Japan’s Energy Efficiency Policy

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Yuzo YAMAGUCHI

Special Adviser to METI, Government of Japan
Chief Representative of NEDO Washington DC office
1. Past trend of Japan’s energy efficiency

2. Measures for energy efficiency

3. Challenge for Carbon Neutrality

4. Further actions
GDP growth is 2.5 times from 1970’s, while growth of final energy consumption is less than the economic growth - 1.2 times.

<table>
<thead>
<tr>
<th>Sector</th>
<th>1973→2018</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>1.2 times</td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td>1.7 times</td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>1.9 times</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td>2.1 times</td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>0.8 times</td>
<td></td>
</tr>
</tbody>
</table>

【Source】Energy Statistics and Annual Report on National Accounts
Japanese economy has been growing, while furthering energy efficiency. Japan’s Energy Intensity is one of the lowest.

[Annual change in the “Energy Supply per Real GDP”]

[Energy Intensity (2018)]

Japanese Efforts on Energy Efficiency

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The Act, enacted in 1979, is the core basis of energy efficiency policy in Japan.

1. Report to government by business operators
2. Top-runner Program

<table>
<thead>
<tr>
<th>Regulatory measures</th>
<th>Industry sector</th>
<th>Consumer sector</th>
<th>Transport sector</th>
</tr>
</thead>
</table>
| ✓ **Annual reports** to the Government by business operators with 1,500 or more kl/yr energy consumption  
- energy conservation measures (energy management operation, facility maintenance/inspection etc.)  
✓ 1% Reduction efforts each year |
| ✓ Energy efficiency standards for buildings and houses (note: New law has been implemented from Apr. 2017, currently not a part of the Act) |
| ✓ “Top runner program” standards for household appliances, equipment, automobiles etc., 32 items in total  
(Account for about 70% of household energy consumption) |
| ✓ Periodic reports by freight carriers and consigners  
✓ 1% Reduction efforts each year |
The Act requires **business operators to report their activities on energy efficiency** to the government. The government evaluates them with the report.

**< Matters to be stated in periodic reports >**
- Implementation status of energy conservation measures
- Changes in specific energy consumption
- Status of the benchmark indices (for only applicable types of business)

- **Judgement on standards for energy efficiency measures** (Matters to be observed concerning business operators’ management systems and management methods of individual devices)
- **Non-binding target** (Reduction by 1% or more on an annual average basis)
- **Benchmark index/target levels** (for several business sectors (e.g. manufacture of steel, power supply, manufacture of cement, manufacture of paper, petroleum refinery, and manufacture of chemicals)
“Top Runner Program” is to encourage competition among companies by setting the higher efficiency targets to be achieved in three to ten years later.

**Example of Top Runner Program**

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

Target Fiscal Year

Achievement is judged by weighted average per product category

**Example of Top Runner Program**

2. Air-conditioners (For ones of 4.0kW or less in cooling capacity) 16.3% (2005FY→2010FY)
3. Electric refrigerators 43.0% (2005FY→2010FY)
4. TV sets (LCD and PDP TV) 29.6% (2004FY→2008FY) etc.

32 items under the program

1. Passenger cars
2. Trucks
3. Air conditioners
4. Television receivers
5. Video tape recorders
6. Lighting apparatuses
7. Copying machines
8. Computers
9. Magnetic disk devices
10. Electrical refrigerators
11. Electrical freezers
12. Heaters
13. Gas cooking appliances
14. Gas water heating appliances
15. Oil water heaters
16. Electric toilet seats
17. Vending machines
18. Power transformer
19. Jar rice cookers
20. Microwave ovens
21. DVD recorders
22. Routing equipment
23. Switching equipment
24. Multifunction Devices
25. Printers
27. AC motors
28. LED lamps
29. Showcase
30. Heat Insulating materials
31. Sashes
32. Multi-Paned Glazing
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In October 2020, Japan declared **Carbon-Neutrality by 2050**. In April 2021, Japan announced **aiming to reduce its GHG emissions by 46 percent** in FY 2030 from its FY 2013 levels, with continued strenuous efforts toward 50 percent reduction.
New Strategic Energy Plan aims to achieve 62 million KLOE energy saving, which requires further 40% efficiency improvement from 2013 to 2030. This is faster than the improvement in energy consumption efficiency after the oil shock.

