic growth (up to 10% per year) and energy intensity and energy efficiency improvements. We note that when economies expand rapidly that their energy intensity typically increases (and energy efficiency may decline) because the emphasis (at the level of the firm) is on the expansion of production and using more energy resource inputs, rather than the efficiency of those inputs. It may therefore not be possible at all times to increase economic growth and reduce energy intensity and/or improve energy efficiency and this needs to be understood and acknowledged by all stakeholders in the energy system.

The Review Team considers that it would be prudent to communicate some of these inherent "trade-offs" in energy policy formulation and implementation to energy system stakeholders and the wider public. This is an important part of managing expectations about what is achievable in the energy efficiency domain and what the consequences of this achievement might be.

With respect to goals, the Review Team has also observed that the concepts of energy intensity and energy efficiency are sometimes used interchangeably and therefore incorrectly in some energy policy documents and public statements. Our expert opinion is that these concepts have different meanings. Energy intensity is a "macro level" concept applicable at the level of a whole economy or sector, while energy efficiency is a "micro-level" concept (essentially an engineering concept) referring to the efficiency of a specific energy using process or appliance. Therefore to talk about an annual 2% improvement in economy-wide energy efficiency is technically incorrect. We suggest that these references need to be corrected in future policy documents and public statements.

Clarifying the difference between energy efficiency and energy intensity will also assist in building public awareness and support for the concept of energy efficiency (as something people can take control of in their own daily lives) and will enable further appropriate policies and programs to be designed to achieve both types of goal without confusing the purpose of those interventions.

Targets

The Review Team notes that the Chinese Taipei Executive Yuan has recently stated bold targets in the public domain for decreasing energy intensity, annual energy efficiency improvement and reducing overall carbon emissions from the economy. We note that this practice of stating targets publicly is consistent with that currently being adopted by governments in other APEC economies at this time and that the Executive Yuan has shown strong leadership in stating these targets publicly.

However, we would like to raise the issue of whether these targets are actually considered achievable or whether they are more "aspirational" in nature. We note that some of the stated targets (for example, a 20% improvement in economy-wide energy intensity by 2015) refer to dates of achievement in the near future and they imply considerable change in energy using technologies and behaviours over the next 5 years.

The bold energy intensity and energy efficiency targets are commendable, but their achievability and the changes in technology and behaviour required to meet them need to be clearly understood and accepted. We are therefore recommending that an analysis of the "step change" required in energy using technologies and behaviours to achieve the stated energy intensity and energy efficiency targets needs to be completed for Chinese Taipei and made available to key stakeholders in the Chinese Taipei energy system.

If Chinese Taipei considers these targets to be realistically achievable, then the Review Team also considers that shorter term milestone targets need to be stated and used as reference points for monitoring activities. For example, 2015 targets should have a check point at 2012 and possibly even annually. At these check points there should be a reported assessment of whether the existing policy and program settings are adequate to achieve the stated targets.

The Review Team notes that the risk of stating aspirational targets that are not achieved by the specified date is that this perceived "failure" can serve to undermine public and business confidence in any further stated targets and the energy efficiency challenge in general. Achieving smaller and realistic targets in the shorter term and publicising the achievement of these can serve to reinforce a perception among households and businesses that their efforts and investments "are making a difference".

We also note the energy intensity and energy efficiency targets stated to date are for the economy as a whole. We consider that, as in other APEC economies, there would be considerable value in specifying targets for energy intensity or efficiency improvements in specific sectors of the economy and potentially also sub-sectors. The Review Team note such sector specific targets might be particularly useful for the industrial and transport sectors, which currently account for a large and growing proportion of total energy use in the Chinese Taipei economy. Sector specific targets can also be aligned with the implementation of certain programs or progress of anticipated regulatory reforms.

Sector level targets can also assist in galvanising stakeholder support within given economic sectors and would be the basis for assigning accountabilities for completing actions to achieve the targets. Where quantitative targets are not possible qualitative measures of performance expectation could also be stated. We note that the suite of targets for sub-sectors of the Chinese Taipei economy could be presented in a strategy (as discussed below).

The Review Team is also recommending that in addition to the stated energy intensity and energy efficiency improvement targets that Chinese Taipei also develops a related target for an absolute reduction in the growth of energy use by the Chinese Taipei economy by a specified date. In effect this type of target would specify a plateau in energy use growth in the Chinese Taipei economy at a certain point in the future.

We consider that this approach is ultimately necessary to drive energy efficiency improvement in the Chinese Taipei economy. In our view the stated energy intensity target could actually be met through the anticipated structural changes in the Chinese Taipei economy, without necessary any energy efficiency improvement occurring in households and businesses. Our view is that this target for a reduction in energy use by a given date should occupy the highest position in a hierarchy of targets

relating to future energy savings (i.e. both energy intensity improvement and energy efficiency improvements would contribute to the ultimate achievement of this energy use reduction target).

The Review Team is of the view that in order to achieve energy efficiency improvement (and the stated energy targets) that an economy-wide pricing instrument needs to be introduced into the Chinese Taipei energy system in a timely manner in order to move towards internalising the costs of energy use, production and transmission in the economy. We note that this is appropriately stated as a "principle" in the sustainable energy policy framework, but as yet no policy instrument has been implemented to give effect to this stated outcome.

We note that a number of policy instruments could be adopted by Chinese Taipei to move towards the internalisation of energy related externalities, including the use of dedicated energy and carbon taxes or the implementation of an emissions trading scheme for greenhouse gas emissions (a "cap and trade" scheme). One possible approach to responding to the Review Team's recommendation in this area would be to fast track the current proposals for the adoption of an "energy tax" in Chinese Taipei.

A key observation of the Review Team is that the price of energy in Chinese Taipei (particularly electricity) is very low and arguably "too low" to provide an adequate incentive for households and businesses to use it more efficiently. If the cost of energy is increased through enhanced government taxation of energy delivery or energy resource inputs (or carbon pricing) then there will be a number of considerations to be worked through concerning how any additional government revenue generated by that increased taxation could be used or recycled to fund energy efficiency programs. We note that the recycling of revenue from energy taxation or carbon pricing to fund energy efficiency programs and retrofits could potentially be a way of mitigating the impact of increased energy prices on low income groups.

Strategy

The Review Team is pleased to see that there is already in place for the Chinese Taipei economy a comprehensive "framework" of policies, programs, laws and action plans to promote greater energy efficiency and energy conservation. We are also pleased to note that there is already a history of government engagement with businesses and the public on energy efficiency and conservation issues in Chinese Taipei, with leadership on these issues coming from the highest parts of the Executive Yuan. This leadership element is critical to the success of the framework and must continue to ensure further progress is made on energy efficiency in Chinese Taipei.

We consider that overall the essential elements of the "framework" are sound and appropriate. However, while we consider the framework is good, it is just that, a framework. We consider that what is really lacking for the Chinese Taipei economy is a "strategy" for energy efficiency and conservation.

An energy efficiency and conservation strategy would essentially specify accountabilities for agencies to achieve certain actions by certain dates (i.e. "who does what by when"). A strategy would also link the outcomes in the existing framework and its key elements with the operational programs and potentially other existing or to be developed "action plans". A strategy should also systematically address the barriers to greater energy efficiency in the various economic sectors (i.e. it would set out a "barriers analysis").

We envisage that the strategy would also specify energy efficiency targets for certain sectors and sub-sectors of the economy (as referred to in the previous section) and it would also assign accountabilities for the completion of actions to achieve those targets. The strategy could address the issue of what further "step changes" in energy using technology and behaviours are required to meet the relatively

bold targets defined for 2025 (essentially what has to change in the economy or individual sectors to meet these 2025 targets).

The essential elements of the strategy should be: goals, objectives, policies, targets, programs, accountabilities and monitoring and reporting. We note that strategies incorporating these elements are now commonly adopted in many developed and developing economies. Their preparation and implementation can provide a basis for engagement with the public on energy efficiency and conservation issues. This public engagement process would build on the momentum already achieved through the previously held National Energy Congresses.

Example: The 2007 New Zealand Energy Efficiency and Conservation Strategy provides government leadership for the energy sector to respond to the challenges of energy security and climate change. It also establishes the action plan for energy efficiency and conservation actions in New Zealand to support increased uptake of energy efficiency and renewable energy. Further, it assigns responsibility for the delivery of each action to a central or local government agency.
See http://www.eeca.govt.nz/sites/all/files/nzeecs-07.pdf for further information.

The requirement to produce a strategy or to have a strategy in place at any one time should be set out in legislation (this approach is adopted in other economies). The government of the day would amend or re-draft the strategy as it saw necessary to reflect the emphasis of its own broader economic and energy policies. An energy efficiency and conservation strategy would also provide a basis for ensuring efficient allocation of available resources and ensuring that available funding is assigned to its best uses within the possible mix of policies and programs on which it could be spent.

2.2. Recommendations

Recommendation 3 *Acknowledge in energy policy documents the "trade-offs" that will likely need to be made between achieving energy efficiency and other energy goals* (MOEA to lead).

This will assist in building household and business understanding that energy efficiency may come at an initial cost in some areas (with paybacks over time).

Recommendation 4 *Ensure that there is no confusion between the use of the concepts of "energy intensity" and "energy efficiency" in energy policy documents and public statements* (MOEA to lead).

This will assist in avoiding confusion among stakeholders and enable the appropriate interventions and programs to be designed and implemented to achieve each type of target.

Recommendation 5 *Ensure that the economy-wide targets are underscored by analysis that clearly shows the scale and timing of the technological and behavioural changes necessary to achieve them (MOEA to lead).*

This process makes the energy efficiency task "real", builds support and an understanding among businesses and households about what is really required to achieve the targets.

Recommendation 6 *Develop, in consultation with stakeholders, specific energy intensity and/or energy efficiency targets for sectors and sub-sectors of the economy (MOEA to lead).*

This will build focus and collaboration among stakeholders in each sector and enable specific programs to be designed and aligned with the sector targets.

Recommendation 7 *Consider developing a target, preferably for an absolute reduction (or "plateau") in energy use in the Chinese Taipei economy to supplement current energy intensity and energy efficiency targets (MOEA to lead).*

Energy intensity targets will not always drive progress towards energy efficiency, but an absolute target for energy reduction will.

Recommendation 8 *Fast track the design and implementation of a pricing instrument to internalise the externality costs of energy use and production. For example, an energy or carbon tax or emissions trading scheme (MOEA to lead).*

The introduction of cost reflective pricing into the energy sector is critical to advancing energy efficiency improvement in Chinese Taipei.

