Specificities to be taken account when developing energy efficiency indicators - EEI activities in Asia-Pacific Region -

The Energy Indicators Workshop organized by IEA

Paris, France
6 – 7 June 2012

Shigeru Kimura
EDMC, IEEJ
Contents

- Energy Efficiency Indicators
- Introduction of Energy Consumption Survey in Asia Region
  - Hong Kong, China
  - Chinese Taipei
  - Philippines
  - Malaysia
  - Pilot Survey in ASEAN
- Conclusion
I. Energy Efficiency Indicators
APEC Economies are diverse

How to measure energy efficiency of the each economy?

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (km²)</td>
<td>17,075,200</td>
<td>707</td>
</tr>
<tr>
<td>Population (million)</td>
<td>1,331.46</td>
<td>0.40</td>
</tr>
<tr>
<td>GDP per capita (US$)</td>
<td>45,745</td>
<td>1,113</td>
</tr>
<tr>
<td>Climate</td>
<td>Tropical zone</td>
<td>Frigid zone</td>
</tr>
<tr>
<td>Economic Structure</td>
<td>Industrialized</td>
<td>Agriculture</td>
</tr>
</tbody>
</table>

As of 2009
Energy Intensity

- Time series
  (1990=100)

- Useful for assessing historical change in each economy
- But useful for comparing economies?

TPES/GDP valued by PPP
TPES doesn’t include biomass

Source: APEC Energy Database, WDI of WB
Energy Intensity

- Cross section

Not appropriate for international comparison due to the diversity

<table>
<thead>
<tr>
<th>Country</th>
<th>Industry</th>
<th>Transport</th>
<th>Residential</th>
<th>Commercial</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>29.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hong Kong, China</td>
<td>7.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: APEC Energy Database, WDI of WB

Land Size (km²) | 17,075,200 | 1,104
Population (million) | 141.85 | 7.00
GDP per capita (US$) | 8,615 | 29,882
Climate | Frigid zone | Subtropical zone
Share of industry (%) | 29.9 | 7.1

As of 2009

Not appropriate for international comparison due to the diversity.
Energy Intensities

- TPES/GDP valued by PPP
  - Overall energy indicator and result from following activities
    - Industry sector
      - Use of more energy efficient boilers, furnaces, equipments
      - Shift from energy intensive industries to less intensive industries such as
    - Transport sector
      - Modal shift
      - Improvement of fuel economy
      - Manage fluent traffic flow (if increased by 2km/hour average traffic flow, can achieve 5% saving of gasoline consumption)
  - Residential & Commercial sector
    - Apply efficient housing technologies and use efficient appliances
    - Apply and expand green building
  - Power generation
    - Improve thermal efficiency: CCGT, CCT

Need of preparation of energy efficiency indicators by each sector

- Improvement of fuel economy
- Manage fluent traffic flow (if increased by 2km/hour average traffic flow, can achieve 5% saving of gasoline consumption)
Energy Efficiency Indicators

- Indicator Pyramid

- Need of Detailed Energy Consumption Data
- Need of an Standard Template such as that of IEA

Data Quality

High

End use indicators such as space heating/floor area

Low

Technology indicators such as blast furnace process
II. Energy Consumption Survey
Energy Policies in Asia Region

- Energy efficiency and conservation is one of key policies in Asia region:
  - APEC
    - APEC leaders agreed to set up a target to improve the energy intensity in the region by 45% by 2035.
  - APERC conducts following energy efficiency activities with cooperation of EGEEC:
    - PREE: Peer review on energy efficiency
    - CEEDS: Cooperative energy efficiency
    - Compendium: Energy efficiency policies

- East Asia Summit (ASEAN+6)
  - All EAS countries set up their energy saving goals and action plans.
  - Report energy saving result come from implementation of the action plans regularly.
  - Assess energy saving potential to be brought by the goals using energy outlook approach.
  - Conduct pilot survey on energy consumption in residential sector in ASEAN countries.

