

Sustainable Energy System for a Low Carbon Economy

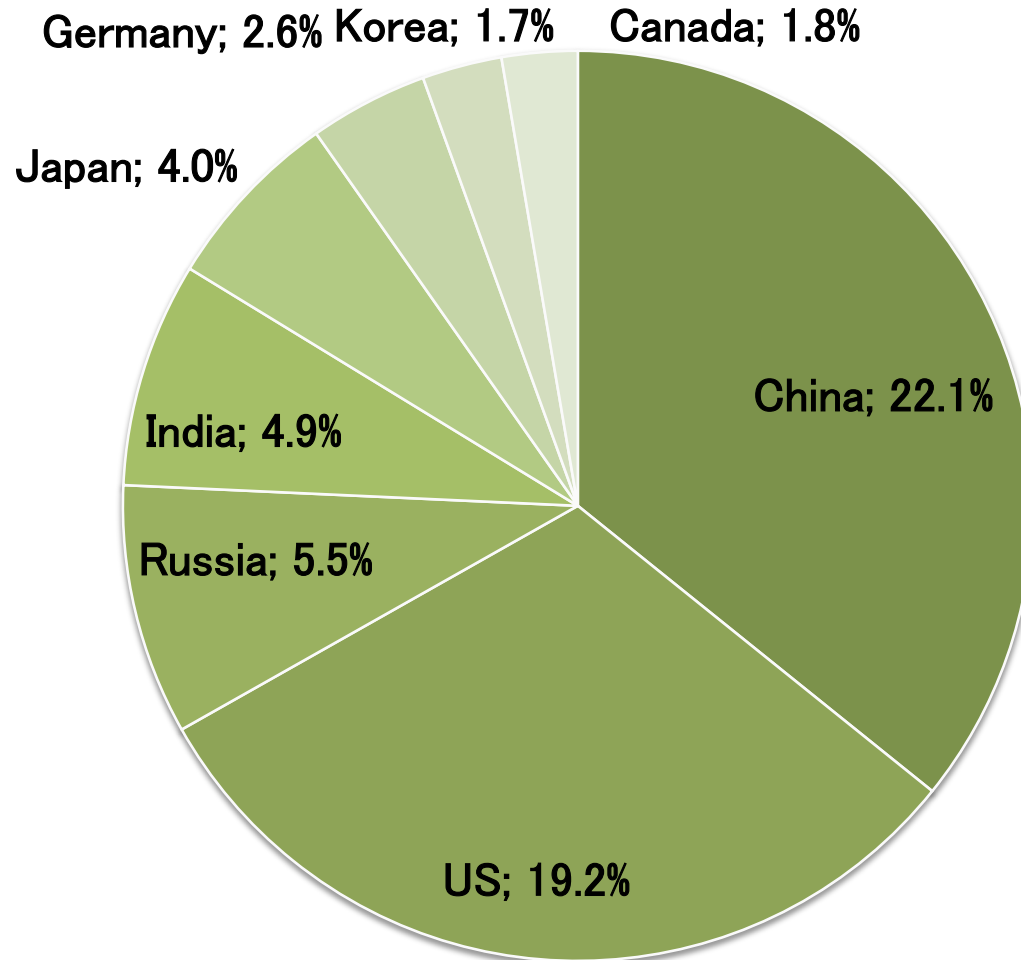
Yoshiki Inuma, Ph.D.
Japan Electric Power Info. Ctr.

