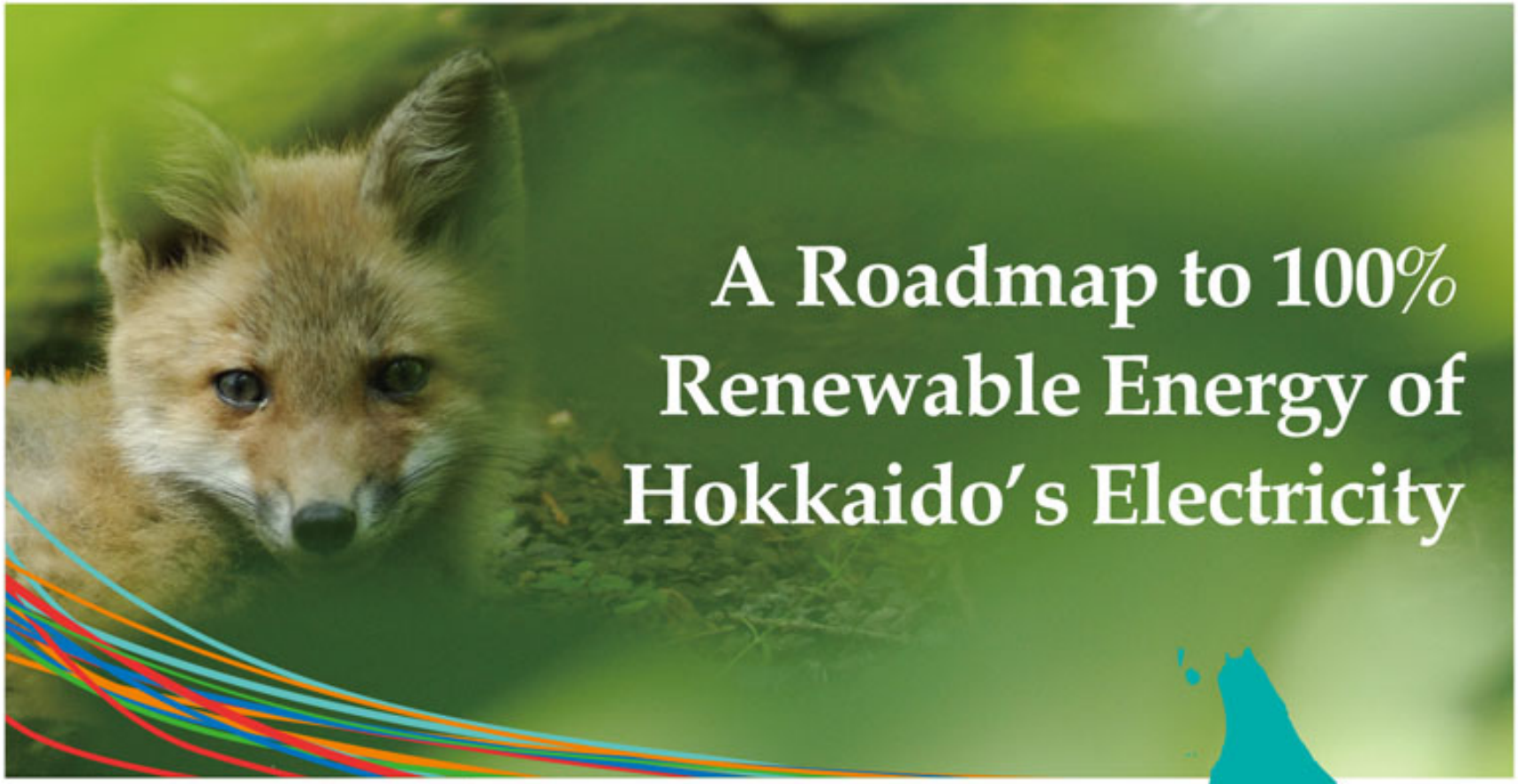
Mapping the future of Hokkaido's energy



北海道の電気 再生可能エネルギー 100% へのロードマップ

Drafted on July 26, 2012 Revised on August 13, 2012
by Hokkaido Energy Changes 100 Project Roadmap Study Team

Revised and translated into English on February 05, 2015
by Hokkaido Energy Change 100 Network &
Hokkaido University Sustainable Low Carbon Society Project

