Best Practices
of the GHG Reduction Measures
in Asian Region (FINAL)

October
2017

World Energy Council
Asian Region
"Best Practices of the GHG Reduction Measures in Asian Region"

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Introduction

In December 2015, COP 21 was held in Paris and nearly 200 countries/regions adopted Paris Agreement. The Agreement sets out a global action plan by limiting global warming to well below 2°C.

Most of the countries/regions submitted the climate action plans, Intended Nationally Determined Contributions, to reduce the Green House Gas (GHG) emission.

To achieve the climate action plans, the countries/regions must have the measures to reduce the GHG emission.

Asia is the most influential region for the global climate change as its share of GHG emission is around 40% and growing rapidly. It is important to implement the most enhanced measures to reduce GHG emission.

This Study is to introduce the Best Practices of the GHG Reduction Measures in Asian Countries/Region of World Energy Council Member Committees, and to enhance the reduction actions of the countries/regions. This Report mentions many references and they might be useful when the details of the Practices are required.

The Asian Countries/Region of World Energy Council Member Committees are China, Hong Kong, India, Indonesia, Japan, Malaysia, Mongolia, Nepal, New Zealand, Pakistan, Republic of Korea, Singapore, Sri Lanka and Thailand.
1. Targets of the Intended Nationally Determined Contributions (INDCs)[1]

In the INDCs, the targets to reduce GHG emission are mentioned. The targets are not in the same format, for example, target year, carbon dioxide emissions per unit of GDP (carbon intensity), comparison from based year level or business-as-usual (BAU) level.

Paris Agreement Article 4 paragraph 2 says “Each Party shall prepare, communicate and maintain successive nationally determined contributions (NDC) that it intends to achieve”. And Article 4 paragraph 9 Each Party shall communicate a NDC every five years [1]. These suggest submitting NDC with more enhanced targets every five years starting from 2020.

The current targets are mentioned in the INDCs as Table 1.

Table 1. Targets of Asian Countries’ INDCs in Paris Agreement

<table>
<thead>
<tr>
<th>Countries, Submitted date</th>
<th>INDC Targets, copied from a part of the INDC</th>
</tr>
</thead>
</table>
| China 2015-06-30          | China has nationally determined its actions by 2030 as follows:  
                          | • To achieve the peaking of carbon dioxide emissions around 2030 and making best efforts to peak early;  
                          | • To lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level;  
                          | • To increase the share of non-fossil fuels in primary energy consumption to around 20%; and  
                          | • To increase the forest stock volume by around 4.5 billion cubic meters on the 2005 level. |
| India 2015-10-01          | • To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.  
                          | • To achieve about 40 percent cumulative electric power installed capacity from non fossil fuel based energy resources by 2030 with the help of transfer of technology and low cost international finance including from Green Climate Fund .  
<pre><code>                      | • To create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030. |
</code></pre>
<table>
<thead>
<tr>
<th>Countries, Submitted date</th>
<th>INDC Targets, copied from a part of INDC</th>
</tr>
</thead>
</table>
| **Indonesia 2015-09-24** | • To reduce emissions by 29% compared to Business As Usual (BAU) scenario by 2030.  
  • With support from international cooperation, the target is expected to increase up to 41% reduction by 2030. |
| **Japan 2015-07-17** | Japan's INDC towards post-2020 GHG emission reductions is at the level of a reduction of 26.0% by fiscal year (FY) 2030 compared to FY 2013. Energy mix of power generation is Renewables approx. 22-24% Nuclear power approx. 22-20% Coal approx. 26% LNG approx. 27% Oil approx. 3% by 2030. |
| **Malaysia 2016-01-18** | Malaysia intends to reduce its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. This consists of 35% on an unconditional basis and a further 10% is condition upon receipt of climate finance, technology transfer and capacity building from developed countries. |
| **Mongolia 2015-09-24** | Mongolia has outlined a series of policies and measures that the country commits to implement up to 2030. The expected mitigation impact of these policies and measures will be a 14% reduction in total national GHG emissions excluding Land use, land use change and forestry (LULUCF) by 2030  
  • Increase renewable electricity capacity from 7.62% in 2014 to 20% by 2020 and to 30% by 2030 as a share of total electricity generation capacity.  
  • Reduce building heat loss by 20% by 2020 and by 40% by 2030, compared to 2014 levels.  
  And etc. |
| **Nepal 2016-02-11** | • 4,000 MW of hydroelectricity by 2020 and 12,000 MW by 2030;  
  • 2,100 MW of solar energy by 2030 with arrangements to distribute it through the grid;  
  • Additional 220 MW of electricity from bio-energy by 2030;  
  • Additional 50 MW of electricity from small and micro hydropower plants;  
  • Increase the share of biogas up to 10% as energy for cooking in rural areas; and  
  • Equip every household in rural areas with smokeless (improved) cooking stoves (ICS) by 2030. |
<table>
<thead>
<tr>
<th>Countries, Submitted date</th>
<th>INDC Targets, copied from a part of INDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Zealand 2015-11-25</td>
<td>Emissions will be reduced to 30% below 2005 levels by 2030.</td>
</tr>
<tr>
<td>Pakistan 2016-11-06</td>
<td>To reduce up to 20% of its 2030 projected GHG emissions subject to availability of international grants to meet the total abatement cost for the indicated 20 percent reduction amounting to about US$ 40 billion at current prices.</td>
</tr>
<tr>
<td>Republic of Korea 2015-06-30</td>
<td>Emission reduction by 37% from the BAU level by 2030</td>
</tr>
<tr>
<td>Singapore 2015-07-03</td>
<td>Singapore communicates that it intends to reduce its Emissions Intensity by 36% from 2005 levels by 2030, and stabilize its emissions with the aim of peaking around 2030.</td>
</tr>
<tr>
<td>Sri Lanka 2016-02-11</td>
<td>Sri Lanka intends to reduce the GHG emissions against Business-As-Usual scenario unconditionally by 7% (Energy sector 4%, and 3% from other sectors) and conditionally 23% (Energy sector 16% and 7% from other sectors) by 2030.</td>
</tr>
<tr>
<td>Thailand 2015-07-03</td>
<td>Thailand intends to reduce its greenhouse gas emissions by 20 percent from the projected business-as-usual (BAU) level by 2030. The level of contribution could increase up to 25 percent, subject to adequate and enhanced access to technology development and transfer, financial resources and capacity building support through a balanced and ambitious global agreement under the United Nations Framework Convention on Climate Change (UNFCCC).</td>
</tr>
</tbody>
</table>

**Reference:**
2. The list of the Best Practices

The Best Practices were selected by the team members and MCs of Asian Region.
They can be categorized as following 7 items.
I. Renewables
II. Enhancement of power plants’ thermal efficiency
III. Switching fossil fuel to a fuel with less emission of CO2
IV. Energy Conservation and Efficiency
V. Low Carbon Transportation
VI. Crediting Mechanism
VII. Reduction of GHG from agriculture

The list of the Best Practices and their categories is shown in the following Table 2.

Table 2. List of Best Practices of the GHG Reduction Measures

<table>
<thead>
<tr>
<th>Country, Region</th>
<th>Category and GHG Reduction Measures</th>
<th>Objective</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>I-1. Wind and solar photovoltaic power development and their recent Feed-in-Tariff in China</td>
<td>Wind 200GW, Solar 100GW by 2020</td>
<td>In 2016, Chinese solar and wind power capacities are both largest in the world</td>
</tr>
<tr>
<td>Hong Kong, China 1/2</td>
<td>I-2. Mitigating Climate Change by Increasing Renewable Energy in Hong Kong</td>
<td>Achieving about 3·4% of realisable RE potential between now and 2030</td>
<td>Encouraging and seeking opportunities to implement more RE, especially in solar energy and Waste-to-Energy (WTE) in private sector, government buildings and public infrastructure</td>
</tr>
<tr>
<td>Country, Region</td>
<td>Category and GHG Reduction Measures</td>
<td>Objective</td>
<td>Note</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------</td>
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<td>------</td>
</tr>
<tr>
<td>III-1. Fuel Mix Strategy in Electricity Generation, Hong Kong, China</td>
<td>Increasing usage of natural gas from 27% in 2015 to 50% by 2020 Reducing carbon intensity by 65%-70% by 2030 from the 2005 level</td>
<td>Coal-fired electricity generation will be phased down gradually and new natural gas plants of higher efficiency are planned to be built</td>
<td></td>
</tr>
<tr>
<td>IV-1. Energy Saving Plan for Hong Kong’s Built Environment 2015~2025+</td>
<td>Reducing Hong Kong’s energy intensity by 40% by 2025 from the 2005 level</td>
<td>Mainly promoting energy saving in buildings, as the buildings consume 90% of the Hong Kong’s electricity</td>
<td></td>
</tr>
<tr>
<td>V-1. Low Carbon Transportation in Hong Kong</td>
<td>Keeping Hong Kong’s per capita transport-related emissions on the low side</td>
<td>Using rail as low carbon public transport backbone plus promotion of walking and cycling, control of private car growth, and facilitation of new automotive technology at the same time raising energy efficiency and reducing GHG emission at different transportation sectors</td>
<td></td>
</tr>
<tr>
<td>IV-2. LED Deployment Replacing Conventional Lighting in India</td>
<td>A goal to deploy 770 million LED bulbs and 13.4 million street lights using energy efficient LED bulbs in 3 years’ time</td>
<td>LED bulbs are 88% energy efficient as compared to incandescent bulbs, 50% less as compared to CFLs.</td>
<td></td>
</tr>
<tr>
<td>VI-1. Perform Achieve and Trade mechanism (PAT) in India</td>
<td>For energy efficiency in energy intensive Industries</td>
<td>A regulatory instrument to reduce energy consumption</td>
<td></td>
</tr>
</tbody>
</table>

India
<table>
<thead>
<tr>
<th>Country, Region</th>
<th>Category and GHG Reduction Measures</th>
<th>Objective</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indonesia</strong></td>
<td>I-3 Targets, Policies and Regulation for Renewable Energy in Indonesia</td>
<td>To increase the use of renewable energy in the national energy mix from 5% in 2015 to 23% by 2025.</td>
<td>National energy mix target, as stipulated in the Government Regulation 79/2014 on National Energy Policy: targeted that the share of new and renewable energy in the national energy mix should reach at least 23% in 2025. Indonesia has implemented a mandatory program of 20% biodiesel blending (B20) in early 2016 for transportation sector.</td>
</tr>
<tr>
<td></td>
<td>IV-3 Indonesian Energy Efficiency Implementation</td>
<td>Energy efficiency implementation through reducing energy intensity 1% per-year up to 2025. Energy elasticity is targeted to below 1 in 2025</td>
<td>Energy Management (Mandatory for consumer 6000 TOE) Energy Audit or Investment Grade Audit (IGA). Energy and Water Saving Program for Public Sector. LED Street Lighting – PV. EE Label for CFL/LED. EE Label/MEPS for AC EE Label/MEPS for other. MEPS : Minimum Energy Performance Standards</td>
</tr>
<tr>
<td></td>
<td>IV-4. Clean Technology for Power Plant in Indonesia</td>
<td>1. GHG emission reductions of the connected grid system (the Waste Heat Recovery system replaces grid electricity). 2. Reduce GHG emission by installing Cogeneration (Cogen) or Combined Heat and Power (CHP) to generate electricity and useful heat at the same time. 3. Reduce GHG emissions from coal fired power plants</td>
<td></td>
</tr>
<tr>
<td>Country, Region</td>
<td>Category and GHG Reduction Measures</td>
<td>Objective</td>
<td>Note</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>Japan</td>
<td>IV-5 Japanese Top Runner Program</td>
<td>Develop the World's Best Energy-Efficient Appliances</td>
<td>Mentioned in the case study of World Energy Trilemma 2016 Report</td>
</tr>
<tr>
<td></td>
<td>VI-2. Joint Crediting Mechanism of Japan</td>
<td>Contribution from Japan to developing countries through the diffusion of low carbon technologies</td>
<td>Mentioned in the Japanese INDC</td>
</tr>
<tr>
<td></td>
<td>II-1. Pursuit of high efficiency in thermal power generation in Japan</td>
<td>Reduce GHG emission by installing A-USC, IGCC and etc.</td>
<td>Mentioned in the Japanese INDC</td>
</tr>
<tr>
<td>Malaysia</td>
<td>I-4. Jatropha based additives</td>
<td>To reduce the consumption of fossil fuels</td>
<td>Biofuel Products from Bionas</td>
</tr>
<tr>
<td>New Zealand</td>
<td>VII-1. Mitigation of agricultural greenhouse gas emissions</td>
<td>Research and development of reducing methane and nitrous oxide emissions</td>
<td>Share of GHG emission from the Agriculture sector is 49% in New Zealand</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>IV-6. Low-Income Energy-efficient Housing Program in Korea</td>
<td>To help low-income homes improve home comfort, lower the energy bills and decrease greenhouse gas emissions</td>
<td>implementation of general energy-saving measures such as window replacement using advanced building foams, floor and wall insulation and etc.</td>
</tr>
<tr>
<td></td>
<td>VI-3. Renewable Energy Certificate (REC) incentives to wind and solar power plants with energy storage system (ESS)</td>
<td>Additional points to those who install the energy storage system at their solar or wind power plants on assessment of their renewable energy certificates.</td>
<td>The points can be sold in the REC trading market and bring additional profits for renewable energy producers, encouraging expansion of solar and power generation.</td>
</tr>
<tr>
<td>Country, Region</td>
<td>Category and GHG Reduction Measures</td>
<td>Objective</td>
<td>Note</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------------------------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>Thailand</td>
<td>I-5 Increasing Renewable energy utilization to reduce CO₂ emission</td>
<td>To increase share of renewable energy 30% of final energy consumption by 2036. In 2016, Thailand can achieve 14% share of Renewable energy</td>
<td>Including Alternative Energy Policy, Feed-in-tariff, Biofuel in transportation and Heat production from Alternative energy.</td>
</tr>
<tr>
<td>Thailand</td>
<td>IV-7 Energy Efficiency standard and labeling scheme in Thailand</td>
<td>To inform consumers about high efficiency products and create awareness of energy conservation among the public by using labeling mechanism.</td>
<td>For electric home appliances such as air conditioners, refrigerators, fans and light bulbs, “No.5 Label” and for non-electric products, industrial products or construction materials, “Energy-saving label”</td>
</tr>
</tbody>
</table>
|                | IV-8 Thailand’s Energy Efficiency Revolving Fund (EERF) | To provide low-interest loan for projects involving energy efficiency | - Project’s simple payback period of no more than 7 years  
- Maximum loan per project of 50 million Baht (approx. 1.5 million USD)  
- interest rate is no more than 3.5% |
3. Best Practices

I. Renewables

I-1 Wind and solar photovoltaic power development and their recent Feed-in-Tariff in China

Objective:
To achieve the installed capacity of wind power reaching 200 gigawatts, the installed capacity of solar power reaching around 100 gigawatts[1] in 2020.

