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Trends in Final Energy Consumption in Japan

Real GDP
1973→2016
2.6 Times

Final energy consumption
1973→2016
1.2-times

Transportation
1973→2016
1.7-times

Residential
1973→2016
1.9-times

Commercial
1973→2016
2.1-times

Industry
1973→2016
0.8-times

Japan’s target for ambitious energy efficiency

- 35% reduction in energy consumption per GDP toward 2030

[Improvement of energy efficiency]

(energy efficiency)

Transition from 1970 to 1990 
(Achievements after oil shock)

Transition from 1990 to 2010

Transition from 2012 to 2030 
(Future prospects)

▲ 35% improvement

※ The energy consumption efficiency in 1970, 1990, 2012 are set to 100
※ efficiency = Final energy consumption/ Real GDP
Energy Efficiency Benchmark Policy in Japan

- The benchmark policy (BM) sets an energy consumption efficiency target for each sector which should be achieved by each company.
- BM was introduced in 2008. Currently, the coverage of BM is 70% of energy consumption in the industrial and business sectors.
- The government and companies can evaluate energy efficiency comparing with other companies.

Achievement of 70% coverage in the industrial and business sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron and steel</td>
<td>22%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>24%</td>
</tr>
<tr>
<td>Ceramics, stone and clay products</td>
<td>5%</td>
</tr>
<tr>
<td>Pulp, paper</td>
<td>3%</td>
</tr>
<tr>
<td>Business offices and buildings</td>
<td>4%</td>
</tr>
<tr>
<td>Schools</td>
<td>5%</td>
</tr>
<tr>
<td>Hotels and inns</td>
<td>2%</td>
</tr>
<tr>
<td>Amusement place 1%</td>
<td></td>
</tr>
<tr>
<td>Other business in the commercial sector 8%</td>
<td></td>
</tr>
<tr>
<td>Other business in the industrial sector 25%</td>
<td></td>
</tr>
</tbody>
</table>

BM Targets

- Blast furnaces and electric furnaces
- Cement
- Pulp, paper
- Business offices and buildings
- Schools
- Hotels and inns
- Amusement place
- Other business in the commercial sector
- Other business in the industrial sector
- Ethylene, soda chemicals, etc.
- Paper and paperboard
- National government buildings
- Convenience store
- Department stores
- Supermarkets
- Shopping centers
- Pachinko* parlor
- *Japanese pinball game
- University
<table>
<thead>
<tr>
<th>Category</th>
<th>Business</th>
<th>Benchmark Indicators (Summary)</th>
<th>Benchmark target</th>
<th>Year of introduction</th>
<th>Number of companies achieved in 2018 periodic reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A</td>
<td>Steel industry using blast furnace</td>
<td>Energy consumption per crude steel production</td>
<td>0.531kloe/t or less</td>
<td>FY 2009</td>
<td>0 / 4 (0.0%)</td>
</tr>
<tr>
<td>1 B</td>
<td>Steel industry using electric furnaces</td>
<td>Sum of energy consumption of upper process per amount of crude steel and that of lower process per rolling amount</td>
<td>0.143kloe/t or less</td>
<td>FY 2009</td>
<td>6/31 (19.4%)</td>
</tr>
<tr>
<td>1 C</td>
<td>Special steel industry using electric furnaces</td>
<td>Sum of energy consumption of upper process per amount of crude steel and that of lower process per shipment</td>
<td>0.36kloe/t or less</td>
<td>FY 2009</td>
<td>4/18 (22.2%)</td>
</tr>
</tbody>
</table>
| 2        | Electric power producing industry | Thermal power generation efficiency A index  
Thermal power generation efficiency B index | A:1.00 or more  
B:44.3% or more | FY 2009 | 32/79 (40.5%) |
| 3        | Cement industry | Sum of energy consumption per production volume or shipment volume in each process of raw material process, firing process, finishing process, and shipping process | 3,739MJ/t or less | FY 2009 | 4/16 (25.0%) |
| 4 A      | Paper industry | Energy consumption per paper production in the paper manufacturing process | 6,626MJ/t or less | FY 2010 | 3/18 (16.7%) |
| 4 B      | Paperboard industry | Energy consumption per paperboard production in the paperboard manufacturing process | 4,944MJ/t or less | FY 2010 | 6/32 (18.8%) |
| 5        | Petroleum refining industry | Energy consumption per standard amount of oil used in the oil refining process | 0.876 or less | FY 2010 | 4/10 (40.0%) |
| 6 A      | Basic petrochemicals manufacturing industry | Energy consumption of ethylene, propylene, butadiene and benzene per the production volume | 11.9GJ/t or less | FY 2010 | 5/10 (50.0%) |
| 6 B      | Caustic soda industry | Sum of energy consumption per production volume and steam heat consumption per liquid caustic soda weight in concentration process | 3.22GJ/t or less | FY 2010 | 6/22 (27.3%) |
Reported value for Energy Efficiency Benchmark (Steel)