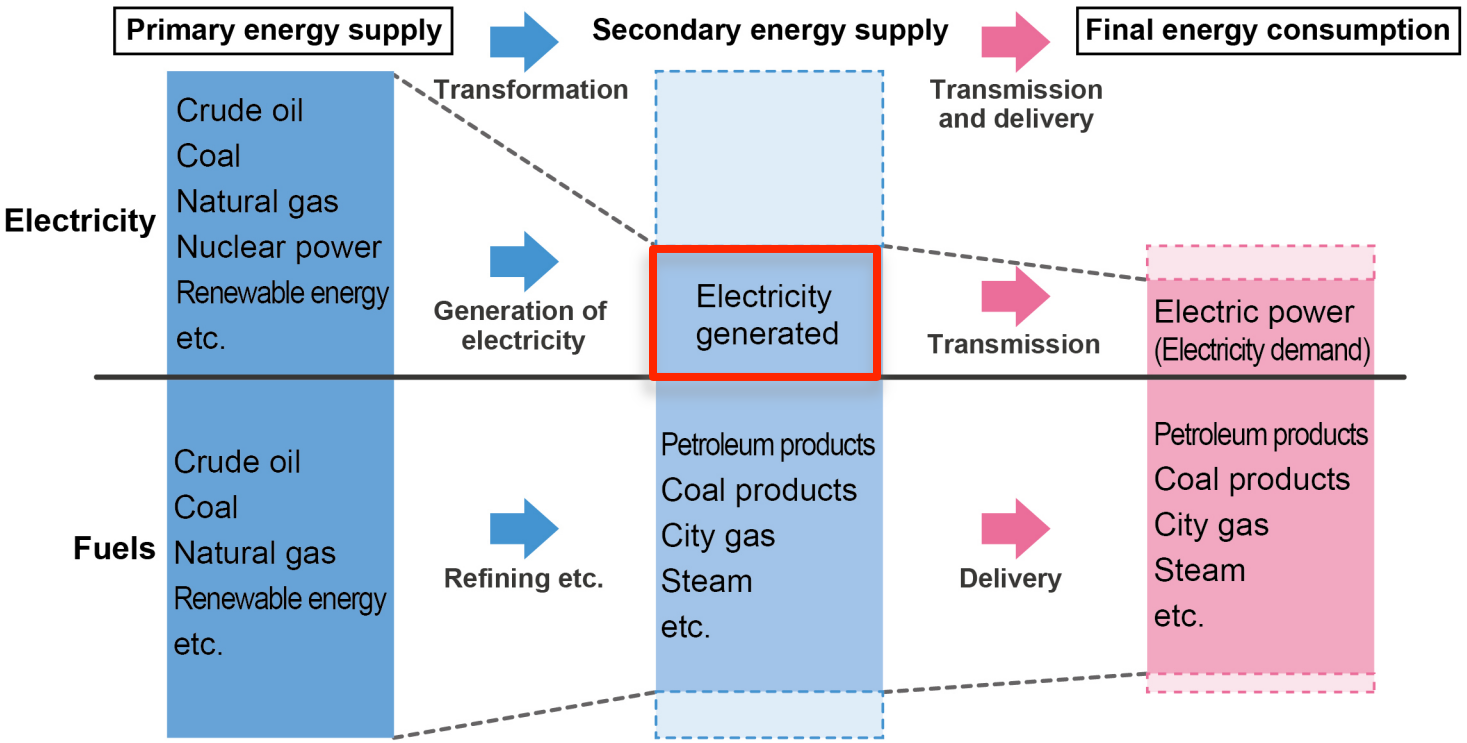
Hokkaido
Energy Changes
100
Network

Index

1. The range of energy indicated by this roadmap

This roadmap identifies the future actions that should be taken in the field of electric power.

Of the total energy supply (primary energy supply) from crude oil, coal, natural gas, nuclear power and other sources, energy for power generation accounts for approximately 40%, of which almost 60% is lost as exhaust heat during power generation. The part within the red frame in the figure below represents the range of energy covered by this roadmap.



(Fundamental Issues Subcommittee, Advisory Committee for Natural Resources and Energy, Ministry of Economy, Trade and Industry)

2. The amount of electricity we need

Electricity usage can be reduced and comfortable living can be realized with less electricity by preventing energy loss and using energy efficiently.