Scope:
The installed capacities of Wind and Solar photovoltaic power in China are both largest in the world.

Wind power:
At the end of year 2016, the wind power capacity in China reached 148.640 GW which is the largest capacity in the world and the Chinese share was 31.9% of the world total 466.505 GW.

Fig. I-1 Installed Wind Power

(Data source: IRENA RE Capacity Statistics 2017)

The capacity of Chinese wind power was increased 19.3 GW in 2016, 32.9GW in 2015 and 19.8GW in 2014. To achieve the target 200GW in 2020,
14.8GW per year will be required for the next 4 years. Therefore the development pace of the wind power is well ahead of the target.

**Solar photovoltaic:**

Also, for the solar photovoltaic power, the capacity was 77.4 GW, the largest in the world and the share was 26.6% of the world total 290.8GW.

![Fig. I-2 Installed Solar Photovoltaic](Data source: IRENA RE Capacity Statistics 2017)

The capacity of solar photovoltaic power was increased 34.2GW in 2016. To achieve the target 100GW in 2020, additional 22.6 GW is required. The target of solar photovoltaic power would be achieved well in advance of 2020.

**Recent Feed-in-Tariff (FIT):**

One of the incentives to promote wind and solar photovoltaic power incentives in China is FIT. FIT is revised year by year and recent PV FIT rate is as Table I-1.
Table I-1. Recent PV FIT rate

<table>
<thead>
<tr>
<th>Resource Region / type</th>
<th>FIT rates for 2016</th>
<th>FIT rates for 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource Region I</td>
<td>0.8</td>
<td>0.65</td>
</tr>
<tr>
<td>Resource Region II</td>
<td>0.88</td>
<td>0.75</td>
</tr>
<tr>
<td>Resource Region III</td>
<td>0.98</td>
<td>0.85</td>
</tr>
<tr>
<td>distributed generation PV systems</td>
<td>0.42</td>
<td>0.42</td>
</tr>
</tbody>
</table>

FIT rate: RMB/kWh

Source: China’s National Development and Reform Commission
Data collection: EnergyTrend

- Region I: northwestern provinces and regions of Gansu, Ningxia, Qinghai, Xinjiang
- Region II: the cities of Beijing and Tianjin
- Region III: others

Key Points:
1. 3 level of FIT for LS-PV based on local solar resources;
2. For distributed PV, 0.42 Yuan/kWh will be subsidized to PV electricity;
3. Subsidy duration: 20 Years;
4. PV developers can choose either FIT or Self-Consumption.

The Subsidy Money is Coming from Surcharge
1. 1.5 cents/kWh charge to the end users. About 60 billion Yuan ($10 billion USD) each year can be collected to support RE power generation.
2. FIT for wind power is 0.5-0.6 Yuan/kWh. Grid-company pays 0.4 Yuan/kWh and about 0.2 Yuan/kWh of subsidy is from the surcharge.
3. About $6.5 billion USD will spend on wind power and the left $3.5 billion can be spend on PV

Reference:
[1] http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf p7
I.-2. Mitigating Climate Change by Increasing Renewable Energy in Hong Kong

Objective:

The Hong Kong Special Administrative Region (HKSAR) Government’s aim is to apply renewable energy (RE) on a wider and larger scale in the immediate years ahead based on mature and commercially available technologies with the public sector taking the lead, and to create the conditions to enable the private sector to consider adopting RE. \[^{1a}\]

Scope:

As stated in the “Hong Kong Climate Action Plan 2030+” (2017) (the Climate Action Plan), Hong Kong does not have favourable conditions for large-scale commercialised RE generation. Based on currently mature and commercially available technologies, the estimate is that Hong Kong has about 3-4% of realisable RE potential arising from wind, solar and waste-to-energy (WTE) that can be exploited between now and 2030. \[^{1b}\]

Wind Energy Potential:

Wind projects in Hong Kong are currently small and sum of which produce less than 1MW. Studies show that the site at South West Lamma can accommodate a 100 MW capacity offshore wind farm producing annual electricity of around 175 GWh. The other site at South East Ninepin can accommodate 200MW offshore wind farm. The combined cost would be well over HK$10 billion to provide less than 1.5% of Hong Kong’s total electricity consumed. This means electricity from wind will be considerably more expensive than from natural gas. Nevertheless, the Government does not rule out the possibility of constructing these wind farms in the medium term. \[^{1c}\]

Solar Energy Potential:

The current cumulative PV installation capacity in Hong Kong is less than 5 MW in total and these projects are relatively small. \[^{1d}\] These projects, ranging from small (under 10kW capacity) to modest-sized ones (up to 350kW such as the one in Electrical and Mechanical Services Department Headquarters) are mainly at schools and on the rooftops of public sector buildings and facilities as a result of the Government taking the lead to encourage RE. \[^{1e}\]

The two largest PV projects in Hong Kong are the 1MW installation at Hong Kong Electric Company’s (HEC) Lamma Power Station commissioned during
2010 and 2013, and Drainage Services Department’s (DSD) new Solar Farm at Siu Ho Wan Sewage Treatment Works, commissioned in 2016 with an installed capacity of 1.1MW. All these projects provide valuable lessons on implementing PV projects in Hong Kong and improve local skills in installation, which will help to bring down cost and encourage the installation of larger scale local solar power system.

The following types of PV projects are being considered on public infrastructure:

- Roofs or open areas of pumping stations and treatment works;
- Reservoirs;
- Rock slopes;
- Noise barriers;
- Roofs of covered footbridges and walkways;
- Roofs of public piers; and
- Lights in parks, public housing etc. [1f]

Solar hot water systems are also being implemented by Leisure and Cultural Services Department (LCSD) for sports centres as these systems are technologically simple and cost effective. [1f]

There have been various general studies on what may be the potential in Hong Kong of PV installation on buildings. However, there are constraints that are hard to estimate without looking at specific buildings. The HKSAR Government wishes to have a more specific study on the potential for PV installation not only on rooftops but also on facades for future policy deliberation. It has commissioned a study taking into account the potential and the barriers and constraints identified. It will help Hong Kong to have a more in depth discussion, as the community will need to consider continuous enhancement under the Paris Agreement.

**Waste-to-energy (WTE) Potential:**

The energy generated as part of the waste treatment process can be captured and put to use. Hong Kong is already on a committed path to turn waste into energy for the long-term. The energy arising from sludge treatment is already used and landfill gas usage is being expanded. Hong Kong also collects and produces biodiesel from waste cooking oils and fats. Energy will be captured from the first organic waste treatment plant scheduled to open towards the end of 2017, and a second plant is being planned for commissioning by 2021. A large scale WTE plant to treat general municipal solid waste (MSW) is expected to
be operational by 2024, which can supply about 480 GWh of surplus electricity each year that equates to the usage of about 100,000 households. Thus, by 2024, the abovementioned projects are expected to provide about 1% of Hong Kong’s total electricity needs. By 2030, another 0.5% may be possible with new projects (such as more organic resource recovery plants) – i.e. a total of not more than 1.5% of Hong Kong’s total electricity needs may be derived from WTE projects. [1g]

Other possible approaches to promote RE include exploration of the introduction of feed-in-tariff and RE certificates in the next Scheme of Control period with the power companies. [1h]

Table I-2. Key Projects Launched/in Progress:

<table>
<thead>
<tr>
<th>Project</th>
<th>Sectors Involved</th>
<th>Installed Capacity</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEC’s Solar Power System at Lamma Power Station</td>
<td>Non – government</td>
<td>1MW</td>
<td>Commissioned (2010 and 2013)</td>
</tr>
<tr>
<td>HEC’s Lamma Wind Power Station</td>
<td>Non – government</td>
<td>800kW</td>
<td>Commissioned (2006)</td>
</tr>
</tbody>
</table>

References:

  - [1a] P.24, 1st paragraph
- [1c] P.25, “Estimate wind energy potential”
- [1d] P.26, “Capturing more solar energy”, 1st paragraph
- [1e] P.26, “Capturing more solar energy”, 2nd paragraph
- [1f] P.27, “Government leadership”
- [1g] P.30, “Waste-to-energy potential”
- [1h] P.27, “Feed-in tariff and re certification”
I-3. Targets, Policies and Regulation for Renewable Energy in Indonesia

Objective:
To increase the use of renewable energy in the national energy mix from 5% in 2015 to 23% by 2025.

Overall Renewable Energy Targets:
In October 2014, Government Regulation No. 79/2014 on National Energy Policy was issued. As stipulated in the National Energy Policy in achieving the Optimal National Primary Energy Mix, new and renewable energy share in Total Primary Energy Supply (TPES) should reach 23% in 2025 (exclude traditional bioenergy consumption) and increase at least 31% by 2050.

Power Sector Regulations:
The establishment of MEMR (Ministry of Energy and Mineral Resources) Regulation No. 50/2017 provided PT PLN (PERSERO) - Indonesia State Electricity Corporation with a legal basis for purchasing renewably energy generated from IPPs (Independent Power Producers). The regulation sets reference price and mechanism for renewable energy – based power plants. It is believed that the regulation will boost the development of renewable energy, since it provides an obligation for PT PLN (PERSERO) to purchase electricity from renewable energy – based power plants, which simplifies licenses and procedures.

Ethanol, Biodiesel, and Pure Plant Oil Blending:
Indonesia’s biofuels program is centered on palm oil-based biodiesel since Indonesia is the largest palm oil producer and the largest palm oil exporter in the world.

As shown by the Table 2, Indonesia has mandated a 20% blend of biodiesel in 2016 and will increase to 30% in 2020. The target is not only for transportation sector, but also for diesel use in industry and power generation.

The blending mandates for ethanol have not been implemented to date.
The targets of 20% ethanol blending in industrial and transportation sectors are set for 2025.

In addition, the Indonesia State Action Plan to Reduce Emissions in the Aviation Sector which is targeted to achieve a 2% blend of Pure Plant Oil for aircrafts sector by 2016, and 5% by 2025.
Table 2. Overview of Targets, Policies and Regulation for Renewable Energy in Indonesia

<table>
<thead>
<tr>
<th>Targets</th>
<th>Targets for 2025</th>
<th>Current policy framework and instruments</th>
<th>Regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Targets</td>
<td>23%</td>
<td>The National Energy Policy sets out the ambition to transform the national energy mix by 2025, in which at least 23% the share of new and renewable energy. To achieve this target, MEMR Regulation No. 50/2017 sets reference price and mechanism for renewable energy – based power plants.</td>
<td>Government Regulation No. 79/2014 MEMR No. 50/2017</td>
</tr>
<tr>
<td>Renewable energy in TPES (excluding traditional uses of bioenergy)</td>
<td>25%</td>
<td>As stipulated in RUKN 2015 – 2034 (General Plan for National Electricity), to support the achievement of the share of new and renewable energy in the national energy mix should reach at least 23% in 2025.</td>
<td>Republic of Indonesia Law No.30/2009 and Government Regulation 23/2014 (Article 8)</td>
</tr>
</tbody>
</table>

Power Sector Targets

<table>
<thead>
<tr>
<th>Targets</th>
<th>Current policy framework and instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Sector Targets</td>
<td>The power purchase shall be conducted through a direct selection mechanism. Hydropower for capacity of more than 10 MW (ten megawatts) shall be capable to operate with capacity</td>
</tr>
<tr>
<td>Power Type</td>
<td>Capacity (GW)</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Large hydropower</td>
<td>18.3</td>
</tr>
<tr>
<td>Small hydropower</td>
<td>3.0</td>
</tr>
</tbody>
</table>
determined based on the agreement of the parties. The power purchase shall use the cooperative model of build, own, operate and transfer (BOOT).

<table>
<thead>
<tr>
<th>Bioenergy power</th>
<th>5.5 GW</th>
<th>For Biomass and a Biogas Power Plant:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>- For area where local Electricity Generation Cost (BPP) &gt; average of National Electricity Generation Cost, the electricity purchase price is maximum 85% of Local BPP.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- For area where local Electricity Generation Cost (BPP) ≤ average of National Electricity Generation Cost, the electricity purchase price is based on agreement between parties.</td>
</tr>
</tbody>
</table>

For Municipal Solid Waste Power Plant:
- For area where local Electricity Generation Cost (BPP) > average of national Electricity Generation Cost, the electricity purchase price is maximum equal to Local BPP.
- For Sumatera, Jawa, Bali and other area where local Electricity Generation Cost (BPP) ≤ average of National Electricity Generation Cost, the electricity purchase price

MEMR No. 50/2017
| Geothermal power | 7.1 GW | National strategy towards 7.1 GW:  
1. Provide a harmonious regulations between each sectors (MEMR, Ministry of Forestry, Ministry of Finance, Local government, etc)  
2. Simplified the bureaucracy in geothermal sector.  
3. Provide incentives for geothermal development (tax holiday, import duty and VAT exemption, etc).  
4. Optimize geothermal potential in large area especially WKP managed by PGE; assignment to State Owned Companies, PSPE.  
5. The power purchase shall be conducted in accordance to laws and regulations.  
In the event that the regional BPP is higher than the average national BPP, the power purchase price shall be at the maximum equal to the BPP in the local power system.  
In the event that the regional BPP is equal to or lower than the average national BPP, the power purchase price shall be determined based on the agreement of the parties.  
The power purchase shall use the cooperative model of build, own, operate and transfer (BOOT).  
6. Financial supports through national banking policy. | Republic of Indonesia Law No. 21/2014 MEMR No. 50/2017 | The power purchase shall be conducted through a direct selection |
<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Capacity (GW)</th>
<th>Power Purchase Mechanism</th>
<th>Power Purchase Price Calculation</th>
<th>Agreement Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>6.4</td>
<td>Mechanism based on Capacity Quota. In the event that the regional BPP is higher than the average national BPP, the power purchase price shall be at the maximum of 85% (eighty-five percent) of BPP in the local power system. In the event that the regional BPP is equal to or lower than the average national BPP, the power purchase price shall be determined based on the agreement of the parties. The power purchase shall use the cooperative model of build, own, operate and transfer (BOOT).</td>
<td>MEMR No. 50/2017</td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>1.8</td>
<td>The power purchase shall be conducted through a direct selection mechanism based on Capacity Quota. In the event that the regional BPP is higher than the average national BPP, the power purchase price shall be at the maximum of 85% (eighty-five percent) of BPP in the local power system. In the event that the regional BPP is equal to or lower than the average national BPP, the power purchase price shall be determined based on the agreement of the parties. The power purchase shall use the cooperative model of build, own, operate and transfer (BOOT).</td>
<td>MEMR No. 50/2017</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The power purchase by PT PLN (PERSERO) shall be conducted</td>
<td></td>
</tr>
</tbody>
</table>

24
<table>
<thead>
<tr>
<th>Industry</th>
<th>20%</th>
<th>5% of mandatory blending in 2016.</th>
<th>MEMR No. 12/2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biodiesel Blending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>30%</td>
<td>20% of mandatory blending in 2016.</td>
<td>MEMR No. 12/2015</td>
</tr>
<tr>
<td>Industry</td>
<td>30%</td>
<td>20% of mandatory blending in 2016.</td>
<td>MEMR No. 12/2015</td>
</tr>
<tr>
<td>Electricity</td>
<td>30%</td>
<td>30% of mandatory blending in 2016.</td>
<td>MEMR No. 12/2015</td>
</tr>
<tr>
<td>Pure Plant Oil (PPO) Blending</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aviation</td>
<td>5%</td>
<td>2% of mandatory blending in 2016 for aircraft sector.</td>
<td>MEMR No. 12/2015</td>
</tr>
</tbody>
</table>

http://www.irena.org/DocumentDownloads/Publications/IRENA_REmap_Indonesia_report_2017.pdf  Table from Page 34
I-4  Jatropha based additives in Malaysia

Objective:
To commercialize Jatropha Based Additive as biofuels additive in Malaysia.

