Japan-US Alliance in Energy Security in the 21st Century:

September 30th, 2014 Washington D.C.
JEF-SAIS conference

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Distinguished Fellow, Center on Global Energy Policy, SIPA Columbia University
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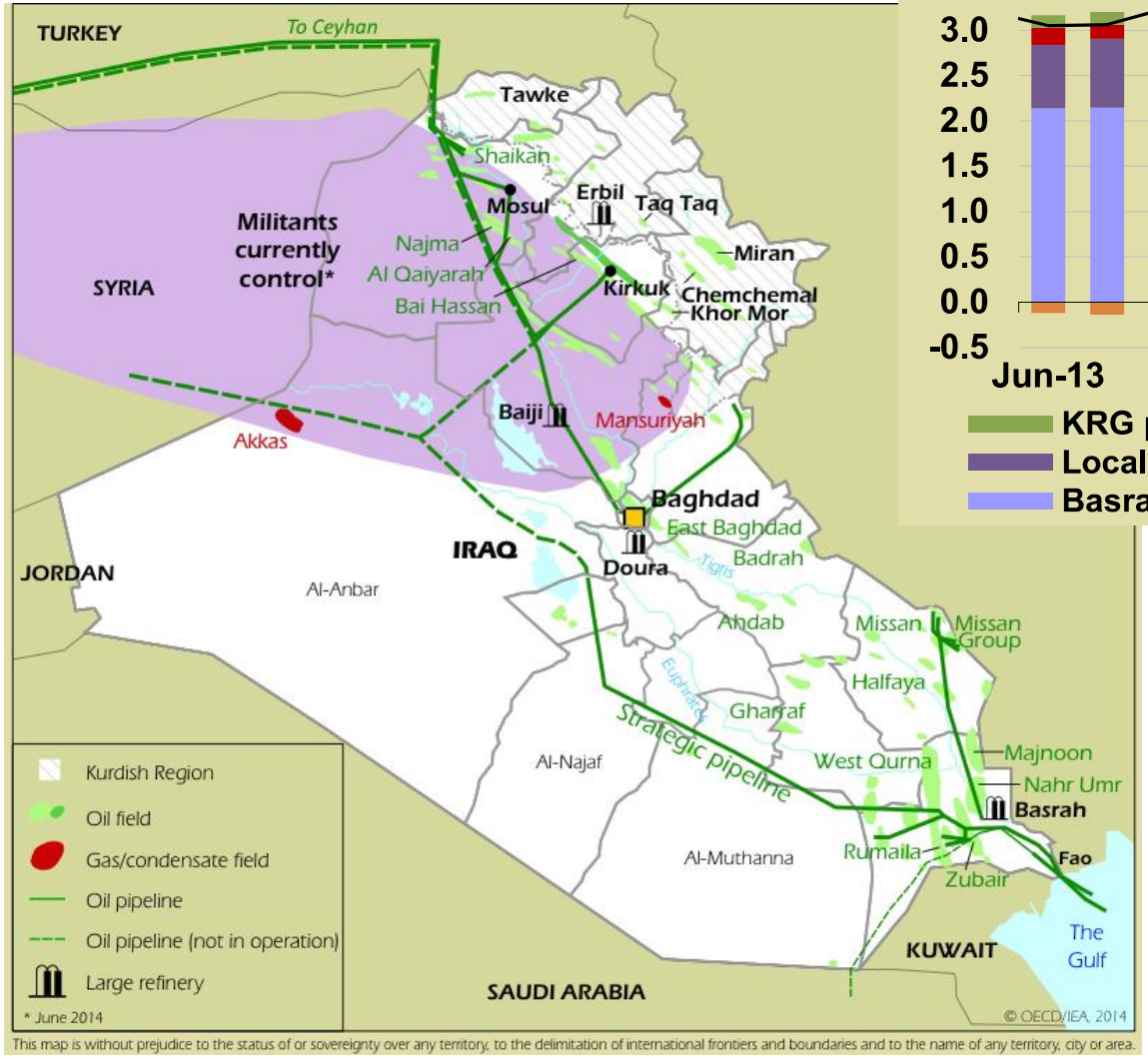
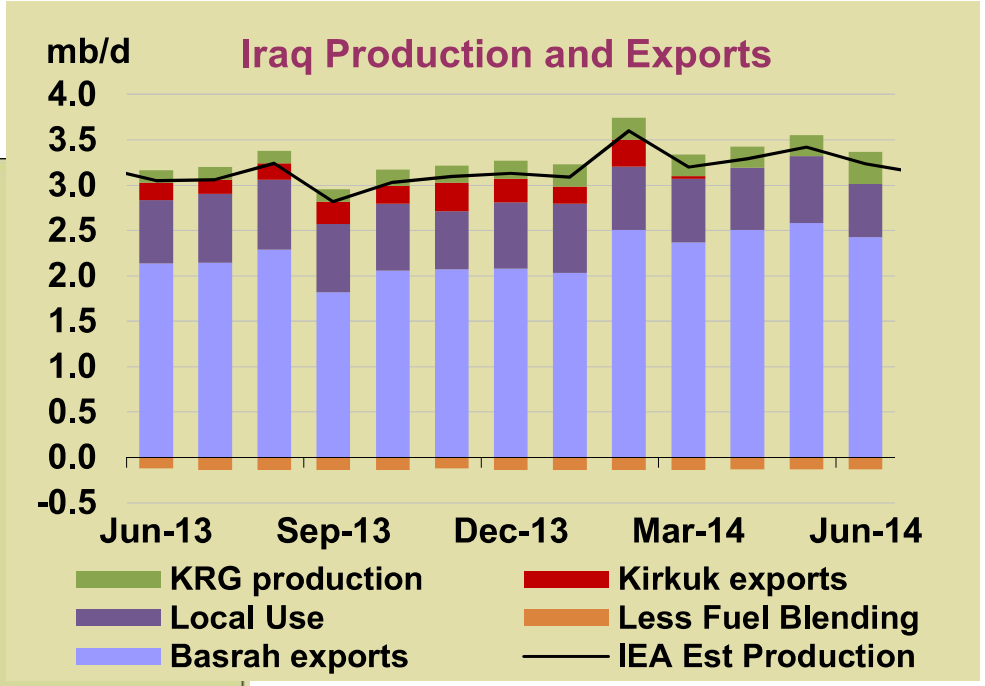
Nobuo TANAKA