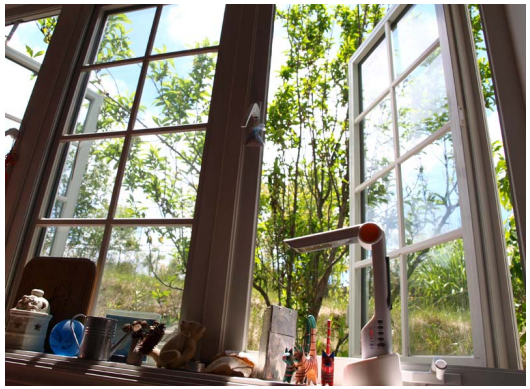
We attempted to imagine how electricity usage should be reduced in the short (by 2020), medium (by 2030) and long (by 2050) terms.

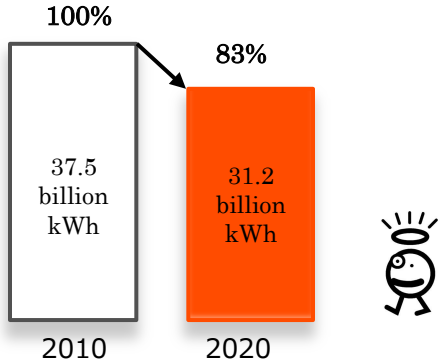
Let’s start reducing electric energy!

2. The amount of electricity we need

Target: 83% of the current usage

by 2020





■ Through the maintenance of and improvement in the operation of existing equipment and the use of energy-saving appliances at homes and offices

By saving energy through the maintenance of and improvement in the operation of existing equipment and upgrading to more efficient appliances, in addition to everyday energy-saving efforts such as running home appliances in energy-saving modes, **it is considered possible to reduce the electricity usage to 31.2 billion kWh in Hokkaido in 2020 by 17% from the usage in 2010 (37.5 billion kWh).** By devising energy-saving ideas, it is sufficiently possible to reduce the electricity usage while improving the comfort level of everyday lives (see Reference I for details energy consumption calculations).

■ Reduction by 17% is considered possible according to a survey by the Sapporo municipal government

The survey on energy conversion conducted by the Sapporo municipal government in FY 2011 also reported that power consumption in Sapporo can be reduced by 17% through energy-saving efforts, such as the replacement to LED light bulbs, energy-saving-type refrigerators and more efficient industrial air conditioning systems.

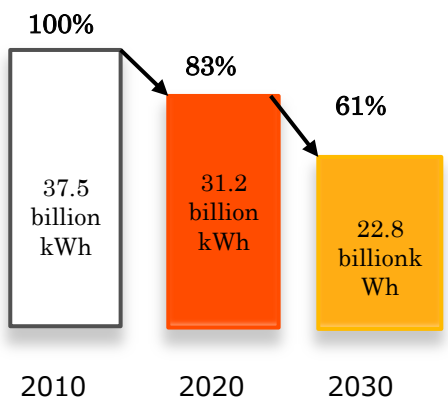
Examples of energy saving

★ Using TVs and refrigerators in energy-saving modes
★ Cleaning the filters of air conditioners and ventilation fans
★ Using cool outside air for room cooling
★ Replacing lighting with LED light bulbs and other energy-saving-type items
★ Attaching insulation film or inner windows to windows
★ Preventing heat loss by conducting heat insulation work for air conditioning and hot water supply systems
★ Shifting heat demand to sources other than electricity by utilizing solar heat, snow/ice cold

2. The amount of electricity we need

Mid-term target: 60% of the current usage

by 2030



■ Continual reduction of energy loss and dramatic improvement in energy efficiency

As the heat insulation performance of buildings has advanced considerably, energy loss can be decreased dramatically not only for new buildings, but also for existing ones through the promotion of energy-saving renovations. Houses without heating systems that require almost no energy for cooling and heating and zero-energy houses that are fully self-sufficient in energy will become popular. The power consumption of electric appliances will be reduced significantly by the top-runner system, which makes energy consumption more efficient than that of the best available appliances.

