

Post Fukushima Energy Strategy : Energy Security and technology options

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Innovative Energy & Environment Strategy

Decision by the Energy & Environment Council , GOJ

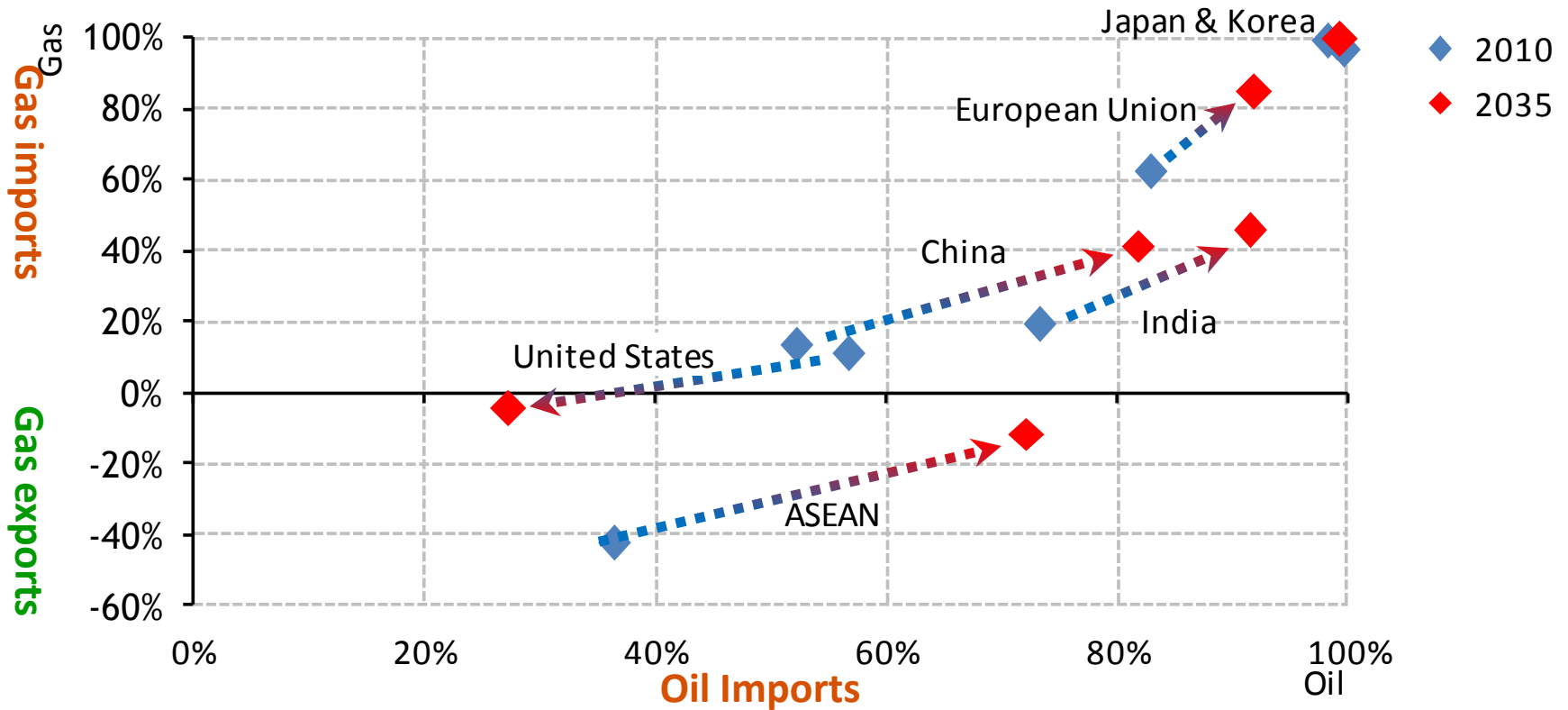
September 14th, 2012

- Mobilize all possible resources to phase out Nuclear Power Generation during 2030s.
 - Strict 40 years life of reactors. Restart reactors with approval by the new NRC. No new construction.
- Green Energy Revolution
 - 10% Power saving and 19% energy efficiency by 2030.
 - Triple Renewables by 2030. (x8 excluding hydro)
 - R&D for new generation vehicles, Hydrogen system, CCS.
- Expand LNG gas power, Combined Heat & Power.
- Reform of power market.
- Flexible review of the decision.

Different trends in oil & gas import dependency

IEA WEO 2012

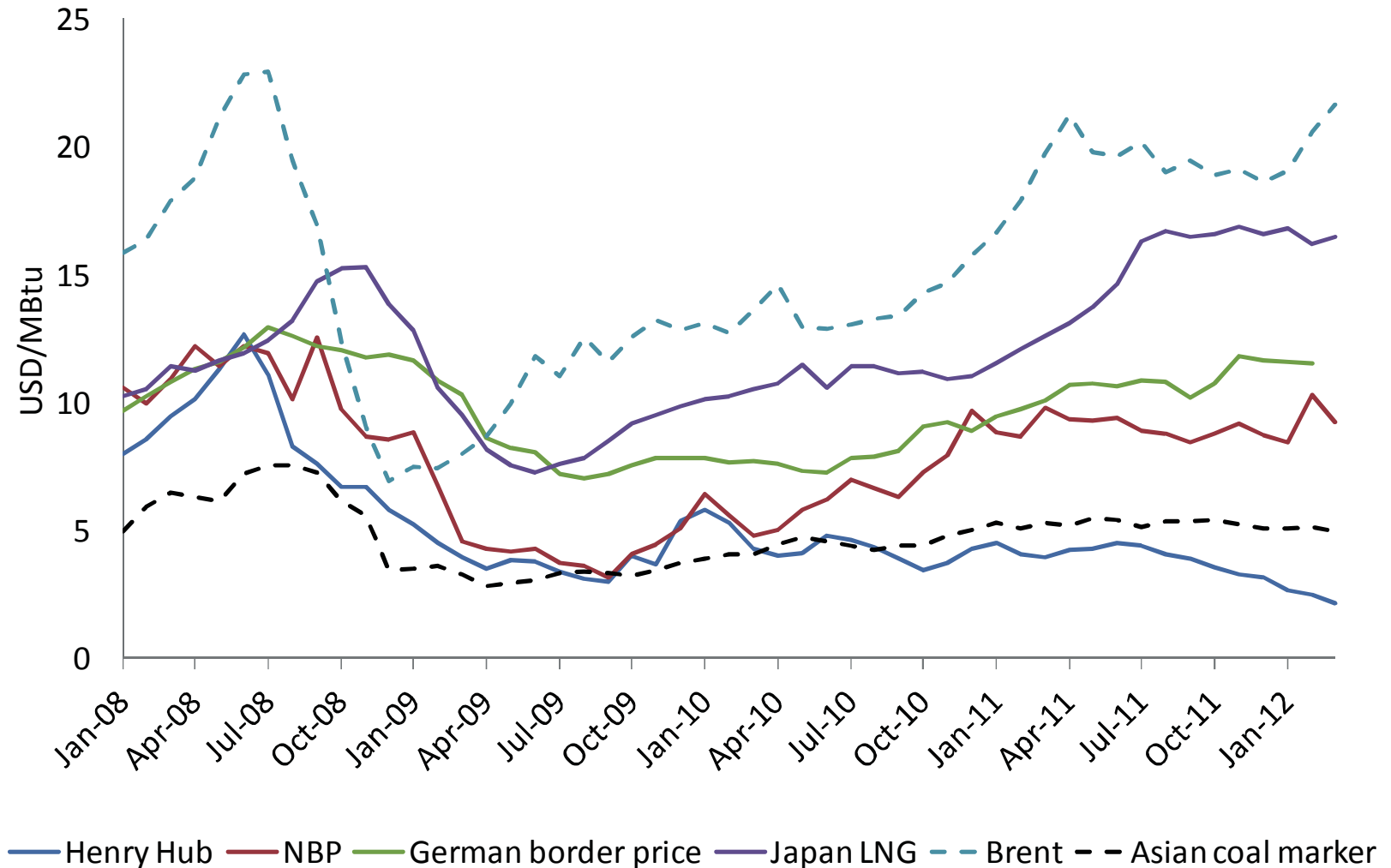
Net oil & gas import dependency in selected countries