Recommendation 9 *Develop a comprehensive energy efficiency and conservation "strategy" for Chinese Taipei in consultation with stakeholders (MOEA to lead).*

Key elements of the Strategy should include:

- Goals (high level outcomes)
- Targets (economy-wide)
- Policies (for each sector)
- Sector targets
- Programs/actions
- Assigned accountabilities
- Monitoring and review process

Recommendation 10 Establish an ongoing requirement for an economy-wide energy efficiency and conservation strategy *(MOEA to lead).*

Enacting a requirement for an energy efficiency and conservation strategy into legislation ensures continuity in efforts and resourcing for energy efficiency policy and programs. It also assists in achieving cross-political support for energy efficiency policy and programs.

3. ENERGY DATA COLLECTION AND MONITORING

3.1. Critique

Data collection and monitoring relating to energy, energy efficiency and conservation (EE&C) and CO_2 reduction in Chinese Taipei has been satisfactory. This is demonstrated by the large number of government agencies and private research institutes and companies that collect energy related data (**Figure 17**). While there are a number of government agencies involved in the collection of data, the ministries share data on request.

Data collection is conducted through a survey questionnaire or directly updating data on the BOE website. Monitoring and evaluation of progress and the achievement of targets are carried out regularly. The introduction of a single organisation or authority will help to streamline and simplify data collection and monitoring efforts.

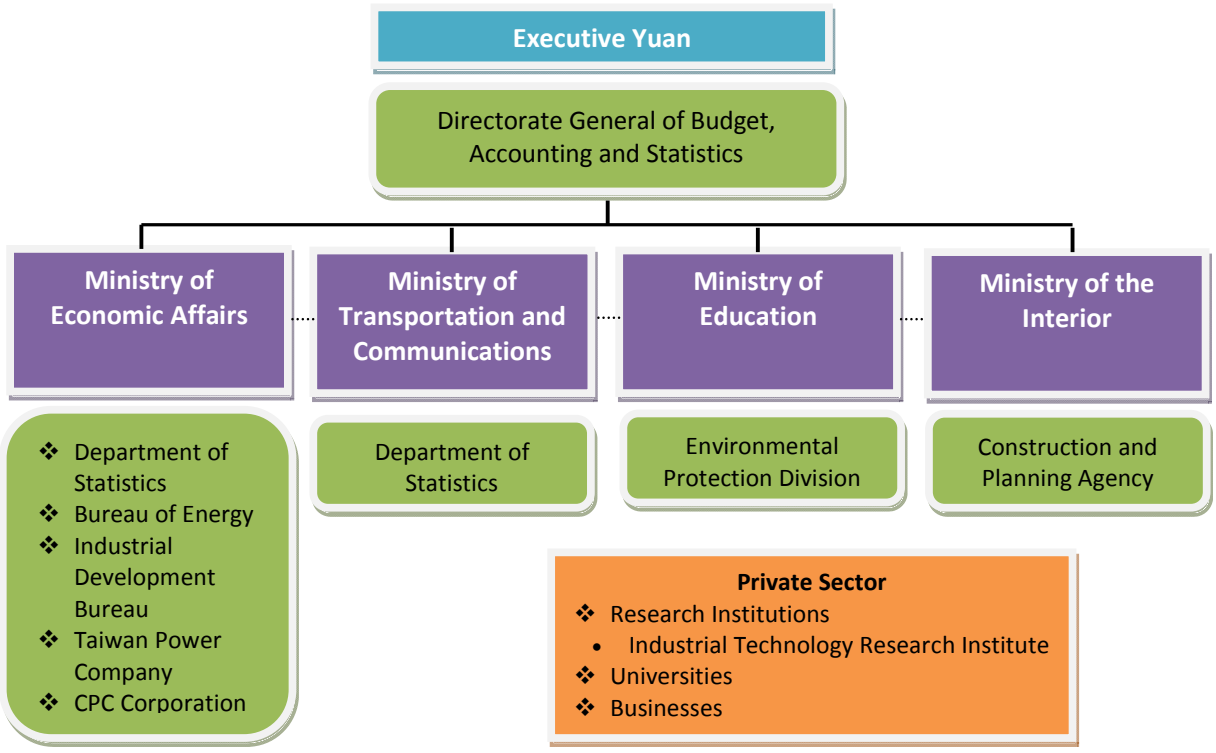


Figure 17 Organisations that collect energy related data

3.2. Recommendations

Recommendation 11 *To establish a "Chinese Taipei Data and Information Centre", which is focused on energy data collection and monitoring.*

The introduction of a new centre is based on the need to ensure a strong focus data collection and analysis in order to monitor progress toward EE&C and CO_2 reduction goals. The introduction of a single organisation or authority will help to streamline and simplify data collection and monitoring efforts.

Example: In Indonesia, the "Data and Information Centre" in the "General Secretariat for Energy and Mineral Resources, Ministry of Energy and Mineral Resources Republic of Indonesia" has been established as the single authority responsible for energy data collection.

4. POLICY MEASURES – INDUSTRY SECTOR

4.1. Critique

The Review Team believes that the IDB and BOE cooperate well with the private sector to achieve important economy-wide policy objectives such as energy diversification and efficiency improvement under scarce domestic energy resources and high import dependence. A comprehensive energy efficiency law was enacted in 1980 and has been revised several times to reflect the changing economic environment. Energy efficiency law in Chinese Taipei focuses on the industry sector which consists of some energy intensive or emerging and promising sub-sectors.

The Review Team acknowledges that Chinese Taipei has clear economy-wide energy efficiency goals. However, goals for the industry sector are not well defined. The economy-wide economic growth strategy is linked with energy efficiency action plans to develop larger markets for PV cells, efficient lighting and appliances.

In the Review Team's opinion, Chinese Taipei has established tangible energy efficiency action plans and milestones, learning from international best practices, and that they are consistent with global standards. MOEA are responsible for and have implemented appropriate mechanisms to follow-up progress and achievements of these action plans and milestones periodically. Major action plans that apply to the industry sector are as follows:

1. Encouraging the replacement of old and inefficient coal-fired power plants with plants based on the best available technology (BAT) such as gas (combined-cycle) plants and ultra super critical coal-fired plants
2. Requiring the adoption of BATs for large investments and following-up that this has been adhered to during the approval and licensing process
3. The provision of appropriate incentives to encourage the uptake of high efficient equipment such as motors, boilers and furnaces
4. Encouraging private companies to integrate energy and resource networks in industrial parks
5. The promotional energy efficiency model project to demonstrate and deploy energy efficient technologies and equipment
6. The development of a product-based specific energy consumption (SEC) standard for production for more than 100 products and processes. An effective mechanism is in place to utilise the knowledge and experiences of experts and manufacturers during the standard setting process
7. Requiring large energy users to report annual energy consumption, future plans for and to investigate their results
8. Promoting voluntary agreements for better energy efficiency in energy intensive sub-sectors
9. Enhancing energy audits and technical advice services for SMEs
10. Providing training courses for energy managers and experts
11. Providing SME support programs, cooperating with ESCOs and large enterprises.

Chinese Taipei has experienced considerable structural change in the industry sector. During the 1980s, the manufacture of consumer goods was dominant, this changed to petrochemical and metals during the 1990s and has been subsequently followed by growth in the production of high added value semiconductor and LCD assembly. As a result of this change, sector-wide energy intensity increased dramatically during the 1990s before declining smoothly in the 2000s. The Review Team considers that it is appropriate to use more specific or categorised indicators based on the characteristics of each sub-sector to fairly evaluate policy effectiveness and energy efficiency activities in the private sector.

BOE collect information on global energy efficiency related R&D activities which they share with domestic stakeholders. Large companies also try to follow these activities. These efforts help Chinese Taipei to provide globally competitive equipment and energy management systems. The government inspection organisation, Taiwan Accreditation Foundation (TAF), evaluates imported products for MEPS and labelling as promptly as domestic products.

Site Visits

The Review Team had an opportunity to visit CHIMEI INNOLUX Corporation in Tainan and China Steel Corporation in Kaohsiung which are globally competitive large enterprises in Chinese Taipei. Both organisations have a good reputation, strong business performance and lead their respective industry segments in energy efficiency activities. Both organisations have a department dedicated to energy efficiency with high level management that have a sound understanding of the government's objectives, energy efficiency law and other related legal frameworks and promote energy management activities. They also have some voluntary efforts for energy efficiency.

CHIMEI understands that electricity for air conditioning is a major part of their energy consumption and tries to optimise temperature, the air flow rate and its path. It sets specific energy consumption benchmarks (kWh/m^2) for their product, LCD panels, and evaluates some plants in the factory. This important benchmark is measured using an established procedure and reported monthly to the Green Committee which is chaired by the high level management in the factory. The benchmark is comparable with those used by plants at other sites. The Green Committee is responsible for promoting energy efficiency, safety and R&D activities and given high priority in the factory.

China Steel Corporation (CSC) is the largest steel making company in Chinese Taipei. It is partially state owned. It produces 10-11 million tonnes of crude steel a year at its integrated steel mill in a large industrial park. CSC also has some subsidiary and/or group steel mills which produce a further 10 million tonnes of steel a year. Energy management and energy efficiency improvements are one of the most important activities for large steel mills. Therefore CSC has created the Energy Conservation Committee chaired by the Vice President of Production and an independent Utilities Department to manage energy use effectively.

CSC has its own power station that uses by-product gases from its blast furnaces and coke plants. The power station is designed to use heavy oil and steaming coal to stabilise its operation. It also installed a coke dry quencher (CDQ), an important piece of BAT equipment to recover heat from hot coke and generate steam and power, a few years ago.

CSC integrates their energy and resource network with some other entities in the industrial park to utilise residual heat. CSC is also ready to share its technical knowledge and experiences with SMEs to improve their energy efficiency.

4.2. Recommendations

Recommendation 12 *Chinese Taipei should continue to collect information on global best practices for policies and measures and recent technology development related to energy efficiency improvement. BOE and relevant agencies should deploy appropriate policies and measures and technologies in the economy.*

Chinese Taipei has already learned a lot from international outcomes. However, international progress in energy efficiency continues to occur. Chinese Taipei will benefit from continued knowledge sharing.

Recommendation 13 *Chinese Taipei should continuously encourage large energy users to report future plans for energy efficiency efforts reflecting recommendations from on-site audits and follow up their achievements.*

To achieve the economy-wide energy efficiency goal, large energy users should realise their potential energy savings. Periodical reporting will invite them to participate more positively in economy-wide energy efficiency activities.

5. POLICY MEASURES – ELECTRICITY SECTOR

5.1. Critique

Chinese Taipei has one integrated power company, the Taiwan Power Company (Taipower), which owns power generators and the transmission and distribution system. There are also nine independent power plants and numerous self generators (renewable and cogeneration). The current structure of the power industry in Chinese Taipei is depicted in **Figure 18**.