Scope:
Malaysia intends to reduce its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030. The major greenhouse gases are carbon dioxide, methane and nitrous oxide. To achieve the target, a Malaysian company, Bionas, has been committed in research, innovation and technical solutions to reduce greenhouse gas emissions from fossil fuels and sharing this knowledge internationally.

Jatropha Plantation Programs:
Numerous efforts to find alternative oil fuel derived from plants have been carried out since that led to the discovery of the Jatropha Curcas plants which are naturally endowed with multitudinous uses and unique properties.

Jatropha Curcas plants have the following unique qualities:

- Oil yield, approx. 35%
- Thrives well in tropical climates such as Malaysia.
- Fast growth: produces fruits after 6 months of cultivation.
- Low maintenance - the use of pesticides and other polluting substances are not necessary, due to the pesticidal and fungicidal properties of the plant.
- Life expectancy of more than 45 years.
- One jatropha fruit contains 2-4 seeds that are processed into oil, which will then be used to produce biofuels.
- Small-sized and shady shrubs which makes it easy to harvest.
- An acre of land is capable of accommodating cultivation of 800 plants. Per acre yields 3.6 metric tons of fruits annually in the first three years and multiply after the third year.

Jatropha is an attractive option and has the potential to become major biofuel, as it grows on very marginal land in tropical regions and it does not compete with farming crops such as corn, soya beans, peanut, cane and rapeseed, which were used in United States and Europe as feed stocks for biofuels. That makes it potentially a better option than plants such as palm oil, which is currently a source of biofuel worldwide, but leads to substantial
rainforest destruction. Jatropha is also toxic so there is no conflict with food production.

During the last seven years, Bionas was able to build up expertise and grand experience in successful Jatropha plantation for the highest internationally recorded yields, as well as develop its own biofuel production technologies, which render the Bionas biofuel produced very cost-effective, compared to the processes the rest of the world has tried to utilize and failed.

Table I-3. Plantation in Malaysia:

<table>
<thead>
<tr>
<th>NO</th>
<th>PLANTATION</th>
<th>LAND SIZE (acre)</th>
<th>LAND SIZE (hectare)</th>
<th>JATROPHA SEED (KG)</th>
<th>JATROPHA OIL (LITER)</th>
<th>JATROPHA ADDITIVE (LITER)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PAHANG</td>
<td>39</td>
<td>15.8</td>
<td>11,060</td>
<td>3,871</td>
<td>11,613</td>
</tr>
<tr>
<td>2</td>
<td>JOHOR</td>
<td>100</td>
<td>40.5</td>
<td>28,350</td>
<td>9,922</td>
<td>29,766</td>
</tr>
<tr>
<td>3</td>
<td>SARAWAK</td>
<td>78,162</td>
<td>31,631.0</td>
<td>22,141,700</td>
<td>7,749,595</td>
<td>23,248,785</td>
</tr>
<tr>
<td>4</td>
<td>SABAH</td>
<td>14,256</td>
<td>5,769.0</td>
<td>4,038,300</td>
<td>1,413,405</td>
<td>4,240,215</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>27,530,379</td>
</tr>
</tbody>
</table>

*1 Hectare = 700 KG seeds/monthly
*Crude Jatropha Oil yield 35% from seeds

**Bionas Biofuels Technology:**

Nano-emulsion technology is a chemical process of blending water, Bionas additive and fossil fuel which in-turn reacts and mix to form stable bonds with each other.

With the technology, water droplets suspended in the fuel thousand times smaller than traditional emulsions. This makes stable over time, temperature and pressure.

The exposed surface of a nano-emulsion facing other components such as oxygen and fuel is one million times larger than that of an emulsion.

A nano-emulsion is stable so that the danger of entry of liquid water to the engine components is null and void.

Water in fuel/diesel/petrol yields the following effects:

1. Water vaporization increases fuel dispersion in the form of smaller droplets.
2. Contact surface between fuel and air is increased.
3. Combustion is more efficient.
4. The explosion of excess water into steam and the splitting of water into H₂ and O₂ will increase power and fuel economy.
5. Reduces combustion temperature peak (lowers NOx)
6. Particulate formation is reduced (lowers PM)
7. Lower emissions: Up to 25% NOx reduction, up to 60% PM reduction, up to 95% smoke reduction, up to 97% CO₂ reduction.
9. Increased thermal efficiency.

The emulsified diesel/fuel is the only emission-control fuel technology that simultaneously lowers both PM and NOx with no free water.

**Challenges to commercialize Jatropha based additive for Biofuels:**

Since the Ninth Malaysia Plan (2006-2010), Malaysia has started initiatives to increase the share of use of non-fossil fuel energy. The National Biofuel Policy 2006 already laid the groundwork for the development and use of biofuels. The National Biofuel Industry Act 2007 was put in place to regulate the biofuel industry and to promote the mandatory use of the B5 domestic blend of 5% palm biodiesel and 95% fossil fuel diesel. At the end of 2014, Malaysia had also introduced the bio-diesel B7 Programme. Jatropha based additive project in Malaysia is private driven because government is more favorable towards palm oil for biofuels.
I-5. Increasing Renewable energy utilization to reduce CO₂ emission in Thailand

Objective:
To increase share of renewable energy 30% of final energy consumption by 2036.

1. **Alternative Energy Policy**

   Thailand launched the Alternative Energy Development Plan (AEDP2015) to promote renewable energy utilization in order to strengthen Thailand’s long-term energy security and reduce the impact of using fossil fuel on environment and community. The target of AEDP2015 is to increase share of renewable energy 30% of the final energy consumption by 2036.

   **Table 1** Status and Target of Electricity Generation by type of fuel

<table>
<thead>
<tr>
<th>Alternative Energy Applications</th>
<th>ktoe</th>
<th>Share of AE compared to final energy consumption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Status as of 2016</td>
</tr>
<tr>
<td>Electricity</td>
<td>2,122</td>
<td>13</td>
</tr>
<tr>
<td>Heat</td>
<td>7,181</td>
<td>21</td>
</tr>
<tr>
<td>Biofuel (EtOH &amp; Biodiesel)</td>
<td>1,747</td>
<td>5.8</td>
</tr>
<tr>
<td><strong>Total Consumption</strong></td>
<td><strong>11,050</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

2. **Feed-in-tariff**

   Ministry of Energy has been promoting the production of electricity from alternative energy since 1989 to purchase electricity from cogeneration power plant that used agricultural waste as feed stock. This policy encouraged private investment, especially entrepreneurs in agro-industry, in electricity generation business. Later, the policy has been expanded to purchase electricity from other renewable energy such as solar, hydropower, wind power, biogas, and waste from the Very Small Power Producers: VSPP (capacity no larger than 10 MW) by adder scheme to make more VSPPs in remote areas to participate in the generation of electricity. The feed-in tariff (FIT) has been initiated since 2014 to replaces the former adder program. FIT is granted for 20 years and the rates are based on power plant size, fuel types and power plant location. Only power plant fuelled by landfill gas can receive support for 10 years. FIT is composed of three components: FIT = FIT(F) +
FIT(V) + FIT Premium. FIT(F) is a portion that is fixed throughout the whole supporting period, while FIT(V) is a portion that varies according to the inflation rate and bio-based feed stock price as well as waste to energy projects (excluding landfill gas projects) The FIT(V) rates were fixed for projects which sell electricity to the grid in 2017, after that the FIT(V) will be revised annually. FIT Premium is granted to promote bio-based fuel for the first 8 years of project lifetime and also granted to the power plant located in designated areas.

**Table 2** Feed-in Tariff (FIT) rate for very small power producers (VSPP)

<table>
<thead>
<tr>
<th>Capacity</th>
<th>FIT (F)</th>
<th>FIT (V)</th>
<th>Total FIT (F+V)</th>
<th>Support period</th>
<th>FIT Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baht/kwh</td>
<td>Baht/kwh</td>
<td>Baht/kwh</td>
<td>Years</td>
<td>Baht/kwh</td>
</tr>
<tr>
<td>1. Waste (Integrated waste management)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity ≤ 1MW</td>
<td>3.13</td>
<td>3.21</td>
<td>6.34</td>
<td>20</td>
<td>0.70</td>
</tr>
<tr>
<td>Capacity &gt; 1-3 MW</td>
<td>2.61</td>
<td>3.21</td>
<td>5.82</td>
<td>20</td>
<td>0.70</td>
</tr>
<tr>
<td>Capacity &gt; 3 MW</td>
<td>2.39</td>
<td>2.69</td>
<td>5.08</td>
<td>20</td>
<td>0.70</td>
</tr>
<tr>
<td>2. Waste (Landfill gas)</td>
<td>5.60</td>
<td>-</td>
<td>5.60</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>3. Biomass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity ≤ 1 MW</td>
<td>3.13</td>
<td>2.21</td>
<td>5.34</td>
<td>20</td>
<td>0.50</td>
</tr>
<tr>
<td>Capacity &gt; 1-3 MW</td>
<td>2.61</td>
<td>2.21</td>
<td>4.82</td>
<td>20</td>
<td>0.40</td>
</tr>
<tr>
<td>Capacity &gt; 3 MW</td>
<td>2.39</td>
<td>1.85</td>
<td>4.24</td>
<td>20</td>
<td>0.30</td>
</tr>
<tr>
<td>4. Biogas (Wastewater/Waste product)</td>
<td>3.76</td>
<td>-</td>
<td>3.76</td>
<td>20</td>
<td>0.50</td>
</tr>
<tr>
<td>5. Biogas (energy crop)</td>
<td>2.79</td>
<td>2.55</td>
<td>5.34</td>
<td>20</td>
<td>0.50</td>
</tr>
<tr>
<td>6. Hydro (≤ 200 kW)</td>
<td>4.90</td>
<td>-</td>
<td>4.90</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>7. Wind Power</td>
<td>6.06</td>
<td>-</td>
<td>6.06</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>8. Solar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.12 | 0.00 | 4.12 | 25 | 0.50

*Yala, Pattani, Narathiwat and 4 districts in Songkla province (i.e. Chana, Thepa, Saba Yoi and Na Thawi)*, Source: [http://www.erc.or.th](http://www.erc.or.th)

### Table 3 Alternative energy power plant target by 2036 and current status

<table>
<thead>
<tr>
<th>Type</th>
<th>Solar (MW)</th>
<th>Wind (MW)</th>
<th>Hydropower (MW)</th>
<th>Biomas (MW)</th>
<th>Biogas (MW)</th>
<th>MSW (MW)</th>
<th>Total (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target (2036)</strong></td>
<td>6.00</td>
<td>2.00</td>
<td>3.28</td>
<td>5.570</td>
<td>1.280</td>
<td>550</td>
<td>19.68</td>
</tr>
<tr>
<td><strong>Current Capacity (2016)</strong></td>
<td>2.44</td>
<td>507</td>
<td>3.10</td>
<td>2.815</td>
<td>435</td>
<td>145</td>
<td>9,436</td>
</tr>
</tbody>
</table>

Source:

### 3. Biofuel in transportation

Ministry of Energy has promoted biofuel since 2004 by licensing biofuel factories, expanding more biofuel stations and building confidence in biofuel utilization for consumers. In 2011, Ministry of Energy started to announce policy to blend biodiesel at 3-5 percent in regular diesel and it has been step up to 7 percent since 2014. Biodiesel was used to replace regular diesel at 1,200 million liters which was equivalent to 3.37 million liters per day in 2016. For ethanol, the government abolished gasoline 91 to switch to gasohol blended 10 percent ethanol instead. Price mechanisms are used to attract consumers to use gasohol blended 20 and 85 percent ethanol. By the year 2016, ethanol consumption was 1,300 million liters which was equivalent to 3.67 million liters per day.

### Table 4 Biofuel target by 2036 and current status

<table>
<thead>
<tr>
<th>Biofuel (million liters per day)</th>
<th>Biodiesel</th>
<th>Ethanol</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target (2036)</strong></td>
<td>14.00</td>
<td>11.30</td>
</tr>
<tr>
<td><strong>Current Capacity (2016)</strong></td>
<td>3.37</td>
<td>3.67</td>
</tr>
</tbody>
</table>

Source:
The key raw materials for biofuel are from food crops such as sugarcane, cassava and palm oil. Therefore, the proportion of biofuel blending can be adjusted appropriately according to circumstances to balance energy and food security in the country.

4. Heat production from Alternative energy

The agro-industries in Thailand such as sugar, palm oil, tapioca starch, wood processing, paper mills and animal farms, are mainly used heat from renewable fuel. Waste from manufacturing processes and agricultural waste can be used as fuel. Biomass from bagasse, rice husk, wood chips, palm fiber palm kernel shells and sawdust and biogas from wastewater are most popular and widely used as renewable fuel that can be beneficial to the industry to reduce fuel costs and reliance on fossil fuels. Consequently, heat production from renewable energy is most commonly used in Thailand. However, governmental support for encouraging more utilization of solar and MSW in service and household sectors is needed to reach the country target.

<table>
<thead>
<tr>
<th>Type</th>
<th>Solar</th>
<th>Biomass</th>
<th>Biogas</th>
<th>MSW</th>
<th>Total (ktoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target (2036)</td>
<td>1,200</td>
<td>22,100</td>
<td>1,283</td>
<td>495</td>
<td>25,079</td>
</tr>
<tr>
<td>Current Capacity (2016)</td>
<td>6.7</td>
<td>6,507</td>
<td>592</td>
<td>75</td>
<td>7,181</td>
</tr>
</tbody>
</table>
II. Enhancement of power plants’ thermal efficiency

II-1. Pursuit of high efficiency in thermal power generation in Japan

Objective:

For 2030, the energy mix is authorized as renewables approx. 22~24%
Nuclear power approx. 22~20% Coal approx. 26% LNG approx. 27% Oil
approx. 3%. Coal and LNG totaled approx. 53%.