While dependence on imported oil & gas rises in many countries, the United States swims against the tide

International Gas Prices

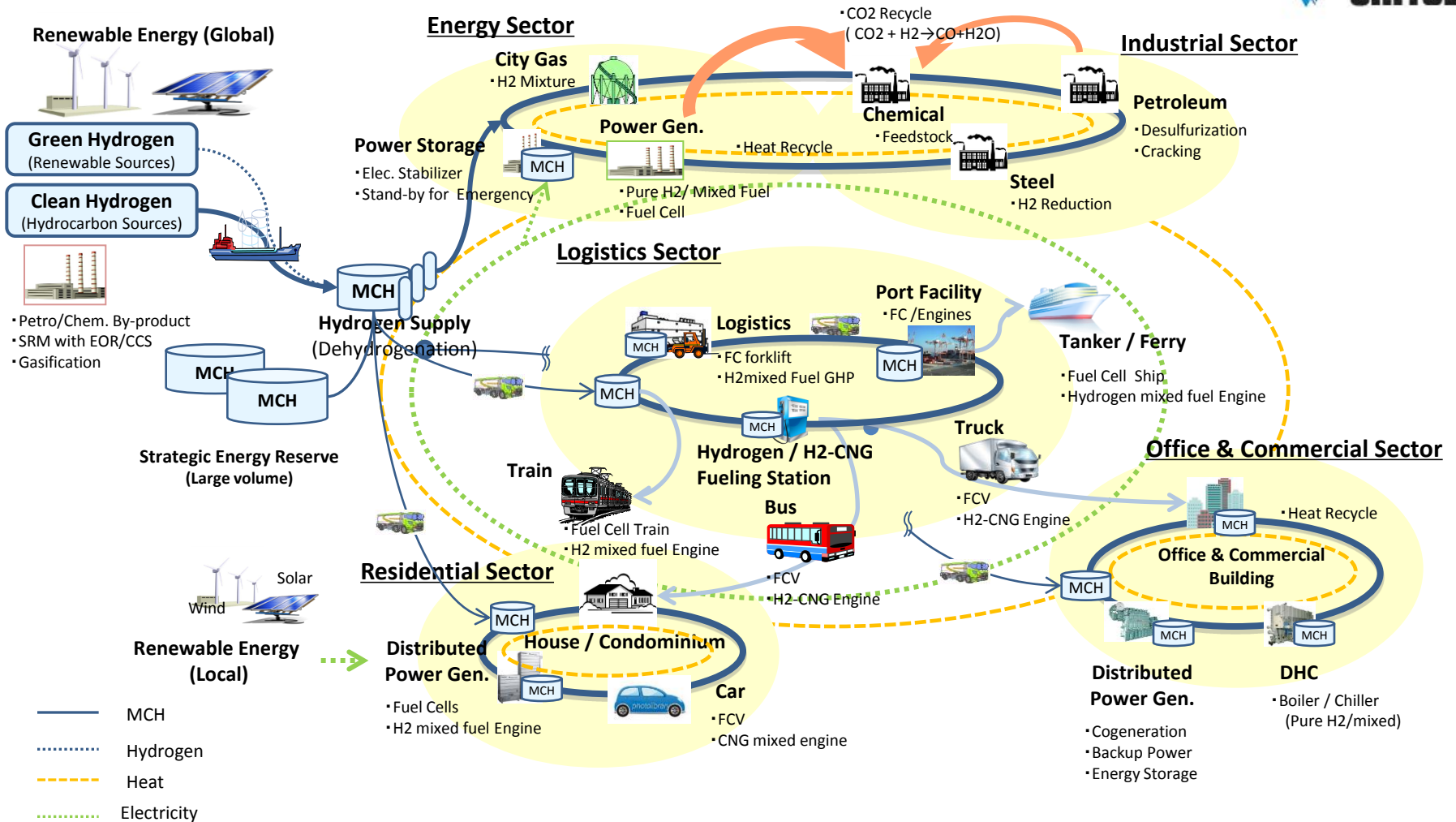
How can we reduce Asian Premium?



Technology helps! Hydrogen Community with MCH



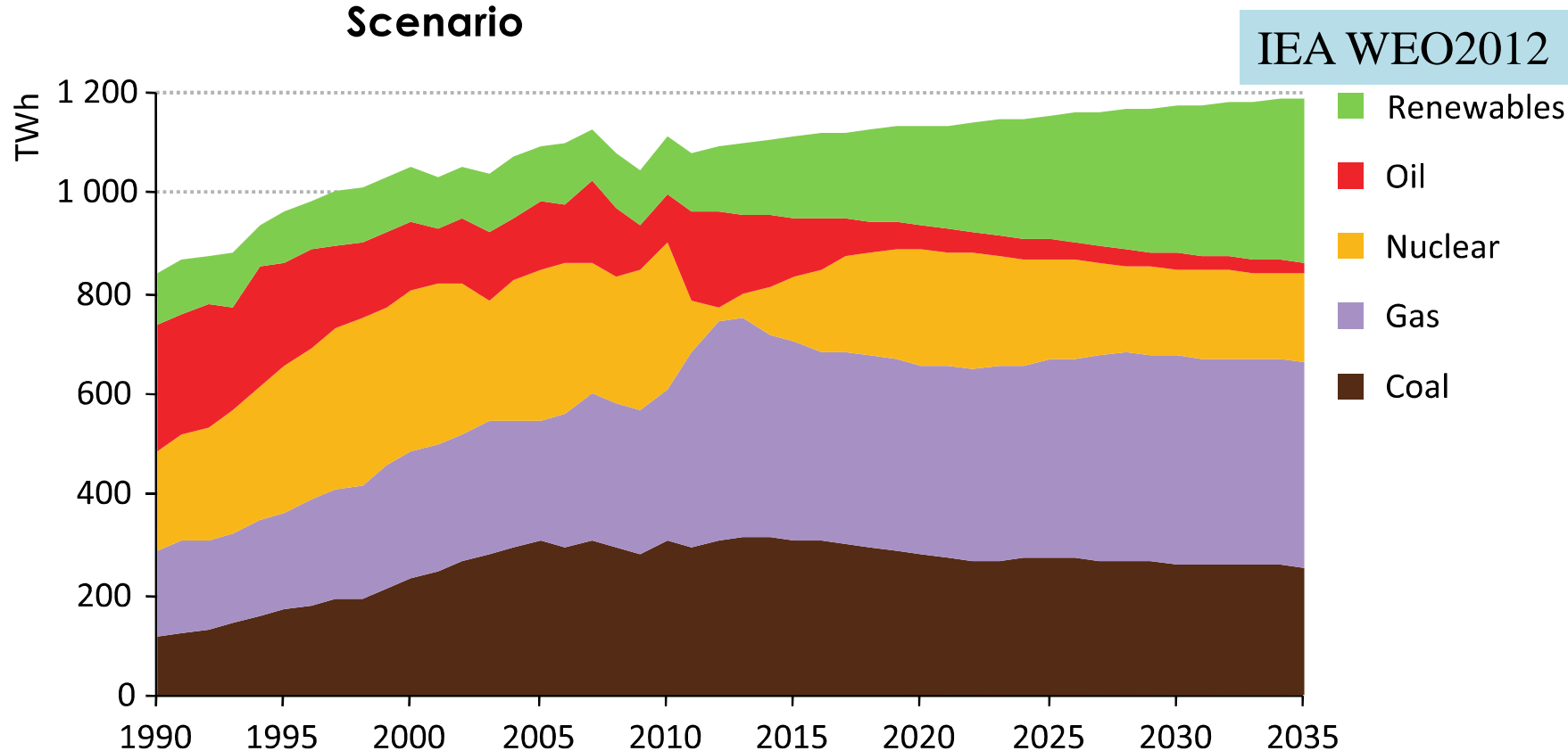
- Large volume Hydrogen transportation & storage technology will be essential to build 'Hydrogen Community'.
- 'Hydrogen Community' realizes Low Emission Carbon Recycling Society, with empowered resistance against disasters.
- New path toward the Hydrogen Society will enhance innovation and create New Industries.