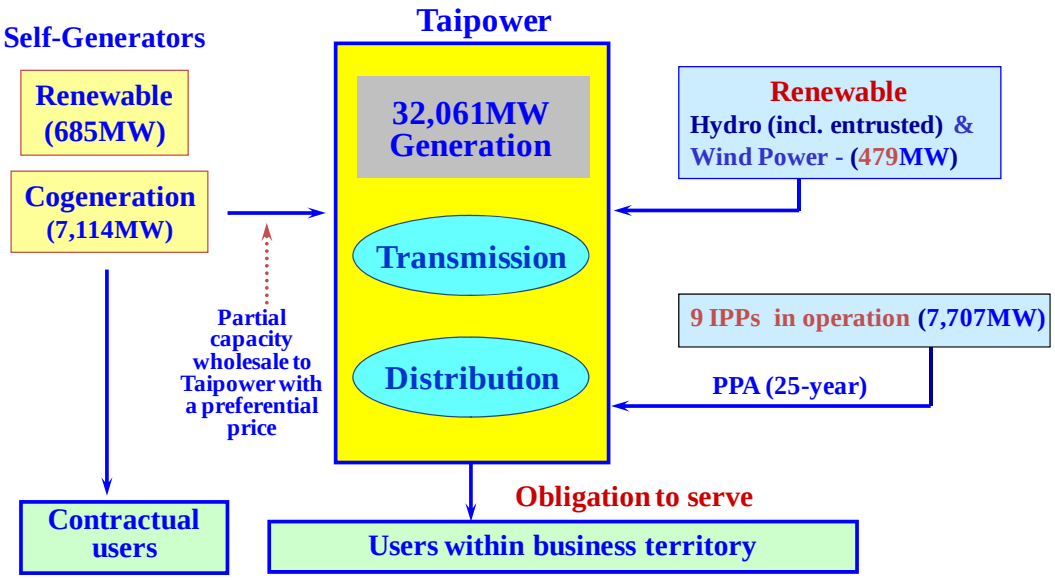


Figure 18 Current Structure of the Power Industry

Installed electricity capacity grew at an average annual rate of 4.9% from 17253.2MW in 1989 to 47984.9MW in 2009. Electricity production grew at an average annual rate of 5.15% from 84.1 TWh in 1989 to 229.7 TWh in 2009. Of the total electricity production in 2009, Taipower's hydro power comprised 3.01%, thermal power 44.09% (coal 28.00%, oil 2.67%, LNG 13.43%), nuclear power 18.10%, wind power 0.16%, cogeneration 17.29%, and IPP 17.35%. The peak load in 2009 reached a record 31,011MW. Electricity consumption increased at an average annual rate of 5.26% from 79.2 TWh in 1989 to 220.8 TWh in 2009. Classified by sector, the industrial sector accounted for 58.37% of electricity consumption, the residential sector 20.46%, the service sector 19.5%, the agriculture sector 1.17% and the transportation sector 0.5%[1].

Wind power and solar energy are more widely used in Chinese Taipei than other forms of renewable energy. The long term goal for renewable energy in Chinese Taipei is for installed capacity to reach 10858 MW by 2030. This is expected to consist of hydro 2502MW (23%), wind power 3156MW (29%), solar 2500MW (23%), biomass 1400 MW (12.9%), ocean energy 600MW (5.5%), geothermal 200MW (1.8%) and Hydrogen fuel cells battery 500MW (4.6%).

[1] Bureau of Energy (2009). Energy Statistics Handbook 2009.

There are many load management measures being implemented to reduce peak load (4568MW in 2009), such as seasonal rates, time of use rates, preferential rates for ice storage and duty cycling control of air conditioning. There are also many successful demand side management policies that provide an incentive pricing mechanism for qualified customers (residential, elementary and junior high schools) to receive a discount on their electricity bill in the range of 5% to 20% when they achieve zero or negative electricity growth. The demand side measures are estimated to reduce energy consumption by 3.7 billion kWh and CO_2 emissions by 2370 thousand tonnes.

However, electricity prices in Chinese Taipei are still lower than other APEC economies as shown in **Table 2**. Low electricity prices can have a negative effect on energy saving. To cope with dramatic fluctuations in fuel prices, Taipower established fuel adjustment clauses to adjust electricity prices seasonally in January 2009. Under this mechanism, the difference between the unit fuel cost (including fuel oil, natural gas and coal) in the base period and the current season is reviewed every three months. If the average electricity unit price (the base year) difference is 1% higher (or lower) than the same season in the previous year, the fuel adjustment clause mechanism will be activated (**Figure 19**). However, it is yet to be implemented. It is very important to introduce a reasonable electricity pricing mechanism in the short-term.

Table 2 Comparison of Residential and Industrial Electricity Price in 2008

Electricity Prices for Households				Electricity Prices for Industry			
Economies	Avg. Price ($/KWh)	Economies	Avg. Price ($/KWh)	Economies	Avg. Price ($/KWh)	Economies	Avg. Price ($/KWh)
Indonesia	0.061	Czech	0.191	Russia	0.05	Spain	0.125
Chinese Taipei	0.086	Poland	0.193	France	0.06	Mexico	0.126
Korea, South	0.089	Austria	0.201	Korea, South	0.06	Portugal	0.131
Thailand	0.094	Japan	0.206	Indonesia	0.064	Turkey	0.139
Mexico	0.096	Spain	0.218	Norway	0.064	Singapore	0.141
United States	0.113	Portugal	0.22	Chinese Taipei	0.067	Chile	0.145
Switzerland	0.154	Slovakia	0.22	United States	0.07	U. K.	0.146
New Zealand	0.164	Hungary	0.224	New Zealand	0.071	Czech	0.151
Norway	0.164	U. K.	0.231	Thailand	0.075	Austria	0.154
Turkey	0.165	Netherlands	0.243	Switzerland	0.094	Hungary	0.17
France	0.169	Ireland	0.267	Finland	0.097	Slovakia	0.174
Finland	0.172	Italy	0.305	Poland	0.119	Dominican Republic	0.207
Singapore	0.19	Denmark	0.396	Brazil	0.12	Italy	0.29

Source: Energy Information Administration (2010)

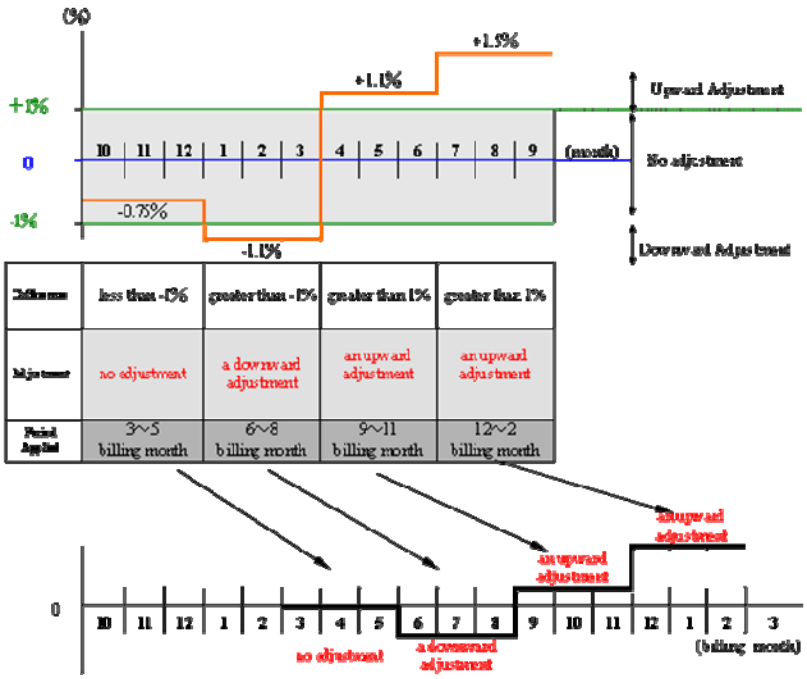


Figure 19 Conceptual Diagram of the Fuel Adjustment Clauses

In 2009, cogeneration (CHP) power supply accounted for 17.29% of total power generation. CHP makes a large contribution to energy conservation because its efficiency is much higher than thermal power plants. Recently, cogeneration facilities have been unwilling to sell electricity to the power grid because the purchasing price, which is based on the present electricity tariff, is too low. Reduced supply to the grid from CHP will affect the energy efficiency of the power sector and increase the total power generation cost.

Since 2004, power system line losses have been less than 5% (**Figure 20**). This is a very strong performance. However, there is still room to improve as the transportation of power from the central and south areas to the demand in the north results in considerable transmission line losses. Ensuring balanced supply and demand for each area could assist in reducing transmission line loss.

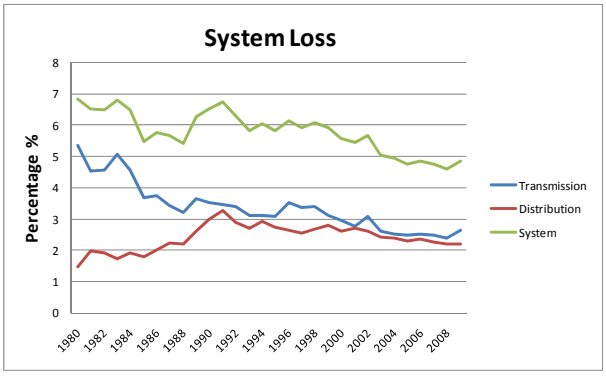


Figure 20 Trend of Line Losses over past 30 years of Taiwan Power Company

5.2. Recommendations

Recommendation 14 *The government needs to adjust the electricity price to meet present electricity generation costs. Once this has been achieved, they should implement existing fuel adjustment clauses, established in January 2009, that adjust electricity prices seasonally.*

To improve the efficiency of electricity consumption and energy saving, a reasonable electricity price is essential. Currently, the electricity price in Chinese Taipei is relatively low compared with other APEC economies. Taipower has lost a considerable amount of money because power generation costs are higher than sale prices. It is difficult for Taipower to invest in improving energy efficiency if it continues to run deficits.