Japan-US Alliance in Energy Security

1. Middle-East and East Asia; Rebalancing or reflaming?

Short term risk No. 1. Iraq Oil Situation





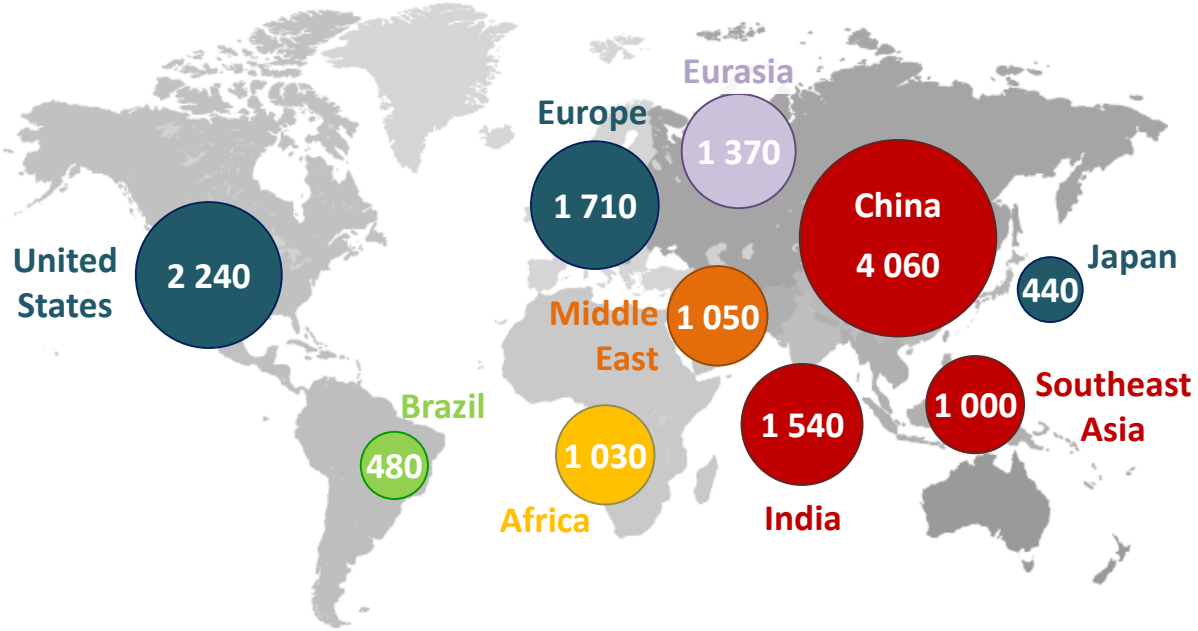
IEA Oil Market Report Aug 2014

IEA MTOMR 2014

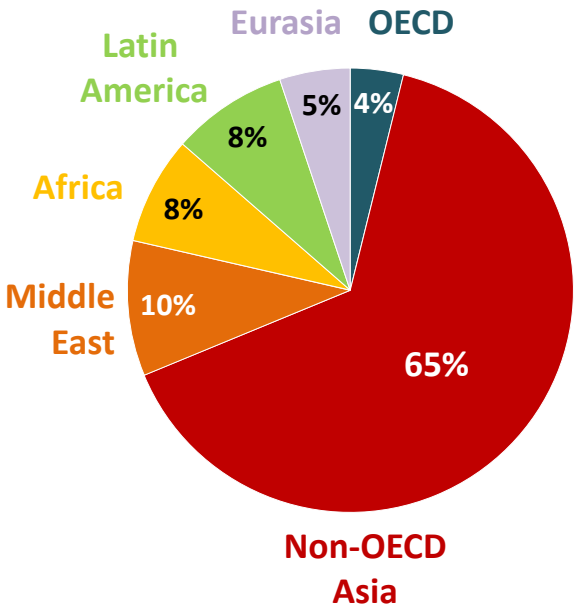
The engine of energy demand growth moves to South Asia

WEO 2013

Primary energy demand, 2035 (Mtoe)



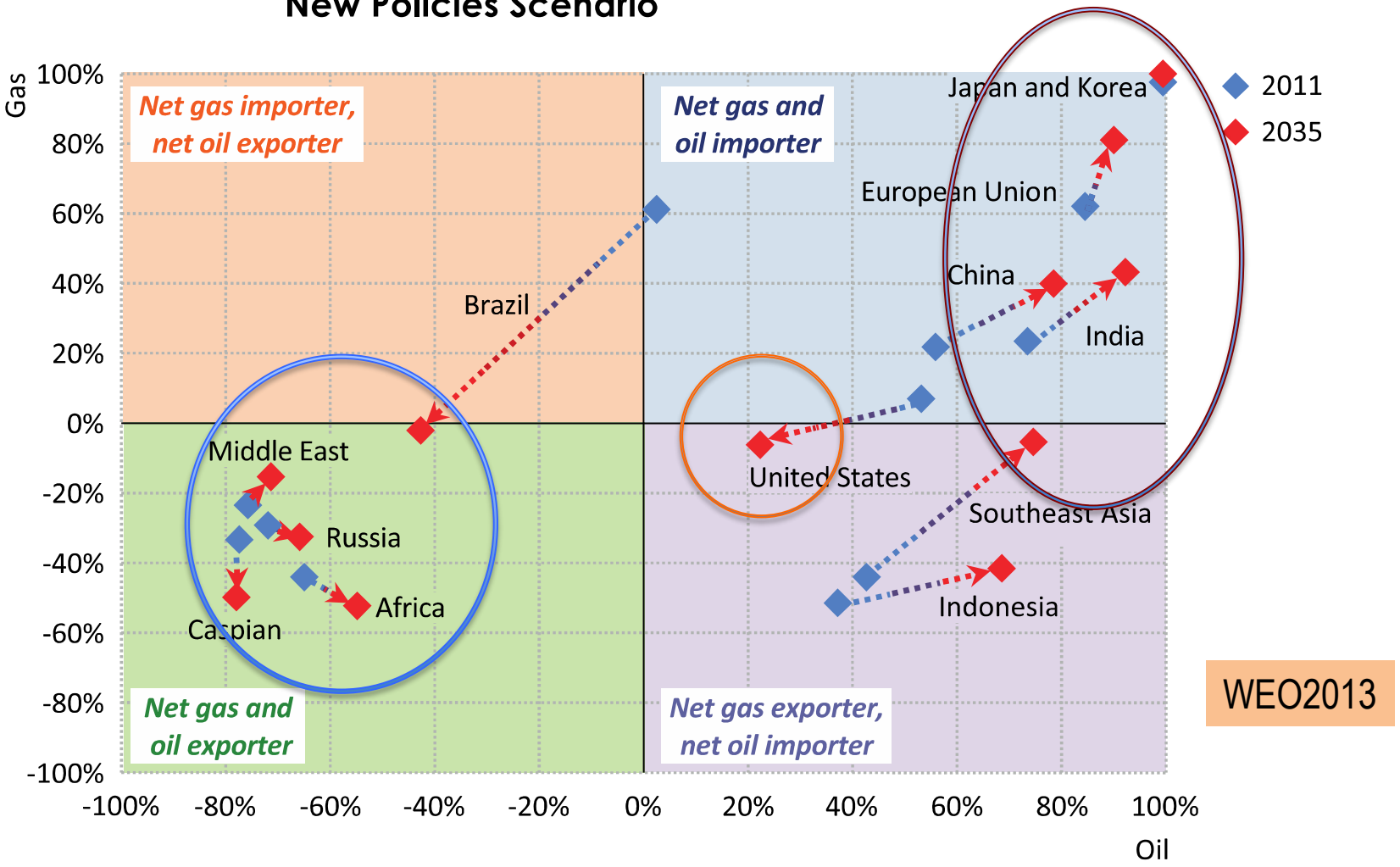
Share of global growth 2012-2035



China is the main driver of increasing energy demand in the current decade, but India takes over in the 2020s as the principal source of growth