(Note) MCH : Methylcyclohexane FC : Fuel Cell FCV : Fuel Cell Vehicle GHP : Gas Heat Pump DHC : District Heating and Cooling

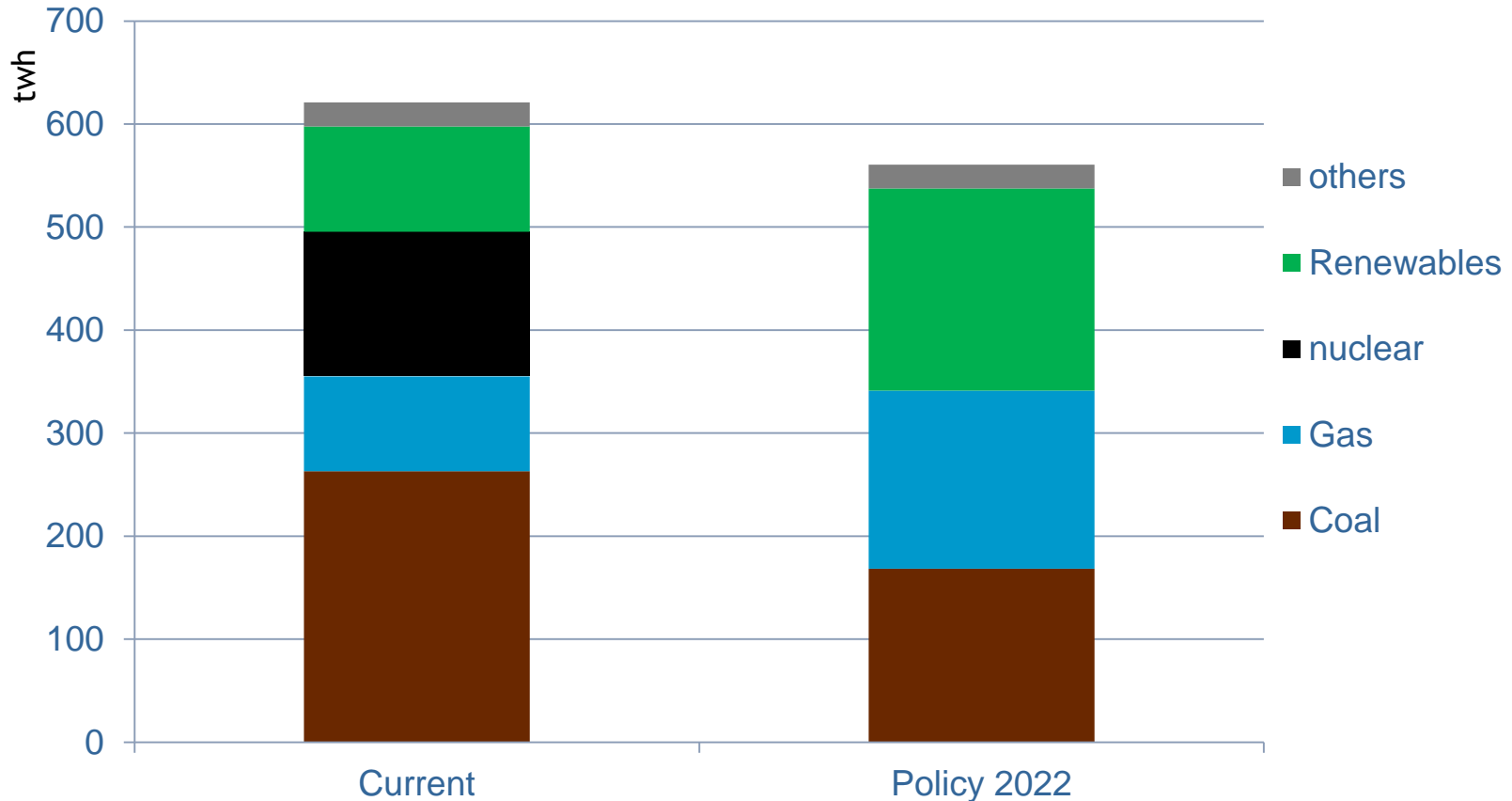
Japan's Power Sector: Renewables, gas and energy efficiency leading the charge

Figure 6.13 ▶ Japan electricity generation by source in the New Policies Scenario



A decline in nuclear is compensated by a 3-fold increase in electricity from renewables, a continued high reliance on LNG imports & improvements in efficiency

Germany may need much more Gas to phase out Nuclear by 2022



Germany needs to import 16 BCM of gas to achieve electricity mix with 10% demand reduction, no nuclear, 35% renewables and CO2 at the target level

Power Grid Connection in Europe

Physical energy flows between European countries, 2008 (GWh)