The high efficiency power generation such as USC (Ultra-Super
Critical), A-USC (Advanced Ultra-Super Critical), IGCC (Integrated coal
Gasification Combined Cycle), etc. will be pursued to achieve Japan’s
emission reduction target, 26.0% by fiscal year (FY) 2030 compared to FY
2013.[1]

Scope:

The government established “Council for early realization of the next-
generation thermal power.” The Council is proposing to develop technology
for improving performance of First and Second generations and also
proposing to develop concrete technology for Third generation which is the
ultimate stage.[2]

The three generations are as follows.

- First generation: Single Cycle, Steam Turbine (ST) or Gas Turbine (GT)
  For coal-fired power, Sub Critical from 1950s, Super Critical (SC) from
  1970s, Ultra SC from 1990s and Advanced–USC from 2010s
  For gas-fired power, Single Cycle ST, GT from 1950s and AHAT
  (Advanced Humid Air Turbine) from 2010s
- Second generation: Combined Cycle (CC), GT plus ST
  For coal-fired power, 1100°C class GTCC from 1980s, 1700°C class
  GTCC from 2020s and over 1800°C class GTCC
  For gas-fired power, 1300°C class IGCC from 2010s, 1800°C class
  IGCC and Innovative IGCC
- Third generation: Triple Combined Cycle, Fuel Cell plus GT plus ST
  For coal-fired power, IGFC (Integrated Coal Gasification, Fuel Cell
  combined cycle) from 2020s
  For gas-fired power, GTFC (Gas Turbine, Fuel Cell combined cycle) from
  2020s
Installed capacity of Japanese Coal and Gas power plants at the end of March 2015:

- Coal-fired power
  - Sub Critical: 4.35 GW from 1960s
  - Super Critical: 12.5 from 1980s
  - USC: 15.3 from around 1995
- Gas-fired power
  - Conventional: 23.9 from 1970s
  - GTCC: 45.25 from 1980s

**Fig.II-2  Comparison of CO2 emission from Coal-fired power:**

CO2 emission of 1000MW coal-fired power plant, capacity factor 70%

![CO2 emission comparison chart](chart.png)

Overseas deployment of next-generation thermal power technology:

The electricity demand will be increased significantly in developing countries, mainly in Asia, and thermal power generation, especially the most economical coal-fired power would be mainly installed.

In addition to the USC, the next-generation technologies such as IGCC should be deployed worldwide to reduce the environmental impact.

In the future, especially in Asian countries, the demand for coal-fired power will be significant. If the next-generation technologies are utilized widely, it would be effective for the CO2 reduction.

Suppose, in Asia up to 2040, the next-generation technologies such as IGCC and IGFC in addition to USC are utilized, it is estimated that the reduction of CO2 would be about 1.5 billion ton compared with the case of
Sub-Critical only.

The promotion of high-efficiency thermal power generation is an effective climate change measure. As Japanese technology in power generation field is the highest level in the world, the technology is expected to contribute for the climate change measure. The technical cooperation with Asian countries would be promoted including human resource development by Japanese public and private sectors.

References:
[1] Japan’s INDC
http://www4.unfccc.int/submissions/INDC/Published%20Documents/Japan/1/20150717_Japan's%20INDC.pdf

“Pursuit of high efficiency in thermal power generation” is mentioned in the list of measures of the Japanese INDC. It is in the Energy-originated CO₂ and is categorized in the Energy conversion sector.
http://www.meti.go.jp/committee/kenkyukai/energy_environment/jisedai_karyoku/pdf/report01_01_00.pdf
III. Switching fossil fuel to a fuel with less emission of CO$_2$

III-1 Fuel Mix Strategy in Electricity Generation, Hong Kong, China

Objective:
Hong Kong Special Administrative Region (HKSAR) Government and local power companies aim at phasing down coal fired electricity generation and using more natural gas. The usage of electricity generation from natural gas is targeted to be raised from around 27% in 2015 to around 50% by 2020 in the generation fuel mix.\[^{[1a]}\]

Hong Kong will continue to phase down its remaining coal plants as they reach their normal retirement life in the next decade and replace them with natural gas and non-fossil fuel sources. This will help Hong Kong achieve its carbon intensity reduction target of 65% to 70% by 2030 using 2005 as the base.\[^{[1b]}\]

Scope:
According to “Future Fuel Mix for Electricity Generation Consultation Document” (2014), and the currently released “Hong Kong Climate Action Plan 2030+” (2017) (the Climate Action Plan), HKSAR Government plans

- to achieve the target of 50% to 60% reduction in carbon intensity using 2005 as the base, equivalent to about 20% of absolute carbon emissions reduction, by 2020;\[^{[2]}\]
- to achieve the target of 65% to 70% reduction in carbon intensity using 2005 as the base, equivalent to about 26% to 36% of absolute carbon emissions reduction by 2030.\[^{[1c]}\]

Phasing down coal:
To achieve carbon intensity reduction target for 2020, natural gas will generate about 50% of local electricity while coal will drop to about 25% by then, as a supply-side mitigation method for GHG reduction.

To meet the new carbon intensity reduction target of 65% to 70% by 2030, Hong Kong will continue to phase down Hong Kong’s remaining coal plants as they reach their normal retirement life in the next decade and replace them with natural gas and non-fossil fuel sources.

The target are demonstrated as Fig III·1:\[^{[1d]}\]
Secure supply-side sufficiency:
This implies that both power companies will need to enter new gas supply contracts to secure the sources of natural gas, install new gas-fired plants, and phase out the existing less efficient coal-fired plants which are scheduled to retire from 2017 and onwards.

To facilitate the increase in usage of natural gas and secure the supply-side sufficiency, the two power companies in Hong Kong are “exploring the feasibility of using an offshore liquefied natural gas (LNG) terminal to bring LNG to Hong Kong for regasification by a floating unit” [1e]

Achieve supply-side efficiency:
The new gas plants also have to be as energy efficient as possible. While our existing gas plants can achieve an efficiency up to 45%, the latest commercially available technology can achieve even higher thermal efficiency. Our current coal plants have a thermal efficiency of about 37% at rated load on average. [1f] Thus, the new gas plants Hong Kong plans to build will be much more efficient.

Progress of meeting the 2020 carbon intensity reduction target:
To meet 2020 emissions targets, the HKSAR Government approved the construction of two new gas-fired generating units by CLP Power Hong Kong Limited/Castle Peak Power Company Limited (CLP) and The Hongkong Electric Company, Limited (HEC) in 2016.[3][4a,b] CLP needs to install and operate a new gas-fired unit which is a combined cycle gas turbine (CCGT) with an installed capacity of 550MW at Black Point Power Station while HEC needs to install a new 380MW CCGT unit at the Lamma Power Station Extension.[3],[4a,b] The plan is summarized as Table III-1:

Table III-1. Summary of Installation of New Gas-Fired Units*
<table>
<thead>
<tr>
<th>Company</th>
<th>Installed Capacities (MW)</th>
<th>No. of Unit</th>
<th>Commission Year</th>
<th>Gas Generation Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2020 Onwards: 49%</td>
</tr>
<tr>
<td>HEC[^4a,b]</td>
<td>380</td>
<td>1</td>
<td>2020</td>
<td>Existing: 34%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2020 Onwards: 50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(55% upon commissioning of another new gas unit in 2022)</td>
</tr>
</tbody>
</table>

References:

  - [1a] P. 21, “Phase down coal by 2030”
  - [1b] P. 21, 1st paragraph
  - [1c] P. 15, 1st paragraph
  - [1d] P. 20, figure 5
  - [1f] P. 21, “Achieve supply-side efficiency”


IV. Energy Conservation and Efficiency

IV-1. Energy Saving Plan for Hong Kong’s Built Environment 2015~2025+

Objective:
As a high-density and developed city of high living standard, buildings consume 90% of the electricity in Hong Kong. To reduce carbon emission and enhance energy efficiency & conservation, the Hong Kong Special Administrative Region (HKSAR) Government targets to achieve energy intensity reduction by 40% by 2025 using 2005 as the base. [5a]

For government buildings and public housing, the plan states the targets of:
[5b]
- new government buildings with construction area of > 5,000m² with central air-conditioning or > 10,000m² to achieve at least BEAM Plus Gold (Upgraded version of Building Environmental Assessment Method); and
- new public housing to achieve at least BEAM Plus Gold ready

Scope:
According to the Energy Saving Plan, the targets are to be achieved via policy and strategy.

From the aspect of policy, the HKSAR Government plans to bring a series of actions in economic, education, regulatory and society aspects to drive energy savings in buildings and make them more energy efficient by 2025.

In strategy part,
- **Public sector** – Government and public sector development agencies to lead by example and set target to reduce electricity consumption in Government buildings by 5% from 2015/16 to 2019/20, using comparable operating conditions in 2013/14 as the base. To achieve this target, energy audits for major government buildings have been arranged to help relevant bureaux and departments formulate energy saving measures to enhance energy efficiency. To help bureaux and departments implement electricity saving projects identified in the energy audits, at least $500 million has been earmarked to gradually implement the relevant energy saving projects to help reduce electricity consumption;
- **Private sector** – Focus on energy saving in new and existing private
sector buildings to capture potential gains; and

- **Partnership** – Collaborate with energy and built environment stakeholders to enable ‘Energy Wise’ transformation.

**Key Actions:**

Please refer to the Table IV-1-1 for the key actions: [5c]

**Table IV-1-1. Key Actions**

<table>
<thead>
<tr>
<th>Aspects</th>
<th>Key Actions</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economics</td>
<td>• Lead the energy saving and green building drive through government buildings, public housing and public sector development; and</td>
<td>• 1/7th of buildings in HK participated in the $450 million Building Energy Efficiency Fund Scheme programme;</td>
</tr>
<tr>
<td></td>
<td>• Government building achieve 5% reduction in electricity by 2019/20 (2013/14 as base); further reduction from 2020-2025 to be determined in 2019-20.</td>
<td>• District cooling at Kai Tak;</td>
</tr>
<tr>
<td></td>
<td>• Government building achieve 5% reduction in electricity by 2019/20 (2013/14 as base); further reduction from 2020-2025 to be determined in 2019-20.</td>
<td>• Gross Floor Area concessions for private-sector green building projects; and</td>
</tr>
<tr>
<td></td>
<td>• Government building achieve 5% reduction in electricity by 2019/20 (2013/14 as base); further reduction from 2020-2025 to be determined in 2019-20.</td>
<td>• Approximately $100 million power companies’ Eco Building Fund (CLP Power Hong Kong (CLP)) and Smart Power Fund (The Hong Kong Electric Company Limited (HEC)) for energy saving 2014-18.</td>
</tr>
<tr>
<td>Education</td>
<td>• Update schools and public education programmes;</td>
<td>• Energy saving in physics curriculum;</td>
</tr>
<tr>
<td></td>
<td>• Strengthen government departmental energy saving efforts through appointing Green Managers and Energy Wardens; and</td>
<td>• Various secondary school materials;</td>
</tr>
<tr>
<td></td>
<td>• Encourage public sector institutions to save energy.</td>
<td>• Energy Efficiency Centre at Hong Kong Science Museum; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Energy website.</td>
</tr>
<tr>
<td>Aspects</td>
<td>Key Actions</td>
<td>Achievement</td>
</tr>
<tr>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Regulatory</td>
<td>• Periodic review, expand and/or tighten relevant energy-related standards:</td>
<td>• BEEO: the Building Energy Code (BEC) under BEEO will be reviewed every three years. The BEC was last reviewed in 2014 to 2015 and the 2015 edition represents a 10% improvement in energy efficiency when compared with the 2012 version;</td>
</tr>
<tr>
<td></td>
<td>Buildings Energy Efficiency Ordinance (BEEO), Building (Energy Efficiency)</td>
<td>• B(EE)R: the Overall Thermal Transfer Value (OTTV) standard for commercial buildings and hotels will be reviewed twice before 2025; the Residential Thermal Transfer Value standard for residential buildings would be reviewed twice before 2030; and</td>
</tr>
<tr>
<td></td>
<td>Regulation, (B(EE)R) and Energy Efficiency (Labeling of Products) Ordinance</td>
<td>• EELPO: the scope and grading standards of the Mandatory Energy Efficiency Labeling Scheme (MEELS) will be regularly reviewed in tandem with technological development. The grading standards for three products were reviewed and tightened in 2015. The scope will be further expanded to cover five more products.</td>
</tr>
<tr>
<td></td>
<td>(EELPO)</td>
<td></td>
</tr>
</tbody>
</table>
Voluntary 4Ts framework: Partnering with Stakeholders

Using the Energy Saving Plan as a backbone, the HKSAR Government proposed a 4Ts Partnership between Government and Built Environment Sector, in which 4Ts stand for “Target, Timeline, Together and Transparency”.

The partnership includes “setting energy saving ‘targets’ according to a timeline that would eventually dovetail with that of Paris Agreement reporting ‘timeline’”, implementing building energy audits and the corresponding recommendations, carrying out retro-commissioning, “procuring green products that would help to save energy”, application of BEAM Plus rating or equivalent for new and existing buildings; and “joining the Government’s Energy Saving Charter”. Both the public and private sector building collaborate and work together and “add
transparency to the energy saving achievements of Hong Kong’s buildings". [1b]

Please refer to the table below for “Review of Possible Pathways for Large Existing Buildings Strategies” as stated in the document “Hong Kong’s Climate Action Plan 2030+” (page 39): [1c]

Table IV-1-2. Review of Possible Pathways for Large Existing Buildings Strategies

<table>
<thead>
<tr>
<th></th>
<th>Existing Policies</th>
<th>Going Forward by 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Audit</td>
<td>• Energy Audit Code (EAC) requires audit every 10 years for 4 types of building services installations of prescribed buildings</td>
<td>• Require more frequent audit for air conditioning system for major energy use buildings</td>
</tr>
<tr>
<td>Benchmarking</td>
<td>• Buildings Energy Efficiency Ordinance requires disclosure of Energy Utilization Index (EUI)</td>
<td>• Voluntary sharing of data moving to mandatory system</td>
</tr>
<tr>
<td>Retro – commissioning</td>
<td>• No requirement and not a common practice yet</td>
<td>• Promote good practice in public sector buildings and co-learn with private sector and professionals</td>
</tr>
<tr>
<td>Retrofitting</td>
<td>• EAC audit provides recommendations but no requirement to carry them out</td>
<td>• Promote recommendations to be carried out</td>
</tr>
<tr>
<td>Green Building Standard</td>
<td>• A new BEAM Plus rating with the option of selective assessment in addition to comprehensive assessment has been developed for existing buildings</td>
<td>• Encourage building owners to consider using the new rating when retro-fitting buildings</td>
</tr>
<tr>
<td>Beyond Compliance</td>
<td>• Created ‘Dialogue Platform’ for public-private sector collaboration</td>
<td>• Continue to energize energy saving in existing buildings</td>
</tr>
</tbody>
</table>
References:

  • [1a] P.12, figure 1
  • [1b] P.40
  • [1c] P.39

  • [5a] P.7, 2nd paragraph
  • [5b] P.5, “Government buildings and public housing”
  • [5c] P.6
IV-2. LED Deployment Replacing Conventional Lighting in India

Objective:
LED provides better light output than conventional light and are 88% energy efficient as compared to incandescent bulbs, 50% less as compared to CFLs.