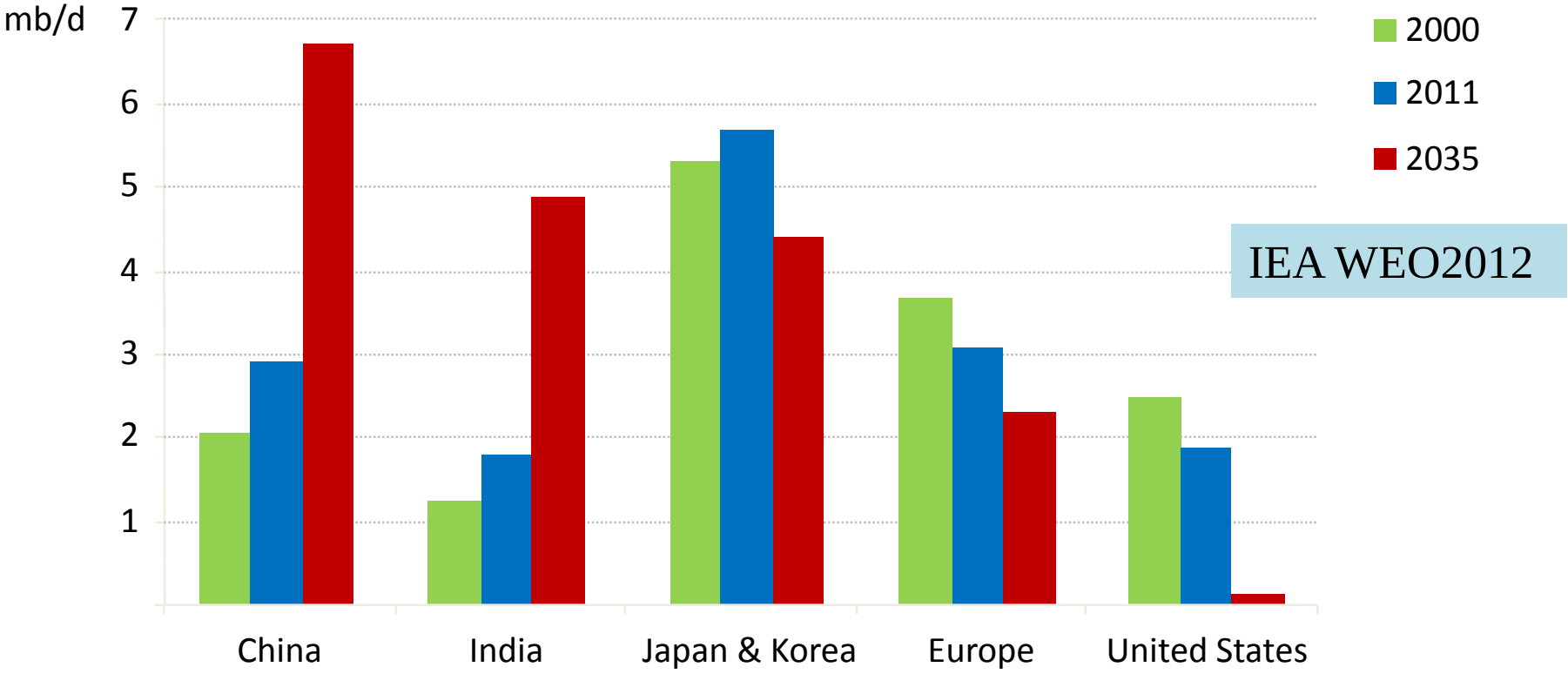
Geopolitical Dichotomy between Oil / Gas exporters and importers. US position?

Figure 2.12 ▷ Net oil and gas import/export shares in selected regions in the New Policies Scenario



North American Energy Independence and Middle East Oil to Asia: a new Energy Geopolitics

Middle East oil export by destination

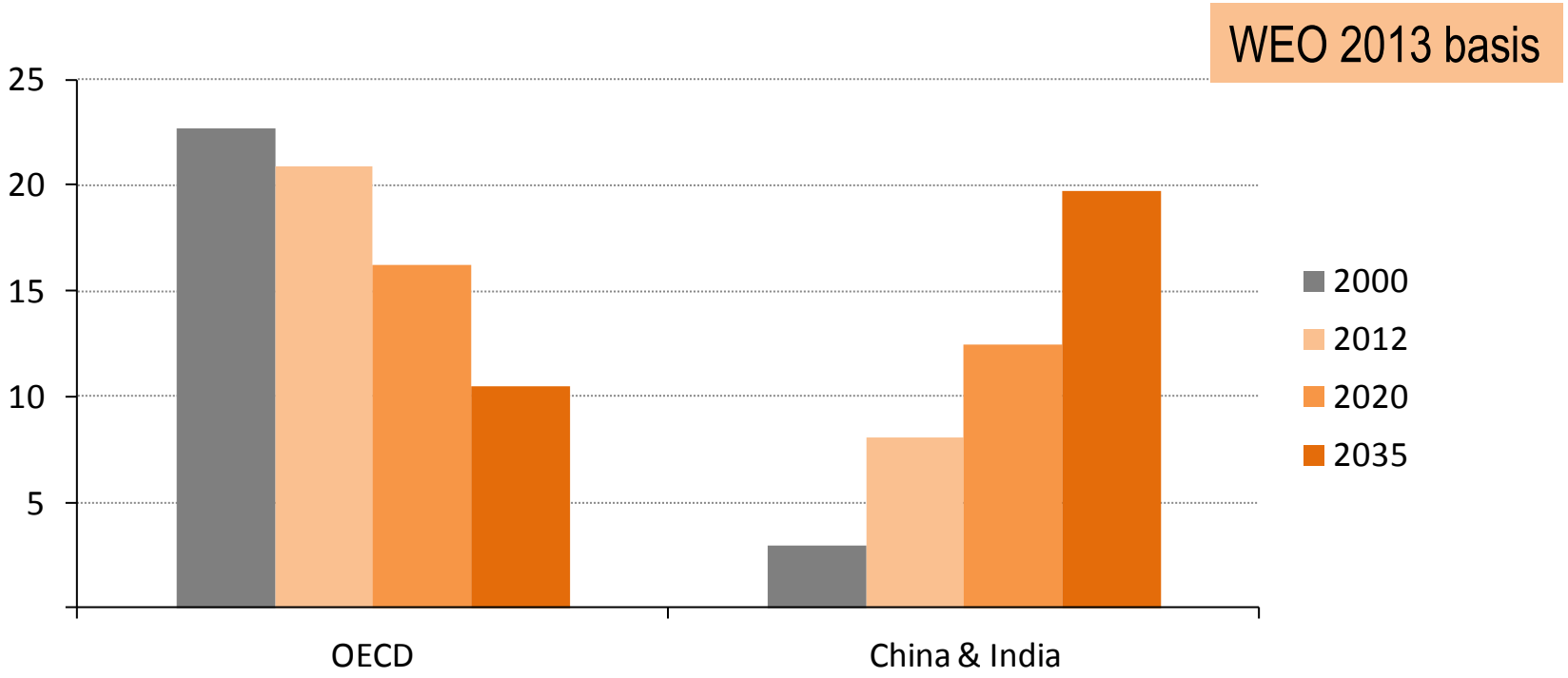


IEA WEO2012

By 2035, almost 90% of Middle Eastern oil exports go to Asia; North America's emergence as a net exporter accelerates the eastward shift in trade

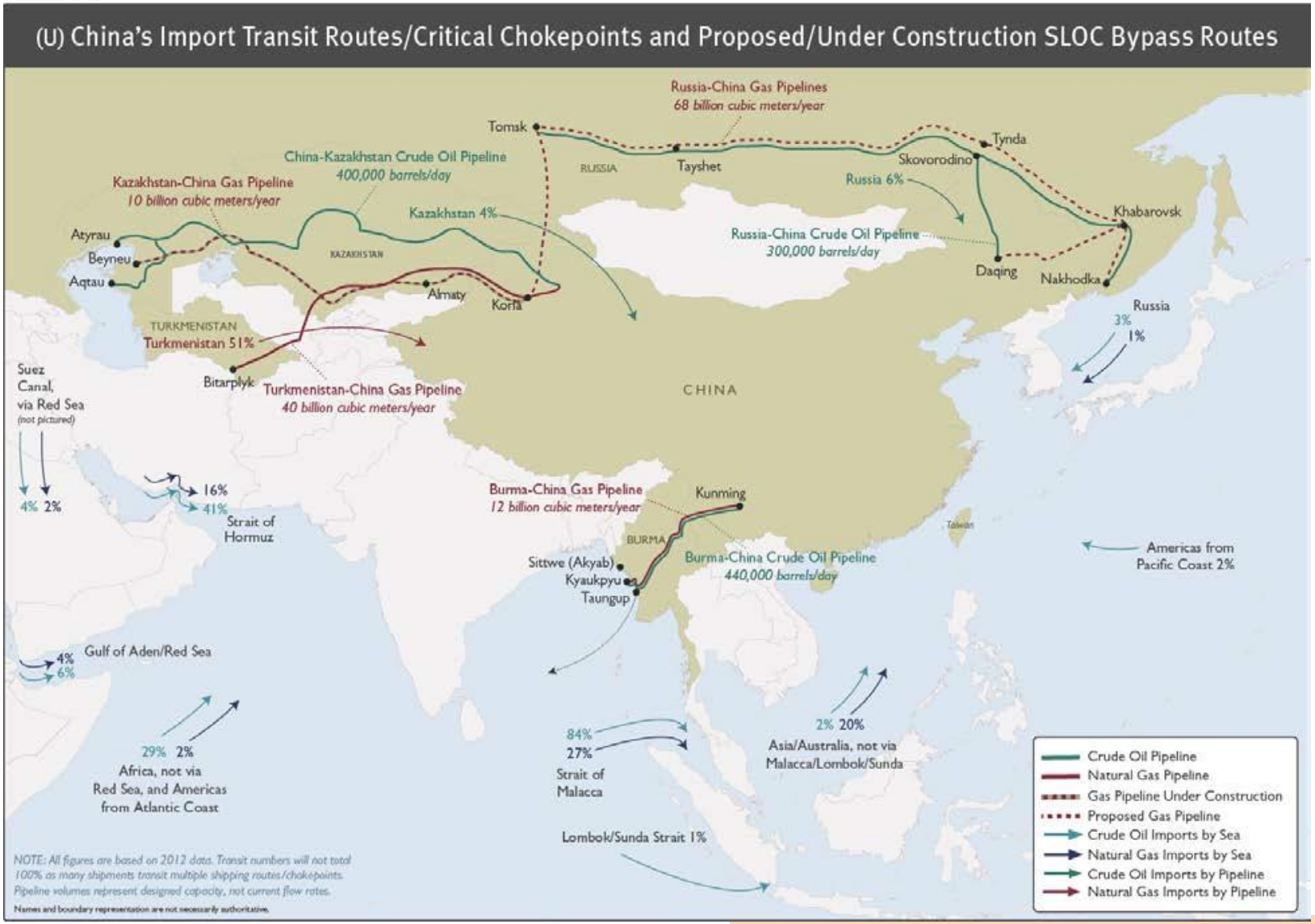
Should China and India join the IEA?