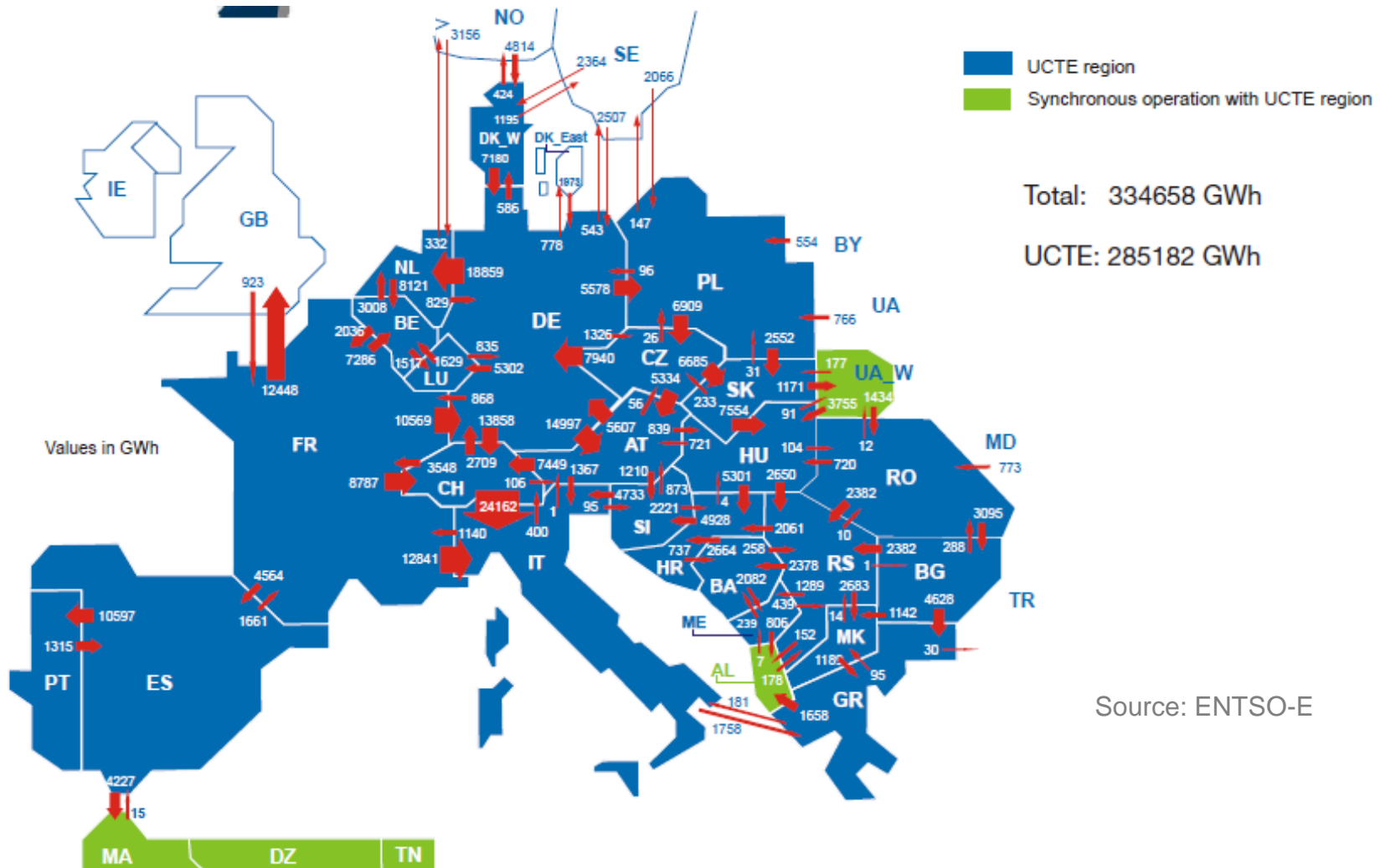
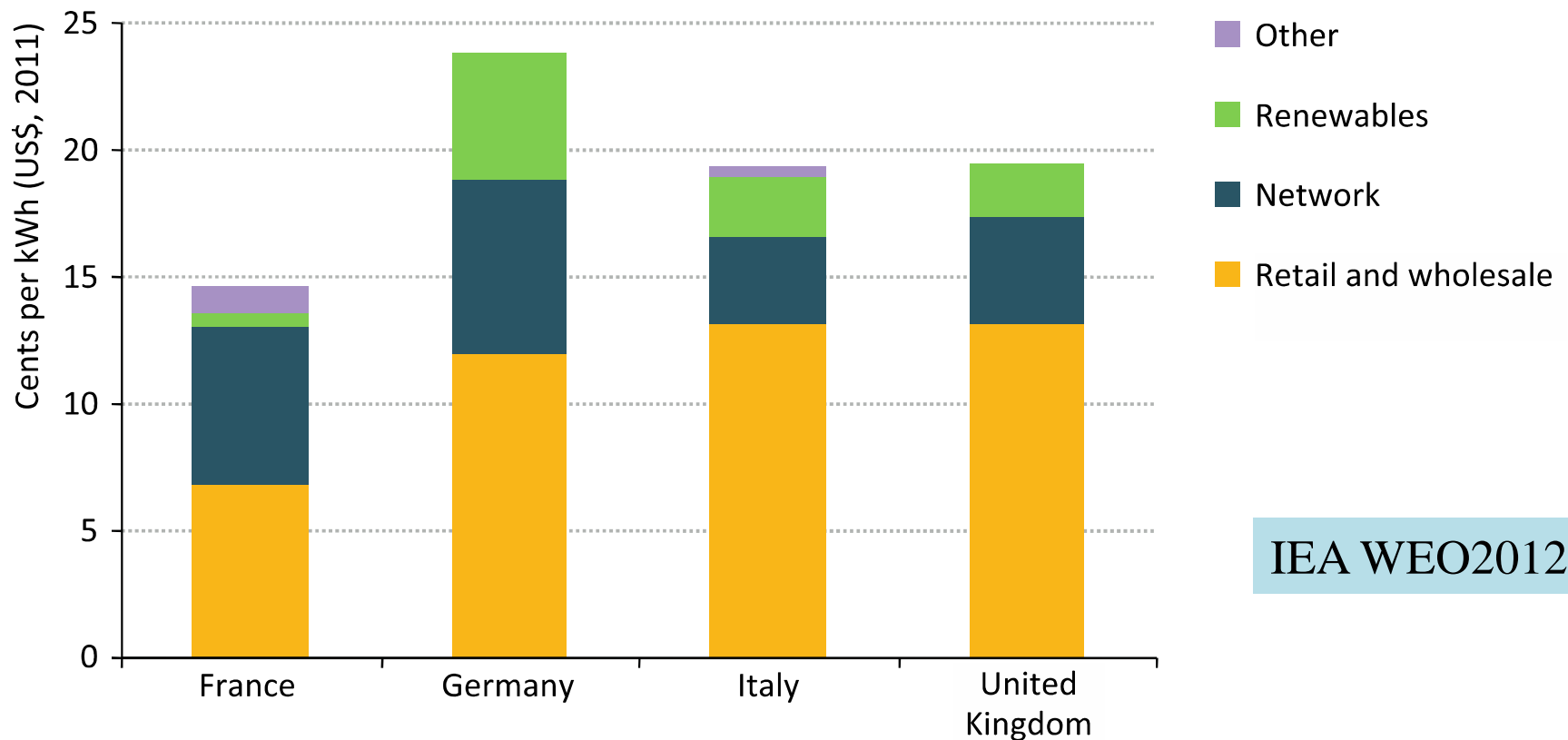


Figure 6.18 ▶ Average electricity price to households in selected European countries by cost component, excluding taxes, 2011