A public sector entity under Ministry of Power, Energy Efficiency Services Limited (EESL), is implementing Unnat Jyoti by Affordable LEDs for All (UJALA) to provide LED bulbs to domestic consumers and Street Light National Programme (SLNP) to replace conventional street lights with LED street lights.

Scope:
The essence of the business model of EESL is PAY AS YOU SAVE (PAYS), where the entire upfront cost in efficiency is made by EESL and the payment is made from the reduction in energy costs over time. There is no requirement of budget to undertake these programmes by Governments and facilities.

As on 2nd November 2017, EESL has saved over 38 billion kWh annually and reduction in GHG emission of 29 million ton CO$_2$ through programmes Unnat Jyoti by Affordable LEDs for All (UJALA) and Street Lighting National Programme (SLNP). EESL has successfully distributed over 272 million LED bulbs and have retrofitted over 3.7 million LED street lights across India.

Unnat Jyoti by Affordable LEDs for All (UJALA):
Energy Efficiency Services Limited (EESL) has evolved a service model where it works with electricity distribution companies (DISCOMs) through a benefit sharing approach. The Domestic Efficient Lighting Programme (DELP) obviates the need for DISCOMs to invest in the upfront cost of LED bulbs: EESL procures the LEDs bulbs and provides to consumers at a rate of 1.5 USD each as against their market price of 5 USD. The upfront investment made by EESL is paid back in two different ways as followings:
(a) DISCOM Cost Recovery: The investments of EESL are recovered from the DISCOMs as annuity over a period of 3-10 years by monetizing the energy savings that accrue as a result of replacement of incandescent lamps with LEDs. Each replacement leads to a reduction of connected load by 53W. The energy savings are monetized based on the peak procurement cost of DISCOM and is used to pay back the investment made by EESL under an approval by the State Electricity Regulatory Commission.
(b) On Bill Financing (OBF): Cost recovery from consumers by deduction of easy instalments of .15 USD every month for 8-12 months. The entire cost of the LED bulbs, including the awareness, distribution and cost of capital is recovered from the consumer bills.

EESL aggregates demand from various locations and initiates procurement of large quantities of LED bulbs to get the benefit of price reduction. The benefit of lower cost is pooled with the ongoing projects and the benefit is passed on to all. As can be seen from the chart below, there has been continuous fall in the LED bulb prices over the last one year.
Street Lighting National Programme (SLNP):

Energy Efficiency Services Limited (EESL) replaces the conventional street lights with LEDs at its own costs (without any need for municipalities to invest) and the consequent reduction in energy and maintenance cost of the municipality is used to repay EESL over a period of time. The contracts that EESL enters into with municipalities are typically of 7 years duration where it not only guarantees a minimum energy saving (of typically 50%) but also provides free replacements and maintenance of lights at no additional cost to the municipality. The service model enables the municipalities to go in for state of the art street lights with no upfront capital cost and repayments to EESL are within the present level of expenditure. Thus there is no additional revenue expenditure required to be incurred by the municipality for change over to smart and energy efficient LED street lights.

EESL aggregates demand from various Urban Local Bodies (ULBs) in a state and initiates procurement of large quantities of LED street lights to get the benefit of price reduction. The benefit of lower cost is passed on to the ULBs. The wattages of the street lights procured are such that they not only are at least 50% lower than the conventional ones but also provide adequate
light to meet the light output as prescribed by the National Lighting Code. The prices of street lights have also reduced (reckoned at rupees per watt of LED given that there are different wattages) by about 35%.

EESL has standardized the replacement wattages as Table IV-2-1.

<table>
<thead>
<tr>
<th>Conventional Light</th>
<th>LED Light</th>
<th>Energy Saving Potential (approx.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluorescent Lamp TL 40W</td>
<td>LED 18W – 20 W</td>
<td>50%</td>
</tr>
<tr>
<td>Sodium Vapour 70W</td>
<td>LED 30W</td>
<td>61%</td>
</tr>
<tr>
<td>Sodium Vapour 150W</td>
<td>LED 70W</td>
<td>53%</td>
</tr>
<tr>
<td>Sodium/Metal Halide 250W</td>
<td>LED 100W -120W</td>
<td>56%</td>
</tr>
<tr>
<td>Sodium 400W</td>
<td>LED 190W</td>
<td>51%</td>
</tr>
<tr>
<td>Manual Switching</td>
<td>CCMS</td>
<td>10% – 25%</td>
</tr>
</tbody>
</table>

References:
- www.ujala.gov.in
- http://iledtheway.in/
IV-3. Indonesian Energy Efficiency Implementation

Objective:

Presidential Regulation No. 22/2017 on General Plan for National Energy (RUEN) sets the goal of reducing energy intensity by 1% annually until 2025, achieving energy elasticity less than one by 2025, and achieving 17% energy savings in final energy consumption by 2025, through the implementation of energy management program, fuel saving program, energy efficiency standard for appliances, and retrofit to improve efficiency of existing facility (household, industry, transportation, commercial).

The energy savings target of 17% is based on a business-as-usual scenario with an average annual growth of energy demand of 7.1% per year.

Ministerial Regulation for Government Regulation No. 70/2009:

Ministerial Regulation includes energy saving reduction of at least 1% a year. The Ministerial Regulation No. 14/2012 regarding method of reporting energy conservation outcome for energy users of 6000 tonnes of oil equivalent, regulates certain aspects of implementation of the mandate for large energy users, as follows:

1. Energy Management

Qualifying users of energy resource and final energy users are obliged to create an Energy Management Team. The Energy Management Team is chaired by the Energy Manager.

The role of Energy Manager is to:

a) Implement energy conservation planning which would include, establishing target and energy conservation program, formulating the energy efficiency operating procedure and executing energy audit.

b) Implement energy conservation which would include implementing energy conservation program, carry-out recommendation of energy audit result; and increase employee awareness and motivation regarding energy conservation.

c) Monitor and evaluate, which includes taking measurements, making notes, prepare report and recommendation on improving the execution of the energy conservation program.

An energy manager is obliged to have a competency certificate in accordance to regulations and law.
2. **Energy Audit**

By Law, energy audit shall be performed periodically, at least once every 3 years applies to energy use in processes and primary energy conversion. Energy audit could be performed by an internal Auditor and/or External Auditor. An Auditor in obligated to have a competency certificate in accordance with regulations and law.

   a) Energy audit recommendation that requires no or low cost to implement shall be compulsory implemented within 1 year.

   b) Energy audit recommendation that requires medium to large investment which satisfies technical and economical investment viability that is measured such as by payback period shall be compulsory implemented in less than 5 years.
IV-4. Clean Technology for Power Plant in Indonesia

Objective:
1. Waste Heat Recovery (WHR)
   GHG emission reductions of the connected grid system (the WHR system replaces grid electricity).
2. Coogeneration or Combined Heat and Power (CHP)
   Reduce GHG emission by installing Cogeneration (Cogen) or Combined Heat and Power (CHP) to generate electricity and useful heat at the same time.
3. Clean Coal Technology
   Reduce GHG emissions from coal fired power plants, and to support the increasing role of low-carbon energy technologies in power sector at national level.

32 MW Waste Heat Power Generation in PT. Semen Indonesia at Tuban Factory:

- Location: Tuban Regency, East Java, Indonesia.
- The WHRPG is built to utilize waste heat from 4 unit of kilns in Tuban factory. Total capacity of the WHRPG is 32 MW with total average electricity production 30.5 MW. This is around 25% of the total electricity demand of the whole factory.
- This project is Indonesia and Japan Bilateral Cooperation Project under Joint Crediting Mechanism (JCM) scheme with the total investment 51 million USD. From this project, approximately 122,000 tons CO₂ per year can be reduced.

   From 4 kilns, 3 kilns had already installed with the waste heat recovery unit, the last kiln will be installed in January 2018 due to business decision reason. Currently the WHRPG is operated in 75% capacity to support PT. Semen Indonesia (Persero) Tuban Factory operation.

   [http://jcm.ekon.go.id/id/](http://jcm.ekon.go.id/id/)

8 MW Co-generation System at PT. Toyota Motor Indonesia:

- This project is intended to reduce energy consumption and CO₂ emission by installing a gas co-generation system with a high generating efficiency gas-engine for that system, and adds on heat recovery system to decrease steam and hot water consumption. The system use natural gas which is
also in paralleled used for the other processes of their manufacturing purposes.

About 8 MW of electricity could be generated by this co-generation system which is about 30% of the total factory’s electricity consumption. In addition, the system also produces hot water which can be used for the factory manufacturing production such as for the painting process, humidity requirements, and pretreatment in the manufacturing.

The project is expected to be able to reduce GHG emission of 20,439 tCO$_2$ per year. The energy efficiency improvement were coming from electricity and steam/hot water production that can substitute 2 previous hot water boilers.

The full operation of the project is expected from September 2017.

http://jcm.ekon.go.id/id/

**Clean Coal Technology:**

Currently, most of the coal-fire plants in Indonesia are sub-critical units. If they are replaced by ultra-supercritical power plant, the 10% coal consumption would be reduced. (Refer to Comparison of CO$_2$ emission from Coal-fired power page 21)

Sumitomo Corporation jointly with PT United Tractors Tbk (a subsidiary company of PT Astra International Tbk), and Kansai Electric Power Co. Inc. have come to an agreement to develop Tanjung Jati B coal-fired power plant Unit 5 & 6 Expansion Project (hereafter Project) and signed the power purchase agreement with PT PLN (PERSERO) · Indonesia State Electricity Corporation, on 13 April 2017.

The Project, which is BOT (Build, Operate and Transfer) scheme, is to build 1,000MW x 2 units of ultra-supercritical power plant adjacent to the existing Unit 1 to 4 of which capacity is 2,640MW in total, located in Central Jawa, Indonesia, to operate and maintain the power plant and to supply electricity over a period of 25 years after commencement of commercial operation. The investment cost of this project is expected to be US$ 4.2 Billion, mainly funded by project finance.

It has also been mandated by Electricity Provision Business Plan of PT PLN (PERSERO) that all new coming unit of coal-fired plant in Java Bali system should adopt the ultra-supercritical technology in order to reduce GHG emission.
- Plant Location
**IV-3. Japanese Top Runner Program**[1]

**Objective:**
To curtail residential, commercial, and transportation sector energy consumption, the Top Runner Program was established to develop a standard for the World’s Best Energy-Efficient products by stimulating continuous efficiency improvements in appliances, machinery, and equipment.

**Top Runner Program Standards**
To scale the impact of the program, new product categories were continually added. The scope of the program was updated in 2005, 2009, and 2013, expanding the program from an initial 11 products to 31 products.


For example, Passengers Vehicles, the standard is as follows.

(1) **Vehicles whose target fiscal year is**:
- FY 2005 and each subsequent fiscal year (until FY 2014) (Diesel passenger vehicles),
- FY 2010 and each subsequent fiscal year (until FY 2014) (Gasoline passenger vehicles),
- FY 2010 and each subsequent fiscal year (until FY 2019) (LP gas passenger vehicles)

**Table IV-3-1. Passenger vehicles that have a riding capacity of 10 persons or less**

<table>
<thead>
<tr>
<th>Passenger vehicles weighing Category</th>
<th>Standard energy consumption efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gasoline</td>
</tr>
<tr>
<td>less than 703 kg</td>
<td>21.2</td>
</tr>
<tr>
<td>Passenger vehicles weighing</td>
<td>Standard energy consumption efficiency</td>
</tr>
<tr>
<td>Category</td>
<td>Gasoline</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>703 or more and less than 828 kg</td>
<td>18.8</td>
</tr>
<tr>
<td>828 or more and less than 1,016 kg</td>
<td>17.9</td>
</tr>
<tr>
<td>1,016 or more and less than 1,266 kg</td>
<td>16.0</td>
</tr>
<tr>
<td>1,266 or more and less than 1,516 kg</td>
<td>13.0</td>
</tr>
<tr>
<td>1,516 or more and less than 1,766 kg</td>
<td>10.5</td>
</tr>
<tr>
<td>1,766 or more and less than 2,016 kg</td>
<td>8.9</td>
</tr>
<tr>
<td>2,016 or more and less than 2,266 kg</td>
<td>7.8</td>
</tr>
<tr>
<td>2,266 kg or more</td>
<td>6.4</td>
</tr>
</tbody>
</table>

(2) Vehicles whose target fiscal year is FY 2015 and each subsequent fiscal year (until FY 2019)

Table IV-3-2. Passenger vehicles fueled with gasoline or diesel oil and having(125,796),(486,915)

<table>
<thead>
<tr>
<th>Passenger vehicles weighing Category</th>
<th>Standard energy consumption efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 601 kg</td>
<td>22.5</td>
</tr>
<tr>
<td>601 or more and less than 741 kg</td>
<td>21.8</td>
</tr>
<tr>
<td>741 or more and less than 856 kg</td>
<td>21.0</td>
</tr>
<tr>
<td>856 or more and less than 971 kg</td>
<td>20.8</td>
</tr>
<tr>
<td>971 or more and less than 1,081 kg</td>
<td>20.5</td>
</tr>
<tr>
<td>1,081 or more and less than 1,196 kg</td>
<td>18.7</td>
</tr>
<tr>
<td>1,196 or more and less than 1,311 kg</td>
<td>17.2</td>
</tr>
<tr>
<td>1,311 or more and less than 1,421 kg</td>
<td>15.8</td>
</tr>
<tr>
<td>1,421 or more and less than 1,531 kg</td>
<td>14.4</td>
</tr>
<tr>
<td>1,531 or more and less than 1,651 kg</td>
<td>13.2</td>
</tr>
<tr>
<td>1,651 or more and less than 1,761 kg</td>
<td>12.2</td>
</tr>
<tr>
<td>1,761 or more and less than 1,871 kg</td>
<td>11.1</td>
</tr>
<tr>
<td>1,871 or more and less than 1,991 kg</td>
<td>10.2</td>
</tr>
<tr>
<td>1,991 or more and less than 2,101 kg</td>
<td>9.4</td>
</tr>
<tr>
<td>2,101 or more and less than 2,271 kg</td>
<td>8.7</td>
</tr>
<tr>
<td>2,271 kg or more</td>
<td>7.4</td>
</tr>
</tbody>
</table>
Verification and measures for failure of the target values:

In cooperation with manufacturers, standards are determined through a study of existing products on the market, and adjusted for forecasted technical improvements.