Twentieth Northeast Asia Economic Forum
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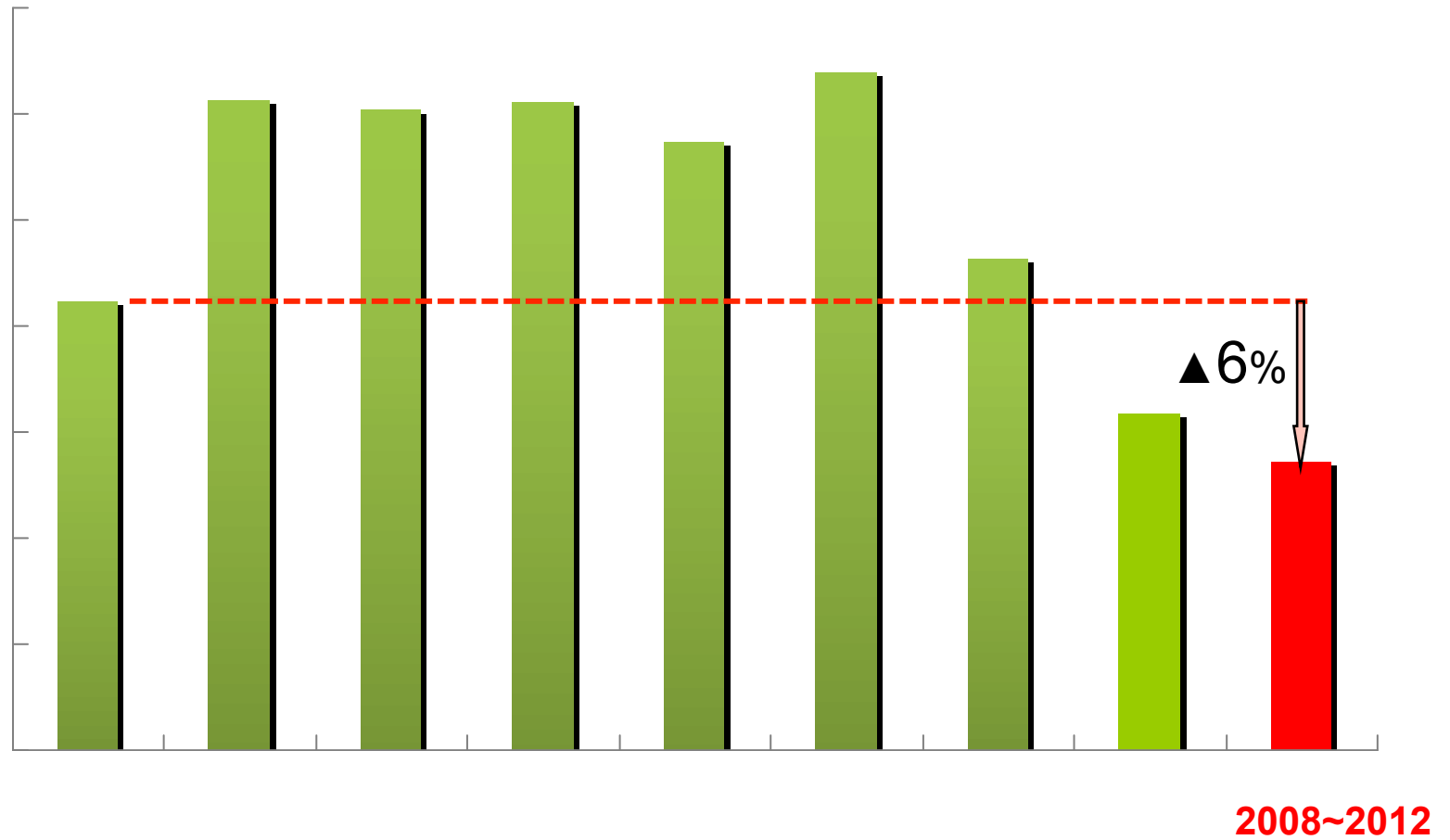
- Status of CO₂ Emission
- Sustainable Energy System
 - Smart Power System
 - More Advanced Thermal Power Generation
 - High-Efficiency Heat Pumps
 - PV
 - Challenges for New Energies
- March 11 Tohoku Earthquake

CO2 Emission by Country (2009)