Net oil imports of selected countries in the New Policies Scenario 2013 (mb/d)



Asia becomes the unrivalled centre of the global oil trade as the region draws in a rising share of the available crude

China's Oil and Gas Import Transit Routes

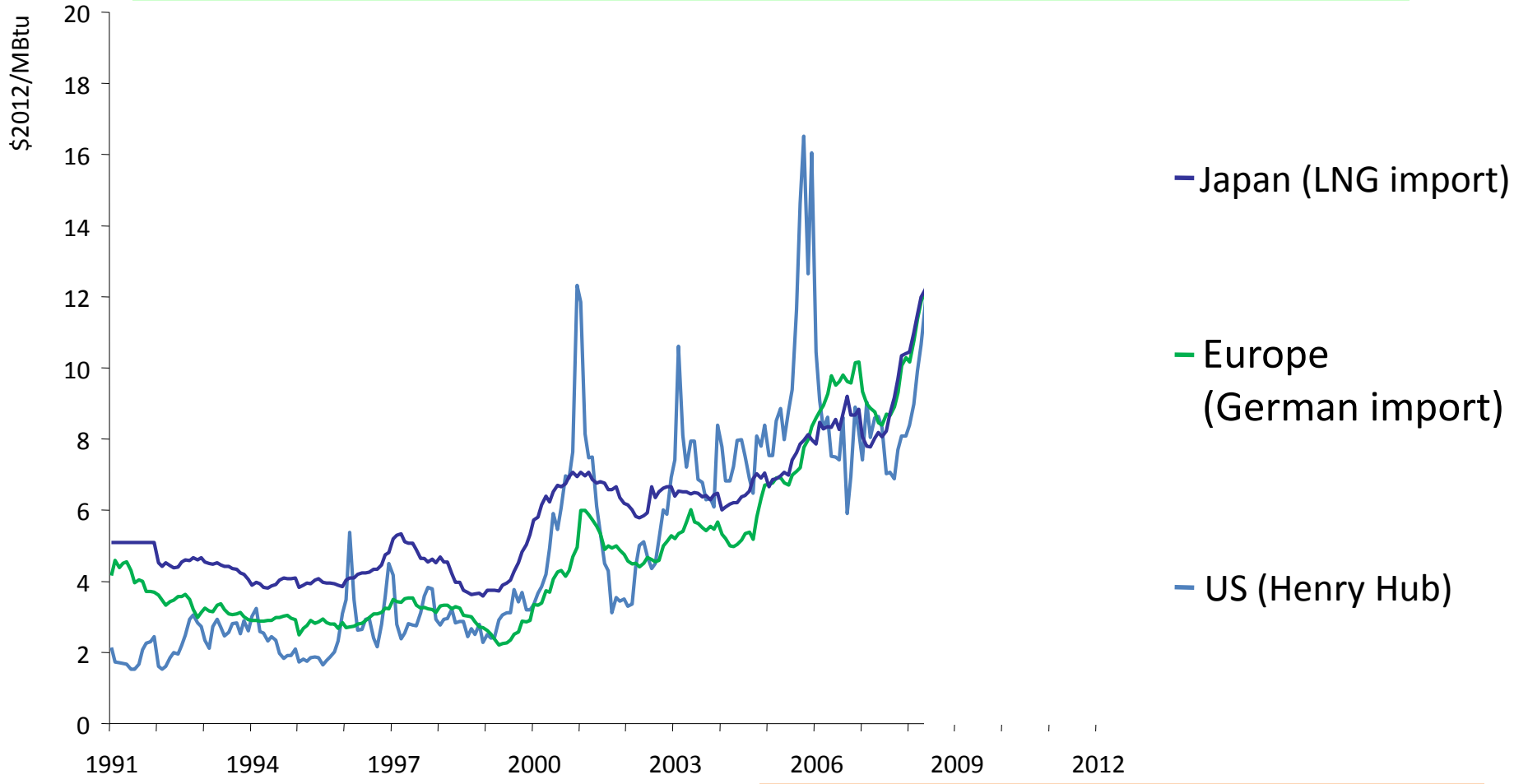


USDOD China Report 2014

Japan-US Alliance in Energy Security

2. LNG Export from US: Industrial competitiveness

LNG pricing : a competitiveness burden on Asian economies

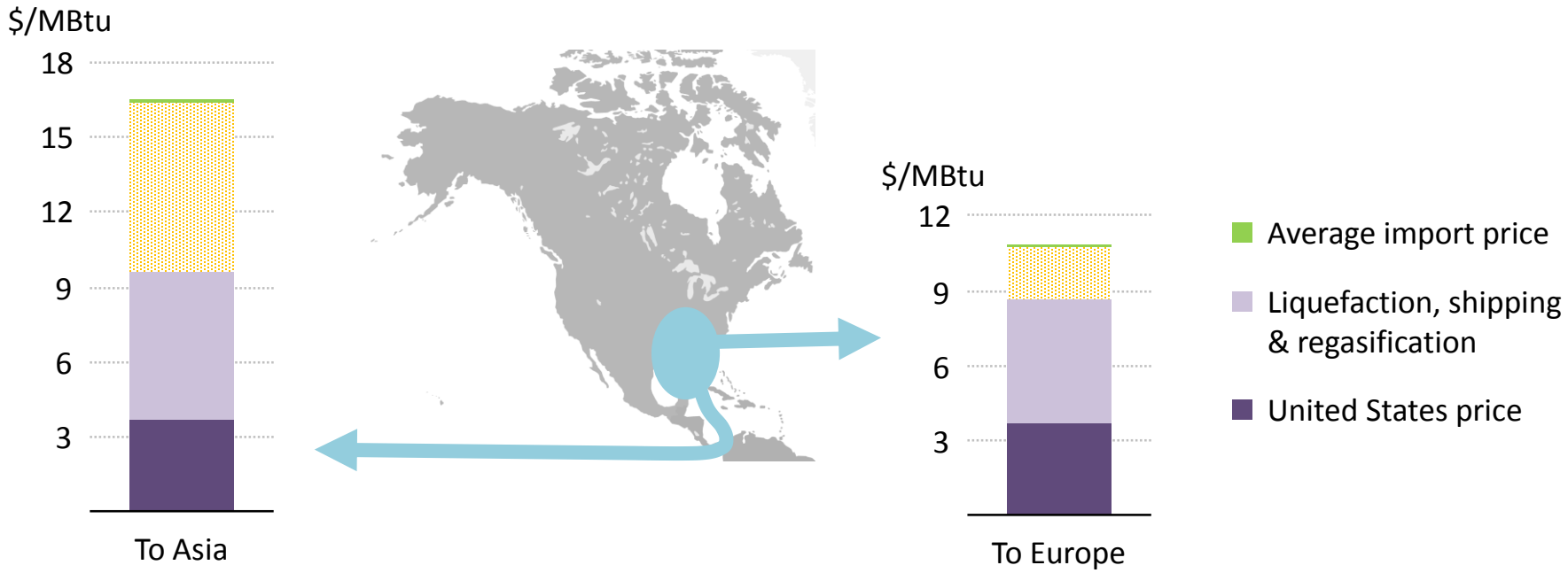


Developing a Natural Gas Trading Hub in Asia (2013 by IEA)