A manufacturer confirms their compliance to the standard through a survey administered in the target year. To facilitate conscious buying, products have labels with energy consumption efficiency information at the time of purchase.

Fig. IV-3-1 Example of Uniform Energy Saving Label (Electric Refrigerator)

For non-CFC electric refrigerators, non-CFC sign is displayed.

Fiscal year when criteria of the 5-star multistage rating is set.

The manufacturer name and model name are displayed to prevent mistaken adherence of the Uniform Energy Saving Label.

[Energy-Saving Labeling Program]

[Expected annual electricity bill]

This information is provided so as to make energy consumption efficiency (e.g. annual energy consumption) comprehensible. Expected annual fuel usage for gas/oil appliances (simplified label).

[Multi-stage rating system]

Air conditioners, TV sets, electric refrigerators, electric toilet seats, lighting equipment (limited to lighting equipment for fluorescent lamp(s) for household use), and electric freezers are rated at five levels, symbolized by the number of stars; the superior the energy saving performance of a marketed product, the greater the number of stars.

In order to clarify the number of stars given to products meeting the Top Runner Program, a border line of 100% target achievement is shown under the stars.
When the target values are not achieved, the ministries offer recommendations to the manufacturer in question as required. Further, if this advice is not followed, the recommendations are made public and the manufacturer may be ordered to follow the recommendations.

**Achievement:**

Since the introduction of the program in 1998, twenty three product categories, selected based on high energy intensity, widespread use or scope for improving energy efficiency, have reached their target improvement date. 91% of these product categories have achieved efficiency gains above the ministry’s expectations, such as TV sets, with 61% improvement between 2009 and 2012, and gas cooking appliances, with 26% efficiency improvement between 2002 and 2008. Overall, the Programme has helped reduce energy consumption by 5% in road transport and by 8% in the residential sector.

**Reference:**

IV-4. **Low-Income Energy-efficient Housing Program in Korea**

**Objective:**
The Energy-efficient Housing Program for Low-income Households in Korea is designed to help low-income homes improve home comfort, lower the energy bills and decrease greenhouse gas emissions through implementation of general energy-saving measures such as window replacement using advanced building foams, floor and wall insulation and etc.

**Scope:**
Low-income homes are not capable to maintain heating at the proper temperature due to lack of capacity in energy efficiency. It is therefore in need of fundamental energy upgrades to improve residents' comfortability in the winter with small use of energy.

The Energy-efficient Housing Program in Korea which aims to help the low-income homes by providing energy-efficient home retrofit service not only helps low-income families to reduce their energy use and costs but it also contributes to energy saving policy at national level, leading to achieve reduction of greenhouse gas emission.

The program mainly targets low-income families who are in need of major energy efficiency upgrades in their home and social welfare facilities. Since the program began in 2007, the Korea Energy Foundation (KOREF), a non-profit agency that manages the program has helped improve lives of 38 million households by providing energy conservation materials such as high efficiency oil and gas-fired boilers and energy efficient upgrades services such as free installation of floor and wall insulation, floor pipe wrap and window replacement at 314.7 billion won (around $300 million) so far.

**Table IV-4-1 Annual budget and target number of Low Income Energy Efficiency Program**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budget(billion won)</td>
<td>10</td>
<td>28.5</td>
<td>28.5</td>
<td>29.2</td>
<td>19.5</td>
<td>29.5</td>
<td>41</td>
<td>67</td>
<td>61.2</td>
</tr>
<tr>
<td>No. of households</td>
<td>16,501</td>
<td>80,130</td>
<td>68,331</td>
<td>43,336</td>
<td>21,428</td>
<td>29,628</td>
<td>36,508</td>
<td>42,158</td>
<td>40,707</td>
</tr>
</tbody>
</table>
Key Achievement:

Low-income Energy Efficient Housing Program brings benefits not only for those who are in need of improvement on energy efficiency in their home but also for the government to meet their aim to save energy consumption and reduce greenhouse gas emission at national level by preventing unnecessary leaking of energy. As the program is not a one-time project, its effectiveness is being accumulated every year, expected to make greater contribution in the future.

According to the effectiveness of the program evaluated by KOREF, each household that received the energy efficient upgrade service has saved around 23% of heating energy consumption per year, from 283 kWh/m² to 217 kWh/m², saving in total of 66 kWh/m² which is the same as the amount that can raise above minimum of 2~3 grades of energy efficient rating of building in Korea. Total energy saved by implementation of the program in 2015 was 117,480,000 kWh.

In technical aspect, surface temperature of the vulnerable area has increased up to 4.9 degree as a result of installation of wall insulation (Picture IV-4-2) and the thermal comfort in winter for each home has improved from PMV -0.7 to -0.26 as a result of energy-efficient upgrade service (Table IV-4-2).
Picture IV-4-2 Wall surface temperature change before and after insulation

<table>
<thead>
<tr>
<th>Thermal Camera</th>
<th>Before insulation</th>
<th>After insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum value</td>
<td>22.0</td>
<td>23.2(1.2 degree ↑)</td>
</tr>
<tr>
<td>Minimum value</td>
<td>16.3</td>
<td>21.2(4.9 degree ↑)</td>
</tr>
</tbody>
</table>

**Table IV-4-2** Comparison of PMV (Predicted Mean Vote) Value before and after the upgrade

*Thermal comfort zone belongs to PMV -0.5 ~ +0.5*

<table>
<thead>
<tr>
<th>Cold</th>
<th>Cool</th>
<th>Slightly Cool</th>
<th>Neutral</th>
<th>Slightly Warm</th>
<th>Warm</th>
<th>Hot</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1.5</td>
<td>-1.0</td>
<td>-0.5</td>
<td>0</td>
<td>+0.5</td>
<td>+1.0</td>
<td>+1.5</td>
</tr>
</tbody>
</table>

△Before △ After

In terms of financial aspect, the program has enabled each households to save 264,155 won (around $200) per year when they maintain proper heating level and overall 10.56 billion won ($9 million) was saved through the program in 2015. (Table IV-4-3)

**Table IV-4-3** Data for equation of Total Energy Saving Price

*Total energy saving price=energy saving per unit area × standard area × energy cost*

<table>
<thead>
<tr>
<th>Energy saving per unite area</th>
<th>Standard area</th>
<th>Energy cost</th>
<th>Total energy saving price</th>
</tr>
</thead>
<tbody>
<tr>
<td>66.0(kWh/m² • y)</td>
<td>44.52(m²)</td>
<td>89.9(won/kWh)</td>
<td>264,155 won</td>
</tr>
</tbody>
</table>

Most importantly, as for the environmental aspect, the program has high potential to make substantial contribution to country’s greenhouse gas emissions.
A result of precise energy evaluation has shown that energy has saved by 23% on average through the energy efficient upgrades and when it is converted to the amount of greenhouse gas emission, it is equivalent to reduction of 1.38(tCO$_2$/y) per household on average. In 2015, a total of 55,200tCO$_2$ was reduced through the upgrade service. (Table IV-4-4)

**Table IV-4-4** Estimation of energy consumption and GHG emissions per unit area

<table>
<thead>
<tr>
<th>(before upgrade) energy consumption per unit area (kWh/m$^2$ • y)</th>
<th>(after upgrade) energy consumption per unit area (kWh/m$^2$ • y)</th>
<th>Standard area (m$^2$)</th>
<th>GHG emission per year (tCO$_2$/y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>283</td>
<td>217</td>
<td>44.5</td>
<td>5.93</td>
</tr>
</tbody>
</table>

**[Calculation Method]**

- IPCC Carbon Emission Factor was used in calculation of average reduction of GHG emission per household. (National carbon emission factor is currently under development)
- *Gross calorific value of national conversion standard for energy calorific value was used in calculation of toe*
- *Net calorific value ‘energy calorific value conversion standard’ of was used in calculation of carbon dioxide*
**IV-5 Energy Efficiency standard and labeling scheme in Thailand**

**Objective:**
To inform consumers about high efficiency products and create awareness of energy conservation among the public by using labeling mechanism.

**Scope:**
In Thailand, there are two types of label which serve the same purpose of increasing energy efficiency. First, very well-known “No.5 Label” is for electric home appliances such as air conditioners, refrigerators, fans and light bulbs. Second, “Energy-saving label”, is for non-electric products, industrial products or construction materials such as LPG gas stoves, small diesel engines and fiberglass insulators. Both of the energy saving labels voluntary programs for high-efficient products.

**No.5 Label:**

No.5 Labels have been implemented by Electricity Generating Authority of Thailand (EGAT) since 1994. Currently, there are 315 million labels that have been issued, covering 29 products.
<table>
<thead>
<tr>
<th>Refrigerator</th>
<th>Electric Water Heater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Conditioner</td>
<td>Ventilators</td>
</tr>
<tr>
<td>Low-Loss Ballast</td>
<td>Electric Irons</td>
</tr>
<tr>
<td>Brown rice 5</td>
<td>Washing Machine</td>
</tr>
<tr>
<td>Fan</td>
<td>LED</td>
</tr>
<tr>
<td>CFL</td>
<td>Retrofit Set T4</td>
</tr>
<tr>
<td>Rice cooker</td>
<td>Microwave</td>
</tr>
<tr>
<td>Lamp</td>
<td>Induction Cooker</td>
</tr>
<tr>
<td>Double oscillating fan</td>
<td>Television</td>
</tr>
<tr>
<td>Thin tube T5</td>
<td>Electric kettle</td>
</tr>
<tr>
<td>Ballast T5</td>
<td>Refrigerated display cabinet</td>
</tr>
<tr>
<td>Standby Power 1 Watt</td>
<td>Electric flying pan</td>
</tr>
<tr>
<td>(TV)</td>
<td></td>
</tr>
<tr>
<td>Standby Power 1 Watt</td>
<td>Automatic water pump</td>
</tr>
<tr>
<td>(Monitor)</td>
<td></td>
</tr>
<tr>
<td>Electric Pot</td>
<td>Water dispenser</td>
</tr>
<tr>
<td>Lamp T5</td>
<td></td>
</tr>
</tbody>
</table>

In 2016, 24 million NO.5 labels have been issued. The maximum electricity demand can be reduced to 204 MW and saved electricity about 1,286 GWh.
Energy-saving label have been implemented by Department of Alternative Energy Development and Efficiency (DEDE) since 2007. Currently, 24 million labels have been issued, covering 11 products.

<table>
<thead>
<tr>
<th>Household LPG Gas Stoves</th>
<th>Small Diesel Engines (Water Cooled)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Speed Drives</td>
<td>Small Gasoline Engines (Air Cooled)</td>
</tr>
<tr>
<td>Flat Plate Glasses</td>
<td>High Pressure Gas Stoves</td>
</tr>
<tr>
<td>Fiberglass Insulators</td>
<td>Heat Pump</td>
</tr>
<tr>
<td>Three-Phase Induction</td>
<td>Air Compressor</td>
</tr>
<tr>
<td>Motors</td>
<td>Paint</td>
</tr>
</tbody>
</table>

In 2016, 6.7 million energy-saving labels have been issued. The energy can be saved about 165 kilo ton of oil equivalent (ktoe)
IV - 6. Thailand's Energy Efficiency Revolving Fund (EERF)

Objective:
Operated since 2003, Energy Efficiency Revolving Fund (EERF) aims to provide low-interest loan for projects involving energy efficiency (EE). This program addresses the key barriers existed for EE investment, namely lack of interest and experience in financing EE projects by financial institution – leading to high perceived risks.

Financing mechanism:
Under supervision by Department of Alternative Energy Development and Efficiency (DEDE) and related committee, loans are provided to participating banks, which then finance EE projects using the loans at favorable interest rate. The borrowers then pay back the loan, with small interest (but no more than 3.5%), in installments over period in accordance with the terms of the contract. The banks then pay the loans back to DEDE, which will then further be used for next phases of EERF. The current phase of EERF (phase 6) is allocated a total of 4.5 billion Baht (approx. 130 million USD) from the Royal Thai Government.

Figure 1: A cycle depicting the workflow of EERF
Criteria:
For projects to be considered for EERF, certain criteria must be satisfied, which include but not limited to:
- Project’s simple payback period of no more than 7 years
- Maximum loan per project of 50 million Baht (approx. 1.5 million USD)
- Must be projects involving energy efficiency (some renewable energy projects can also be considered under certain circumstances)
- Subjected to further consideration by the board of committee, composing of experts on EE

Results (as of June 2017):

<table>
<thead>
<tr>
<th>Data</th>
<th>Unit</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of projects approved</td>
<td>Projects</td>
<td>78</td>
<td>83</td>
<td>98</td>
<td>12</td>
<td>24</td>
<td>295</td>
</tr>
<tr>
<td>Total investment</td>
<td>million Baht</td>
<td>3,370.98</td>
<td>2,096.63</td>
<td>5126.97</td>
<td>1,309.35</td>
<td>1,290.91</td>
<td>13,194.84</td>
</tr>
<tr>
<td>Total funding via DEDE</td>
<td>million Baht</td>
<td>1,902.25</td>
<td>1,734.96</td>
<td>2702.04</td>
<td>392.73</td>
<td>499.96</td>
<td>7,231.94</td>
</tr>
<tr>
<td>Energy saved</td>
<td>TJ/year</td>
<td>416,583.22</td>
<td>98,139.28</td>
<td>104858.7328</td>
<td>13,143.13</td>
<td>4,194.48</td>
<td>636,918.84</td>
</tr>
<tr>
<td>Value of energy saved</td>
<td>million Baht/year</td>
<td>1,271.36</td>
<td>27,291.70</td>
<td>29468.11</td>
<td>3,782.27</td>
<td>1,327.62</td>
<td>63,141.06</td>
</tr>
</tbody>
</table>
V. Low Carbon Transportation

V-1. Low Carbon Transportation in Hong Hong

Objective:
To alleviate Hong Kong’s per capita transport-related emission at low level, the Hong Kong Special Administrative Region (HKSAR) Government will continue to improve public transport and facilitate daily walking for short and medium distances in the following aspects: [1]

• Ensure public transport remains preferred choice for the community;
• Reshape travel patterns to minimize vehicle-based community needs and facilitate walking;
• Improve traffic management systems to reduce congestion;
• Save energy where possible; and
• Partner with stakeholders and community to optimize overall gains.