■ Decrease in the population and number of households / improvement in energy efficiency / self-generation and consumption of electricity

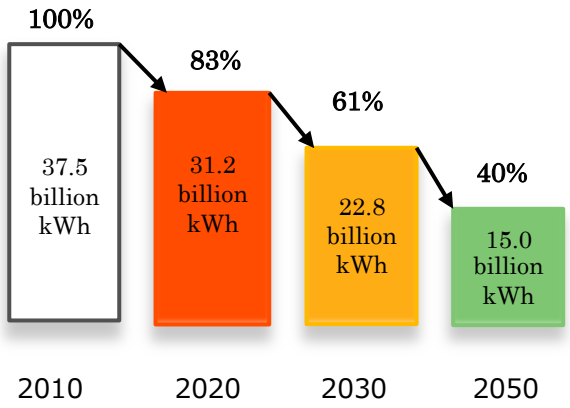
The population and number of households in Hokkaido in 2030 are expected to be 85% and 89% of those of 2010, respectively (according to the *National Institute of Population and Social Security Research*). Therefore, it is assumed that energy consumption will naturally decrease by approximately 13%.

The amount of electricity bought from power companies in 2030 (2.28 billion kWh) will be 61% of that in 2020 (37.5 billion kWh), as the concept of saving electricity and energy through restraint will disappear, energy efficiency will be improved to enable reduced energy usage while maintaining comfort, and the self-generation and consumption of electricity at homes and offices will become popular.

2. The amount of electricity we need

Long term target: 40% of the current usage

by 2050



■ Living with a single earth

It is said that, if people all over the world consumed resources and discharged waste the same way as the Japanese do, 2.3 earths would be necessary. This indicator showing how we live and what mark we leave on the earth is known as the ecological footprint. We believe that our final goal is to live happily on this single earth. Therefore, we will make a society where people can live happily at a consumption level that is 40% (1 / 2.3) of current consumption. It should be a truly affluent civilized society where there is no threat to the survival of future generations, people on the other side of the earth and all creatures that constitute the ecosystem.

■ Creation of a new civilization

In such a society 35 years from now, renewable energy technology will be considerably advanced and innovative energy that has not yet been discovered may also be in practical application. As a result, **it is assumed that the amount of electricity purchased from power companies in 2050 will be 40% (15 billion kWh) of that in 2010 (37.5 billion kWh).**

3. How can electricity be secured? (example)

IC: Installed capacity; EG: Electricity generated

	2010 (past record)	2020	2030	2050
Existing hydro	IC: 1.645 million kW EG: 7.97 billion kWh	IC: 1.645 million kW EG: 7.97 billion kWh	IC: 1.65 million kW EG: 8.0 billion kWh	IC: 1.65 million kW EG: 8.0 billion kWh
Mini/micro hydro			IC: 0.19 million kW EG: 1.0 billion kWh	IC: 3.8 million kW EG: 2.0 billion kWh
Geothermal	IC: 0.05 million kW EG: 0.10 billion kWh	IC 0.025 million kW EG: 0.08 billion kWh	IC: 0.30 million kW EG: 2.1 billion kWh	IC: 0.80 million kW EG: 5.6 billion kWh
Wind power	IC: 0.245 million kW EG: 0.51 billion kWh	IC: 0.56 million kW EG: 1.28 billion kWh	IC 2.5 million kW EG: 5.7 billion kWh	IC: 5.00 million kW EG: 11.4 billion kWh
Solar power	IC: 0.005 million kW EG: 0.005 billion kWh	IC: 0. 900 million kW EG: 0.950 billion kW	IC: 1.500 million kW EG: 1.600 billion kWh	IC: 2.000 million kW EG: 2.100 billion kWh
Biomass		Mostly for heat utilization	Mostly for heat utilization	IC: 0.10 million kW EG: 0.7 billion kWh
Thermal power	IC: 4.065 million kW EG: 12.68 billion kWh	IC: 4.065 million kW EG: 20.92 billion kWh	IC: 2.65 million kW EG: 4.40 billion kWh	For backup power 0 .00 billion kWh
Nuclear power	IC: 2.07 million kW EG: 16.26 billion kWh	For backup power 0.00 billion kWh	- -	- -
Net	IC: 8.08 million kW EG: 37.53 billion kWh	IC: 7.195 million kW EG: 31.20 billion kWh	IC: 8.79 million kW EG: 22.80 billion kWh	15.00 billion kWh (+15.00 billion kWh for supply to outside Hokkaido)
Remarks	Hydropower includes transmitted electricity received from J Power and private power generations but excludes transmission end supply capacity and consumed electricity consumed by private generations.	The facility use rate is 26% for wind power, 12% for solar power, and 59% for thermal power (covered by purchasing electricity from private generations and emergent electric power supply).	The facility use rate is 60% for mini/micro hydropower, 80% for geothermal, 26% for wind power, 12% for solar power and 19% for thermal power (1.60 million kW for Ishikari LNG, 0.70 million for Tomato-Atsuma 4th, and 0.35 million kW for Shiriuchi 2nd).	Energy Change 100 is achieved. The power self-sufficiency rate is 200%. The IC of the Hokkaido-Honshu high voltage direct current link is intensified to 1.8 million kW.