LNG from the United States can shake up gas markets

WEO 2013

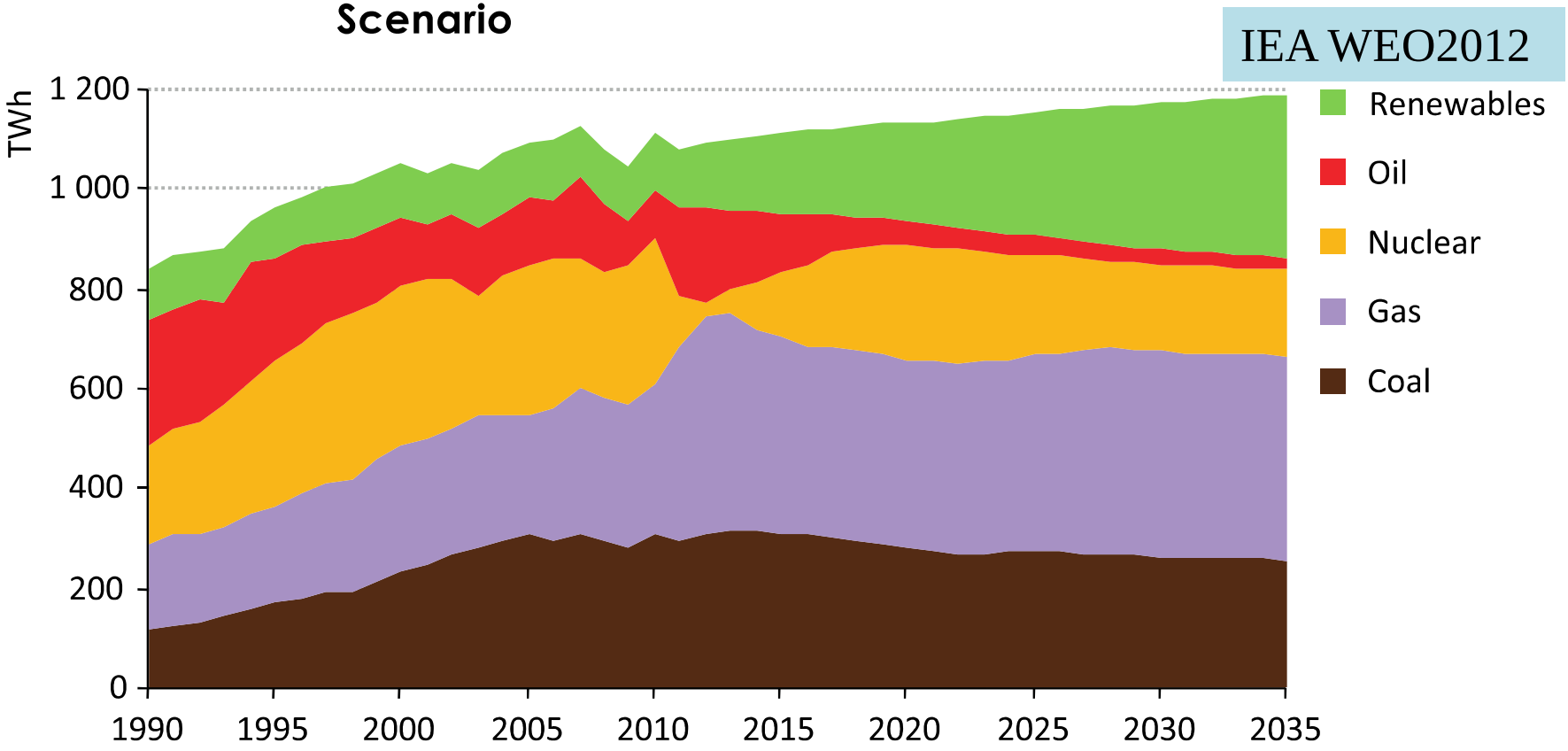
Indicative economics of LNG export from the US Gulf Coast (at current prices)



New LNG supplies accelerate movement towards a more interconnected global market, but high costs of transport between regions mean no single global gas price

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

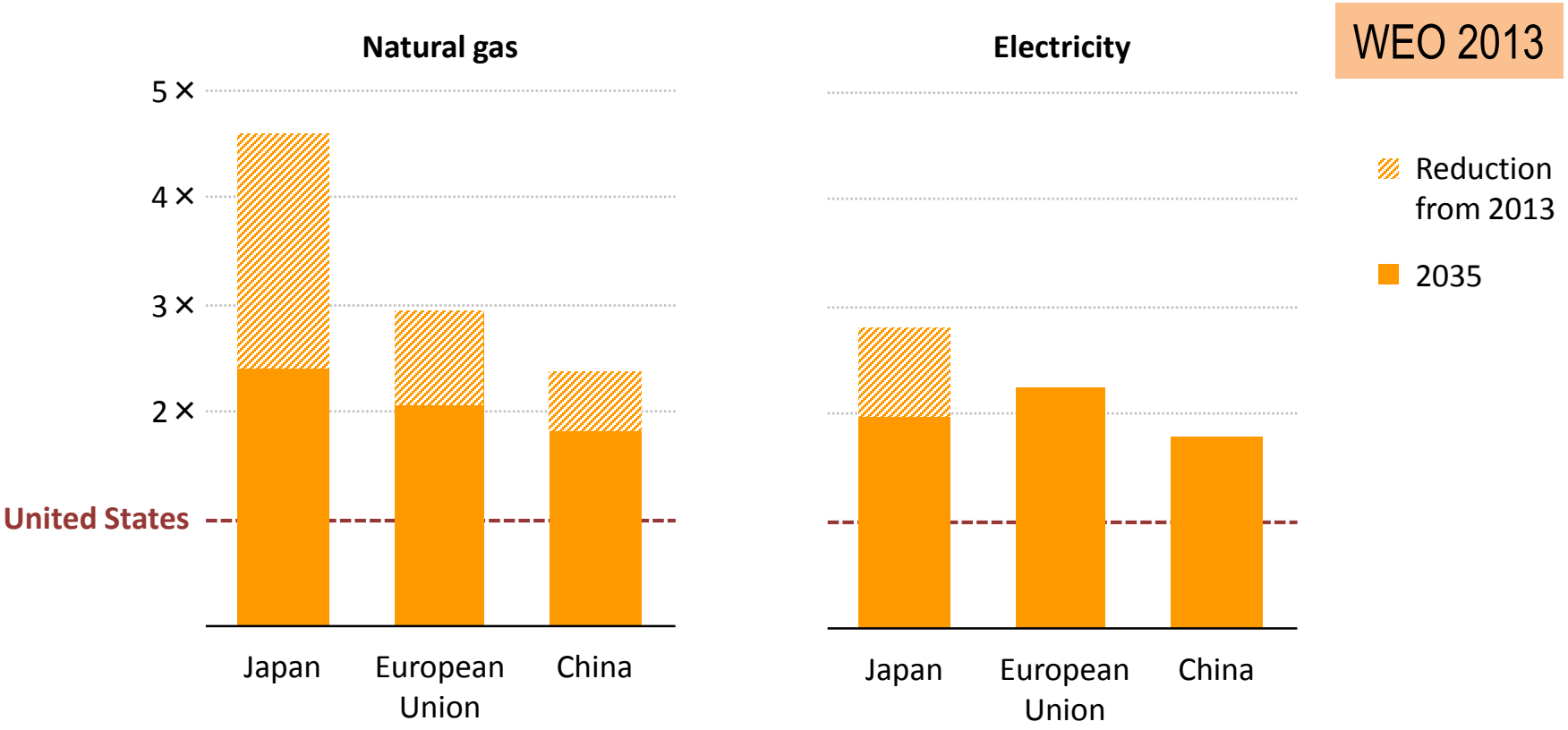
Figure 6.13 ▷ Japan electricity generation by source in the New Policies Scenario



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

Who has the energy to compete?