- Need of Detailed Energy Consumption Data
- Energy Consumption Surveys have Started

  - Compendium: Energy efficiency policies
Hong Kong, China

- Implementing body: Energy Efficiency Office, Electricity and Mechanical Service Department, Hong Kong Government
- Purpose: End use data
- Target sectors: Residential, commercial, industry and transport
- Energy consumption survey: conducted in each sector separately in a 3-year cycle.
- Data structure: sector (4) – segment (28) – end use (21) – technology (69)
  - Ex. Commercial – Restaurant – Cooking – Cooking equipments
- Combination of top-down approach and bottom-up approach
- Top-down:
  - Publications, data provided by other Government department such as transport, data collected from various utilities (power, railway, bus and ferry companies)
- Bottom-up: Results from the surveys
Hong Kong, China

- Residential survey
  - Random sampling (1% coverage to total number of households)
  - Work with a consultant team
  - Segment
    - Public housing, Government-subsidized housing, Private housing, Other housing
  - Notification letter before survey
- Questionnaires
  - Appliances (penetration, ownership and rating), Operating behavior
  - Fuel type, penetration
  - Energy bill, household size, floor area
- End use
  - Lighting, space conditioning, cooking, refrigeration, entertainment, information technology
- Pilot field work (training of field worker) – Main field work
- Data processing, validation and analysis
- Final report
Energy Consumption Survey

- Hong Kong, China

2007 Residential Energy End-uses (52667TJ)

21% Cooking
19% Space conditioning
11% Hot water
21% Refrigeration
8% Others
20% Lighting

2011年9月印發
ISSUED IN SEPTEMBER - 2011
Chinese Taipei (Taiwan)

- Bureau of Energy (Government) ordered Taiwan Research Institute (TRI) to conduct the energy consumption survey in residential and service sectors from January to September in 2010.
- Random sampling: 1,718 and 1,649 complete samples in residential and service sectors respectively. The coverage was around 10%.
- Transport survey was also included.
- Questionnaire for residential sector
  - General information: House (type, space area, location), head of household (gender, age, education, occupation), household members, household income
  - Energy expenditure
  - Energy consumption by appliances
  - Awareness of energy conservation
**Chinese Taipei (Taiwan)**

- Result from the Residential Survey

<table>
<thead>
<tr>
<th></th>
<th>Petrol.</th>
<th>LPG</th>
<th>NG</th>
<th>Renew.</th>
<th>Eletr.</th>
<th>Total</th>
<th>Diffus.</th>
<th>Stock</th>
<th>Average EC per appliance</th>
<th>Average EC per Household</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1000 KLOE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>%</td>
<td>Unit</td>
<td>LOE</td>
<td></td>
</tr>
<tr>
<td>Space heating</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td>131</td>
<td>131</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Space cooling</td>
<td>-</td>
<td></td>
<td></td>
<td>2,583</td>
<td>2,583</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Water heating</td>
<td>592</td>
<td>573</td>
<td>100</td>
<td>1,568</td>
<td>2,833</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cooking</td>
<td>695</td>
<td>435</td>
<td>100</td>
<td>884</td>
<td>2,014</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Lighting</td>
<td></td>
<td></td>
<td></td>
<td>1,223</td>
<td>1,223</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Refrigerator</td>
<td></td>
<td></td>
<td></td>
<td>46</td>
<td>46</td>
<td>3.2</td>
<td>379,530</td>
<td>121</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Freezer</td>
<td></td>
<td></td>
<td></td>
<td>81</td>
<td>81</td>
<td>1.8</td>
<td>160,860</td>
<td>504</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Refriger./ Freezer</td>
<td></td>
<td></td>
<td></td>
<td>1,192</td>
<td>1,192</td>
<td>93.7</td>
<td>8,114,537</td>
<td>147</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>Dish washer</td>
<td></td>
<td></td>
<td></td>
<td>19</td>
<td>19</td>
<td>30.5</td>
<td>2,401,634</td>
<td>8</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Clothes washer</td>
<td></td>
<td></td>
<td></td>
<td>192</td>
<td>192</td>
<td>88.8</td>
<td>7,065,975</td>
<td>27</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Clothes Drier</td>
<td></td>
<td></td>
<td></td>
<td>26</td>
<td>26</td>
<td>12.0</td>
<td>963,348</td>
<td>27</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>TV/ Entertain.</td>
<td></td>
<td></td>
<td></td>
<td>651</td>
<td>651</td>
<td>97.0</td>
<td>18,342,577</td>
<td>35</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>PC/ ITC</td>
<td></td>
<td></td>
<td></td>
<td>1,027</td>
<td>1,027</td>
<td>71.4</td>
<td>10,474,718</td>
<td>98</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>Other appl.</td>
<td></td>
<td></td>
<td></td>
<td>1,218</td>
<td>1,218</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>-</td>
<td></td>
<td></td>
<td>1,287</td>
<td>1,008</td>
<td>100</td>
<td>10,841</td>
<td>13,235</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Annual EC per Household (LOE)</strong></td>
<td>165</td>
<td>129</td>
<td>13</td>
<td>1,389</td>
<td>1,696</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Transport</td>
<td>6,287</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td>6,287</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
### Chinese Taipei (Taiwan)