- Steel industry using electric furnace steadily improves efficiency

Transition of reported value for BM by industry

※Calculated with 2011 report value as 100
Reported value for Energy Efficiency Benchmark (Cement, Paper, Paperboard)

- Reported value was improved in all three industries
- The value changes by the amount of production

Transition of reported value for BM by industry

※Calculated with 2011 report value as 100
Reported value for Energy Efficiency Benchmark (Petroleum, petrochemicals)

- Both the petroleum refining and basic petrochemicals manufacturing industries steadily improved value

![Transition of reported value for BM by industry](image-url)

※Calculated with 2011 report value as 100
### Reference: Benchmark Policies in G20 Members

<table>
<thead>
<tr>
<th>Country</th>
<th>Benchmark system name</th>
<th>Setting method</th>
<th>Number of target industries</th>
<th>Steel</th>
<th>Cement</th>
<th>Pulp and paper</th>
<th>Chemistry</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>Energy Star (Energy benchmark)</td>
<td>25% or more</td>
<td>18</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>—</td>
</tr>
<tr>
<td>EU</td>
<td>EU Emissions Trading System (CO2 benchmark)</td>
<td>Top 10% average</td>
<td>ETS covered industry</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>China</td>
<td>National recommended standards (Energy benchmark)</td>
<td>International standard reference</td>
<td>All industry</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>India</td>
<td>Perform Achieve and Trade (PAT) (Energy benchmark)</td>
<td>Adjustment by sector and company</td>
<td>11</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Canada</td>
<td>Output-based pricing system (CO2 benchmark)</td>
<td>20-30% higher than the industry average</td>
<td>17</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>UK</td>
<td>Climate Change Agreement (CCA) (Negotiated Target)</td>
<td>Group or company negotiates with government</td>
<td>All industry</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Korea</td>
<td>KETS (CO2 benchmark)</td>
<td>Industry average</td>
<td>23</td>
<td>—</td>
<td>✔</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>Energy benchmark</td>
<td>Global top 1/4 level (New Plants)</td>
<td>3</td>
<td>✔</td>
<td>✔</td>
<td>—</td>
<td>✔</td>
</tr>
<tr>
<td>Japan</td>
<td>Energy benchmark</td>
<td>Top 10% to 20% level</td>
<td>10</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Source: The Institute of Energy Economics, Japan
“Top-Runner Program” for Equipment and Materials

① The "Top-Runner Program" is a mandatory program.
② The government set targets based on the most efficient performance of equipment on the market.
③ Companies need to achieve such targets in 3 to 10 years.

Example of Top Runner Program

<table>
<thead>
<tr>
<th>Fuel Efficiency (km/L)</th>
<th>At the time of standard setting</th>
<th>Target Fiscal Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td></td>
<td>19km/L</td>
</tr>
<tr>
<td>15km/L</td>
<td></td>
<td>18km/L</td>
</tr>
<tr>
<td>14km/L</td>
<td></td>
<td>17km/L</td>
</tr>
<tr>
<td>13km/L</td>
<td></td>
<td>15km/L</td>
</tr>
<tr>
<td>12km/L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Achievement is judged by weighted average per product category