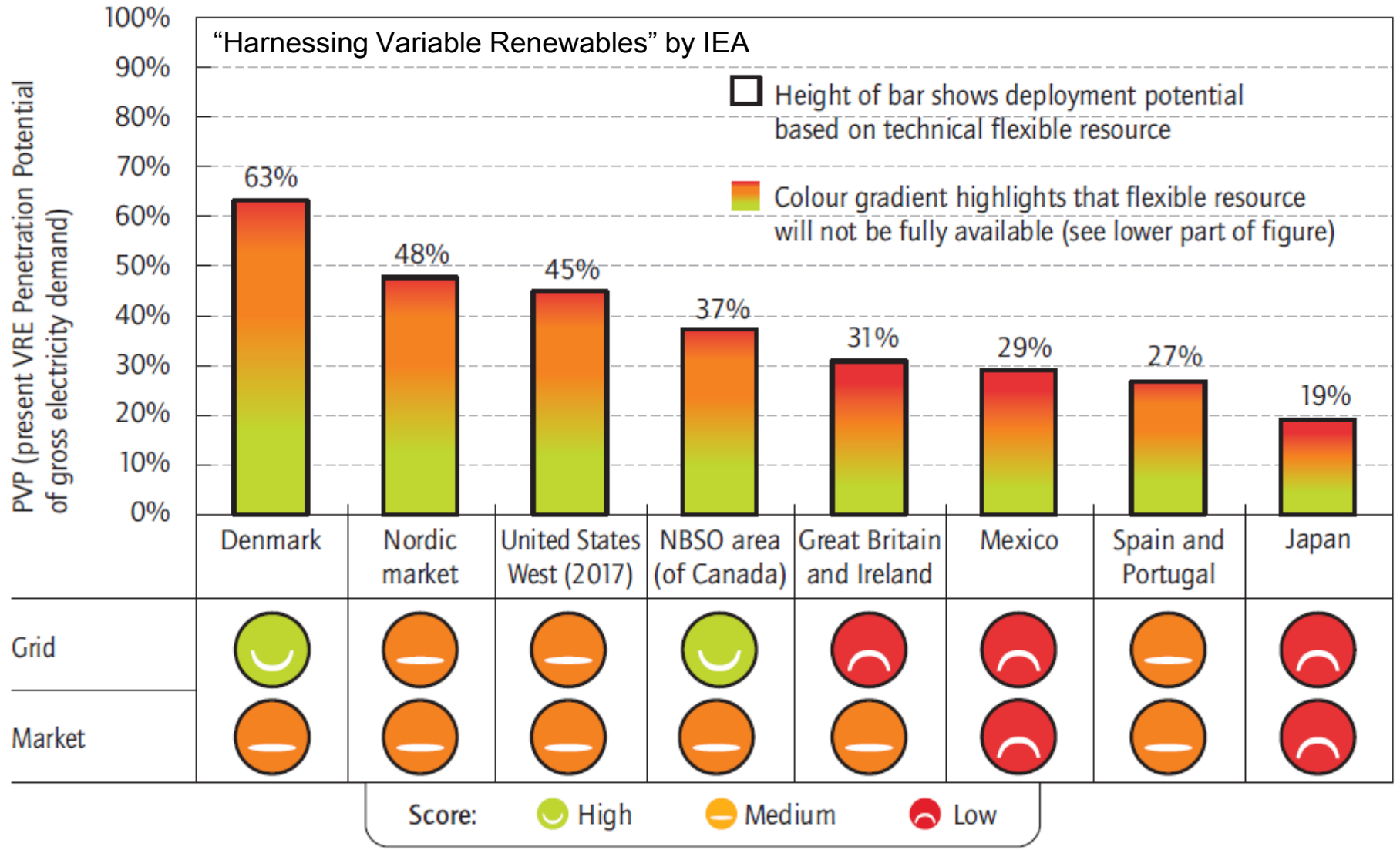
IEA WEO2012

Sources: Ofgem (2012); BDEW (2011); CRE (2011); Autorita' per l'Energia Elettrica e il Gas (2012); IEA (2012).

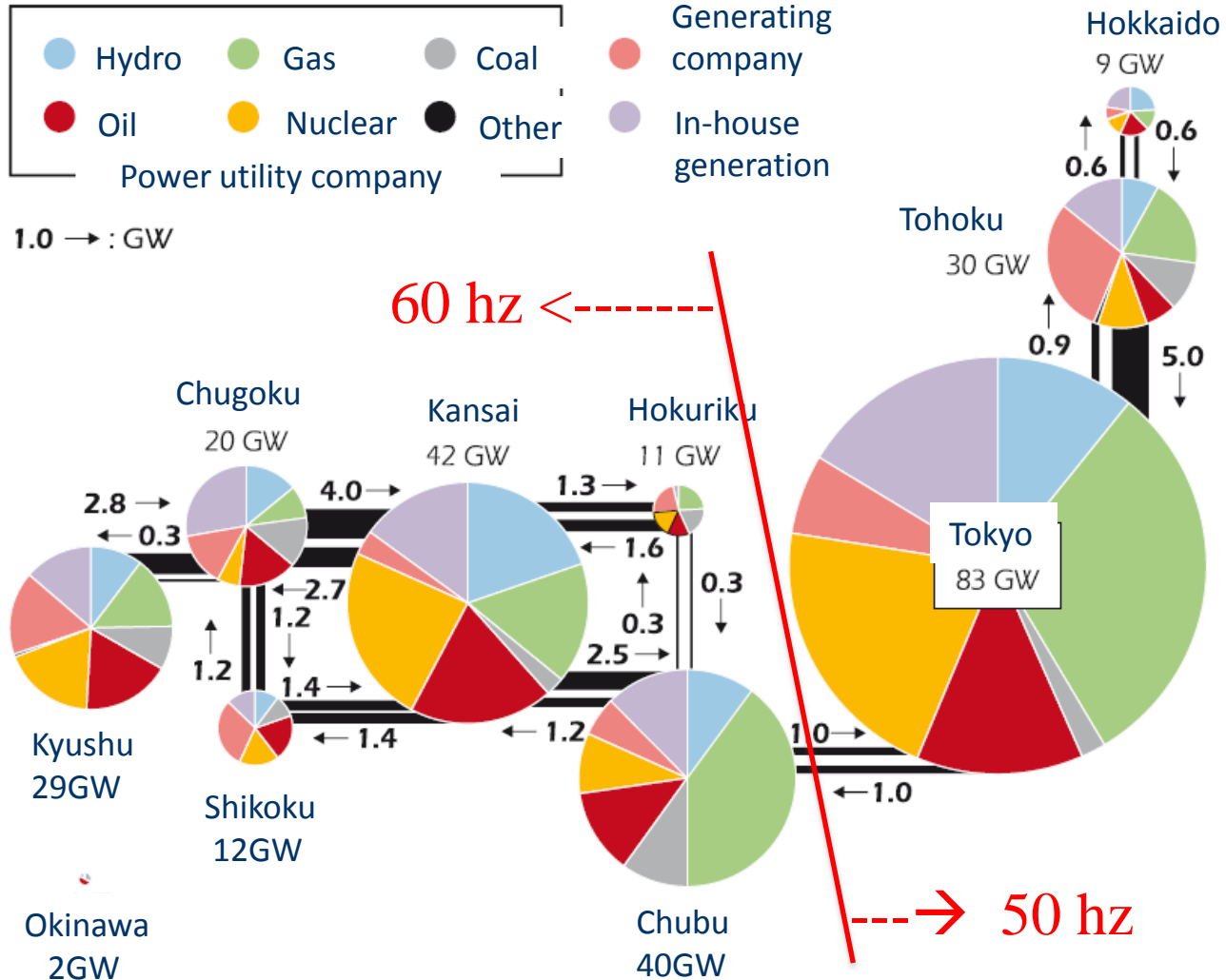
About 1/5 of German pretax price for electricity was due to renewables. 12% in Italy, 11% in UK and 4% in France.