- **Results from the Service Sectors Survey**

<table>
<thead>
<tr>
<th>Average Energy Consumption Per Unit Space Area</th>
<th>Total</th>
<th>Space heating</th>
<th>Space cooling</th>
<th>Lighting</th>
<th>Other app</th>
<th>LOE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>282</td>
<td>1</td>
<td>49</td>
<td>26</td>
<td>206</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wholesale and Retail</td>
<td>259</td>
<td>1</td>
<td>52</td>
<td>31</td>
<td>175</td>
<td></td>
</tr>
<tr>
<td>Hotels and Restaurants</td>
<td>336</td>
<td>1</td>
<td>52</td>
<td>30</td>
<td>253</td>
<td></td>
</tr>
<tr>
<td>Transport Services</td>
<td>369</td>
<td>2</td>
<td>35</td>
<td>22</td>
<td>310</td>
<td></td>
</tr>
<tr>
<td>Storage and Warehousing</td>
<td>1,442</td>
<td>1</td>
<td>81</td>
<td>65</td>
<td>1,295</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>729</td>
<td>1</td>
<td>124</td>
<td>36</td>
<td>568</td>
<td></td>
</tr>
<tr>
<td>Finance, Insurance and Real Estate</td>
<td>314</td>
<td>0</td>
<td>48</td>
<td>24</td>
<td>241</td>
<td></td>
</tr>
<tr>
<td>Business Services</td>
<td>279</td>
<td>0</td>
<td>49</td>
<td>24</td>
<td>206</td>
<td></td>
</tr>
<tr>
<td>Social and Personal Services</td>
<td>484</td>
<td>1</td>
<td>58</td>
<td>26</td>
<td>399</td>
<td></td>
</tr>
<tr>
<td>Public Administration</td>
<td>302</td>
<td>1</td>
<td>30</td>
<td>8</td>
<td>264</td>
<td></td>
</tr>
<tr>
<td>Activities Not Adequately Defined</td>
<td>256</td>
<td>0</td>
<td>38</td>
<td>13</td>
<td>205</td>
<td></td>
</tr>
</tbody>
</table>
Philippines

- 2011 Household Energy Consumption Survey (HECS)
- Collaboration with National Statistics Office due to authority of the survey
- Objectives
  - Determine the change in energy consumption patterns
  - Establish fuel/energy mix of the residential sector
  - Determine the most energy consuming appliances, devices and equipments
- Questionnaires
  - Part 1: Geographic information and household (characteristics of household head and household members)
  - Part 2: Details of energy usage
  - Part 3: Family income
  - Part 4: Housing characteristics
- The final results will be released around end of December 2012.
Survey Schedule