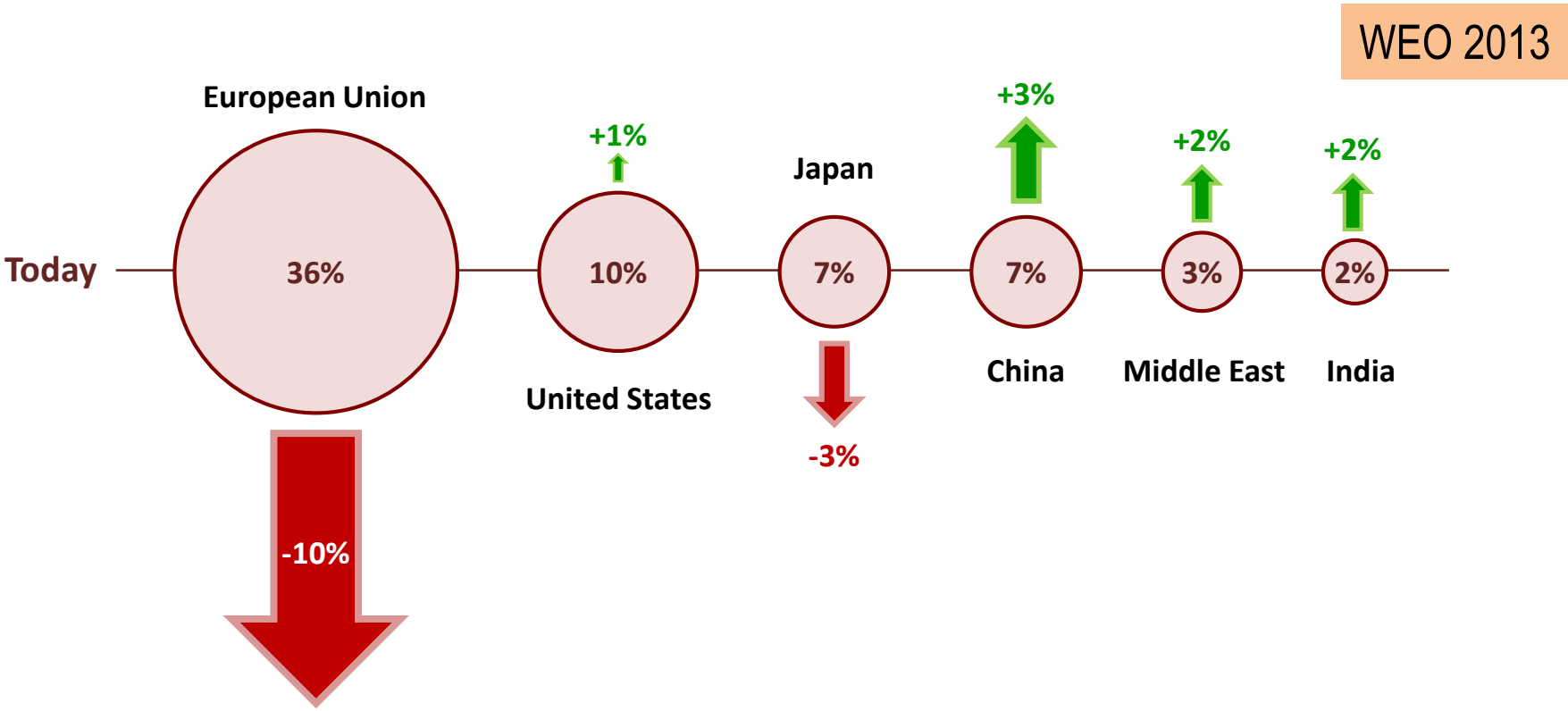
Ratio of industrial energy prices relative to the United States



Regional differences in natural gas prices narrow from today's very high levels but remain large through to 2035; electricity price differentials also persist

An energy boost to the economy?

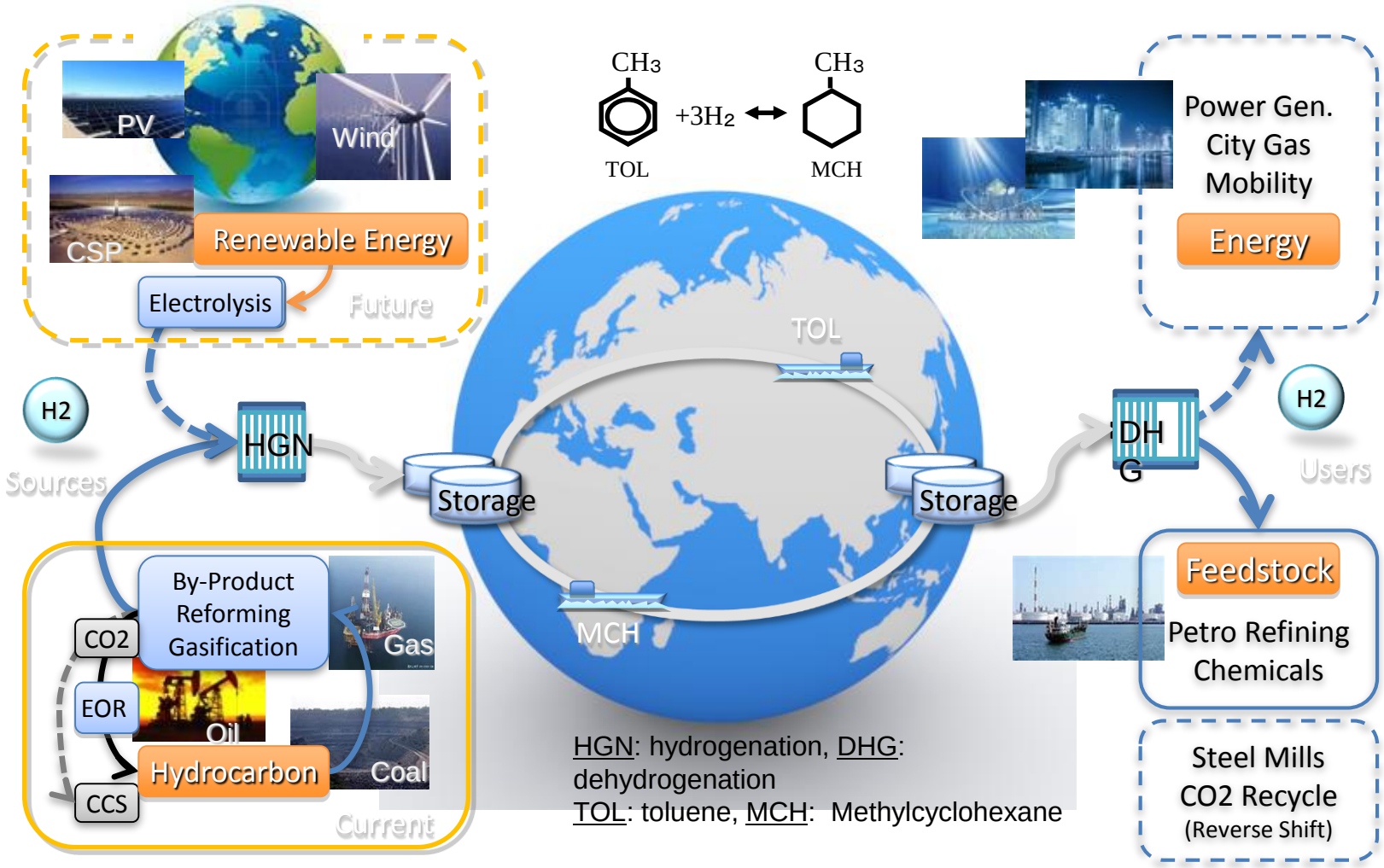
Share of global export market for energy-intensive goods