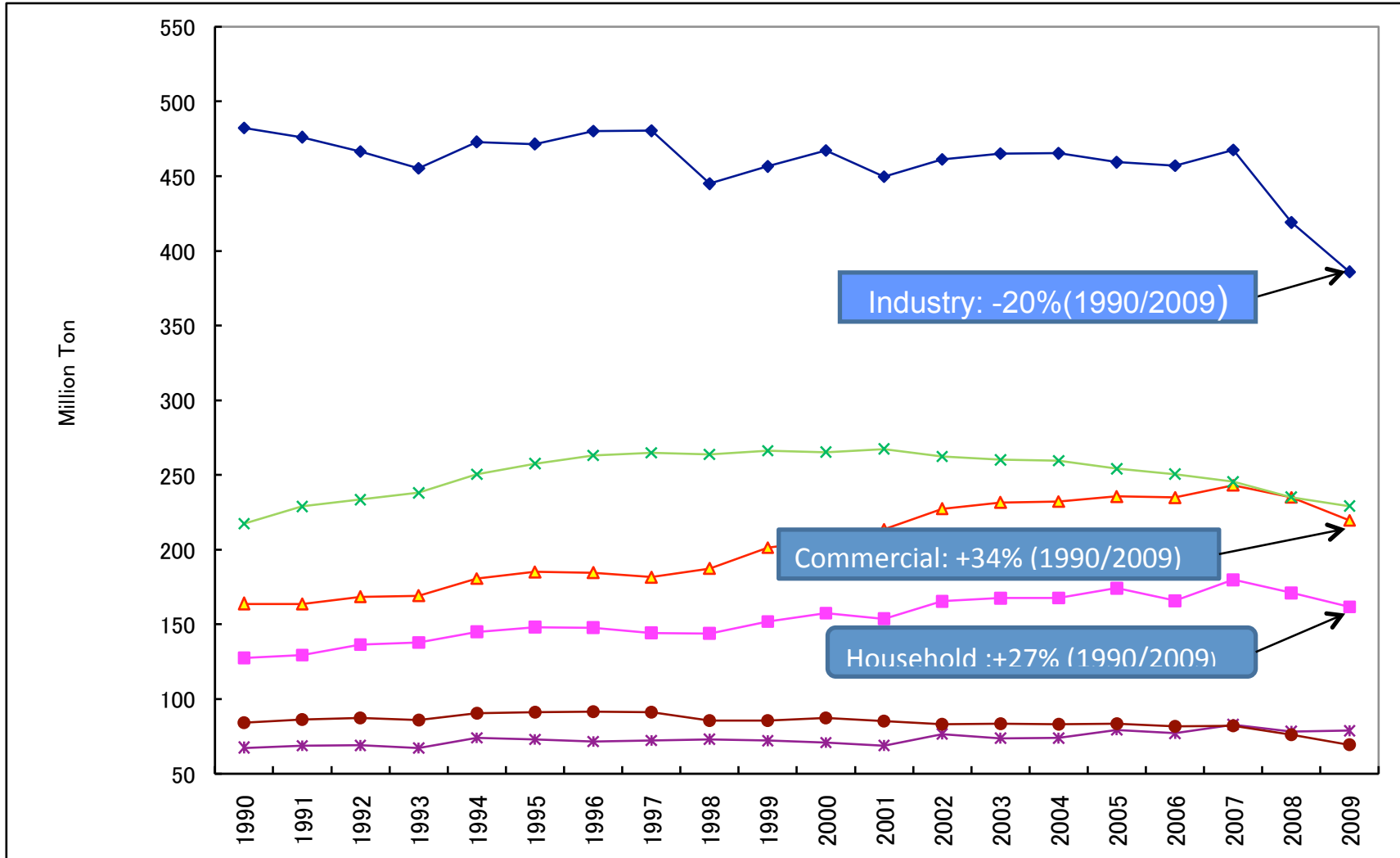


Total CO2 Emission: 29,471 Million Ton

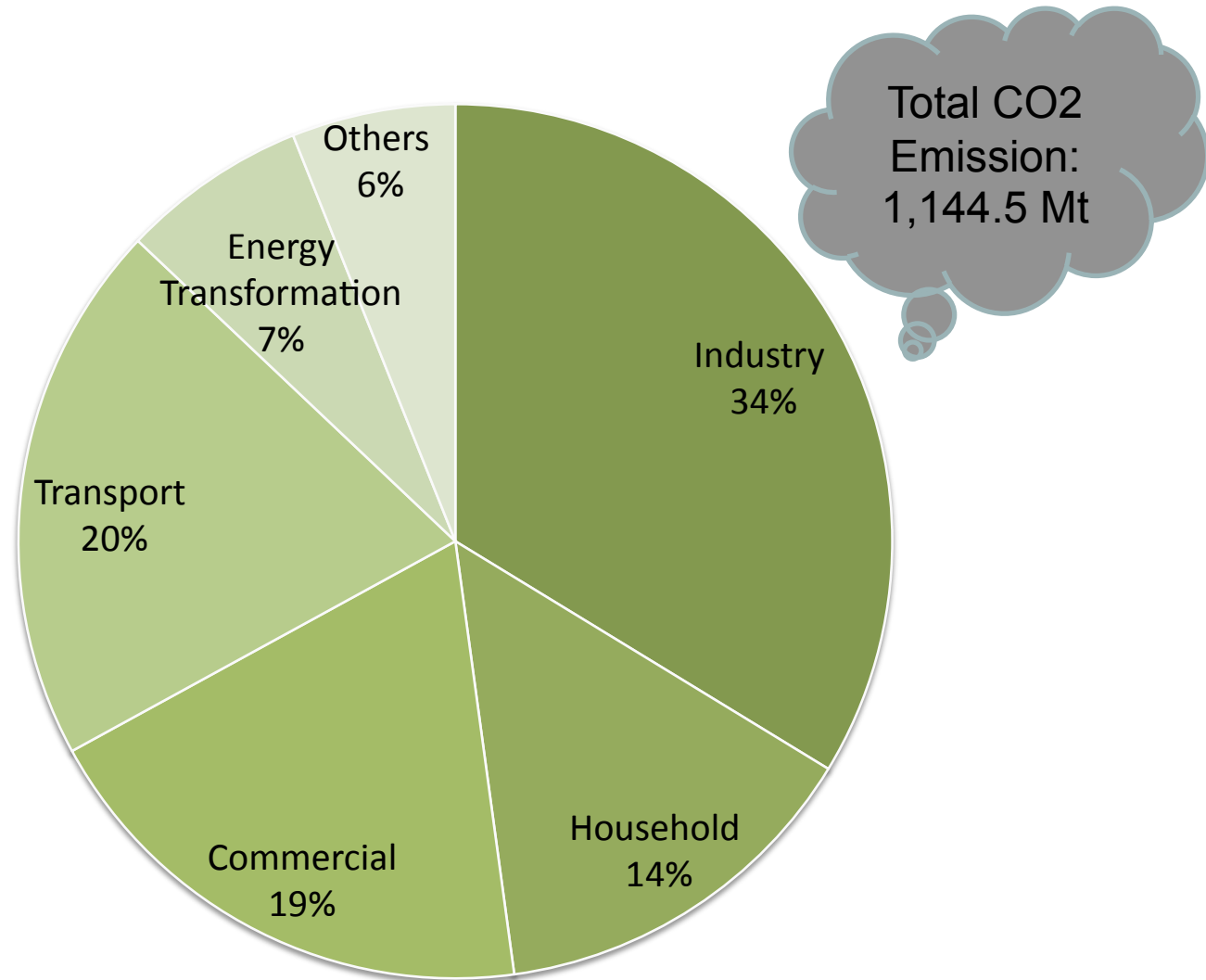
Status of GHG in Japan



CO2 Emission by Sector(1990-2009)