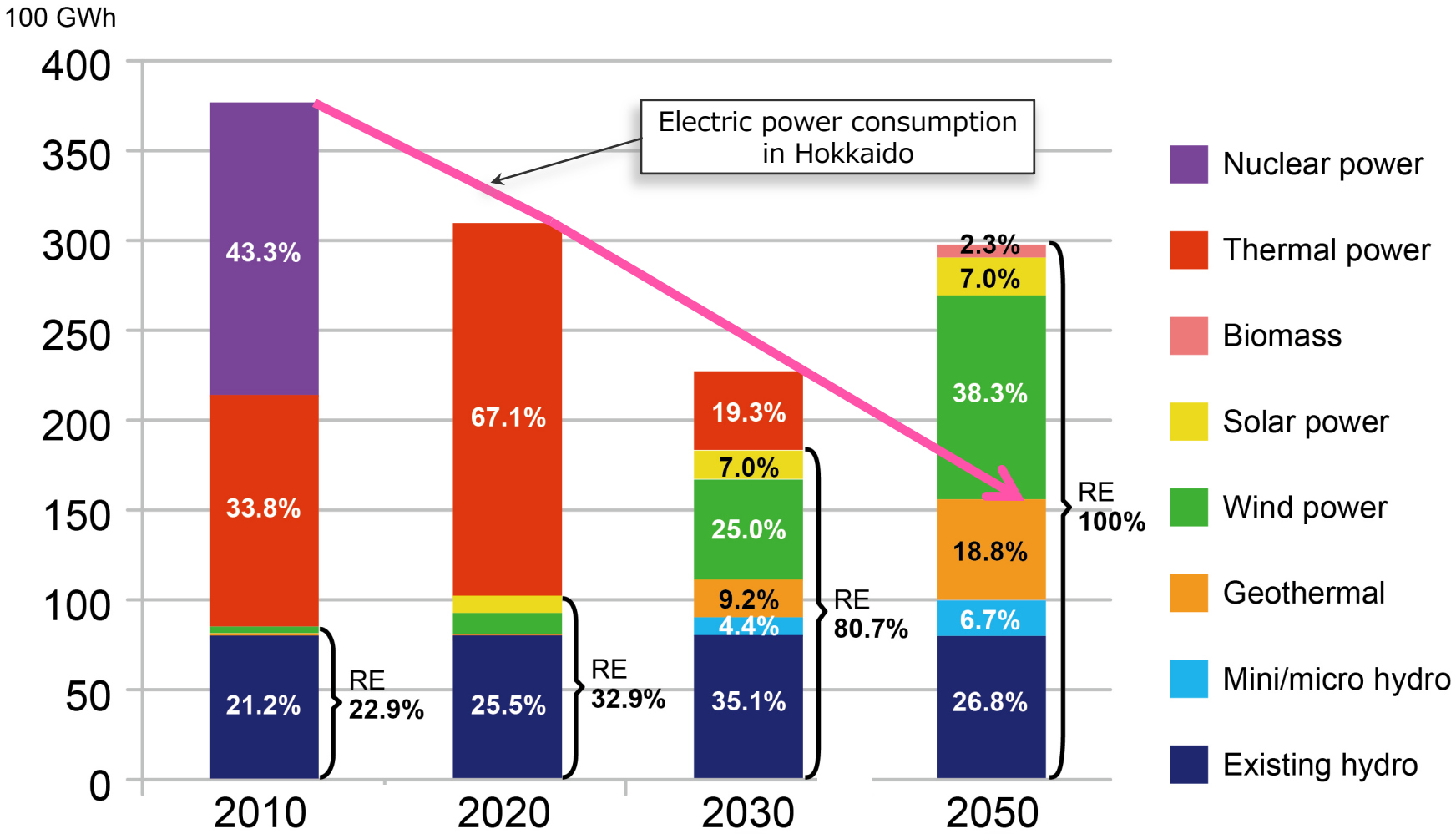
■ Power generation with power usage allocation that takes the potential of renewable energy into account

