Much more electrification toward full carbon neutral 2050

NPERC-J

Hiromichi Ohashi

Basic questions for the postponing statement

- What will be *the total energy needed by humanity* in 2050?
- If all the energy will be carbon-free, *how much will be provided through electricity?*
- What could be *the best electrical energy system* for generating, transporting and supplying all that electricity globally?
- *What power electronics technology advances* are necessary for the envisioned global energy system?

Total Energy needed by humanity

World electrification status

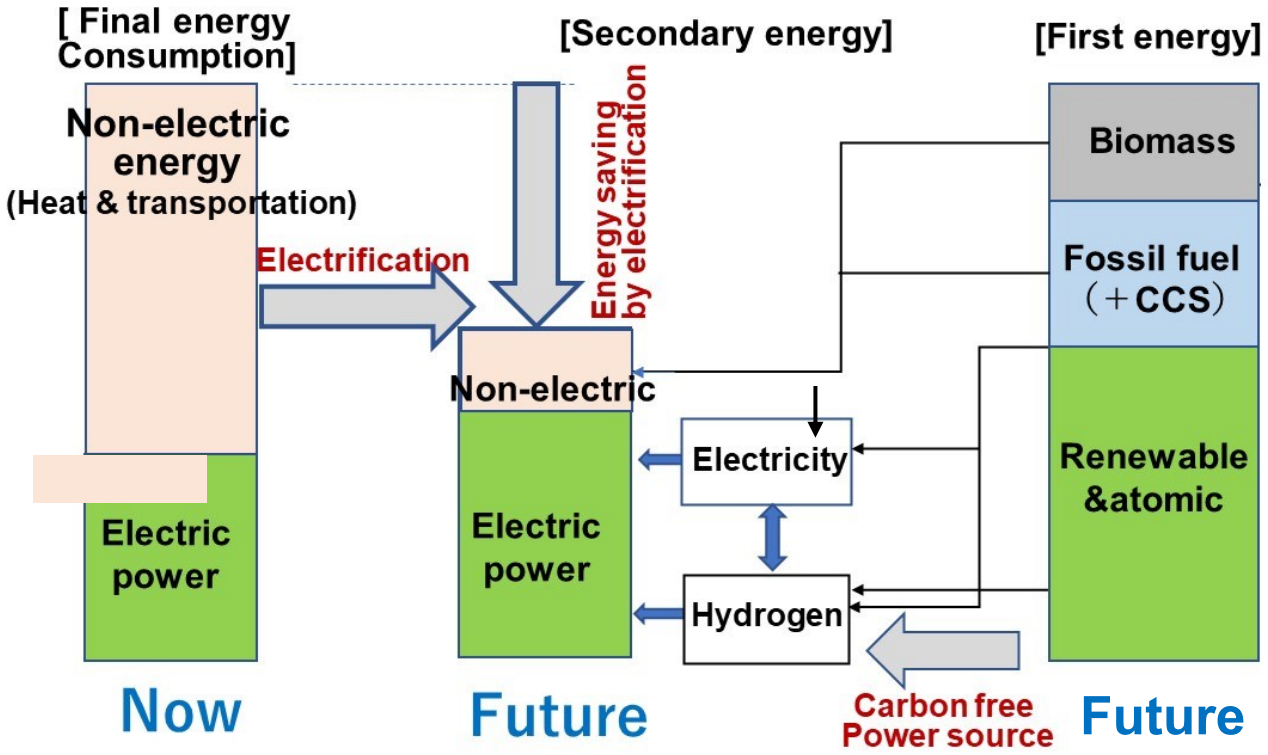
	2008(Dashan' at FEPPCON 2015)			2050 (Rough estimation by Ohashi)		
	population	Daily electricity use per capita	Power/year (billion kWh)	population	Daily electricity use per capita	Power/year (billion kWh)
Advanced world	~1.5 Billion	~24kWh	~12960	~1.4 Billion	~20kWh	~10080
Developed world	~ 2 .2 Billion	~8.5kWh	~6732	~2.5 Billion	~20kWh	~18000
Undeveloped world	~3.4 Billion	~2.0 Wh	~2448	~4.0 Billion	~10kWh	~14400
Uncivilized world	~1.3 Billion	~0.0kWh	~0	~2.1 Billion	~2kWh	~1512
The whole world	~7.8 Billion		~22140	~10 billion		~43992

Total power consumption of 2050 would be almost two times larger than that of 2008