Scope:
Carbon emissions from transport constitute around 16% of the total emissions in Hong Kong. From estimation, 90% of Hong Kong’s daily passengers are made by public transport, which is amongst the highest in the world. Even though it is the case, its transport related emission is relatively low on a per capita basis. Still, the Paris Agreement reminds that Hong Kong needs to strive to do better. [1]

To keep the emission levels at low side, the scope of action includes: [1]

• Expanding rail and better integration of urban planning, housing and transport;
• Improving accessibility and connectivity for walking, and quality of urban footpaths and streetscapes;
• Enhancing further the quality of public transport services;
• Leveraging smart technology for better traffic management;
• Fostering further a bicycle-friendly environment in suitable areas;
• Partnering with public transport operators to further improve operational efficiencies, trial greener vehicles, study the applicability of green ferry technologies, as well as save energy;
• Facilitating the introduction of new automotive technology; and
• Strengthening enforcement against traffic congestion offences.

Actions in Progress:
To promote new technologies for energy saving and low-carbon emissions, the HKSAR Government conducts a series of implementations, trials and feasibility studies as listed below. [1]

- The current franchised bus standard is Euro 5 and will change to Euro 6 by 2018. Trial on several types of new technologies, for example, hybrid – electric (Euro 6 and electric) double-decked buses, battery and super-capacitor single-decked buses, are carried out currently, under the financial supports by the Environmental Protection Department (EPD); and

- Green ferries, powered by natural gas, battery or hybrid propulsion systems, and those using new techniques, such as light-weight carbon fiber for reduction of weight to achieve energy saving, are expected to serve the regional routes by 2030. Diesel electric vessels are under trial by the HKSAR Government.

For the improvement in walkability, accessibility and connectivity, Hong Kong has taken the following actions: [1]

- Universal accessibility programme, launched by the government, aims to enhance barrier free access facilities at public walkways;

- Harbourfront promenades will be created and act as the zero-carbon choices for recreation, minimizing “the need for mechanized transport over short and even medium distances.”

- Urban footpath will be maintained and replace with paving blocks made of environmentally-friendly materials. It is estimated by the Action Plan that “the carbon reduction from the difference in footpath design and materials used between 2017 and 2022 is about 480 tonnes annually” [1]. Additionally, such paving blocks are easier to maintain and save carbon emission amounting to 4,600 tonnes per year.

Promotion of low-emission transport can be achieved by:

- Development of New Territories Cycle Track Network and fostering a bicycle-friendly environment in new towns and new development areas; and

- Controlling rate of private car growth as an indirect method for promotion of green mobility.
In smart management of road usage, the following actions have been taken:

- Transport Department has been developing the Intelligent Transport Systems (ITS) under a three-pronged approach, for dissemination of traffic information to the public and traffic control and traffic enforcement support;
- At the same time, other companies, such as MTR Corporation Limited (MTRCL) and the franchised bus companies will also work in phase with government, to provide information via smart means as an improvement on overall travel experience for passengers; and
- Electronic road pricing (ERP) as an effective traffic management tool to alleviate local traffic congestion is now studied.

To response to Paris Agreement and Global Trend in reduction of GHG emission, companies such as MTRCL, also set the goal of reduction in 21% of electricity consumed per passenger – kilometer in their heavy rail network as compared with 2008 levels. [1] Up to 2015, 16.1% reduction of electricity intensity was recorded, indicating an intermediate success in their energy saving measures. [1]

Reference:
VI. Crediting Mechanism

VI-1. Perform Achieve and Trade (PAT) in India

Objective:

To achieve energy efficiency in energy intensive sectors in India

Background:

Enhancing energy efficiency in industries in order to reduce carbon emissions and to combat against the threats of climate change is a priority concern for India. The Perform Achieve and Trade (PAT) scheme was formulated to achieve the objective of improving energy efficiency in energy intensive industries of India. PAT scheme is one of the four initiatives under the National Mission for Enhanced Energy Efficiency (NMEEE) which is one of the eight national missions under National Action Plan on Climate Change (NAPCC) released in 2008.

PAT is a regulatory instrument to reduce specific energy consumption in energy intensive industries, with an associated market based mechanism to enhance the cost effectiveness through certification of excess energy saving which can be traded. Other than PAT, NMEEE comprises of other three initiatives viz. Market Transformation for Energy Efficiency, Energy Efficiency Financing Platform and Framework for Energy Efficient Economic Development with an objective to transform market towards the use of energy efficient appliances, providing platform for capacity building of financing initiatives and developing fiscal instruments to leverage finance for financing Energy Efficiency (EE) projects respectively including PAT scheme towards creation of an enhanced energy efficient ecosystem.

Perform Achieve and Trade (PAT) Scheme

It has been observed in the recent years that, attempts are being made by energy intensive industries to become more and more efficient through implementation of energy efficiency projects. In order to provide more encouragement to these industries and further accelerate the process of reduction in carbon emissions, PAT scheme has been launched by the Government of India. The energy intensive industries including the thermal power plants are the major players in this entire scheme of PAT. PAT is a
mechanism designed to achieve the emissions reduction in energy intensive industries and revolves around the concept of reduction in Specific Energy Consumption (SEC). It refers to the calculation of SEC in the baseline year and projected SEC in the target year covering different forms of net energy going into the boundary of the designated consumers’ plant and the products leaving it over a particular cycle. SEC is calculated on a Gate-to-Gate concept which is pictorially shown below in Figure VI-1-1. The SEC of an industry on Gate-to-Gate concept is calculated with the following formula:

\[
\text{Specific energy} = \frac{\text{Net energy input into the designated consumers' boundary}}{\text{Total quantity of output exported from designated consumers’ boundary}}.
\]

**Figure VI-1-1. Sketch of Gate-to-Gate Concept**

**Identification of Potential Sectors for Coverage under PAT Scheme**

Creation of the PAT mechanism comes from the provisions of the Energy Conservation Act, 2001 which also empowers the Central Government to notify energy intensive industries as listed out in the Schedule to the Act, as Designated Consumers (DCs). As of now Ministry of Power (MoP), based on the recommendations of Bureau of Energy Efficiency (BEE) notified industrial units and other establishments having annual energy consumption more than the threshold in eleven industrial sectors viz. Aluminum, Cement, Chlor-
Alkali, Fertilizer, Iron & Steel, Paper & Pulp, Thermal Power Plant, Textile, Railways, Refineries and DISCOMs as Designated Consumers (DCs) as given in the Table VI-1-1.

**Table VI-1-1 Minimum annual energy consumption of Designated Consumers**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Sector</th>
<th>Annual energy consumption Norm to be DC (toe) *</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Aluminium</td>
<td>7500</td>
</tr>
<tr>
<td>2</td>
<td>Cement</td>
<td>30000</td>
</tr>
<tr>
<td>3.</td>
<td>Chlor-Alkali</td>
<td>12000</td>
</tr>
<tr>
<td>4.</td>
<td>Fertilizer</td>
<td>30000</td>
</tr>
<tr>
<td>5.</td>
<td>Iron and Steel</td>
<td>30000</td>
</tr>
<tr>
<td>6.</td>
<td>Pulp and Paper</td>
<td>30000</td>
</tr>
<tr>
<td>7.</td>
<td>Textile</td>
<td>3000</td>
</tr>
<tr>
<td>8.</td>
<td>Thermal Power Plant</td>
<td>30000</td>
</tr>
<tr>
<td>9</td>
<td>Zonal Railways</td>
<td>70000</td>
</tr>
<tr>
<td></td>
<td>Railway Workshops</td>
<td>30000</td>
</tr>
<tr>
<td>10.</td>
<td>Refineries</td>
<td>90000</td>
</tr>
<tr>
<td>11.</td>
<td>DISCOMs</td>
<td>86000</td>
</tr>
</tbody>
</table>

* toe: tonne of oil equivalent

**Setting of Energy Consumption (SEC) Norms and Standards:**

Bureau of Energy Efficiency (BEE) had conducted sector specific studies to do the situational analysis. The studies showed that there is a wide bandwidth of
SEC within an industrial sector that indicated large energy-savings potential in the sector. The wide bandwidth is also a reflection of the differences in the energy-saving possibilities amongst plants because of their varying vintage, production capacity, raw material quality, and product-mix. Such a wide variation also makes it difficult to specify a single benchmark SEC for the sector as a whole. Older plants will find the benchmark impossibly high if it is set at the level of newer plants, newer plants will find it trivial if it is set at the level of older plants. The broad bandwidth of SEC within a sector, and the inability of all plants to achieve a sectoral benchmark SEC, suggests that SEC improvement norms had to be set for individual plants. These SEC improvement targets are based on the trend of energy consumption and energy-savings potential of the plants. In general, the higher the energy efficiency (or the lower the SEC), the lower the energy-savings potential. Thus, it became evident that it is not feasible to define a single norm/standard unless there is significant homogeneity amongst units in a sector. Therefore under PAT, the energy efficiency improvement targets fixed are “unit specific”. Each Designated Consumer (DC) is mandated to reduce its SEC by a certain value, based on its current SEC (or baseline SEC) within the sectoral bandwidth. A pictorial representation is provided in Figure VI-1-2.

**Figure VI-1-2. Energy Saving Target linked with the unit’s baseline effective SEC**
Setting Up of Targets for Designated Consumers (DCs):

Bureau of Energy Efficiency (BEE) has carried out background work to enable designing of a transparent, flexible, efficient and robust system for the PAT mechanism. In compliance with the directions of the Prime Minister's Council on Climate Change, BEE consulted all the key stakeholders like Designated Consumers, Energy Auditors/Managers, Industry Associations, Academics, etc. and solicited comments while framing the complete mechanism of PAT Scheme.

The target reduction for each DC is based on the prevailing levels of energy efficiency, so that energy efficient units will have low target of percentage reduction, as compared to less energy efficient units which will have higher targets. Each DC is given a mandatory target of SEC reduction with a time period of three years from the date of notification by the Central Government. DCs which are able to achieve SEC level that are lower than their targets can receive Energy Savings Certificates (EScerts) for their excess savings. On the other hand, the DCs which fail to achieve the given targets either through their own actions or through purchase of ESCerts are liable to financial penalty under the Energy Conservation Act, 2001.

The ESCerts are to be traded at two power exchanges that is Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL) or bought by other units under PAT who can use them to meet their compliance requirements.

Monitoring and Verification under PAT Scheme:

Monitoring and Verification (M&V) process is one of the key features of the PAT Scheme. M&V of DCs who have been notified under PAT Scheme is a process to verify the SEC and other related parameters through verifiable means in the baseline year and in the assessment year by empaneled accredited energy auditing firms. BEE empanels accredited energy auditors (AEAs) especially for conducting and M&V of the DCs. A brief process of the M&V phase is as follows:

- Engagement of Empaneled Accredited Energy Auditing (EmAEA) firms by BEE to carry out M&V of the DCs.
- Preparation and submission of data in relation to energy consumed and specific energy consumption per unit of production in the baseline year and in the target year in Form 1 as specified by BEE.
- Verification of the data submitted by the DCs in Form 1 by the EmAEAs.
- Filling up of Form-A (as specified by BEE) and submission of other related documents by the DCs.
- Submission of filled up Form-1 and Form-A to the auditing firm.
- The auditing firm after verification of the submitted Forms then submits a certificate of verification through Form B.
- Submission of Form 1, Form A, Form B and other requisite documents to the State Designated Agency (SDA) with a copy to BEE.
- The state designated agencies upon verification of the completeness and consistency of the submitted data, sends the data to BEE for further scrutiny.
- BEE then conducts scrutiny at its end and finally submits recommendations to the Central Government for issuance/entitled to purchase of Energy Saving Certificates.

The process flow and timelines is shown in Figure 3.

**Figure VI-1-3 Process flow of M&V**

![Figure VI-1-3 Process flow of M&V](image-url)
1. **PAT Cycle – I (2012-12 to 2014-15):**

   PAT cycle – I started from 1st April 2012 and in its first cycle, it was envisaged to reduce the SEC of 478 industrial units in 8 sectors (Table 2) viz. Aluminum, Cement, Chlor-Alkali, Fertilizer, Iron & Steel, Paper & Pulp, Thermal Power Plant and Textile. Energy saving targets were given to these 478 Designated Consumers (DCs). The overall SEC reduction targets aimed to secure an energy saving of 6.686 million tonne of oil equivalent. PAT Cycle I was completed on 31st March, 2015. The energy savings achieved in PAT Cycle –I is 8.67 MTOE which is an over achievement of about 30 percent against the target of 6.686 MTOE. This energy saving also translates into avoiding about 31 million tonne of CO2 emission. The details of energy saving target and achievements listed in Table VI-1-2.

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>Sectors</th>
<th>No. of Identified DCs</th>
<th>Annual Energy Consumption (Million toe)</th>
<th>Target of Energy Reduction (Million toe)</th>
<th>Actual Savings (Million toe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminium</td>
<td>10</td>
<td>7.71</td>
<td>0.46</td>
<td>0.73</td>
</tr>
<tr>
<td>2</td>
<td>Cement</td>
<td>85</td>
<td>15</td>
<td>0.82</td>
<td>1.44</td>
</tr>
<tr>
<td>3</td>
<td>Chlor-Alkali</td>
<td>22</td>
<td>0.88</td>
<td>0.05</td>
<td>0.13</td>
</tr>
<tr>
<td>4</td>
<td>Fertilizer</td>
<td>29</td>
<td>8.2</td>
<td>0.48</td>
<td>0.83</td>
</tr>
<tr>
<td>5</td>
<td>Iron &amp; Steel</td>
<td>67</td>
<td>25.3</td>
<td>1.49</td>
<td>2.10</td>
</tr>
<tr>
<td>6</td>
<td>Paper &amp; Pulp</td>
<td>31</td>
<td>2.09</td>
<td>0.12</td>
<td>0.26</td>
</tr>
<tr>
<td>7</td>
<td>Textile</td>
<td>90</td>
<td>1.2</td>
<td>0.07</td>
<td>0.12</td>
</tr>
<tr>
<td>8</td>
<td>Thermal Power Plant</td>
<td>144</td>
<td>105</td>
<td>3.21</td>
<td>3.06</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>478</strong></td>
<td><strong>164.97</strong></td>
<td><strong>6.68</strong></td>
<td><strong>8.67</strong></td>
</tr>
</tbody>
</table>
2. PAT Cycle –II (2016-17 to 2018-19):
In order to include new sectors and to identify new DCs under PAT Scheme, “Deepening study” –identifying new DCs in existing sectors and “Widening study” –including new sectors of PAT, was respectively carried out before the commencement of the second cycle. Deepening study resulted into identification of 89 DCs from the existing sectors of PAT. Widening study resulted into notification of three new sectors namely Refineries, Railways and DISCOMs under PAT scheme. PAT in its second cycle (2016-17 to 2018-19) seeks to achieve an overall energy consumption reduction of 8.869 MTOE for which energy reduction targets have been assigned and notified to DCs in these 11 sectors (eight existing sectors and three new sectors). This energy saving will translate into avoiding about more than 31 million tonne of Carbon dioxide. PAT Cycle II commenced from 1st April, 2016 covering 621 DCs from 11 sectors which include eight existing sectors and three new sectors viz. Railways, Refineries and DISCOMs as is listed in Table VI-1-3.