**Final energy consumption** (Long-term energy demand & supply outlook)

- Economic growth
- Decrease of population (estimate)

363 million KLOE

![Energy Efficiency Improvement towards 2030](chart.png)

Energy Efficiency Improvement

Energy efficiency rate = Final energy consumption / real GDP

- Industry 45%
- Commercial 18%
- Transport 23%
- Residential 14%

2013 (Actual)

2030 (With development of Energy Efficiency measures)

Final Energy Consumption 280 million KLOE

62 million KLOE Energy Saving

350 million KLOE
For 2050 carbon-neutral target, it is necessary to **promote**
① **thorough energy efficiency** and
② **strengthen measures to expand the introduction of non-fossil energy.**

### Direction of Demand Side Measures

**<Thorough Strengthen Energy Efficiency>**
- **[Regulatory measures]**
  - The Act on the Rational Use of Energy
  - The Act on the Improvement of Energy Consumption Performance of Buildings
- **[Support measures]**
  - Subsidies including ZEB/ZEH promotion, tax incentives etc.

### Remaining CO₂

**<Promotion of energy transition>**
- Expansion of non-fossil energy sources on demand side
- Optimization of demand through digitalization for the utilization of VRE
- Use of in-house power generation and equipment control to stabilize the grid

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**Timeline**

- **Now**
- **2030**
- **2050**

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**Energy Consumption**

- **Fossil Energy**
- **Expansion of Non-Fossil Energy**
- **Strengthen Energy Efficiency**
62 million KLOE Energy Saving can be estimated by energy conservation targets in the industrial, business, residential, and transportation sectors. In addition to current energy conservation measures, we will work to strengthen enforcement of the Rational use of Energy Act and support the development of advanced energy-saving technologies.

<table>
<thead>
<tr>
<th>Sector</th>
<th>Approx. KLOE Energy Saving</th>
<th>Main Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Sector</td>
<td>~13.50 million kL</td>
<td>• Promotion of efficient lights including LED [1.08 million kL]</td>
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<tr>
<td></td>
<td></td>
<td>• Introduction of industrial heat pump [0.88 million kL]</td>
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<tr>
<td></td>
<td></td>
<td>• Introduction of industrial motors and inverters [1.66 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Implementation of energy management through FEMS [0.74 million kL]</td>
</tr>
<tr>
<td>Commercial Sector</td>
<td>~13.76 million kL</td>
<td>• Promotion of efficient lights including LED [1.95 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve energy-saving performance of equipment by equipment top runner program [3.42 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Implementation of energy management through BEMS [2.38 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Promotion of energy-saving buildings [5.46 million kL]</td>
</tr>
<tr>
<td>Residential Sector</td>
<td>~12.08 million kL</td>
<td>• Promotion of efficient lights including LED [1.93 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Improve energy-saving performance of equipment by equipment top runner program [1.73 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Promotion of energy-saving house [3.44 million kL]</td>
</tr>
<tr>
<td>Transportation Sector</td>
<td>~23.05 million kL</td>
<td>• Diffusion of next-generation automobiles [9.90 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Other measures in transportation sector [13.15 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Breakdown)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Freight transport [8.52 million kL]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Passenger transport [4.63 million kL]</td>
</tr>
</tbody>
</table>

Total <approx. -62 million kL>
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4. Further actions
Review the Definition of Energy and Expand the Use of Non-Fossil Energy

It is necessary to **promote further energy conservation and non-fossilization**. The government will aim to rationalize **all types of energy, including non-fossil energy**, and will establish a **system to secure the introduction and expansion of non-fossil energy**.