32 equipment and materials

1. Passenger vehicles
2. Air conditioners
3. Lighting equipment
4. TV sets
5. Copying machines
6. Computers
7. Magnetic disk units
8. Freight Vehicles
9. Video cassette recorders
10. Electrical refrigerators
11. Electrical freezers
12. Space heaters
13. Gas cooking appliances
14. Gas water heaters
15. Oil water heaters
16. Electric toilet seats
17. Vending machines
18. Transformers
19. Electric rice cookers
20. Microwave ovens
21. DVD recorders
22. Routers
23. Switching units
24. Multifunction devices
25. Printers
26. Electric water heaters
27. AC motors
28. Lamps
29. Showcase
30. Insulation materials
31. Sashes
32. Multi-paned glazing
Improvements in Energy-Efficiency under “Top Runner Program”

[Passenger vehicles]

<table>
<thead>
<tr>
<th>Year</th>
<th>Fuel Economy (km/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>14.0</td>
</tr>
<tr>
<td>2003</td>
<td>14.6</td>
</tr>
<tr>
<td>2005</td>
<td>15.0</td>
</tr>
<tr>
<td>2007</td>
<td>15.5</td>
</tr>
<tr>
<td>2009</td>
<td>16.5</td>
</tr>
<tr>
<td>2011</td>
<td>17.8</td>
</tr>
<tr>
<td>2013</td>
<td>21.1</td>
</tr>
<tr>
<td>2017</td>
<td>23.8</td>
</tr>
</tbody>
</table>

70% improvement

(Source) Ministry of Land, Infrastructure and Transport

[Air conditioners]

<table>
<thead>
<tr>
<th>Year</th>
<th>Electric Power Consumption (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>1241</td>
</tr>
<tr>
<td>2001</td>
<td>1220</td>
</tr>
<tr>
<td>2003</td>
<td>1212</td>
</tr>
<tr>
<td>2005</td>
<td>1174</td>
</tr>
<tr>
<td>2007</td>
<td>1157</td>
</tr>
<tr>
<td>2009</td>
<td>1028</td>
</tr>
<tr>
<td>2011</td>
<td>997</td>
</tr>
<tr>
<td>2013</td>
<td>924</td>
</tr>
<tr>
<td>2015</td>
<td>884</td>
</tr>
<tr>
<td>2017</td>
<td>860</td>
</tr>
<tr>
<td>2017</td>
<td>857</td>
</tr>
</tbody>
</table>

31% improvement

(Source) Created from “Energy Efficiency Performance Catalog”.
Air conditioner (Background)

① The number of air conditioners (ACs) units is increasing worldwide (North America, Europe and Asia)
② Energy demand for AC is increasing.
③ Energy efficiency is important to achieve the goals of the Paris Agreement.
④ Energy efficiency of ACs are quite different by countries and manufacturers.
⑤ There is a room for improving energy efficiency by using high efficient ACs.

Worldwide stock and capacity of ACs by sector

![Graph showing the worldwide stock and capacity of ACs by sector.]

Improvement of energy efficiency of ACs in Japan

![Graph showing the improvement of energy efficiency of ACs in Japan over the years.]

Source: IEA(2018) The Future of Cooling Fig. 3.1
Source: Created from “Energy Efficiency Performance Catalog”
Air conditioner (Points to better analysis)

- Differences of the test methods and energy efficiency performance calculation for AC in the world (e.g. there are methods apply to neither ISO, US standard, nor EU standard)
- Importance of accurate evaluation methods which can evaluate actual AC use (e.g. partial output)
- Reasonable and tighter regulation for AC efficiency in each country
- Potential of decreasing energy consumption by using energy efficient ACs

Reference: Standard of energy efficiency of ACs in Japan

\[
\text{APF} = \frac{\text{Cooling Seasonal Total Load[kWh]} + \text{Heating Seasonal Total Load[kWh]}}{\text{Cooling Seasonal Energy Consumption[kWh]} + \text{Heating Seasonal Energy Consumption[kWh]}}
\]

- Calculation method is based on JIS (Japan Industrial Standards) C 9612:2013 (based on ISO 5151:2010)

Example of air conditioner testing facility

(Source) Japan Air Conditioning and Refrigeration Testing Laboratory
Expectations for IEA’s Global EE Benchmarking work

- By recognizing each country’s position in the world, it is possible for each government to promote energy efficiency policies.
- We think it is appropriate to begin with case studies for the steel industry, the cement industry and air conditioners.
- However, we should note that the results of energy efficiency are affected by the differences of the process, climate and temperature, etc. in each industry.
Thank you