Electricity as carbon free energy

Green growth strategy by METI Japan as example

Scenario toward carbon free society ⇒ Cinergy effect achievement of Electrification, Carbon free PW source and Saving energy



LNG with **C**arbon-dioxide **C**apture and **S**torage use

Carbon free scenario will be achieved by the above scenario

Drawing up by referring to materials of Tokyo Electric Power Company Holdings

Example of the best energy system at 2050 in Japan

Predicted electric power generation structure

Renewal energy of national grid (Billion kWh) **for 2050**

Solar	Wind	Hydro	geothermal	Biomass	Tidal	Total
223.9	188.0	87.5	30.2	27.0	10.1	566.7

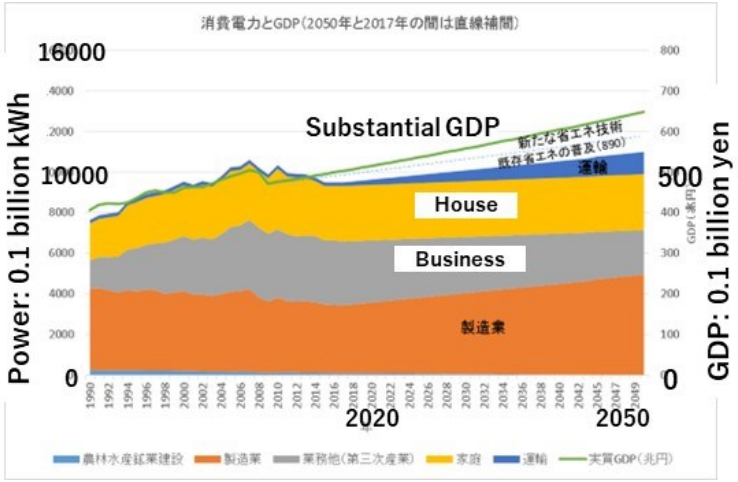
Traditional electric power of National Grid in Japan with CCS

LNG	Atomic	Total
292.5	0.0	292.5

PV power mainly generated in each sector including use of **CCS**

House	Industry	Transport.	Business.	Total
128.2	105.3	23.4	46.8	303.7

Power generation
Total:1163 Billion kWh



Electric power consumsion at 2050

House	Industry	Transport.	Business.
275	495	110	220

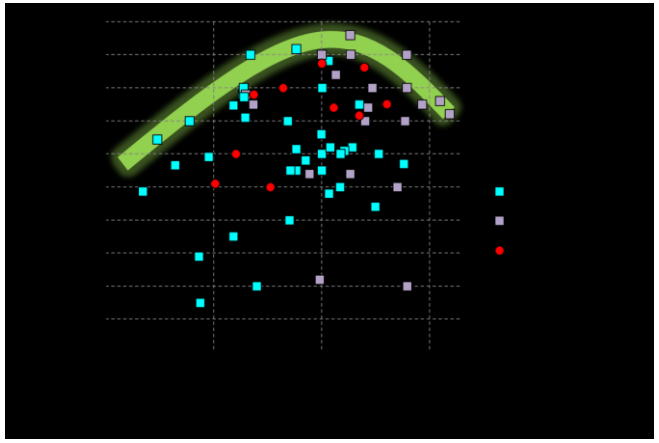
Power consumption
Total:1100 Billion kWh

Carbon free society achievement could be possible in 2050 Japan

power electronics technology advances

Now day's real PE situation and where it will go?

Power electronics(PE1) Now



- At present time, output power density(OPD) is stagnant around 10W/cm^3 with peak efficiency of around 99%
- Power module size is approaching to limitation of chip size determined heat exhausting ability of heat sink.

New generation PEs beyond Newell PEs (PE2)

- Progress in component and system integration will become more important area.
- Gate electronics creation will stimulate internet connected PE advances.
- Series and parallel free connection and more highly reliable PE system will become key technology for ubiquitous PE penetration into the future society.

Carbon free energy achievement toward 2050

Synergy of Basic strategies

- Electrification of non-electric energy (Heat and transportation)
- Carbon free generation (Renewable energy)
- Saving energy

The new generation PE will become key technology for the achievement of basic strategies

- Ubiquitous PE penetration into society
- Network connected PE in society

- Two times larger electric power demand will emerge in 2050 in the world
- Much amount of electric power will be managed by the new generation PE
- PE penetration into the society, will become normal ones as an important infrastructure, making network with cyber system.

Thank you