Not only Feed-in-tariffs but Grid integration !

Snapshot of present penetration potentials



Power grid in Japan

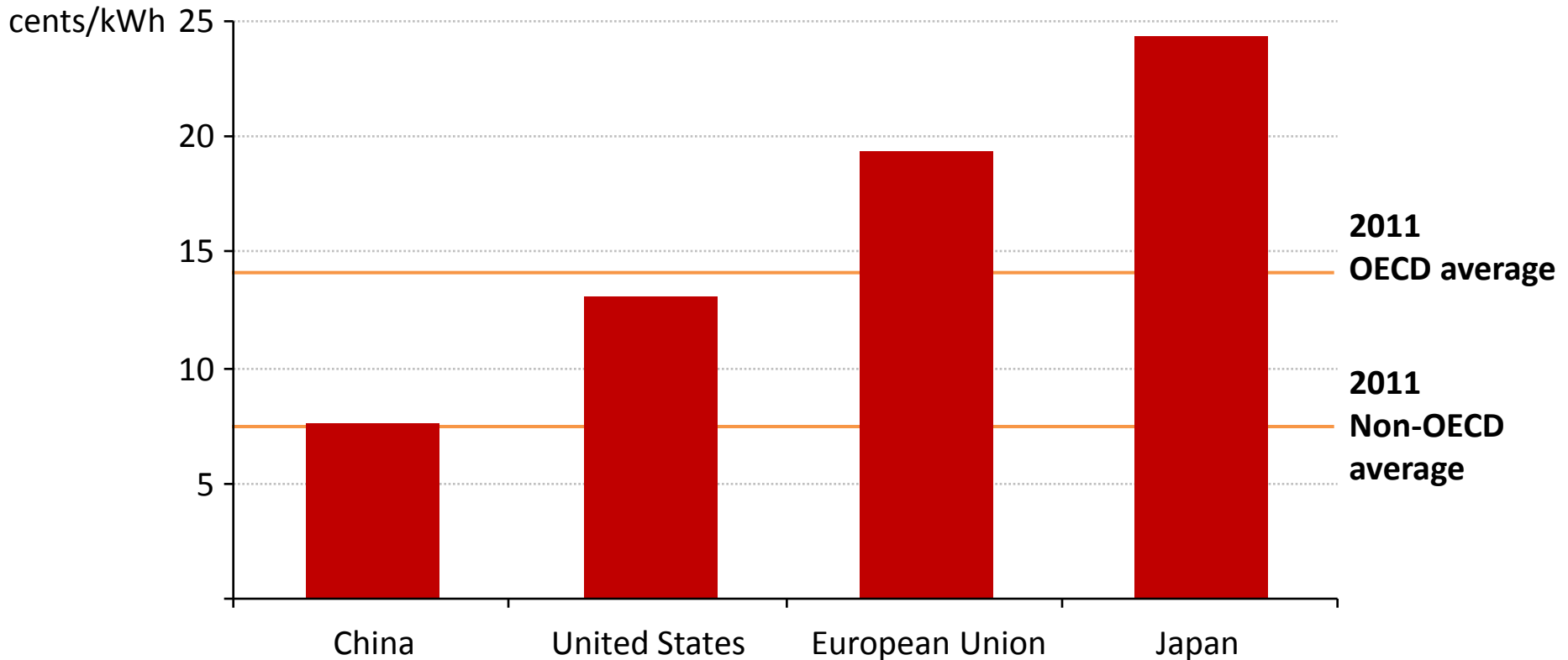


Source: Agency for Natural Resources and Energy, The Federation of Electric Power Companies of Japan, Electric Power System Council of Japan, The International Energy Agency

Wide variations in the price of power

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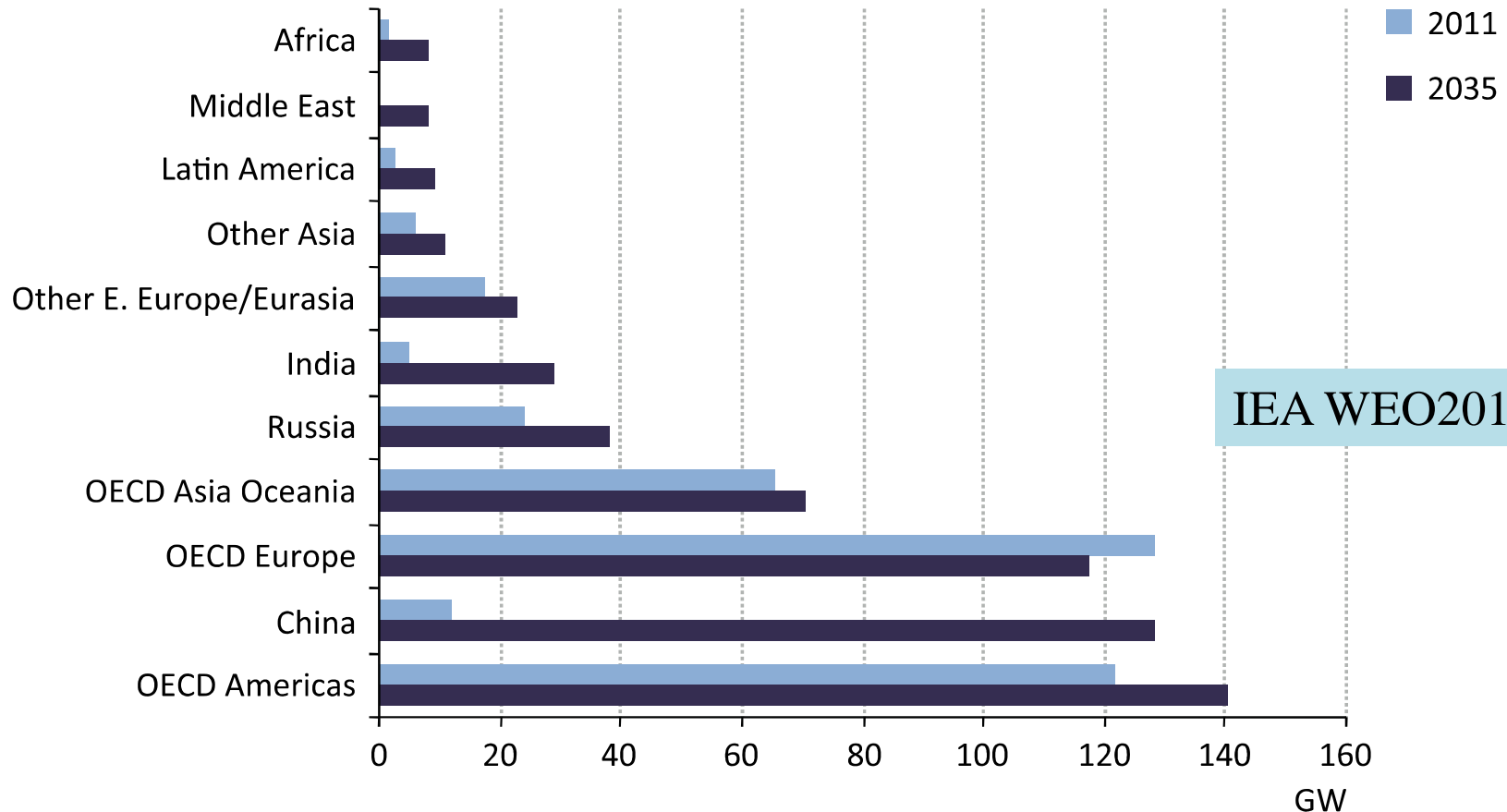
Average household electricity prices, 2035