Example: Tokyo Electricity Power Company (TEPCO) has a good mechanism for a fuel cost adjustment system. The system automatically adjusts monthly electricity prices based on changes between a three month average fuel price, including crude oil, liquefied natural gas and coal, and a standard fuel price. A fuel cost adjusted unit price calculated on the basis of average fuel prices from January to March, is applied to electricity fees for June as shown in **Figure 21** and monthly electricity fees are calculated by adding or subtracting the fuel cost adjustment amount as shown in **Figure 22**.
(http://www.tepco.co.jp/en/customer/guide/fuelcost-e.html)

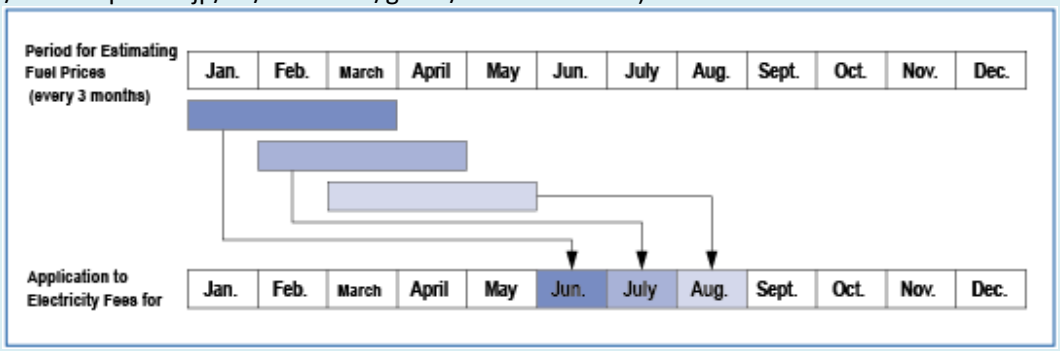


Figure 21 Conceptual Diagram of Fuel Cost Adjustment System

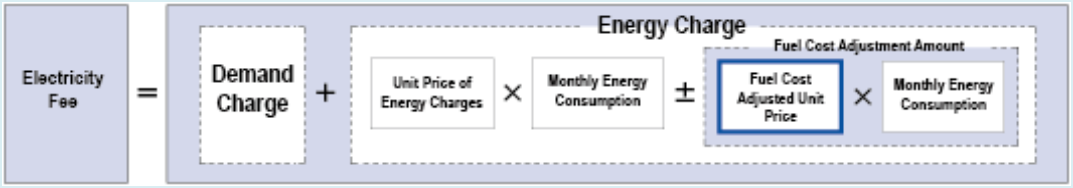


Figure 22 Electricity Fee Calculation

Recommendation 15 *The BOE and Taipower should consider energy efficiency in the overall power supply to set appropriate incentives and reasonable purchase and sales tariffs for cogeneration, such as a dynamic purchasing price based on Taipower's generation cost.*

Cogeneration plays an important role in improving the energy efficiency of power supply because its energy efficiency is higher than thermal power plants. Recently, cogeneration plants have had no intention to sell power to Taipower because it purchases electricity based on the time of use price of electricity. Therefore, they tend to purchase power from Taipower during low tariff times. This situation impacts energy savings in the power sector.

Recommendation 16 *As part of the long-term power resource planning, new unit building costs and end-user efficiency improvement costs should be analysed using cost-benefit analysis.*

In Chinese Taipei, end-user energy saving is still highly political and more money is required to support energy efficiency policies and action plans. Long-term power resource planning needs to evaluate the cost effectiveness of increasing the supply resource compared with reducing end-user demand.

6. POLICY MEASURES – COMMERCIAL AND RESIDENTIAL SECTOR

6.1. Critique

The commercial and residential sectors, though not the largest energy consuming sectors in Chinese Taipei, account for 23.1% of the economy's total energy demand (residential accounts for 11.6% and commercial 11.5%)[2]. These two sectors hold great potential for energy efficiency improvements particularly as the occupants of both residential and commercial buildings continue to add plug loads (more electric appliances and equipment) to their current buildings. The BOE has recognised this and has determined that restraining the growth of consumption in these two sectors (and the transport sector) are its second highest priority as stated in the Strategic Promotion of Energy Conservation Policy in the economy[3]. From 1989 to 2009, Chinese Taipei's energy consumption increased at an average annual rate of 4.92% and electricity production grew at an average rate of 5.15% a year[4].

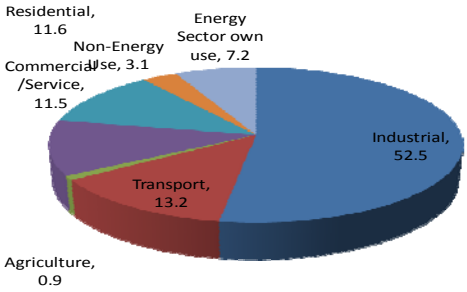


Figure 23 Chinese Taipei's Final Energy Consumption by Sector in 2009[5]

Electricity consumption in the residential sector accounted for 19.5% of total electrical energy use in 2009[6]. Similarly, the commercial sector accounted for 20.5% of total electrical energy use in the same year[7]. In light of the world-wide economic downturn, the demand for electric power declined by 2.8% between 2006 and 2009[8]. However, while demand in the commercial sector declined by 3% over this period, the demand for electricity in the residential sector increased by 1.42%[9]. The increase in

[2] Bureau of Energy, MOEA, *Energy Statistics Handbook 2009*, pg. 12
[3] See, http://www.moeaboe.gov.tw/About/webpage/book_en5/page2.htm
[4] Bureau of Energy, MOEA, *Energy Statistics Handbook 2009*, pg. 13
[5] David Yih-Liang Chan, ITRI, August 23, 2010, slide 4
[6] Bureau of Energy, MOEA, *Energy Statistics Handbook 2009*, pg. 86-87
[7] Ibid, pg. 86-87
[8] Ibid, pg. 35
[9] Ibid, pg. 85

residential electricity demand, even during the downturn, is evidence of the increasing electricity use of Chinese Taipei's population.

Air conditioning, lighting and refrigeration make up the bulk of residential energy use and as these appliances and equipment become more ubiquitous throughout the economy, demand will continue to increase. As in other developed and developing economies, these appliances (and a myriad of others) become more common over time and the energy needed to run them increases as well.

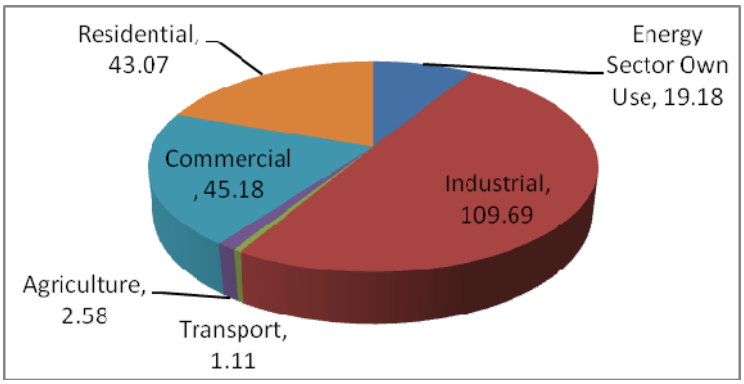


Figure 24 Chinese Taipei's Electricity Consumption by Sector in 2009[10]

The potential for greater electric demand in the future is one of the strongest drivers for Chinese Taipei to dramatically and quickly increase the efficiency of these appliances and accelerate their entry into the market. A very effective means of mitigating rising electric demand is the enactment of strong product standards and labels; a detailed discussion of this is contained in chapter 8 of this report.

Overall, the Review Team believes that Chinese Taipei is working to make energy saving part of their culture and is encouraging energy conservation in all sectors – including the residential and commercial sectors. Chinese Taipei's government leaders in the energy sector recognise that one important aspect of making energy efficiency the "norm" in the residential and commercial sector is to promote changes in consumer behaviour. Chinese Taipei has taken a significant policy and program approach to making these two sectors more energy efficient through a number of efforts:

- Mandatory economy-wide building codes for energy saving were enacted in 1997
- For commercial buildings, a Green Building chapter was included in the National Building Code
- The public sector is required to pass the Green Building design prior to obtaining a building permit
- Technology R&D Action Plans are being implemented for both residential and commercial buildings
- ITRI's RD&D efforts in inverter-fed air conditioning units, high-efficiency chillers, and smart fans have been transferred to the commercial building sector, thereby increasing commercial building efficiency
- BOE Green Building residential building research includes high-efficiency demonstrations (e.g. Taipei Zoo House, photo[11] below)

[10] Bureau of Energy, MOEA, *Energy Statistics Handbook 2009*, pg. 85.

[11] See, http://www.egnret.ewg.apec.org/meetings/engret33/APEC%20EGNRET%2033rd%20Meeting(PDF)/5.%20Zero%20energy%20building/7.%20Moving%20Towards%20Zero%20Energy%20Buildings%20in%20Chinese%20Taipei.pdf

- Highly efficient Green Buildings commercial showcases have been built; for example the National Stadium[12] below, Taipei Library, TSMC Fab, Delta, Inc., etc. (31.2 million m^2 in total)

- Energy Information & Communications Technologies (EICT) are set to drive highly-efficient intelligent green buildings and green industries through synergies in the technology
- Mandatory appliance MEPS for some household products have been coupled with voluntary appliance labelling programs.

Consequently, the energy efficiency policy and program measures implemented by Chinese Taipei resulted in significant savings between 2005 and 2009:

- Large commercial buildings (a sample of 1001) reduced electric use by 6.6% and the associated costs by 7.3%
- Retail chain stores reduced electric use by 12.6 % with an average payback of less than 2.4 years.

Nonetheless, there are a number of areas which could provide greater energy efficiency benefits in the future. This chapter of the report will focus more on the potential for other building efficiency measures that can make a significant impact on increasing the energy efficiency of both residential and commercial buildings in Chinese Taipei. In a recent 2009 report[13], data from a building simulation performed by the National Taipei University of Technology's Department of Energy, Refrigeration and

[12] Photo from, NNSAC presentation to the PREE Experts Group on August 25, 2010.
[13] European Chamber of Commerce Taipei, *Energy Savings Measures for Taiwan's Built Environment*, pgs. 16-19, 2009.

Air Conditioning, shows that cooling (air conditioning) is the area where the largest single load reduction can be achieved in office buildings as well as low-rise and high-rise residential buildings. Improved building codes that increase the efficiency of the building envelope and a strong enforcement program are one way to ensure that such reductions are achieved.

Building Energy Codes Development[14]

As noted previously, Chinese Taipei has economy-wide mandatory building energy codes for commercial and residential buildings:

- *Non-residential Energy Efficiency Standard*, passed in 1995
- *Residential Efficiency Standard*, passed in 1997.

The non-residential (i.e. commercial code) covers five air-conditioned building types:

- office buildings
- department stores
- shopping centres
- hotels
- hospitals.

The 2003 APEC study and the Asia Business Council report both state that the non-residential code is a performance standard covering only the building envelope. However, in a paper submitted to the Review Team by the Construction and Planning Agency of the Ministry of the Interior (CPAMI), it is noted that there are a variety of prescriptive levels for solar heat gain, thermal and optical window properties, etc. The code uses ENVLOAD, a regression-based software program, to calculate the annual cooling load of perimeter spaces against maximum allowable loads for the building envelope. Although minimum efficiencies for HVAC and lighting systems have been proposed, they have not yet been incorporated into the code. Japan uses a similar two-part approach of separating the perimeter envelope load from the HVAC.