The US, together with key emerging economies, increases its export market share for energy-intensive goods, while the EU and Japan see a sharp decline

Introduction - Chiyoda's Hydrogen Supply Chain Outlook

- Chiyoda established a complete system which enables economic H2 storage and transportation.
- MCH, an H2 carrier, stays in a liquid state under ambient conditions anywhere.



- H2 Supply of a 0.1-0.2mmtpa LNG equivalent scale (M.E. to Japan) could be feasible.

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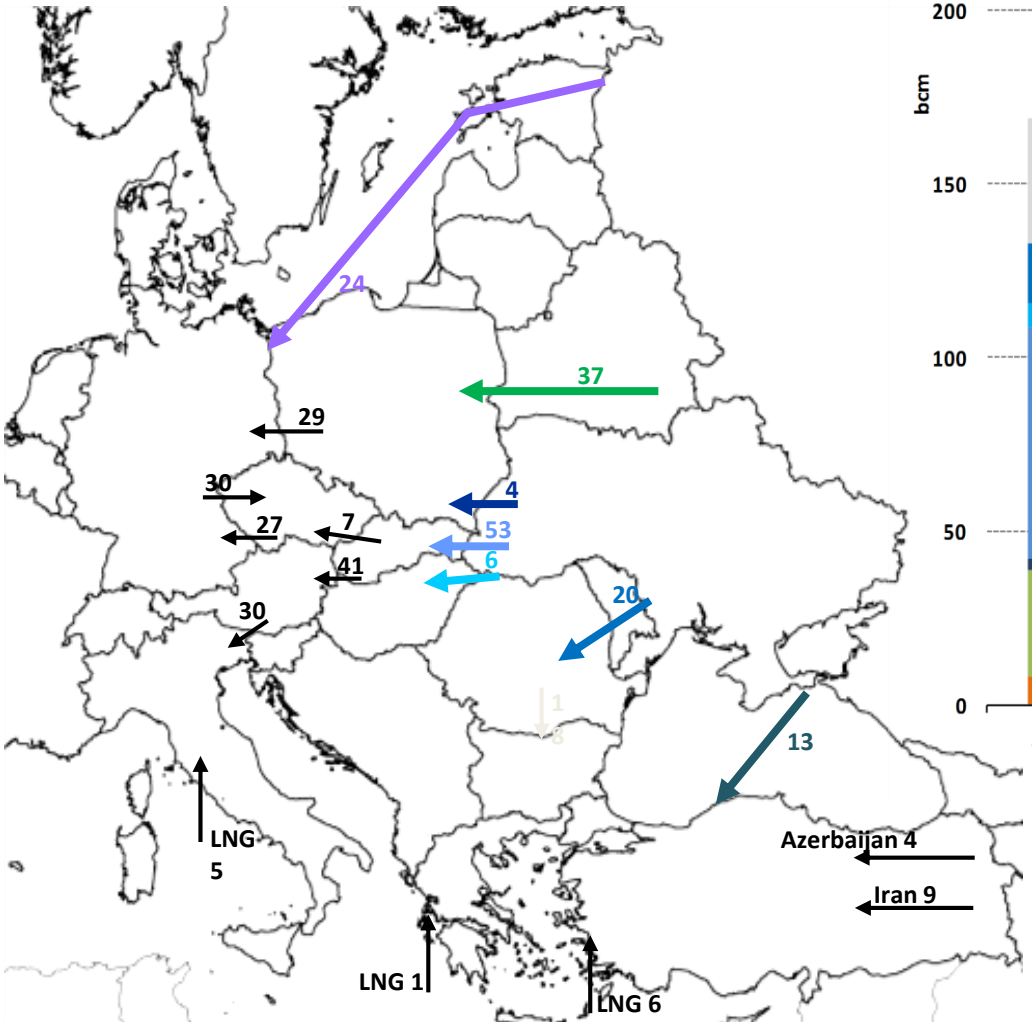
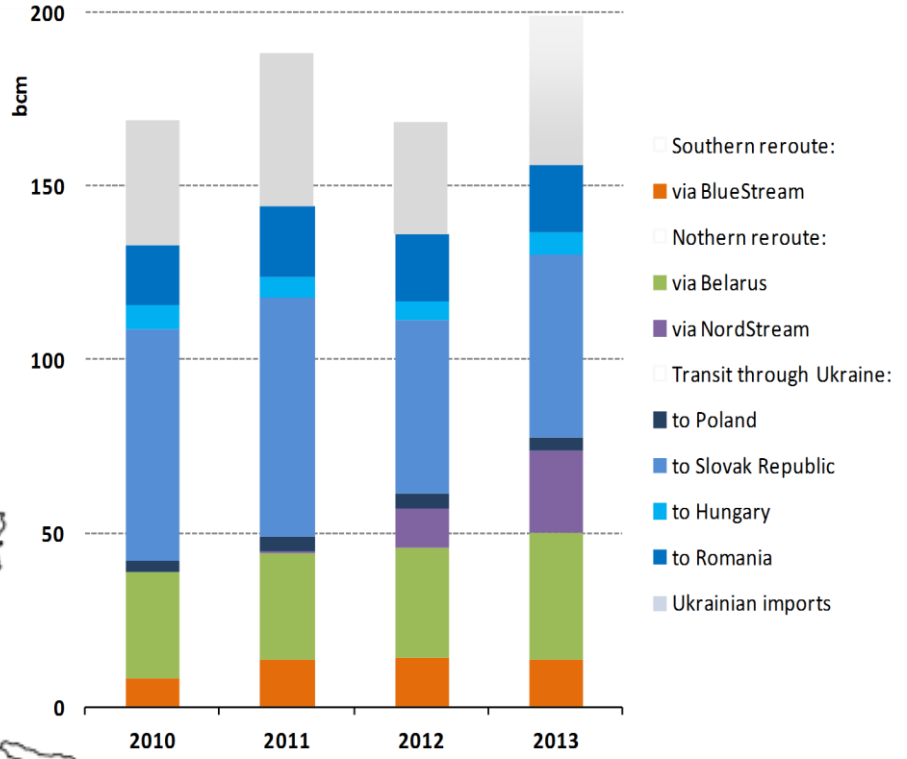
3. Role of russia

Short term Risk No.2 : Russian Gas through Ukraine

Major physical flows in 2013 in bcm



Russian gas exports to Europe



Data from IEA 2014

Russian Gas Pipelines Will Extend to the East: China Deal

Russian Gas Infrastructure

The boundaries and names shown and the designations used on maps included in this publication do not imply official endorsement or acceptance by the IEA.