Electricity prices are set to increase with the highest prices persisting in the European Union & Japan, well above those in China & the United States

Nuclear Power in World Energy Outlook 2012

Figure 6.7 ▶ Nuclear power capacity by region in the New Policies Scenario



In aggregate, world nuclear capacity reaches 580GW in 2035, 50GW lower from 2011 WEO. Production rises from 2756TWh to 4370TWh, almost 60% increase, though the share in total generation falls from 13% to 12%.

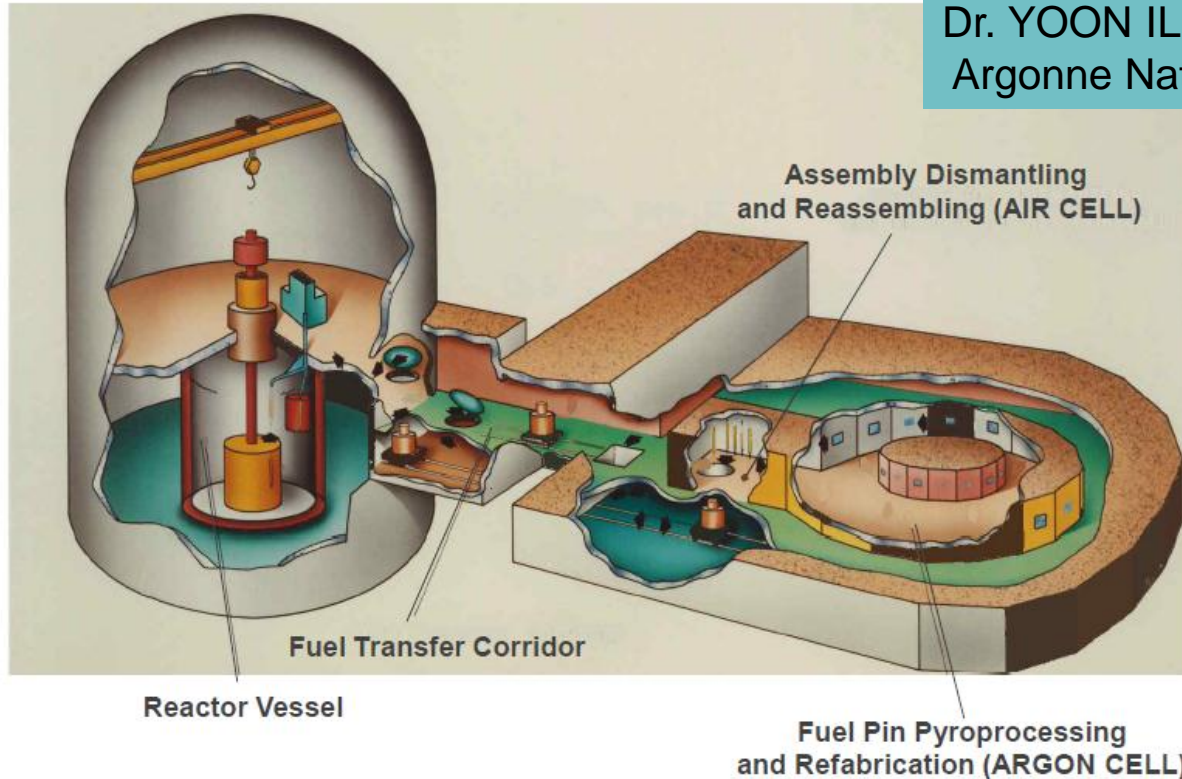
Lessons of the Fukushima

- Lessons to be Shared
 - **Think about the unthinkable**; Tsunami and Station Black Out. Large scale Blackout. Change total mind set for “Safety”.
 - Prepare for the severe accidents by defense in depth, common cause failure & compound disasters.
 - Clarify why it happened only to Fukushima Daiichi and NOT to Fukushima Daini, Onagawa nor Tokai daini.
- Safety Principles
 - Fukushima accident was caused by **human error and should have been avoided**. (Mr. Hatamura, Parliament Investigation Commission report)
 - International Cooperation : A nuclear accident anywhere is an accident everywhere.
 - Independent Regulatory authority ; Transparency and Trust, “Back Fitting” of regulation
- Secured supply of Electricity
 - Power station location
 - Strengthened interconnection of grid lines
- Once disaster has happened, Recovery from disaster is at least as important as preparing for it.
 - FEMA like organization and training of the nuclear emergency staff including the self defense force ; integration of safety and security.
- New Technology. New type of Reactors such as **Integral Fast Reactor**

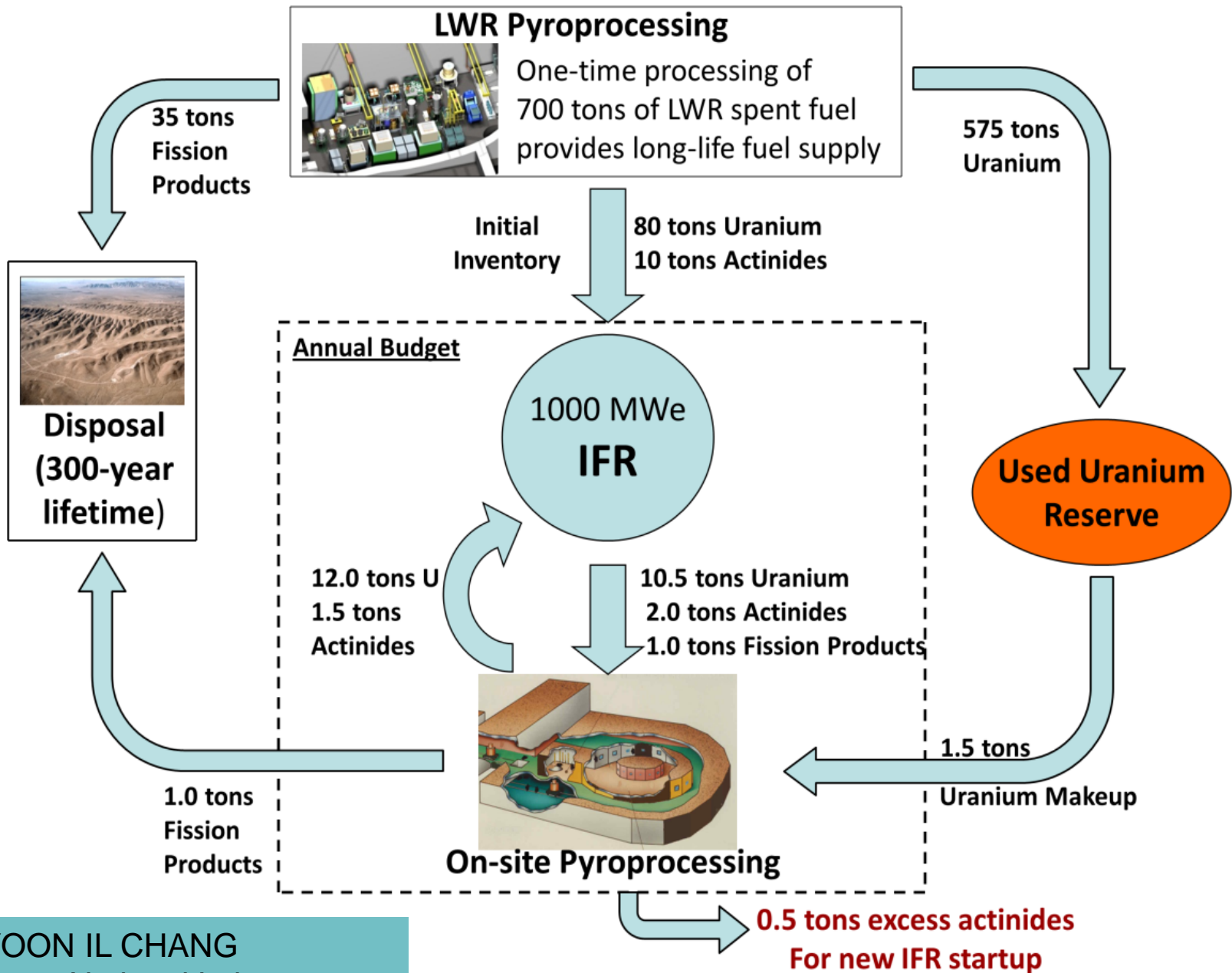
Integral Fast Reactor and Pyroprocessing