CO2 Emission by Sector (2009)



CO₂ Identity

$$CO_2 = \frac{CO_2}{E} \frac{E}{GDP} GDP$$

$$\therefore \Delta CO_2 = \Delta \frac{CO_2}{E} + \Delta \frac{E}{GDP} + \Delta GDP$$

CO₂ Intensity
in energy

Energy intensity
in economy

Composition of Change in CO2

	1990-2000	2000-2005	2005-2009	30% Reduction Target (2005-2020)
ΔGDP	1.1	1.3	-0.6	1.1
$\Delta \frac{CO_2}{E}$	-0.5	0.3	-0.6	-3.5
$\Delta \frac{E}{GDP}$	0.3	-1.1	-1.7	
ΔCO_2	0.9	0.5	-2.9	-2.4

$$\Delta GDP + \Delta \frac{E}{GDP} = \Delta E$$

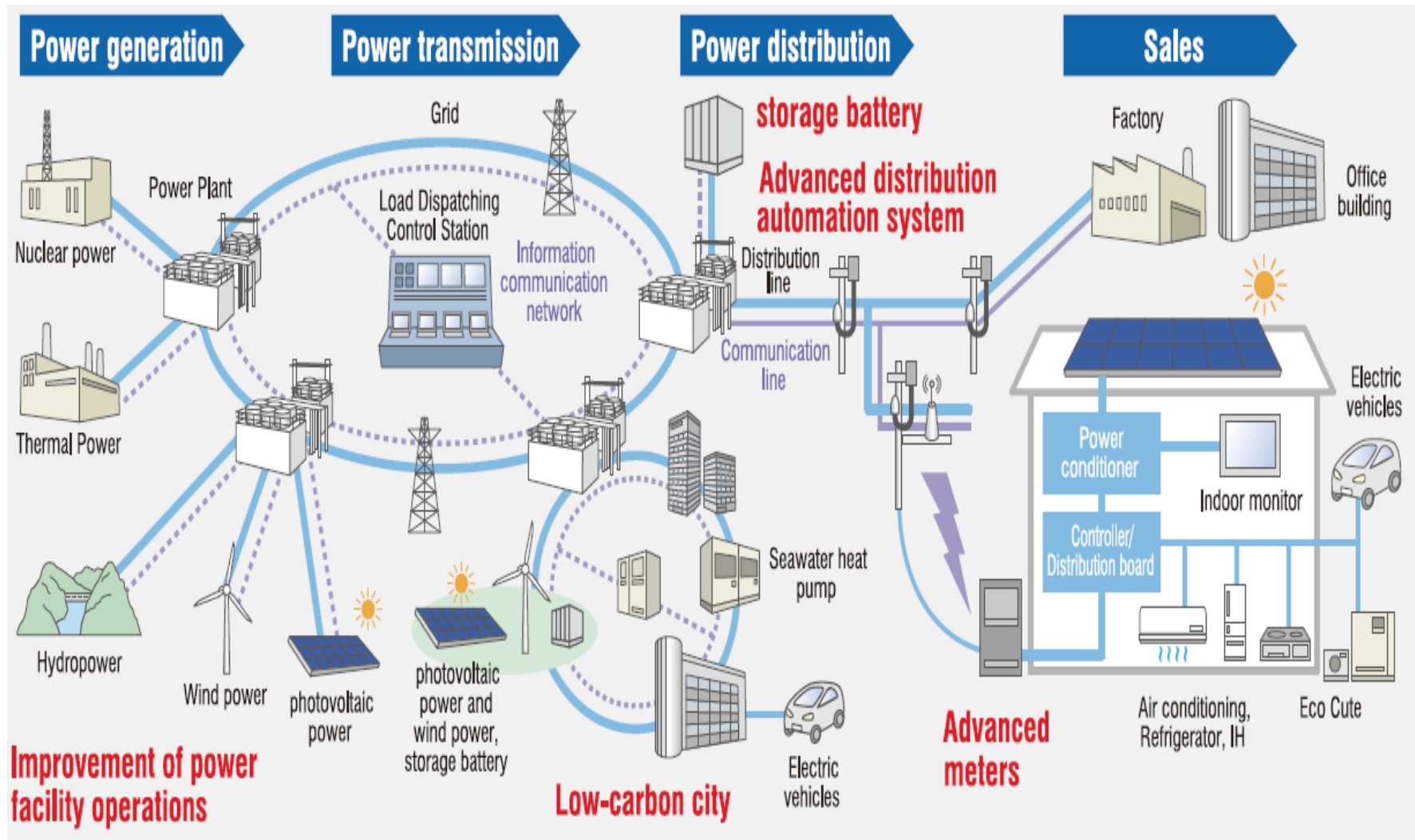
(+) (-)