As noted above, the commercial code includes only five types of air-conditioned buildings. While the five types are a significant segment of all commercial buildings, there still remain other types of commercial buildings that would benefit from stronger building energy codes. CPAMI in the document cited above notes that the five categories of buildings include many related types of buildings within the category. Therefore, the code may well include other types of commercial buildings.

Nonetheless, Chinese Taipei should consider assessing the building sector and amending the current codes to include all significant non-residential building types, such as high rise multi-family and public buildings.

Example: Singapore's 2008 Code on Environmental Sustainability of Buildings applies to all new buildings and links into the economy's Green Mark program which promotes higher levels of efficiency along with green building.

The residential code is prescriptive. It uses a U-factor requirement for the roof and walls and prescribes a required index level for fenestration. The code is standardised at an economy-wide level but has

[14] *The primary sources of information for this section are a 2003 APEC study, the PREE discussion on 24 August 2010 with representatives of the ARBI and CPA agencies of the Ministry of the Interior, an overview of energy efficiency building standards in Taiwan from the Asia Business Council website, and Aleisha Khan, Director of the Buildings Code Assistance Program who notes that the latter document is not dated but fairly recent as it includes a reference to a 2006 source.*

regional variations based on climate. This does limit the ability of builders to enjoy the flexibility of meeting the code by innovative measures or combinations of measures that are not specifically prescribed.

Consequently, this is a critical item missing from the economy's existing building energy code program. Development of a performance based option should be implemented as it could permit greater efficiency to be achieved in residential construction.

Example: India has a voluntary non-residential building energy code with both a prescriptive and performance compliance path. They are currently working on software, training, and resources to build the skills and knowledge needed to model buildings under the performance option.

Furthermore, building energy codes, as they currently exist are only for new construction. But since new construction represents only a very small percentage (generally less than 3%) of all buildings, the impact of strong building energy codes is relatively small over a short-term time period. However, if building energy codes are applied to major renovations of existing buildings, a much greater reduction in energy consumption and greenhouse gas emissions is possible in the short-term. Renovations could include retrofitting of air conditioning systems, adding ductless split air conditioning units commonly used and seen throughout Asia today (particularly in multi-family residences) or other major renovations.

Therefore, a critical addition to the building energy codes would be to extend the coverage of the current building energy code to include major renovations in both the residential and commercial sector.

Example: Though not widely enforced, the US maintains energy requirements comparable to the new construction standards for major renovations of buildings. The European Union is moving in the direction of requiring energy requirements to be met at time of sale or rent (per discussions at the CEEDS workshop 8-10 September).

Building Energy Code Adoption & enforcement

The Asia Business Council overview estimates that code compliance in Chinese Taipei is over 80%. This high degree of compliance may be attributable to the fact that Chinese Taipei officials are equating this requirement to mean that the design of the proposed building meets the mandatory code requirements before receiving a building permit. However, this is not the same as ensuring that the code is actually complied with during the construction of the building. Enforcement or compliance of building energy codes requires that during and after construction, officials check to see that codes are being followed. Although the Review Team pursued this issue with representatives from the Ministry of the Interior, we were unable to either further confirm any information on the compliance of actual construction or determine any level of checking/enforcement process after the initial building plans have been submitted. In a subsequent document received from CPAMI (referred to above), it is noted that under Chinese Taipei's Building Act, Article 56 (inspections during construction) and Article 70 (inspections after construction is complete) require local governments to complete inspections prior to issuance of a building usage license. Article 87 of the above cited Building Act provides for fines if the work is not performed in accordance with the code requirements.

Consequently, it appears that the economy's existing building energy code program does provide for code compliance, though an analysis of the results of the inspections would be very useful in

determining the level of compliance. Therefore, it would be prudent to conduct a study of compliance enforcement to verify that the code was in fact followed during, and after, the building completion.

Example: The European Union has innovative examples of strategies for code enforcement including professional architect certification that can be revoked if a building is found to be out of compliance with the code. Denmark uses a two-stage compliance process – first providing permission to build based on code compliance of the building design and second, providing permission for occupancy based on the construction meeting the design requirements. Sweden requires a follow-up report two years AFTER construction to verify the predicted performance of each building.

Building Energy Code Review and Updates

From the documentation and the discussions, the specific process to review and update the energy codes is not clear. However, as stated above, additions to the commercial code have been proposed (either initially or since the code was established in 1995). Discussions during the Review Team's meetings indicated that there are plans to update the code as a part of Chinese Taipei's recent goals for energy reduction by 2025 and information provided by Chinese Taipei indicates that codes have been revised "…every 2 to 3 years"..

Nonetheless, ad hoc updating of codes is not the best way to drive improved efficiency in the building market. A regular code updating process is used by a number of economies (e.g. the US) to ensure that the construction of buildings keeps up with the newest and most efficient technologies. Without mandatory requirements or performance goals, the efficiency of buildings will tend to stagnate, flat line, or at best show only very small improvements over time. However, with increasingly stringent building energy codes, reviewed and updated on a regular basis, an economy can ensure that its buildings will become more and more efficient over time. One way that this will occur is by providing incentives to use the newest commercially available energy efficient building technologies in the construction of new buildings, and locking these practices into code once they are proven to be cost-effective and widely-available. In this way, the economy can ensure that construction and technology are moving forward in tandem. In addition, a regular code review process ensures that all stakeholders are given an opportunity to provide feedback into the process, which helps ensure buy-in to code amendments from all interested parties.

Therefore, reviews and updates are an area that could be improved and which would enhance the overall codes process. Chinese Taipei should address this critical item missing from the economy's existing building energy code program by developing a clear and transparent process for improving the codes on a regular basis.

Example: Although US energy codes are not developed by the government, as in most other economies, the process provides consistency through revisions every three years, and facilitates support, by engaging policymakers and industry. These two elements are critical, and could be replicated effectively in a different manner appropriate to Chinese Taipei.

Building Energy Code Stringency

How stringent a code is compared with another code can provide valuable insight and data to determine the code's effectiveness. For example, in the United States, code-to-code comparisons are completed to determine the potential effect of a change from one code requirement level to another, or to compare the effectiveness of a new building energy code to the prior one. Understanding the

changes to codes can help measure the effectiveness and overall energy savings of new or proposed codes[15].

Comparing codes between economies is more difficult as climate, infrastructure, product availability, and buildings covered may differ. Nonetheless, a codes comparison can still be used to help enhance existing or proposed codes in a single economy by understanding similar code issues where they overlap. By looking at overall energy building codes, or just specific code sections, in other similar economies with similar climate, infrastructure, etc., Chinese Taipei may be able to improve its current codes.

Therefore, while the Review Team are not aware of any studies that compare the stringency levels of Chinese Taipei's code to other economies, a study comparing codes, or at least common sections of codes, to other economies with similar climate and infrastructure conditions should be performed. This study should include modelling potential code changes in Chinese Taipei to assess their impact. This approach would inform code officials in the Ministry of the Interior where enhancements could be achieved and yield significant results in energy efficiency and savings for Chinese Taipei's building sector.

Example: A model comparison was developed for India's energy code, the Energy Conservation Building Code (ECBC), and ASHRAE Standard 90.1, developed for the US. The India model comparison code helped inform appropriate changes to meet the specific characteristics of the Indian climate**.**

The Green Building Program and Label

Chinese Taipei has more than a decade of work on developing a "Green Building Era" throughout the economy[16]. Beginning in 1998, Chinese Taipei began developing a Green Building evaluation system, which by 2005 was institutionalised in a chapter of the National Building Code, and followed by a Green Building rating system in 2007. This program has been quite effective.

One of the actions that made this program effective was the inclusion of local government buildings in the Green Building Evaluation system in 2003. From induction until 2009, more than 2,400 public sector buildings have been certified as "Green Buildings".

Another critical action implemented to improve the energy efficiency of the building stock is that since 2004 the Ministry of the Interior has been budgeting for an incentive program to initiate design and improvement measures in the existing building sector (which represents 97% of the total building sector). From 2004 to 2009, 69 private sector buildings received incentives for improving and demonstrating construction of Green Buildings.

The addition of a "Green Building" code in the National Building Code in 2005 also provided strong government leadership to improve its new and existing building stock. The technical Green Building regulations include five specific areas for buildings above a specified size:

- Greenery of the Site
- Soil Water Content

[15] For example, see, http://www.pnl.gov/main/publications/external/technical_reports/PNNL-15356.pdf

[16] See, "*An Overview of Green Building Promotion in Chinese Taipei*", C Bor-Shyun & L Chung-Pi presentation, August 24, 2010.

[15a] A Green Materials Label was created in 2004 and has been incorporated into the Green Buildings chapter of the National Building Energy Codes.

- Energy Savings of the Building
- Recycling of Rainwater and Waste Water
- Green Building Materials.

Chinese Taipei Green Building Label

綠建築標章
GREEN BUILDING

Chinese Taipei Green Materials Label[15a]

綠建材
Green Building Material
高性能 High-performance
再生 Recycling
生態 Ecological
健康 Healthy

Figure 25 Green Building Labels

The regulations require that the architect be responsible to implement the certification system. Initially the regulations only applied to building design. However, currently the certification label (for public sector buildings) can only be obtained after the completion of construction work.

In 2007, a new Green Building Evaluation system was established with five levels of certification:

Table 3 Chinese Taipei's Building Rating Levels and Scoring Ranges

Level	Points
Certified	12 to 26
Bronze	26 to 34
Silver	34 to 42
Gold	42 to 53
Diamond	53 and up

The criteria and the points for achieving a particular level are specified in the table below:

Table 4 Chinese Taipei's Building Evaluation and Scoring Criteria

Evaluation Criteria	Indicators	Minimum	Maximum	Total
Ecology	Biodiversity	2	9	27
	Greenery	2	9	
	Soil Water Content	2	9	
Energy Saving	Shell	2	12	28
	HVAC	2	10	
	Lighting	2	6	
Waste Reduction	CO_2 Emissions	2	9	18
	Waste Reduction	2	9	
Health	IEQ	2	12	27
	Water Conservation	2	9	
	Sewage & Garbage	2	6	

While the Green Building Evaluation system and corresponding certifications and labels are a significant means to achieve higher levels of efficiency in the building sector, Chinese Taipei should consider amending the regulations to make building labels mandatory.

Eco-Cities Program

Chinese Taipei has committed to a long-term strategy on becoming a more sustainable economy through its energy efficiency programs on buildings as a first step to Eco-Cities. The government has made Eco-Cities a top priority of its sustainability program. The actions it has taken through the implementation of the Green Buildings chapter in the National Building Code and incentive programs to bring the private sector segment of the buildings industry into the Green Buildings program is moving the economy in the right direction.

The Eco-City program has enveloped the Green Building Promotion program which runs from 2008 through 2011. This "promotion" program includes a number of critical strategic directions[17]:

- Strengthening mandatory green building certification for public sector buildings
- Energy efficiency improvements in the existing building stock
- Protection of human health and IEQ improvements
- Development of Eco-Communities as part of the Eco-City program.