Table VI-1-3: Notified sectors in PAT cycle –II

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aluminum</td>
<td>10</td>
<td>2</td>
<td>12</td>
<td>Total Energy Consumption from 11 sectors 227 mtoe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Chlor-Alkali</td>
<td>22</td>
<td>3</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Textile</td>
<td>90</td>
<td>14</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pulp &amp; Paper</td>
<td>31</td>
<td>4</td>
<td>29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Iron &amp; Steel</td>
<td>67</td>
<td>9</td>
<td>71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Fertilizer</td>
<td>29</td>
<td>8</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Cement</td>
<td>55</td>
<td>27</td>
<td>111</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Thermal Power Plants</td>
<td>144</td>
<td>22</td>
<td>154</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Refinery</td>
<td>NA</td>
<td>18</td>
<td>18</td>
<td></td>
<td></td>
<td>National Target = 8.869 mtoe at the end of 2nd PAT Cycle (by 2018-19)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>DISCOMS</td>
<td>NA</td>
<td>44</td>
<td>44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Railway</td>
<td>NA</td>
<td>22</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>624</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. PAT Cycle –III (2017-18 to 2019-20)
The Parliamentary Standing Committee on Energy, Executive Committee on Climate Change under Prime Minister’s Office (PMO) and Group of Secretaries recommended to include DCs annually for accelerated coverage of DCs under PAT. Consequently, PAT scheme is being implemented on a rolling cycle basis.
where new DCs/sectors will be included every year. In view of this PAT cycle – III has started from 1st April, 2017. PAT Scheme in its third cycle seeks to achieve and overall energy consumption reduction of 1.06 MTOE for which SEC reduction targets have been assigned to 116 Designated Consumers from six sectors viz. Thermal Power Plant, Cement, Aluminum, Pulp & Paper, Iron & Steel and Textile. The energy consumption of these DCs is 35.00 MTOE.

4. PAT Beyond Cycle –III:
As PAT scheme is now being implemented on a rolling cycle basis, i.e. new DCs will be notified every year. In the future cycles of the PAT scheme, it is envisaged that new sectors will be included such as Commercial Buildings, Petrochemicals and other sectors as listed in the Schedule of the Energy Conservation Act, 2001.

**Salient features of PAT Scheme:**

1. PAT scheme is a blend of regulatory mechanism embedded with market component as the Designated Consumer upon complying to mandatory SEC reduction targets, their excess energy saving is incentivized to enable trading in a market.
2. The SEC reduction targets are unit specific so that units are competing against their own benchmark.
3. The national/sectoral energy saving targets are assigned based on their level of energy consumption.
4. The saving targets are relatively assigned based on their level of efficiencies i.e. unit which is more efficient gets lesser target compared to the one that is relatively inefficient recognizing the fact that the already efficient one would have lesser room for further improvement in efficiency.
5. This employs a robust M&V procedure where achievements of each DC is verified with utmost detail through an independent third party agency and thereafter again the reports get scrutinized at various State and Central Government levels before arriving at conclusion of their performance.
VI-2. Joint Crediting Mechanism (JCM) of Japan

Objective:
Japanese government established JCM “to appropriately evaluate contributions from Japan to GHG emission reductions or removals in a quantitative manner achieved through the diffusion of low carbon technologies, products, systems, services, and infrastructure as well as implementation of mitigation actions in developing countries, and to use them to achieve Japan’s emission reduction target.”

Scope:
The JCM scheme between Japan and host country is explained by the following Figure.

Figure VI-2

The Joint Committee (JC) develops rules and guidelines necessary for the implementation of the JCM. The JC determines either to approve or reject the proposed methodologies, as well as develops JCM methodologies. The JC designates the third-party entities (TPEs) and the JC decides on whether to register JCM projects which have been validated by the TPEs.

For the JCM Promotion Scheme, there are Demonstration Projects, JCM Feasibility Studies (FS) and Capacity Building Programmes.

Progress of JCM:
Japan has held consultations for the JCM with developing countries since 2011. At the end of 2015, Japan has established 15 JCM partner countries, Mongolia, Bangladesh, Ethiopia, Kenya, Maldives, Viet Nam, Lao PDR, Indonesia, Costa Rica, Palau, Cambodia, Mexico, Saudi Arabia, Chile, Myanmar and Thailand.
Some of the JCM projects are the Feasibility Studies of Wind-Power generation in Mongolia, Ultra Super Critical Coal Power Plants in Vietnam, geothermal power generation in Kenya, CCS into onshore oil field in Mexico and others.

Japanese government would support financing the JCM projects through JICA, ADB and others.

6. Relevance to the Paris Agreement of COP21

In Article 6, it is stipulated “2. Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.”

JCM would be “a voluntary basis in cooperative approaches” depending on the “guidance adopted by the Conference of the Parties.”

References:
[1] Japan’s INDC
http://www4.unfccc.int/submissions/INDC/Published%20Documents/Japan/1/20150717_Japan's%20INDC.pdf

JCM is mentioned in page 7 of the Japanese INDC.
VI-2. Renewable Energy Certificate (REC) incentives to wind and solar power plants with energy storage system (ESS) in Republic of Korea

Objective:

REC incentives to wind and solar power plants linked to ESS are provided by the South Korean government since last year, aiming at increasing efficiency of renewable power generation and fostering the national renewable energy market. The government provides additional points to those who install the energy storage system at their solar or wind power plants on assessment of their renewable energy certificates. These points can be sold in the REC trading market and bring additional profits for renewable energy producers, encouraging expansion of solar and power generation.¹

Scope:

The South Korean Government has been focusing on reducing fossil fuel energy and expanding green energy resources by shutting down 10 superannuated coal-powered plants nationwide and setting the renewable power supply target at 6 percent by 2020.²

As part of its effort to achieve this goal, the South Korean government has adopted the Renewable Portfolio Standards (RPS), a regulation that requires power generators (for more than 500,000Kw) to produce a specified fraction of their electricity from renewable energy sources since 2012. Utilities can run their own renewable energy power plants or buy the points of REC* from other generators to meet their annual quota.³

*Renewable Energy Certificate (REC) is a certificate that represents the power produced and supplied by renewable energy facilities. The certificate shows the actual supply amount of electricity multiplied by a weight value. REC = power generated by renewable energy × weight.⁴

RPS became the most important element of the 2030 new energy industry development policy of Korea which is designed to cope with the new climate regime and to make a successful transition to a low-carbon society.⁴

Moreover, the government adopted REC weight incentive system which provides additional points to companies that install an ESS at their solar or wind power plants to deal with the intermittent nature of renewable power generation and to promote more investment in wind and solar energy. Those who install the energy storage at their wind power plant has been given 5.5 additional point on assessment of their REC starting from 2015 and the same incentive system has been applied to solar power generated electricity
As a result of the REC incentive policy, 93MWh ESS linked to wind power generating plant was installed in 6 areas of South Korea since after adoption of the policy in October, 2015.³

As for the solar power generation, the 1.4 MW solar farm with an ESS of a 3.3 MWh capacity, which is South Korea’s first large-scale solar power plant was opened in mountainous rural area Gangwon Province, east of the country’s capital Seoul. Considering that there are about 21,000 solar power plants nationwide, the Ministry of Trade, Industry and Energy (MOTIE) is expecting that the number of ESS-linked model will grow across the country.⁵

In general, the government is expecting to increase efficiency and profitability of renewable power generation as well as to expand ESS market in Korea through adoption of this policy. More specifically, it is expected that a combined 440 billion won (US$391.6 million) worth of new demand for ESS will be created by 2020. Moreover, additional installation of 200MW of solar power plant will be possible with the extra grid capacity secured.⁶ Expansion of ESS market, which is a key technology to solve limitation of intermittent and unstable nature of renewable power generation will promote expansion of renewable power generation, contributing to reduction of CO2 emissions.⁶
Picture VI-2 Wind and solar power plant with ESS in Korea

<table>
<thead>
<tr>
<th>Solar Farm with ESS</th>
<th>Wind Power Plant with ESS</th>
</tr>
</thead>
</table>

References:


VII. Reduction of GHG from agriculture

VII-1. Mitigation of agricultural greenhouse gas emissions in New Zealand

Objective:
Research and demonstration of reducing agricultural methane and nitrous oxide emissions

Scope:
The greenhouse gas emissions from agriculture account for approximately half of New Zealand total greenhouse gas emissions. The major greenhouse gases are methane and nitrous oxide.

Figure VII-1

(Source: NZAGRC, How we measure emissions [1] page 12)

To achieve the INDC’s target, 30% below 2005 levels by 2030, New Zealand has been committed in research, innovation and technical solutions to reduce greenhouse gas emissions from agriculture, and sharing this knowledge internationally. The New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) was established to deliver knowledge, technologies and
practices to enable New Zealand to enhance agricultural productivity.

New Zealand was a founding member of the Global Research Alliance on Agricultural Greenhouse Gases (GRA). The GRA was established with the aim of increasing international cooperation, collaboration and investment in agricultural greenhouse gas research, to find ways to grow more food without growing greenhouse gas emissions.

**Methane from enteric fermentation:**[2]

Methane is a powerful but relatively short-lived greenhouse gas. The global warming potential1 of methane is 25 times that of one ton of carbon dioxide.

Enteric fermentation is the process in which animals produce methane via digestion of consumed plant material.

In New Zealand, most methane comes from belching by ruminant animals: sheep, beef cattle, dairy cows, and deer, and some from animal manure. Non-ruminants, such as poultry and pigs, also produce methane from their manure but these constitute a very small source in New Zealand.

To reduce the methane emissions, following options are demonstrating or researching by NZAGRC.

- Breeding low-emitting sheep and cattle
  
  Some animals emit less methane than others and that this trait is genetic and can be passed on to their offspring. This has been demonstrated clearly for sheep and work on cattle has begun.

- Low methane feeds and feed additives
  
  For sheep forage rape (a kind of grass) has consistently reduced methane emissions by 20-30% when fed as full diet.

  High cereal diets can reduce methane emissions per unit of product: but cereal must make up at least 30-60% of the diet.

  Other feeds or feed additives have also been shown to reduce methane production in animals in some studies. However this does not necessarily mean they will work under New Zealand conditions.

- Methane inhibitors

  An inhibitor developed by the Dutch company DSM has been shown to reduce methane emissions by 30% with commercial release planned by 2019.

**Nitrous oxide from agricultural soils:**[2]

Nitrous oxide is a much more powerful greenhouse gas than methane: 298 times more powerful than carbon dioxide.

The absolute amount of nitrous oxide emitted from agriculture is lower. In
New Zealand, the equivalent CO2 emission by nitrous oxide is less than half of that by methane.

Most nitrous oxide is produced by the action of soil bacteria in urine patches in paddocks. Smaller amounts come from dung deposited during grazing, stored manures spread back onto pasture, and from nitrogen fertiliser.

To reduce nitrous oxide emission, nitrification inhibitors such as DCD (dicyandiamide) and similar product, DMPP, are effective in reducing nitrous oxide emissions from urine patches in grazed pasture, with emissions reductions of about 60%. Nitrification inhibitors slow the conversion of ammonium (NH4+), deposited into the soil in the form of urine, to nitrate (NO3), which leaches into waterways. Nitrous oxide (N2O) is released into the atmosphere as a part of this process.

**Challenges to reducing greenhouse gas from agriculture:**[3]

To prove the reduction of methane and nitrous oxide emissions, they need to be measured accurately as possible. But it is difficult to pursue the emissions from cows, sheep, and cattle as they move in their pasture or feedlot.

The additives and the inhibitors for the reduction of methane and nitrous oxide may not be realistic to apply as they are usually very expensive and need lot of work. And it takes long time to find side effects of the additives and inhibitors. Therefore, demonstrations or field tests are required to show their practical application.

It is important to collaborate and to share internationally the research and development of reducing greenhouse gas from agriculture.

**References:**


4. Conclusion

To enhance the GHG reduction actions of the countries, one of the ways is to learn from the Best Practices from the other countries.

To modify or to apply GHG reduction program by learning from the other countries’ Best Practices, needs to check the effectiveness including their cost performances.

As the objectives are same in any countries, collaboration and/or exchange of information regarding the research, demonstration of the GHG reduction measure would reduce the cost.

It is essential to collaborate or to cooperate the research and demonstration to achieve the INDC targets which might be enhanced every 5 years.
Acknowledgements

- Team Members

  Leader: Hajime MURATA (Mr.), Executive Research Fellow, Japanese MC
  Members: John CHENG (Dr.), Secretary General of Hong Kong MC
  (Till the end of June 2017)
  Amit Kumar Bharadwaj (Mr.), Sr. Manager (Technical), Energy Efficiency Services Limited, India
  Ashok KUMAR (Dr.), Energy Economist Bureau of Energy Efficiency, India
  Atsushi NODA (Mr.), Secretary of Japanese MC
  Zurina AMNAN (Ms.), Secretary of Malaysian MC
  Woo Jung BON (Mr.), Secretary General of Rep. of Korea MC

Appendix 1

Intended Nationally Determined Contributions (INDCs) References

China
http://www4.unfccc.int/submissions/INDC/Published%20Documents/China/1/China's%20INDC%20-%20on%2030%20June%202015.pdf

India
http://www4.unfccc.int/submissions/INDC/Published%20Documents/India/1/INDIA%20INDC%20TO%20UNFCCC.pdf

Indonesia
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Japan
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Malaysia
http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Malaysia/1/INDC%20Malaysia%20Final%2027%20November%202015%20Revised%20Final%20UNFCCC.pdf

Mongolia
http://www4.unfccc.int/Submissions/INDC/Published%20Documents/Mongolia/1/150924_INDCs%20of%20Mongolia.pdf

Nepal
New Zealand
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Singapore
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Sri Lanka

Thailand
http://www4.unfccc.int/submissions/INDC/Published%20Documents/Thailand/1/Thailand%20INDC.pdf

Appendix 2
Summary of Hong Kong’s References
http://www.info.gov.hk/gia/general/201612/13/P2016121300652.htm?fontSize=1