And in general $\Delta E > 0$

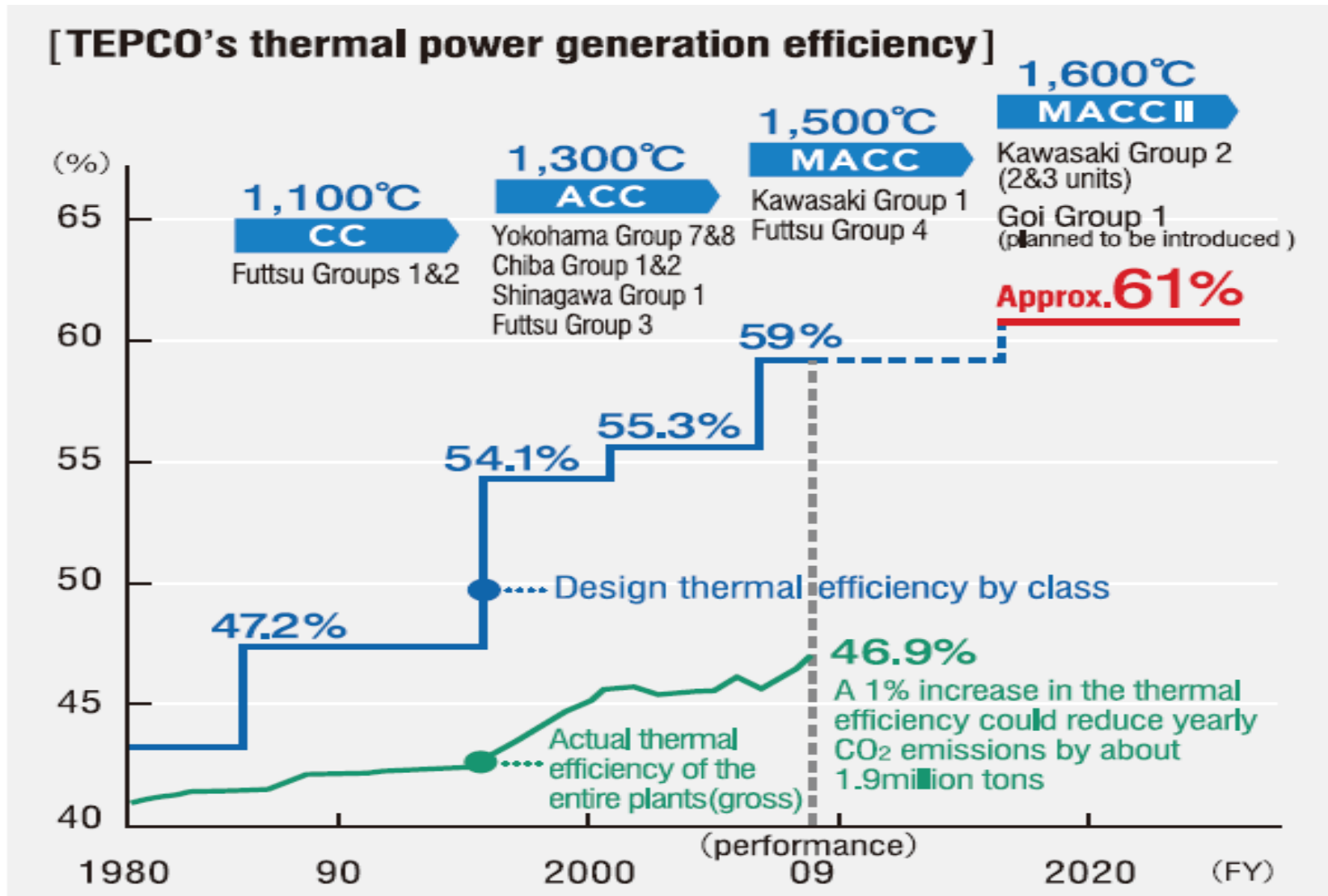
To reduce CO₂,

$$-\Delta \frac{CO_2}{E} > \Delta E$$

Smart Power System



More Efficient Generating Plant



High Efficiency Heat Pump

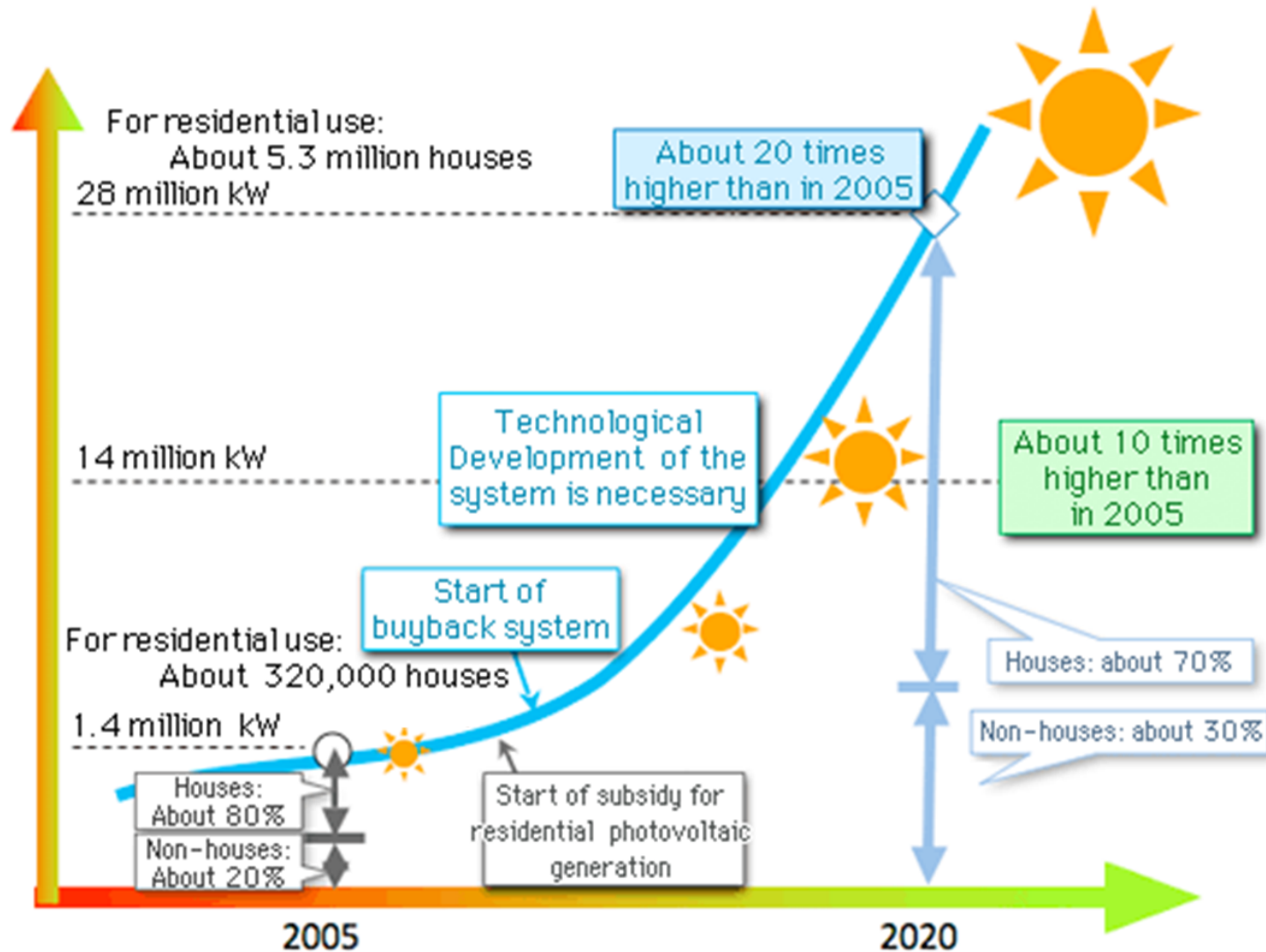
- Heat in the air is renewable resource for heating, cooling and hot water supply.
- Ideal COP is quite high.