Three additional areas which could be added to the Eco-City program would include "Cool Roofs", "Watergy", and a low income residential retrofit program.

Cool Roofs is a program that has been supported for many years by the US Department of Energy[18] and is an ideal program for economies with a tropical or subtropical climate. Cool roofs incorporate, among other technologies, lighter colours and infrared (IR) Blocking Pigments. Cool Roof programs are focused on solar reflectance and thermal emittance. Numerous economies are aware of cool roof benefits and some have building code requirements, but general testing and rating infrastructure often does not exist. Cool roofs save up to around 25% of the roofing energy loads or roughly 5% to 15% of total air conditioning loads. Modelling of peak demand reduction stemming from cool roofs in India show a 7% to 8% reduction for new construction with much higher results for existing buildings.

Consequently, Cool Roofs is a program that Chinese Taipei should adopt as part of its Eco-City program and amend the Green Building chapter of the Code to include a Cool Roofs regulation.

The Water Resources Agency of MOEA is actively promoting water-saving products and the use of recycled rainwater and domestic wastewater. The water supply corporation or related units are making a big effort to replace old water pipes and establish a web-based management system for each water supply district. This is a good start on reducing water and energy waste. An example of a structured water/energy program that has a high rate of success is Watergy, a program that has been carried out by the Alliance to Save Energy for nearly 15 years[19]. The program helps cities realise significant energy, water and monetary savings through technical and managerial changes in municipal water supply systems, providing consumers with quality water while using minimal water and energy. Watergy projects implement efficiency measures that repay themselves quickly and the resulting savings in money and water reap many rewards: immediate improvements in water service, increased water delivery, reduced water and energy consumption, and more revenue for system upgrades and new

[16] Op cit. #15
[17] Marc LaFrance, US Department of Energy, "*Proposed Cool Roof Project for APP"*, October 7, 2009 presentation.
[18] See, http://www.watergy.org/ for case studies and additional information.

customer connections. Aside from reducing energy consumption and greenhouse gas emissions of the municipal water utility, at the core of all projects is the strategy of designing projects to build capacity locally so the benefits of any intervention continue long after the project has ended. This is a key principal of sustainability and therefore, Chinese Taipei should adopt and implement a Watergy type program as part of its overall Eco-City program.

Finally, although the Review Team did not have any discussions about improving the energy efficiency of residences in the low-income community in Chinese Taipei, this is an important topic when viewing an economy's overall energy efficiency program. In many economies, this segment of the population is often saddled with the oldest and most inefficient buildings and appliances. They are also the segment of the citizenry that is most likely to be unable to meet even minimum costs for energy and therefore the most uncomfortable in extreme weather conditions. Creation of a government subsidised assistance program to weatherise these residences and replace major energy using appliances should be part of any city's overall sustainability program. Chinese Taipei could implement a low-income residential retrofit program.

6.2. Recommendations

Recommendation 17 *Perform a "comparative study" of the stringency levels of Chinese Taipei's code to other similar economies with similar climate conditions and building infrastructure.*

A study will help chart a pathway to more stringent code adoption, resulting in Chinese Taipei being viewed as leader in energy codes in the region. A study undertaken in Florida USA showed a 4% decrease in electric consumption under a more stringent 2002 code compared with a prior code.

Recommendation 18 *Create a "Performance" based building energy code for residential construction.*

More flexibility for builders and owners to meet code.

Recommendation 19 *Conduct a study on code compliance to ensure (1) that green building criteria contained in the building codes are met during post construction review/approval and (2) that a high level of compliance is achieved.*

Ensures buildings are built to design specifications and that a robust level of compliance with the codes is achieved.

Recommendation 20 *Include major renovations and promote "passive" design features.*

Major renovations bring the other 97% of buildings (the "existing" buildings sector) into potential code compliance. Passive design can lower solar heat gain (SHG) and significantly reduce heat load and decrease energy consumption.

Recommendation 21 *Promote "cool roofs" as a major component of codes and as part of the Eco-Cities program.*

Cool Roofs are most effective for low rise buildings in tropical and sub-tropical climates and can reduce energy consumption by up to 15% of total air conditioning loads. A study of cool roofs in India showed that electric demand could be reduced by more than 7% when cool roofs are used.

Recommendation 22 *Building energy codes should be revised and increased every 2 years.*

Having a "regular" process and timing for enhancing the building code ensures construction keeps pace with technology advancement, while allowing feedback from all interested stakeholders. In addition, energy consumption is guaranteed to be reduced in new buildings over time.

Recommendation 23 *Enact regulations to make building labels mandatory for both the residential and commercial building sectors.*

Labels drive consumers to demand higher efficiency in the homes they build (similar to how labels for appliances drive purchasers to buy high efficiency products). Further, labels drive consumers to demand more efficient and green commercial buildings, making them prime investments and commanding a higher sale price and rent than conventional non-green or efficient buildings.

Recommendation 24 *The Government should lead by example. i.e. demonstrate "net-zero energy buildings" and challenge the private sector to match/exceed agency goals/targets.*

While government buildings are mandated to meet Green Building design criteria in the National Building Code, government should push the technology envelope, mitigating the inherent risks and lead in the adoption of new technologies. A challenge to the public based on government goals can accelerate the green technology industry throughout the economy.

Recommendation 25 *Under the Eco-Cities program, have a special focus on municipal water utilities to reduce water loss and decrease energy use.*

City water utilities consume enormous amounts of energy moving water from the source to the consumer. Water loss is common through leakage and old infrastructure and thereby uses energy to move water that never reaches the consumer. Leakage control, maintenance improvements, SCADA like control systems, and proper sizing and operation of pumps and motors can significantly reduce energy consumption and have paybacks of 4 months to 2 years. Energy savings can then be used for other City needs. The improved system helps achieve the Eco-City designation.

Recommendation 26 *Develop a Low Income Residential Retrofit Program*

This program would ensure lower energy expenditure for most vulnerable citizens and will enhances social leadership programs.

7. POLICY MEASURES – TRANSPORT SECTOR

7.1. Critique

Energy use in the transport sector in Chinese Taipei is relatively low with respect to its population and economic development. **Figure 26** shows a comparison of the energy use in the road and railway transportation for selected economies. On a per capita basis, energy use in Chinese Taipei is lower than most OECD economies including Korea and Japan.

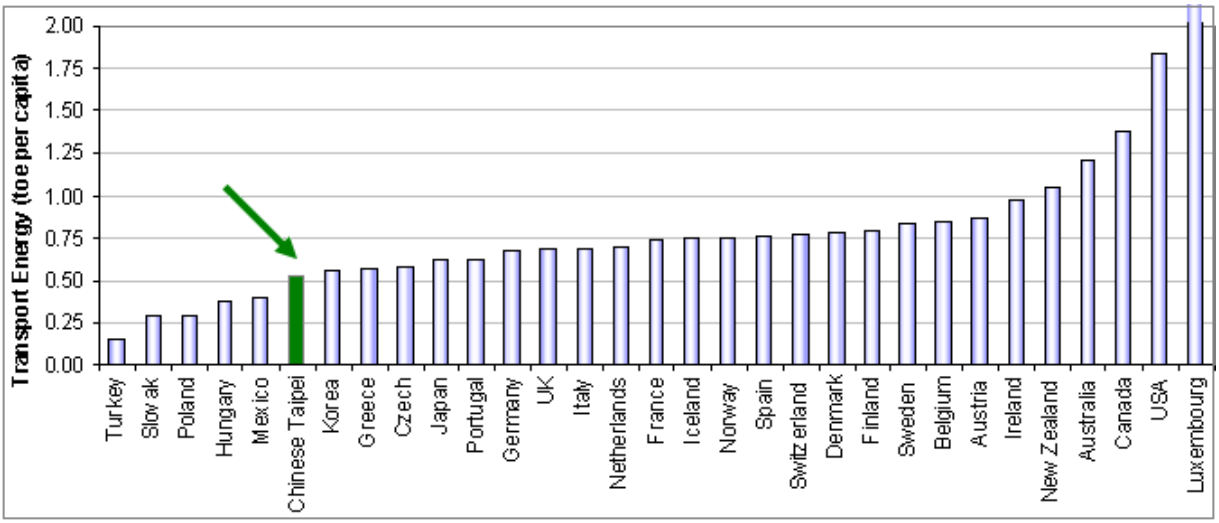


Figure 26 Comparison of Energy Use in Road and Railway Transportation (2004, toe per capita)*

*Data sources: OECD Environmental Data Compendium 2006-2008; Institute of Transportation (IOT) in the Ministry of Transportation and Communications (MOTC), Chinese Taipei. *toe = Ton of Oil Equivalent*

Chinese Taipei has put in place excellent strategies, plans, and actions for the development of mass public transportation systems. These include:

- Mass Rapid Transit systems are operational in Taipei and Kaohsiung, under construction for connecting Taipei-Taoyuan (International Airport), and planned for Taichung
- High speed rail, connecting Taipei and Kaohsiung, the two largest cities in Chinese Taipei located in the north and the south, respectively
- Connecting services for high speed rail and public transport transfer centres
- Replacing the old buses and deploying a dynamic bus network, priority information system
- Integrated public transport ticketing system.

Car ownership and motor vehicle composition in Chinese Taipei may contribute to the relatively low energy use. The motor vehicle population at the end of 2009 was 21.4 million, among which, 5.7 million were cars and 14.6 million motorcycles. Compared with economies at a similar level of economic development, car ownership in Chinese Taipei is low. An unusually high percentage of travel is made by motorcycles. From an energy efficiency point of view, this is good as travel by motorcycle consumes much less energy than by car (see **Figure 27**).

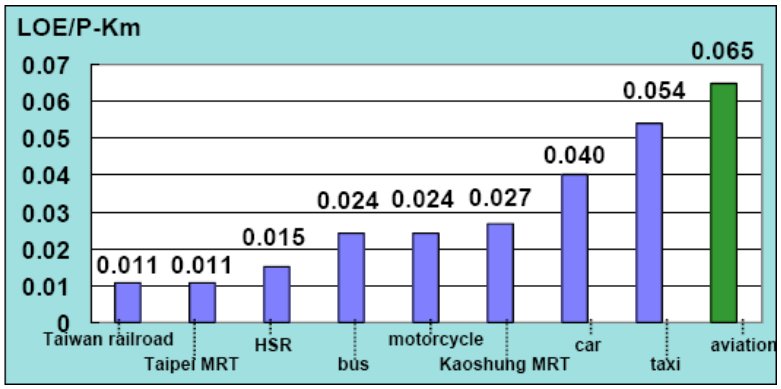


Figure 27 Comparison of Energy Consumption per Passenger-km by Mode

Data source: Institute of Transportation (IOT) in the Ministry of Transportation and Communications (MOTC)

The 13.4% modal share of public transportation in Chinese Taipei can be improved. Examination of modal share by region reveals that in a few cities and counties, the modal share of public transportation is significantly higher than other regions. These include Taipei City, Keelung City, and Taipei County (see **Figure 28**).