Pyroprocessing was used to demonstrate the EBR-II fuel cycle closure during 1964-69

Dr. YOON IL CHANG
Argonne National Laboratory



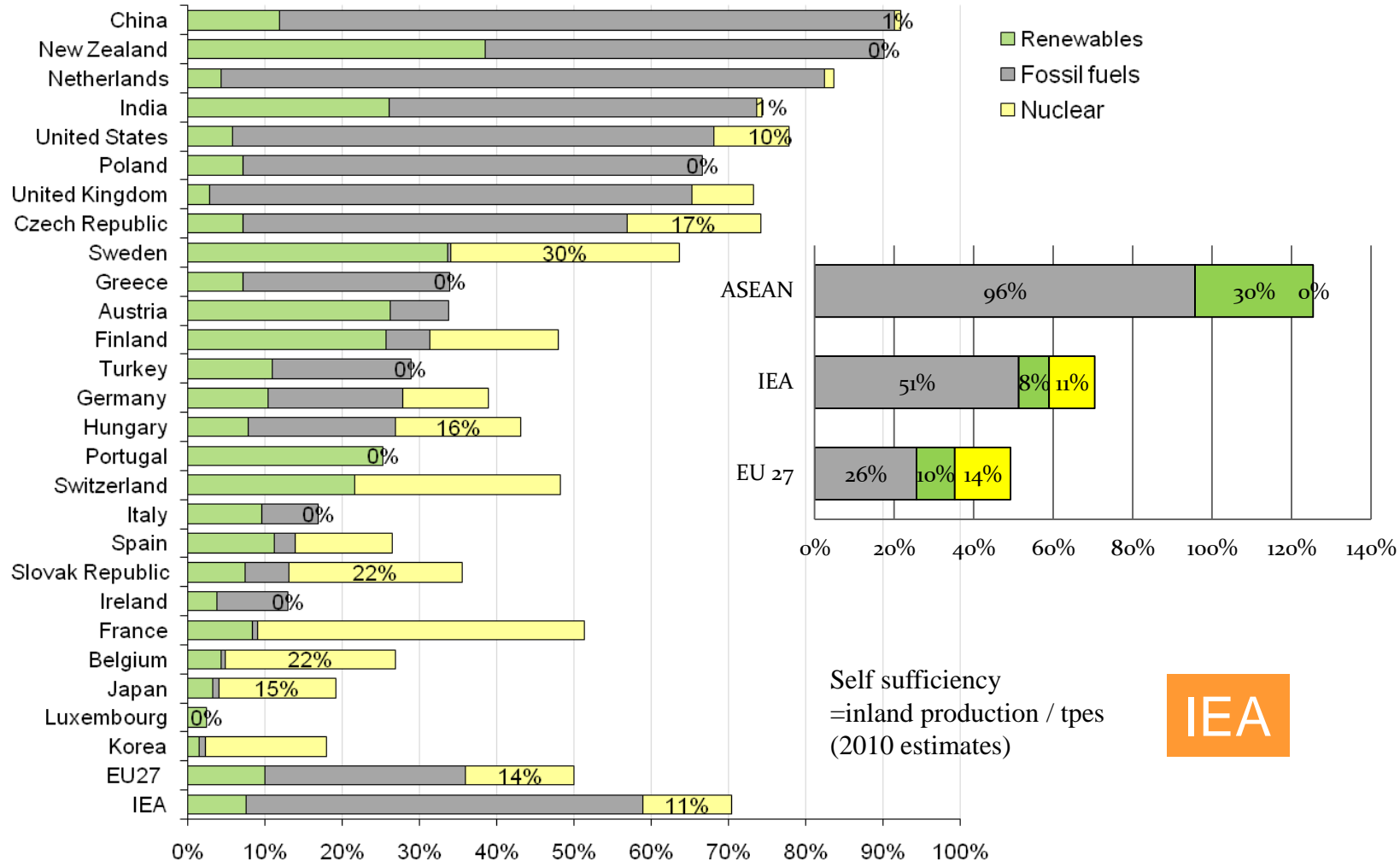
IFR has features as Inexhaustible Energy Supply ,Inherent Passive Safety ,Long-term Waste Management Solution , Proliferation-Resistance , Economic Fuel Cycle Closure.



Diversity means Energy Security .

”Safety and certainty in oil lie in variety and variety alone.” (Churchill)

Energy Self -Sufficiency rates by fuels in 2010



Nuclear is an important option for countries with limited indigenous energy resources .

One cannot enhance energy security by risking someone else 's.

- Lesson of the Quake and Tsunami : Think about the unthinkable.
- Energy Security for the 21st Century must be Comprehensive Electricity Supply Security under sustainability constraints.
- EU Model of Collective Energy Security be applied to the growing Asia. Develop Regional Power Grid interconnection & Gas Pipelines including Russia.
- Innovation in Power supply: Efficiency, Decentralized Renewables, EVs, Smart Grids, Storage, etc.
- Develop gas resources and infrastructure. Diversify supply and demand. Russia remains as a key player.
- For coal to remain the backbone of power supply, CCS readiness & highly efficient power plants are needed.
- Nuclear Power will continue to play a major role in the world. Japan's role after Fukushima is to share the lessons learned for safer Nuclear Power deployment in Asia and elsewhere. Develop safer and more proliferation-free reactor models, e.g. Integral Fast Reactor as the 4G or Modular.
- New technologies help; hydrogen economy, Methane-hydrate , Super-conductivity grid.