A Study on Local Energy Planning for Hachinohe City

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1. Introduction
2. Hachinohe City
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Contents
1. Introduction

Fig 1. The number of renewable energy project until 2006 (Region)

Fig 2. The number of renewable energy project until 2006 (Sector)

(The number of photovoltaic power generation for the ordinary family is excluded.)

Sources: Central Research Institute of Electric Power Industry, Governmental statistics concerning on subsidy program

2. Hachinohe City

- City’s guidance
  - Largest industrial city of Aomori Prefecture, population is 240,000.
  - Enter in the energy field in 2003 and start “Microgrid Project”

- Project motivation
  - Aomori’s aim for converting “nuclear base” image.
  - Hachinohe’s aim for local economy revitalization.
  - R&D project subsidized entirely by the National Government.
**Hachinohe energy center**  
*Gas engine, battery, biomass boiler*

![Image of Hachinohe energy center](image1)

- Digested gas tank
- Boiler
- Gas engine 510kW
- Battery 100kW

**Wind power generation 8kW**  
*Public elementary school*

![Image of wind power generation](image2)

Photo by Hachinohe Municipality
Photovoltaic generation 10kW
Public junior high school

Photovoltaic 10kW, Wind power generation 4kW
Hachinohe City Hall
3. Practice of local energy planning

- Objectives
  - Make city’s future energy demand and supply plan,
  - Analyze the result of reference case,
  - Reflect city’s existing target to the model, and
  - Propose appropriate policy to the local government.

- MARKAL model
  - An bottom-up engineering model using linear programming,
  - Achieved by the international cooperation under ETSAP/IEA,
  - Objective function is cost minimizing under various constraints,
  - Suitable for renewable energy introduction analysis.
  - Japanese MARKAL has been maintained by Japan Atomic Energy Agency, it covers all demand sectors, 260 energy technology and 40 energy carriers in the period of 1990-2050.

  - We try to make regional MARKAL model (Hachinohe MARKAL) using the basic concept of Japanese MARKAL.
(1) Hachinohe MARKAL reference case
Input factor of the system

<table>
<thead>
<tr>
<th>Item</th>
<th>Input data</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period, Time slice</td>
<td>2000-2030, seven 5-year period, 6 time slices of ID:0.2106 SD:0.1009 WD:0.1885 IN:0.1961 SN:0.0135 WN:0.2904</td>
<td>The number of heating/cooling day of city office and daylight hours in 2005.</td>
</tr>
<tr>
<td>Demand side discount rate</td>
<td>I1: Industry manufacture: 0.0127, 0</td>
<td>New energy vision, Japan Long-Term Energy Outlook 2030, and other various sources</td>
</tr>
<tr>
<td></td>
<td>I2: Industry non-manufacture: -0.0022, 0</td>
<td></td>
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<tr>
<td></td>
<td>R1: Residential office: 0.0204, 0.0036</td>
<td></td>
</tr>
<tr>
<td></td>
<td>R2: Residential house: 0.0066, 0.0032</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T1: Transport car&amp;bus: 0.0190, 0.0015</td>
<td></td>
</tr>
<tr>
<td>Supply side</td>
<td>Source(13), Energy carrier(25), Process technology(13), Conversion tech.(7), Demand tech.(25=dummy)</td>
<td>Japanese MARKAL JAEA database</td>
</tr>
<tr>
<td>Unit</td>
<td>TJ, GW, kt-CO2/TJ, Mil JPY</td>
<td>Japanese MARKAL (1/1000)</td>
</tr>
<tr>
<td>Fuel price</td>
<td>Oil and oil related fuels =1.27</td>
<td>Various sources</td>
</tr>
<tr>
<td></td>
<td>Electricity (production cost) =0.94</td>
<td></td>
</tr>
<tr>
<td>Emission</td>
<td>CO2 emission of each fuel is counted at the time of import.</td>
<td>Ministry of the Environment, Japanese MARKAL, Tohoku Electric Power Company</td>
</tr>
</tbody>
</table>

(1) Hachinohe MARKAL reference case
Energy flow of the system
(1) Result of Hachinohe MARKAL reference case

**Case RES: End-Use Demand**

![Graph showing end-use demand](image)

- **66,437 TJ (2010)**
- **67,624 TJ (2030)**

**Case RES: Primary Energy Supply**

![Graph showing primary energy supply](image)

- **114,398 TJ (2010)**
- **94,961 TJ (2030)**

LNG base is installed in 2010.
(1) Result of Hachinohe MARKAL reference case

Case RES: CO2 Emissions from resource technology

(2) Hachinohe MARKAL alternative scenario

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<th>Item</th>
<th>Input factor</th>
<th>References</th>
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</thead>
<tbody>
<tr>
<td>(1) Energy demand reduction</td>
<td>2005 ⏐ 2010                    All sectors minus 5.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2000 ⏐ 2030                    Industry minus 8.8%, Residential minus 25.8%, Transport minus 42.0%</td>
<td>Triple 50 target (Tokyo University and others)</td>
</tr>
<tr>
<td>(2) Renewable energy introduction</td>
<td>2000 ⏐ 2010                    Rate of renewable energy use in the final energy consumption to 6%</td>
<td>New energy plan, Committee report on Hachinohe offshore wind, and other sources..</td>
</tr>
</tbody>
</table>
(2) Result of Hachinohe MARKAL alternative scenario

**CO2 reduction scenario:**
End-Use Demand

- **2000**: 35,000 TJ
- **2010**: 30,000 TJ
- **2020**: 25,000 TJ
- **2030**: 20,000 TJ

- **58,349 TJ** (2000)
- **59,480 TJ** (2010)
- **49,843 TJ** (2030)

**Output of renewable energy**

- **230 TJ (RES)**

- **Renewable 12.5%**
- **Renewable 4.7%**

**Rate = Renewable/ Final Energy Consumption**

**Legend:**
- Municipal Waste
- Other Waste
- Solar PV
- Biogas Engine
- Wind Power
- Solar Heat
- Cogeneration
(2) Result of Hachinohe MARKAL alternative scenario

4. Conclusion

- For renewable energy implementation
  - It is indispensable for local governments to overcome the dissociation between vision and project.
  - Develop local energy planning which shows a sustainable path to introduce renewable energy.

- Further research topics
  - Improve the regional MARKAL model and sub-modeling tools (updating technical data), and
  - Investigate the method for advancement of local energy planning in cooperation with local actors.
  - In reference with the ALEP methodology (ETSAP/IEA)
    1) Assessment of the present situation,
    2) Main Study with energy modeling tool (MARKAL),
    3) Project Implementation, and
    4) Review and Monitoring.
Thank you for listening.