In line with the target to reduce CO_2 to the 2000 level, the transportation sector has been set a target to reduce emissions by 11.57 million tonnes of CO_2 from the Business As Usual (BAU) scenario in 2025, which is estimated to be 45.08 million tonnes. In order to achieve this ambitious target, the Ministry of Transportation and Communications (MOTC) has, together with other ministries and agencies, worked out a set of action plans. CO_2 reduction has been estimated for many of the action plans. These include:

- Providing a convenient public transportation system. It is estimated that the enhancement of the road public transport system would result in the reduction of emissions by 0.019 million tonnes CO_2 annually by 2012, and building a convenient rail transportation network by 0.839 million tonnes CO_2 annually by 2025.
- Building an electronic toll collection system on the freeway, estimated annual reduction of CO_2 emissions of 0.029 million tonnes by 2025.
- Building bicycle and pedestrian systems in urban areas, estimated CO_2 reduction of 0.809 million tonnes annually by 2012
- Encouraging the use of alternative fuel vehicles, estimated CO_2 reduction of 2.25 million tonnes annually by 2025.
- Raising vehicle fuel economy standards by 25% in 2015.
- Reviewing and revising standards for road lighting.

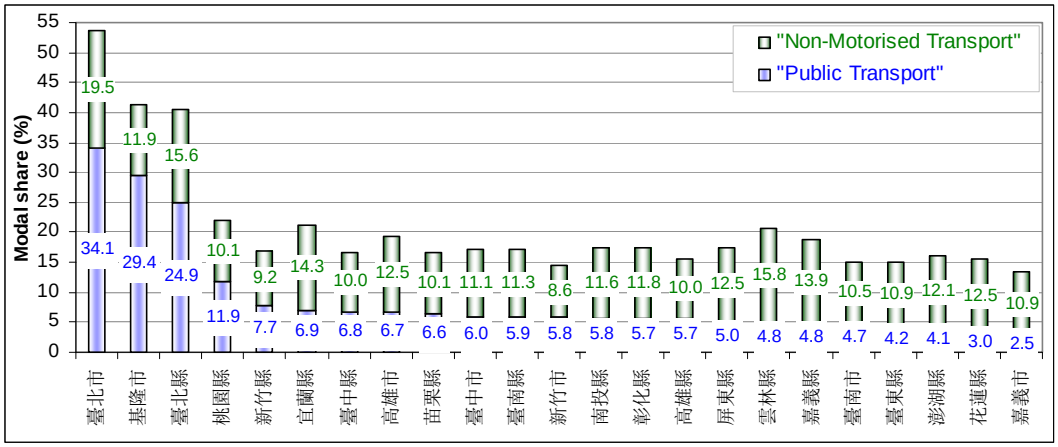


Figure 28 Green Transport Mode Share by City / County in Chinese Taipei

Data source: Ministry of Transportation and Communications (MOTC) http://www.motc.gov.tw/

Unlike other sectors in Chinese Taipei, the share of the transportation sector in energy consumption declined from 16.8% in 1999 to 13.2% in 2009 (**Figure 6**, part 1). While total energy consumption increased by 1.39% from 2005 to 2008, energy consumption in the transportation sector declined by 2.37%.

It is noted that the annual mileage per car on average declined significantly from 2006 to 2009 (see **Figure 29a**), which might had been a main contributing factor to the reduced energy consumption. Although fuel economy standards could have helped more energy efficient vehicles to be placed in the market, motorists have been acquiring larger cars over the years (see **Figure 29b**). The percentage of cars with an engine size greater than 1,800cc increased from 42.7% in 2004 to 46.1% in 2009. It is therefore not clear to what extent fuel economy standards have contributed to the reduction in the overall fuel consumption.

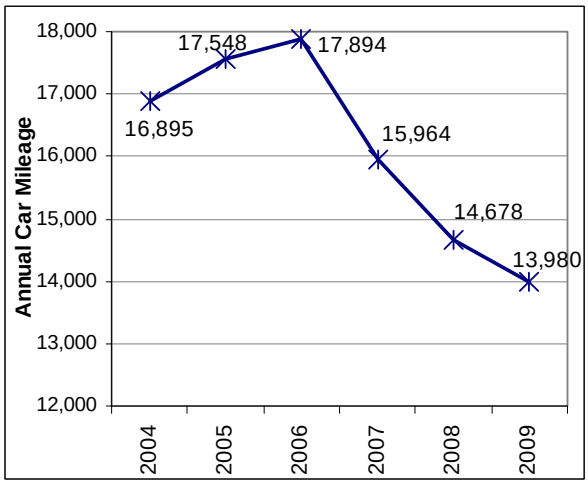


Figure 29a Change in Annual Mileage (km)

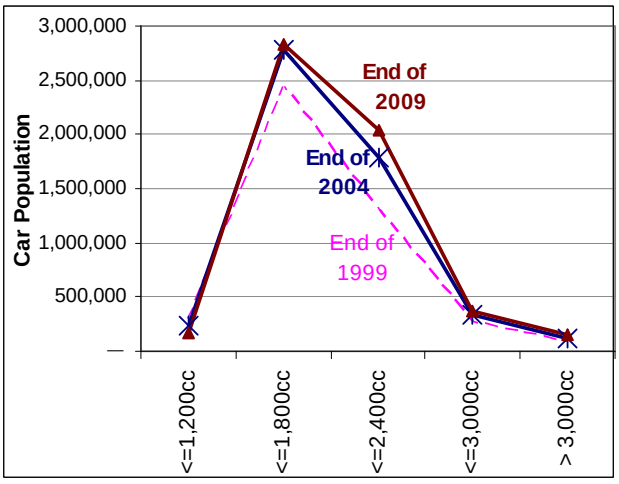


Figure 29b Change in Car Population by Engine Size

Data source: Ministry of Transportation and Communications (MOTC) http://www.motc.gov.tw/

The Review Team believes that the promotion of energy efficient transportation by multiple agencies is good practice. For example, freight transportation companies are required under Energy Management Law to report energy consumption, and are provided assistance by Energy Conservation technical services on fleet scheduling. The "Low Carbon Campus" program coordinated by the Ministry of Education also promotes green transportation in schools.

7.2. Recommendations

Recommendation 27 *Chinese Taipei should set a sub-target for energy consumption in the transportation sector in relation to the economy-wide energy intensity target, and regularly monitor the progress towards this sub-target.*

- The sub-target for the transportation sector can be integrated into the existing CO_2 reduction target, but contributions from energy efficiency improvement and the use of lower-carbon energy need to be clearly defined
- Transportation demand growth and the road-based freight transportation need to be taken into consideration when the actions to achieve this sub-target are planned
- There should be regular monitoring of the sub-target, and analysis of the effectiveness of actions in order to refine the action plans to achieve this sub-target.

The economy-wide target needs to be directly supported by sector sub-targets, this is especially so in the transportation sector where demand increases with economic development. Overall energy consumption can only be controlled if the progress towards the target is regularly monitored, the overall effectiveness of actions analysed, and the plans and programs refined to close any missing gaps. There is a need to further analyse the contributing factors for the reduction in energy consumption in recent years. This is to ensure that other policy measures, in addition to raising the fuel economy standards, are put in place to sustain the reduced energy consumption in the transportation sector.

Recommendation 28 *Chinese Taipei should summarise best practices from cities with high modal share of mass public transportation, including lower car usage, and deploy economy-wide.*

- There should be systematic studies on the success factors from cities with high modal share of mass public transportation
- The best practices summarised from these studies should be deployed to other cities and regions. The Chinese Taipei government should consider using collaborative frameworks, incentives and legislation for the local governments to increase modal share of mass public transportation and/or to adopt the best practices.

The provision of mass public transportation systems alone does not guarantee an efficient use of these systems, as in the case of Kaohsiung. Best practices that have contributed to the high utilisation of MRT systems and buses in the local context such as those in Taipei would be more likely to be effective and easier to deploy, than those imported from overseas. The Chinese Taipei government should consider using collaborative frameworks, incentives and legislation based on the performance targets of system utilisation (outcome-based) and/or the adoption of best practices (prescriptive), to ensure that the local governments work towards the economy-wide targets.

Recommendation 29 *Chinese Taipei should develop a holistic pricing structure for the whole passenger transport system in order to discourage the use of inefficient transportation modes and vehicles.*

- Increasing the cost of driving would deter the use of cars, the least energy efficient transportation mode. However, it is not easy to gain buy-in from the public, communities and organisations to raise the motoring cost in any economy. A few methods to increase the cost of driving are listed below for consideration:
  - Raising the fuel price (e.g. carbon tax, energy tax, fuel tax)
  - Raising parking fees (e.g. parking tax, limiting provision of parking spaces)
  - Raising toll fees or introducing congestion charging.
- To gain buy-in from citizens and communities, additional revenue from these measures may be earmarked to special mass transport development and promotion funds
- Ensure a system to support low-income groups.

A lack of cost disparity sends the wrong signal to society, especially motorists, as driving is more convenient and comfortable but consumes more resources than using mass public transportation systems. A holistic pricing structure for the whole passenger transport system can be regarded as the ultimate target for all transportation modes and vehicles. In this way, taxes and/or legislations proposed at different times when opportunities arise would follow a pre-defined roadmap towards the ultimate pricing structure, instead of piecemeal which might send conflicting signals to the society. When developing the holistic pricing structure, Chinese Taipei should design mechanisms that help gain public buy-in (e.g. earmark increased charges to special mass transport development and promotion funds) and ensure a system to support low-income groups.

Recommendation 30 *Chinese Taipei should use targeted marketing to promote and encourage organisations and individuals to adopt efficient transportation modes and travel behaviours (e.g. personalised travel planning, workplace travel planning, eco-driving).*

- These targeted marketing efforts can be integrated into the existing energy conservation technical services, the “Low Carbon Campus” program, and/or new projects or programs.
- Programs should be developed to continually encourage organisations to shift their employees from driving to green transport (e.g. public transportation, cycling, walking), home-based working, and tele-conferencing.
- Personalised travel plans and workplace travel plans should be promoted to change travel behaviours (e.g. TravelSmart in Australia, Smarter Choice Programs in the UK, Travel Feedback Programs in Japan)
- Efficient transport practices should be further promoted and trained to organisations with fleet operations, e.g. eco-driving, reducing empty-cruise

The Review Team noted that there is a low awareness of many soft measures to promote and encourage organisations and individuals to adopt efficient transportation modes and travel behaviours (e.g. personalised travel planning, workplace travel planning, eco-driving). These measures have been widely applied in many economies. Targeted marketing such as travel planning complement the provision of infrastructure, services and pricing mechanisms, and help gain public buy-in when the cost of driving is raised. Targeted marketing also complements general marketing (e.g. no-driving day) by developing technical know-how in the society and continually encouraging organisations and individuals to start and sustain their behaviour changes.