■ In 2020: Considering the aging of thermal power stations, it may be necessary to increase purchases from self-power generation and install emergency power sources. If electricity- and energy-saving do not advance, it may be necessary to resume the operation of the Tomari Power Plant by 2015. The Ishikari Bay New Port Thermal Plant (500,000 kW) will be constructed from 2015 and the initial operation is scheduled to start in 2018 or later (Hokkaido Electric Power Co., Inc.). Its total output will be 1.6 million kW.

■ In 2030: Renewable energy will account for 70% (including existing hydropower generation) and thermal power will account for 30% in Hokkaido. The target rate of renewable energy in the entire nation will be 25 to 30% and less than half of that in Hokkaido.

■ In 2050: The export of renewable energy to areas outside of Hokkaido will develop into an industry that equals Hokkaido's current fishery industry.

3. How can electricity be secured? (example)



Target renewable energy rate in the entire nation in 2030: 25-35%
(Fundamental Issues Subcommittee, Advisory Committee for Natural Resources and Energy, Ministry of Economy, Trade and Industry)

Achievement of Energy Change 100
Power self-sufficiency rate: 200%
Conversion of Japan to a power supply base

4. Conversion to power lines that can transmit renewable energy

If the power generation and transmission sectors are separated, power transmission lines that have been owned and managed by power companies will be open under fair rules. It is expected that renewable energy power generation enterprises will become able to use power transmission lines more easily and the consumer will be able to choose the power company they use.

■ Quality of electricity

Of renewable energy, wind and solar power requires fluctuations caused by weather conditions to be controlled. If voltage and frequency are not constant, it can cause problems for power consumers, such as the uneven thickness of thread, paper or iron plates at fabric, paper and iron factories.

■ To connect renewable energy with power transmission lines

The following measures are considered effective for connecting fluctuating renewable energy with power transmission lines.

(1) The absorption of fluctuations in a large power transmission network by connecting transmission lines in Hokkaido and Honshu through the constant opening of the Hokkaido-Honshu interconnection link installed at the bottom of the Tsugaru Strait

(2) The improvement of power transmission lines in northern Hokkaido (north of Nishi Nayoro Substation) with a high wind power generation potential through joint efforts between the government and private sectors

(3) Utilizing wind and solar power generation in combination with pump-storage and biomass power generation or simultaneous utilization with storage cells to absorb fluctuations

(4) Evening out the fluctuation cycles by increasing the scale of wind farms, mega-solar systems and other wind and solar power generation facilities

☞

Points to remember

We have a history of damaging precious flora and fauna and other natural features with large-scale development. To avoid making the same mistake in renewable energy development, it will be necessary to conduct environmental impact surveys in advance, as well as to carefully examine the environmental impacts after the installation of facilities and respond to problems immediately after they arise.

5. How will the economy be affected?

Investment into renewable energy is an economic measure to create new enterprises and employment and revitalize the economy. It will be a bridge to an economic system in which local communities and citizens play a leading role.

■To make renewable energy the driving force for a new economy

At present, wind power generation is thought to have the highest potential in Hokkaido. A large windmill on land is said to have approximately 20,000 parts, and the scale is equivalent to that of a gasoline (approx. 30,000) or electric (approx. 10,000) vehicle. Considering the labor necessary for production, as well as construction and management after installation, the wind and other renewable energy industries have the potential to be the driving force for the 21st-century economy in the same way as the 20th-century automobile industry.

■Synergy effect with agriculture and tourism

The clean image of an island using renewable energy adds a new value of safety/security to high-quality farm products. If a new energy system with a low environmental impact can be created in Hokkaido before other regions, it will also serve as a tourist resource.