**Current**

  - Improve energy consumption efficiency by 1% per year
  - Industry Benchmark Targets
  - Implementation of energy conservation measures at factories
  → Guidance, advice, penalties, etc., as necessary (Institutional Collateral)

**2050**

- **Rationalization of all energy use**
  - Combining incentives with regulations and subsidies based on the Energy Conservation Law to further promote energy conservation

**Non-Fossilization and Energy Transition**

- **To achieve the Act on the Rational Use of Energy (Energy Conservation Act)’s commitment**
  - Partial use of non-fossil energy

- **Low carbon society action plan, zero challenge, RE 100, EV 100, etc.**
  → Voluntary efforts by operators

- **Develop a medium- to long-term plan for conversion to non-fossil energy sources**
- **Report them to the government**

- **Promotion of non-fossilization and energy conversion**
  - Expanding the use of non-fossil energy
  - Electrification of manufacturing processes, hydrogenation, etc.
  - Non-fossilization of purchased energy
Research and development of energy-saving technologies
FY2022 $70,000,000

Objectives

- Research and development of energy-saving technologies
- Development of technologies for innovative utilization of unused thermal energy

Outcome Targets

(1) Contribute to reducing Japan's energy consumption by 20,000,000 kL of crude oil equivalent by 2050.

(2) Contribute to a reduction of approximately 17,600,000 t/y of carbon dioxide by 2030 through the reduction, recovery, and reuse of unused thermal energy.

Social Implementation

Forms of effective use of heat

- **Reduce**: Technology to reduce heat use (thermal insulation)
- **Reuse**: Technology to reuse heat (Heat pumps)
- **Recycle**: Technology to convert and utilize heat (thermoelectric conversion)

The "3Rs" of heat
High-efficiency gas turbine
(30 MW-class high-efficiency gas turbine with fast load response)

Developed 30 MW class high-efficiency gas turbine

Renewable Energy (RE) with unstable output + 30 MW-class high-efficiency gas turbine (GT) capable of fast load response → Overall stabilization by linking unstable renewable energy output with gas turbine output

The combined cycle power plant (CCPP) with this new turbine improves power generation efficiency from 51.1% to 54.4%.

Subsidiaries: Kawasaki Heavy Industries, Ltd.
High Performance Thermal Storage System
(Compact thermal storage system capable of utilizing waste heat below 100°C (212°F))

The plant using this technology achieved a **primary energy reduction of 22.7%** and a CO2 emissions reduction of **4,830 tons/year**.

**On-site use:** Demonstrated at the titanium oxide drying process at the Yokkaichi Plant of “Ishihara Sangyo”.

**Offline heat transport:** Demonstrated from “Hino Motors” Hamura Plant to the heated pool at the “Hamura City Swimming Center”.

Subsidiaries: **Takasago Thermal Engineering Co., Ltd., etc.**
CFRP Recycling System
(Technology to regenerate carbon fiber from CFRP waste with less energy)

Since CFRP (Carbon Fiber Reinforced Plastic) is lighter than iron and aluminum, as well as having equivalent or more strength, and has a high fatigue life, it is used for various applications including aircraft, rockets, automobiles, fishing rods, umbrellas and glasses.

A variety of CFRP waste materials

- Thick high-pressure gas container
- Prepreg
- Vertical Material for Reinforcement

World’s highest energy efficiency and economic efficiency

- 50% reduction in kerosene consumption in carbonization furnaces
- 70% reduction in electricity costs for firing furnaces
- 1/30th of the manufacturing fuel cost per unit volume of CFRP for recycling

Subsidiaries: Carbon Fiber Recycling Industry Co., Ltd.
High-efficiency power converters
(high-efficiency compact power converter system using SiC devices)

- Toshiba developed an inverter that changes the motor drive according to the operating condition, and they introduced it in **newly built cars (Tokyo Metro 2000 series) on the Tokyo Metro Marunouchi Line** in FY2018.

- Compared with the current cars in Marunouchi Line, the new cars are expected to **reduce power consumption by about 33%**.
Thank you

NEDO Representative Office in Washington DC

1717 H St., NW, Suite 815
Washington, D.C. 20006, U.S.A.