8. APPLIANCES AND EQUIPMENT

8.1. Critique

Chinese Taipei's energy standards and labelling programs have been implemented since 2001, targeting products including home appliances, low-voltage single and three phase motors, lighting, office equipment, gas burning appliances and vehicles (automobiles, light trucks and motorcycles).

For equipment and appliance energy consumers, the Bureau of Energy (BOE) has developed 15 Minimum Energy Performance Standards (MEPS).

Chinese Taipei has developed a mechanism for post-market surveillance and inspection to ensure that the energy consumption volume and the efficiency of specified appliances or equipment meet the requirements. BOE enforces the post-market surveillance actions.

Currently, there are 30 product categories, 4,397 products and 260 brand names that have obtained an energy efficiency label. Since 1 July 2010, air conditioners, refrigerators, automobiles and motorcycles have become part of the mandatory labelling program. At present, there are 2,354 air conditioner models, 494 refrigerator models, 1,700 automobile models and 420 motorcycle models that have completed mandatory energy label applications.

Between 1 October 2008 and 31 March 31 2009, Chinese Taipei implemented the Rebate on High Efficiency Electric Appliances program. The program was for 320,000 units including air conditioners, refrigerators and clothes washers manufactured in Chinese Taipei and marked with an energy-saving label. The rebate subsidy was NTD 2,000 per unit and contributed to annual energy savings of 39.48 GWh and an annual CO_2 reduction of 25,151 tonnes.

The cumulative volume savings resulting from energy conservation labelling between 2004 and 2009 is estimated to be around 591,000 kLOE, and CO_2 reductions of around 1,522,000 tonnes.

Two main energy efficiency policies are adopted in many economies for appliances and equipment. These are Minimum Energy Performance Standards (MEPS) and Energy Information Labelling (EIL). These policies especially Mandatory MEPS and EIL will enhance the uptake of high efficiency products.

BOE has developed 15 MEPS. However, some MEPS should be revised to meet minimum energy efficiency specifications in accordance with current available technology and MEPS should also be extended to other equipment.

The energy efficiency labelling program considers a five-level ranking scheme, where a ranking of one indicates the most efficient product while a ranking of five indicates that it is less efficient. The labels are shown in **Figure 14** (Part 1).

The basis for determining the energy efficiency criteria for energy labelled products is to evaluate the energy performance of products on the market and select the middle to top performers on the efficiency distribution curve. The efficiency criteria are then periodically reviewed and revised to reflect market conditions. The above measures ensure creditability of the energy label in denoting high energy efficiency products.

Of the 30 products that currently have an energy efficiency label, 27 products categories are part of a voluntary labelling program. Recently labelling of air conditioners, refrigerators, automobiles and motorcycles became mandatory. It is easier to find appliances labelled as level 5 than it is to find products with a ranking of 1.

To implement the Revised Energy Management Law, Chinese Taipei will launch an energy efficiency level classification and labelling system for mandatory implementation on all energy consuming equipment and appliances. However, an implementation date has not been set.

To promote energy conservation; encourage the industry to produce high-efficiency, energy-saving products; and guide consumer preference, the BOE has formulated guidelines for using energy conservation labels.

BOE has publicised its draft energy-efficiency standard for incandescent bulbs. It estimated that around 22.5 million incandescent bulbs will need to be replaced with power-saving lighting or LED (light emitting diode) lights. This is a great opportunity for LED technology and it will be an example for the world.

8.2. Recommendations

Recommendation 31 *Chinese Taipei should extend its MEPS and labelling program to other appliances and equipment in accordance with technical and economic assessment viability and technology reality, including commercial and industrial equipment.*

Worldwide experiences have shown that MEPS are an efficient and effective solution in improving energy efficiency of appliances and equipment. Labelling, especially Mandatory Energy Performance Labelling will enhance the implementation of MEPS.

For example, electric motor-pumps for domestic water already have MEPS but the group motor-pump effectiveness it is a different parameter that should be standardised.

Recommendation 32 *Revise MEPS for low voltage three phase squirrel-cage induction motors.*

In several economies MEPS for low voltage three phase squirrel-cage induction motors specifies "nominal" full load efficiency and "associate" minimum efficiency. Variations in materials, manufacturing processes, and tests results in motor-to-motor efficiency variations for a given motor design. The full-load efficiency for a large population of motors of a single design is not a unique efficiency but rather a band of efficiency. Therefore, a logical series of nominal motor efficiencies and the minimum associated with each nominal have been established. The nominal efficiency represents a value which should be used to compute the energy consumption of a motor or group of motors.

Currently in Chinese Taipei the low voltage three phase squirrel-cage induction motors MEPS specifies the minimum efficiency associate instead of full load nominal efficiency.

In Chinese Taipei MEPS for electric motors have a scope up to 250 hp, but in other economies, MEPS are considered up to 500 hp. Regulatory authorities in many economies have introduced or are planning legislation to encourage the manufacture and use of higher efficiency motors known as "premium efficiency motors".

Recommendation 33 *Chinese Taipei should promote and provide incentives for manufacturers, importers and end users to produce and procure appliances labelled as level 1 to achieve highest efficiency.*

It is currently easier to find appliances labelled as level 5 than level 1. If more level 1 appliances are purchased energy savings will be much higher.

9. EDUCATION AND ENERGY EFFICIENCY RELATED RESEARCH AND DEVELOPMENT

9.1. Critique

The Review Team was impressed by the policies and actions undertaken by the Chinese Taipei government to improve energy efficiency education. The government uses many different forms of media to inform the community about energy efficiency and to encourage the uptake of energy efficient products. These are described in part 1 of the report.

Under the Environmental Education Act, personnel of government agencies (including the Executive Yuan) and schools must undertake four hours of study in the area of energy efficiency each year. Within the education system, energy conservation and environmental protection are now part of the curriculum. Students are informed about ways to save energy to encourage behaviour change within the home. As students progress through the education system, the curriculum evolves from providing a basic understanding of the issues to a deeper knowledge about technology and the development of professional skills and R&D capabilities. Industry and non-government agencies have been providing support to students that want to pursue a career in this field.

The Review Team believe that the framework for research, development and demonstration (RD&D) in Chinese Taipei is well established, with the set-up featuring many elements of best practice. R&D in Chinese Taipei is undertaken by a number of organisations including the Central Research Institute, ITRI, universities, the R&D departments of state-owned enterprises and other non-profit organisations. While expenditure on R&D is low compared with large APEC economies, such as Japan and the United States, the increased dedication of funds to this sector over the past decade and over the next five years is commendable.

Chinese Taipei has established an R&D strategy that focuses on industry development and energy conservation. The priorities for setting research topics are 1) the potential for energy conservation after implementation; 2) the possibility of creating a new industry or enhancing the competitiveness of an existing industry in the global market; 3) job creation opportunities and 4) undertaking the fundamental research required for long-term technology options. Based on this, the current focus of R&D in Chinese Taipei is LED lighting; Heating, Ventilation, Air Conditioning and Refrigeration (HVAC&R); and Energy Information Communication Technology (EICT).

The Chinese Taipei Government has encouraged the participation of the private sector in RD&D. Engagement is much greater during the commercialisation stage. The government of Chinese Taipei provide a number of incentives to industry including access to low-interest loans and subsidies.

The Review Team noted that assessment and monitoring mechanisms were in place. The determination of research projects is based on compliance with government strategies and a cost-benefit analysis of the options available. There are many screening processes in place to decide on research projects, including screening within the BOE and by other agencies such as the NSC, industry and academia. The NSC ensures that there no overlaps in project work. Most research organisations have internal review processes for their projects which often include quarterly reviews (against key performance indicators) and annual reviews which ultimately determine the success (or failure) of a project. Major projects will also go to the NSC for review. All large projects must report to the Executive Yuan.

The Review Team believes that Chinese Taipei makes a great effort to become involved in research cooperation with other economies. It is also involved in research collaboration with a number of

laboratories and universities abroad. For example, ITRI has a joint laboratory at USC Berkeley. Four to six staff from ITRI visit the laboratory each year to engage in their research.

The Chinese Taipei Government has stated that technology R&D is critical to achieving the goal of reducing the energy intensity of the economy by 50% by 2025. However, there does not appear to be a clear link between the current R&D priorities and the attainment of this goal. To achieve such a large reduction in the energy intensity of the economy will require a transformation in the technology used. It is important to have a clear understanding of the step-change in technology that is required and how the R&D program in Chinese Taipei can contribute to this. It is recommended that the government develop a technology roadmap. The roadmap can be developed in conjunction with the strategy recommended in chapter 2.

9.2. Recommendations

Recommendation 34 *An Energy Technology Roadmap should be developed in conjunction with the energy efficiency strategy to create a common understanding of the technologies and R&D required to achieve stated energy efficiency goals. The roadmap should consider a portfolio approach including a mix of short term, low risk innovation and longer term, higher risk projects.*

A technology roadmap can be a useful tool to help policy makers, industry and society understand the optimum, cost effective paths that can be pursued for each technology to achieve energy efficiency goals by providing a quick and clear assessment of the relevant technologies and the steps required to accelerate adoption. This will maximise the net benefit of investment in research, development, demonstration and deployment of new technologies.

The technology roadmap should identify milestones, financing, policies and programs and public engagement that will be required for the technology to reach full potential. It can also help identify areas of strength and weakness and where further cooperation and collaboration with other economies could be beneficial.

Key elements of the roadmap should include:

- Why the technology is important
- How the technology presently performs, which economies are world leaders?
- Technology development milestones and actions
- Financing
- Policies and programs
- Public engagement
- Cooperation
- Assigned accountabilities
- Monitoring and review process

A portfolio approach will help manage the risk associated with technology development while allowing for high return breakthroughs.

The IEA has developed a number of technology roadmaps that could be used as a basis for a roadmap in Chinese Taipei.

Recommendation 35 *Chinese Taipei should continue to work with industry in research and development and to accelerate the commercialisation and deployment of energy efficient technology.*

Continued engagement with industry will foster industry leadership to achieve technology development goals, particularly for technologies that have strong future potential but are currently unable to attract the required investment. The government can encourage greater investment by removing some of the financial risks involved with investing in R&D by increasing the range of incentives available.

APPENDIX A: PEER REVIEW TEAM MEMBERS

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APPENDIX B: ORGANISATIONS AND OFFICIALS CONSULTED

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Ministry of Interior

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Ministry of Education

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China Steel Company

Delta Electronics Ltd.