**Field Operation & Timeline**

**2011 Household Energy Consumption Survey**

- **22-14 March** – Pre-testing of HECS Questionnaire in Pangasinan
- **15-19 Aug** – HECS First Level Training (Trainors’ Training)
- **22-26 Aug** – HECS Second Level Training (Regional Level)
- **5-9 Sept** – HECS Third Level Training (Provincial Level)
- **Sept 16 – Oct 8** – Actual Enumeration Period
- Data Processing & Validation of Survey

Series of Writeshops for the 2011 HECS Questionnaire & Enumerators’ Manual

Revision and finalization of the 2011 HECS Questionnaire & Enumerators’ Manual

**Philippines**
Malaysia

- Urban household energy consumption survey
- Executing body: CETDEM (Center for Environment, Technology and Development, Malaysia) is a NGO established in 1985 and commit to improve environmental quality.

Outline of survey
- Housing characteristics: 5 types
- Energy sources: electricity, gas (LPG), petrol/diesel
- Energy consumption components;
  - Kitchen: refrigerator, cooking element (electricity)
  - Bathroom/Laundry: Washing machine, water heater
  - Living room: Cooling (air conditioners, fans), entertainments, lightings and others
  - LPG usage (kitchen)
  - Petrol/diesel usage (transport)
Malaysia

- Results from the Survey

Proportion of Average Electricity Consumption Breakdown by Usage Component

- Refrigerator: 23.2%
- Cooking: 10.9%
- Washing: 10.4%
- Heating: 10.3%
- Cooling Air-cond & fan: 8.8%
- Entertainment: 2.3%
- Lighting: 0.6%
- Others: 10.3%
Pilot Survey in ASEAN

- Executing body: ERIA Working Group for Analysis of Energy Saving Potential in EAS Region
  - ERIA: Economic Research Institute for ASEAN and East Asia
- Purpose: Increase capacity on energy consumption survey in residential sector
- Members of the WG from 16 EAS countries engaged in the pilot survey;
  - Design the questionnaire
  - Determine the samples (minimum 10 samples)
  - Request her/his colleagues to join the survey
- Cambodia, Indonesia, Lao PDR, Malaysia, Philippines, Singapore conducted the survey. Total number of samples were 68.
- Questionnaire
  - General information: floor area, household members, electricity bill per month
  - Energy sources: electricity, LPG, coal briquettes, renewable energy
  - End use: cooking, lighting, cooling, water heating
Pilot Survey in ASEAN

- Entering power rating is very hard
- ASEAN standard power rating of appliances will be prepared

<table>
<thead>
<tr>
<th>KIND OF EQUIPMENT</th>
<th>EQUIPMENT</th>
<th>POWER RATING</th>
<th>HOURS OF DAILY USAGE</th>
<th>NUMBER OF DAYS OF USAGE PER MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhaust Fan (EF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EF3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Entering power rating is very hard
- ASEAN standard power rating of appliances will be prepared
Pilot Survey in ASEAN

- Pilot Survey in ASEAN

Residential Energy Consumption per Capita (kg of oil equivalent)

Cambodia: 62
Indonesia: 74
Laos: 69
Malaysia: 60
Philippines: 78
Singapore: 104
Total: 73

- Other Appliances (including standby power)
- Lighting
- Water heating
- Refrigeration
- Cooking & Other Kitchen Use
- Heating
- Cooling & Ventilation
## Conclusion

- In APEC region, energy demand-supply data, which are usually used for making energy balance tables, have been improving due to use of the existing questionnaires being comparable to IEA questionnaires and continuous capacity buildings provided by Japanese Government.

- On the other hand, detailed energy consumption data are indispensable due to promotion of energy efficiency activities, but preparation of energy efficiency indicators is still a challenge in this region.

- However several NON-OECD countries/economies have started to conduct energy consumption surveys. This is a good signal to the international society.

- In near future the countries/economies in Asia region will use the IEA EEI template and introduce their achievement on energy savings showing the relevant data.

Thank you for your attention.