■ To be an energy supply base for Japan

Wind, solar power, geothermal heat and water are regional resources. By utilizing them and selling power while involving citizens and enterprises in Hokkaido as leading actors, it will be possible to make Hokkaido an energy supply base for Japan.

(Example of a trial calculation for 2050)

Power sales to Honshu Island of 15 billion kWh × unit power selling price of 10–20 yen/kWh = 150–300 billion yen

This is equivalent to the fishery industry in Hokkaido in FY 2010, which generated 250 billion yen.

6. Fate of nuclear power generation

CO_2 reduction
Since the amount of CO_2 has increased due to the abolishment of nuclear power plants and the increased use rate of thermal power plants, it will be necessary to accelerate energy-saving measures. These include shifting to natural gas power generation, whose CO_2 emissions are less than half of those of coal-fired plants, improving the heat efficiency of coal-fired plants (through horizontal integration with top-efficiency power generation technology) and reducing the use of fossil fuel heat and energy in transportation and all other areas.

■ Learning from a historic accident

"In Japan's nuclear power plants, it is highly unlikely that an accident that involves the release of a large amount of radioactive material will occur because accident-prevention measures based on the defense-in-depth approach and the education/training of employees are both sufficient" (Nuclear System News vol. 15, Nuclear Systems Association).

In Fukushima, an accident that should not have occurred actually occurred, and we keenly realize that the responsibility for it is too large for one company or one nation to bear.

■ Soft-landing on a non-nuclear society

A large-scale power outage that would greatly impact on society must be avoided. That is why we must promote energy- and electricity-saving thoroughly, and every possible investment should be made for it.

■ New regional development in areas with nuclear power facilities

It is considered necessary to support communities with nuclear power facilities, which have been exposed to the risk of accidents, by supporting the regional economy by establishing technological centers for the disposal of radioactive waste and the decommissioning of reactors and allocating sufficient budget for the abandonment of nuclear power plants.

7. What people in Hokkaido can do

Realization of a society using 100% renewable energy depends on the choices and actions of everybody in Hokkaido.

■ Energy reduction first

Electricity- and energy-saving is sometimes called the fourth power source after nuclear, thermal and renewable energy. It is a power plant that can be created by each person. To fully promote such electricity saving, it will be necessary to shift from energy saving based on restraint to comfortable, nature-oriented energy saving. We believe that learning from nature and reducing energy consumption by improving insulation and other energy efficiency will lead to a reduction of energy consumption without lowering consumers' comfort levels.

■ Let's make homemade energy

In addition to making the electricity flowing through transmission lines clean, let's create "another energy path," through which electricity, fuels and other energy can be obtained at homes and in communities. Self-sufficient energy generated by solar panels on the roofs of homes, wooden pellets and firewood will serve as a lifeline at times of disasters and foster connections among members of communities. The possibility of utilizing snow/ice cold energy may also be expanded by devising new ideas.

■ Let's learn about energy and take action

Energy is a subject as close to our lives as food. Let's create and actively participate in opportunities to consider and share constructive views on the future state of energy together instead of leaving it all to the government and power companies.

Hokkaido Energy Change 100 Network
http://www.enechan100.com/

Top photo by Takayuki Monma

Conclusion

In the last few years, the development of renewable energy has progressed elsewhere in the world, mainly in the USA, China and Europe, at a scale and speed not comparable to that in Japan. While it has been considered impossible for renewable energy to cover the power demand, we are presenting a new idea by saying that it is possible by promoting energy reduction as part of this roadmap. Technological progress 30 years from now will be much faster than that in the past 30 years, and it should be. It is also expected that small-scale, decentralized renewable energy systems that have not yet been considered will spread. We are reaffirming our commitment to the creation of our future with an ambition for Japan, which experienced energy issues due to the Great East Japan Earthquake, to play a leading role in the energy field.

There are other important subjects that could not be included in this roadmap. For example, how much of the cost for introducing renewable energy and the total cost for decommissioning reactors and disposing of nuclear waste should be borne by us? How much energy-saving potential does Hokkaido have? Can we manage to reduce CO_2 in time? Our work of making the roadmap will continue while addressing such remaining problems until Energy Change 100 will be achieved.

To be continued.