indoor temperature : 28 Celsius outdoor temperature: 35 Celsius

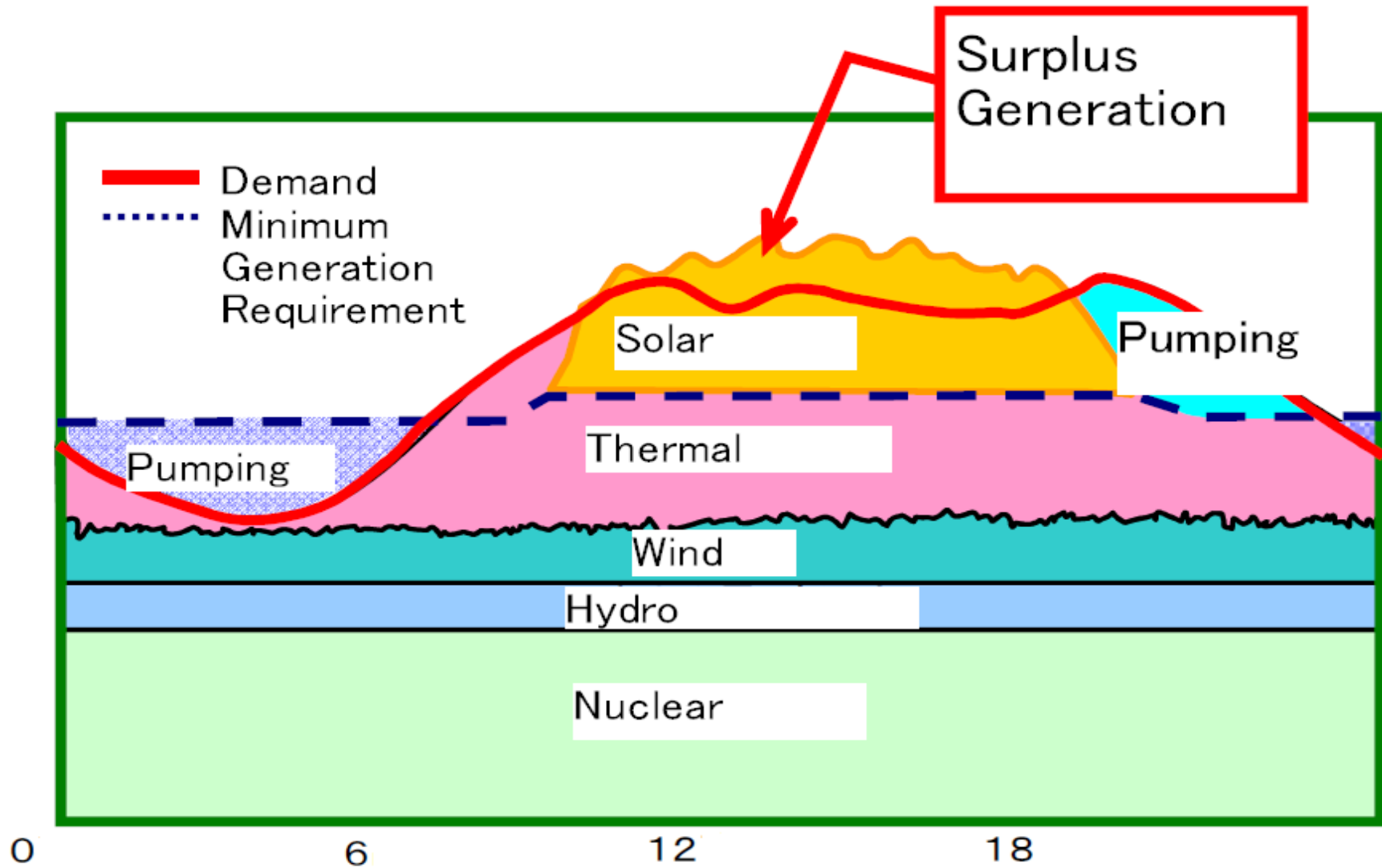
Ideal COP is $(273+28)/(35-28)= 43$

- Air-conditioner using heat pump is now available even in frigid place.

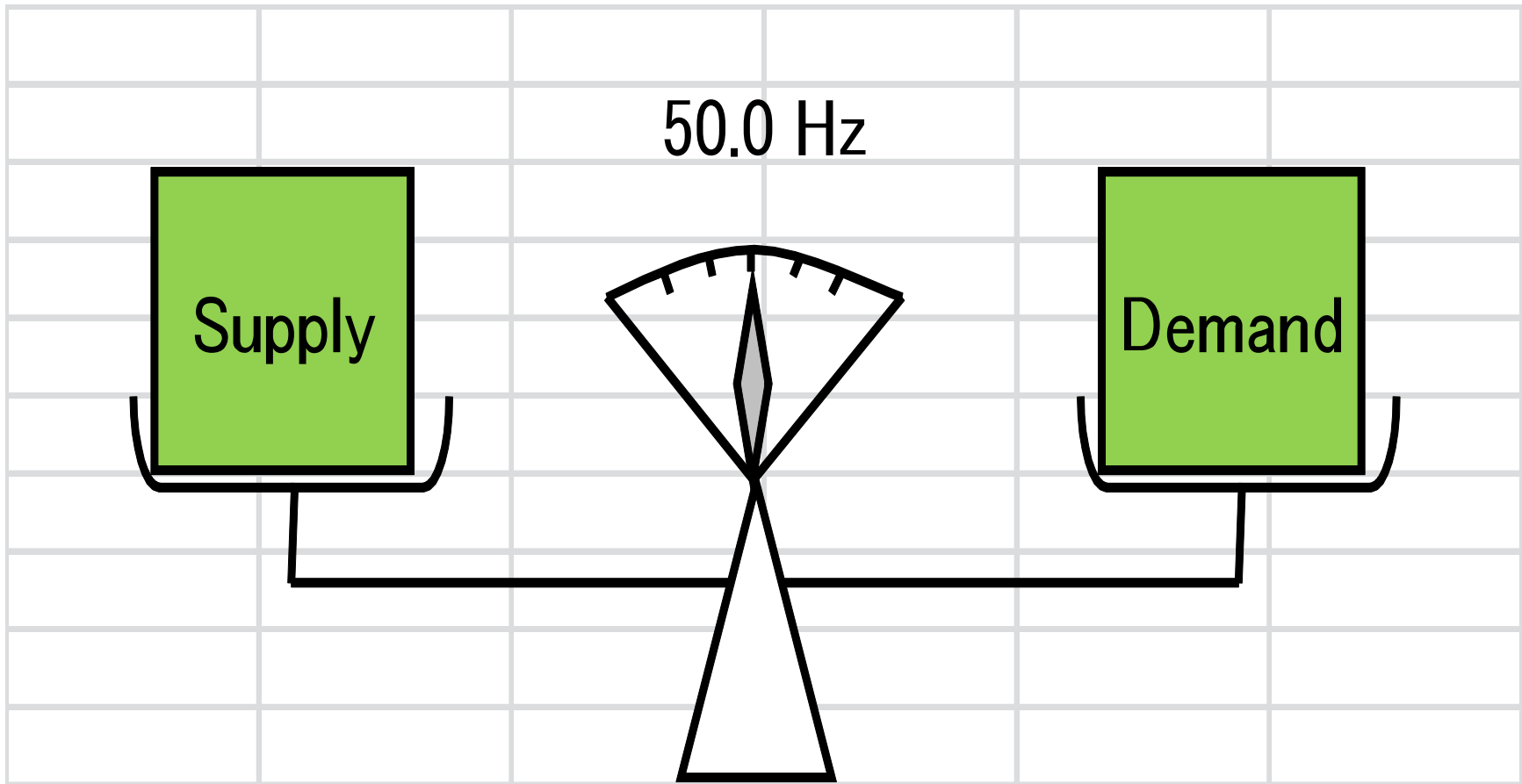
28GW PV in 2020



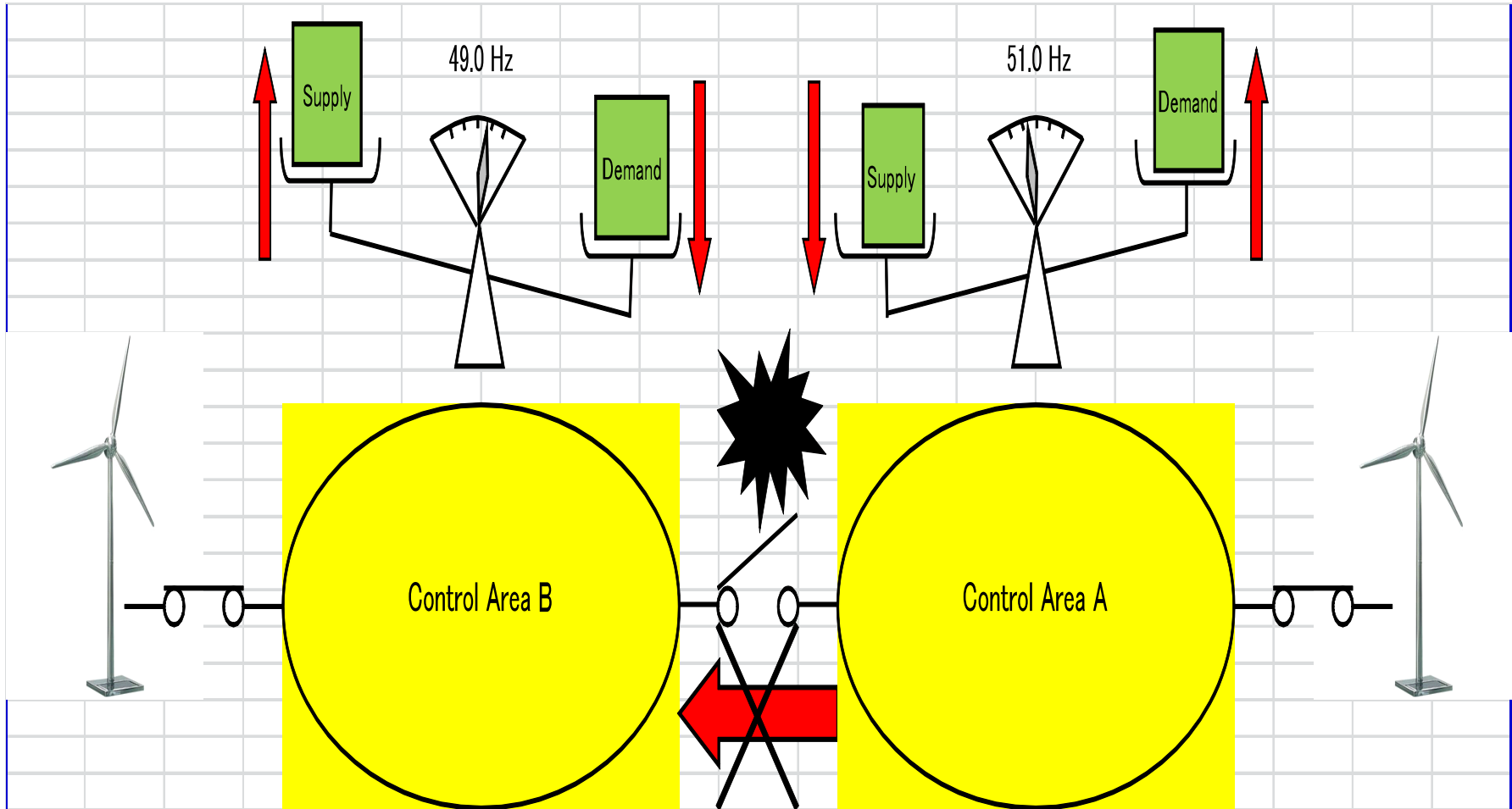
What If Generation Exceeds Load ?



Electricity 101



Challenges for Intermittent Energies



Future Generation Patterns



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Source:http://www.illexenergy.com/pages/Documents/Other/Woodhouse_Eurelectric_9Feb2011_v1_0.pdf

Aftermath of Fukushima Nuclear Havoc

- Unprecedented earthquake and tsunami was also a major shock for nuclear power industries in not only Japan also the world.
- Several countries have already abandoned nuclear power.
- Nuclear power will remain an option on the condition of safety and emergency preparedness in many countries including emerging countries.

Challenges Ahead

- Nuclear Accidents at Fukushima evoked a number of questions.
- What to do with nuclear power in the energy mix?
- How can we achieve CO₂ targets ?
- How should we promote renewable energies?
- Is unbundling necessary ?
- Is existing regulatory system acceptable?

Mahalo!