Source: IEA

Mid-Term Oil & Gas Market 2010, IEA

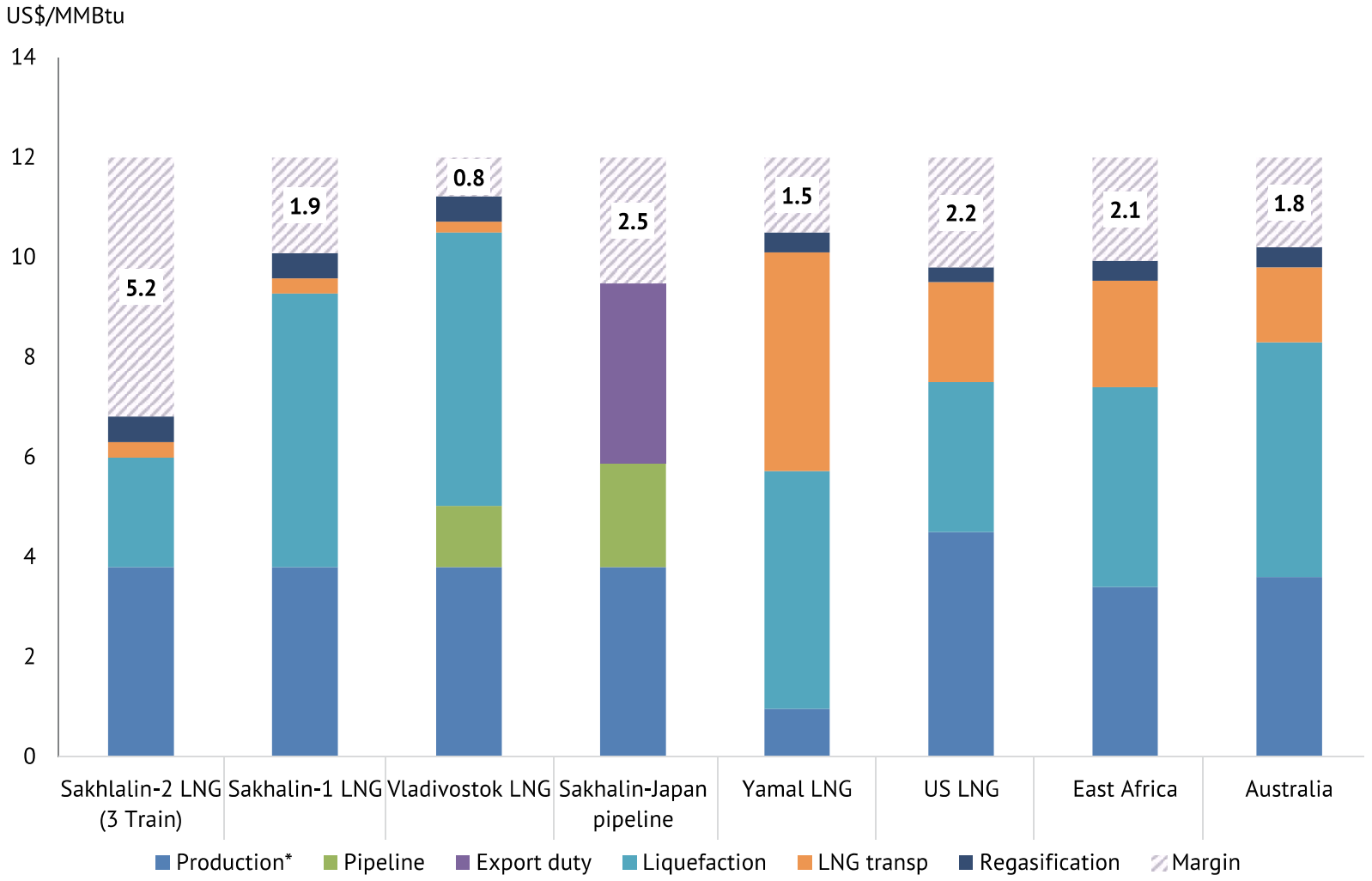
Possible Pipeline Project from Russia to Japan

Figure 1. Proposed Subsea Pipeline Route*

* Only the Ishikari-Tomakomai section has onshore PL.

Estimated volume of 8bcm pa

Figure 2. International Comparison of LNG Projects' Costs under Planning (est.)



*Production tax included, except for the Yamal project.

Source: Compiled by ERI and IEEJ, based on various sources.

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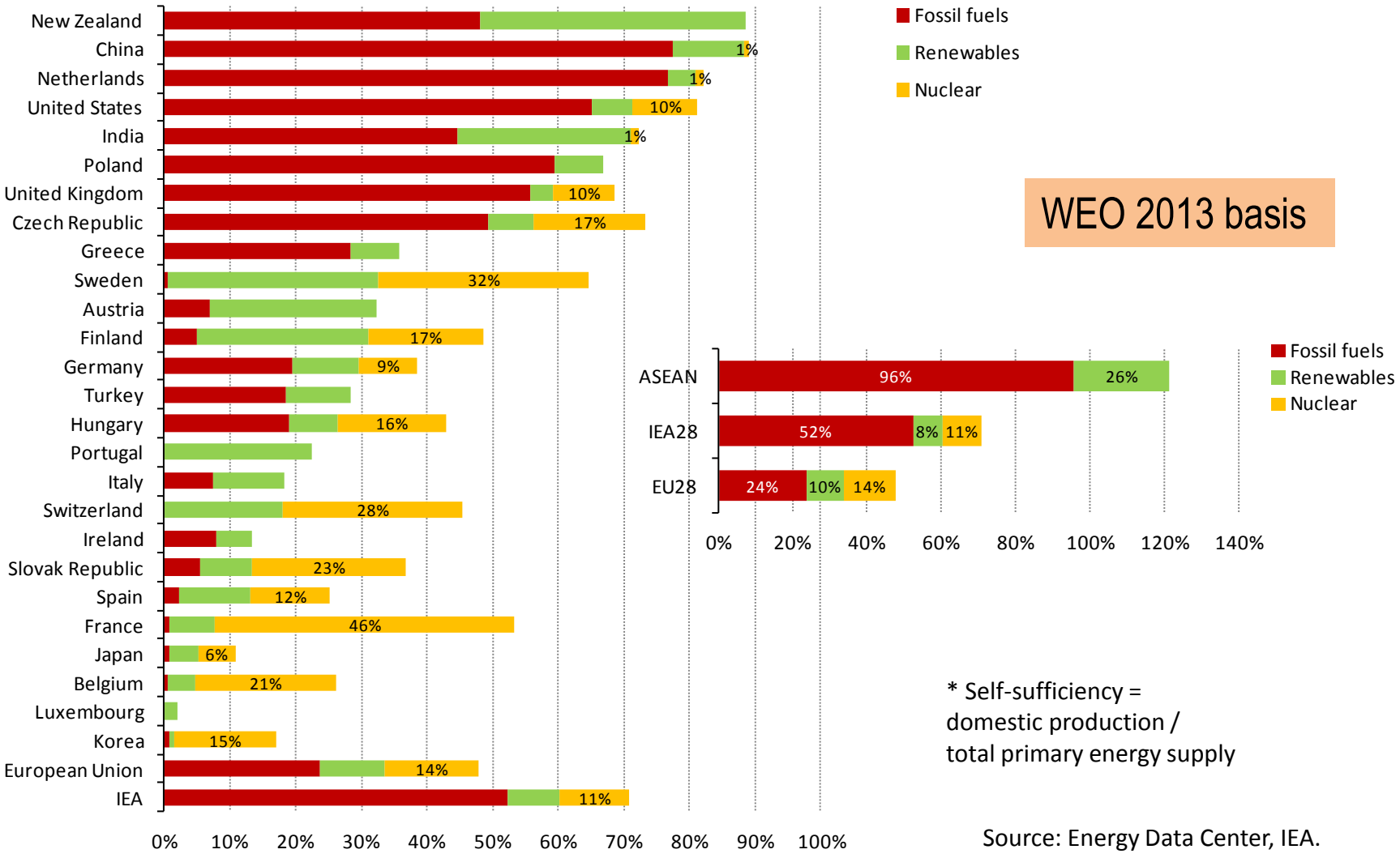
4. Regional security framework in east asia

Collective Energy Security and Sustainability by Diversity, Connectivity and Nuclear

Energy self-sufficiency* by fuel in 2011



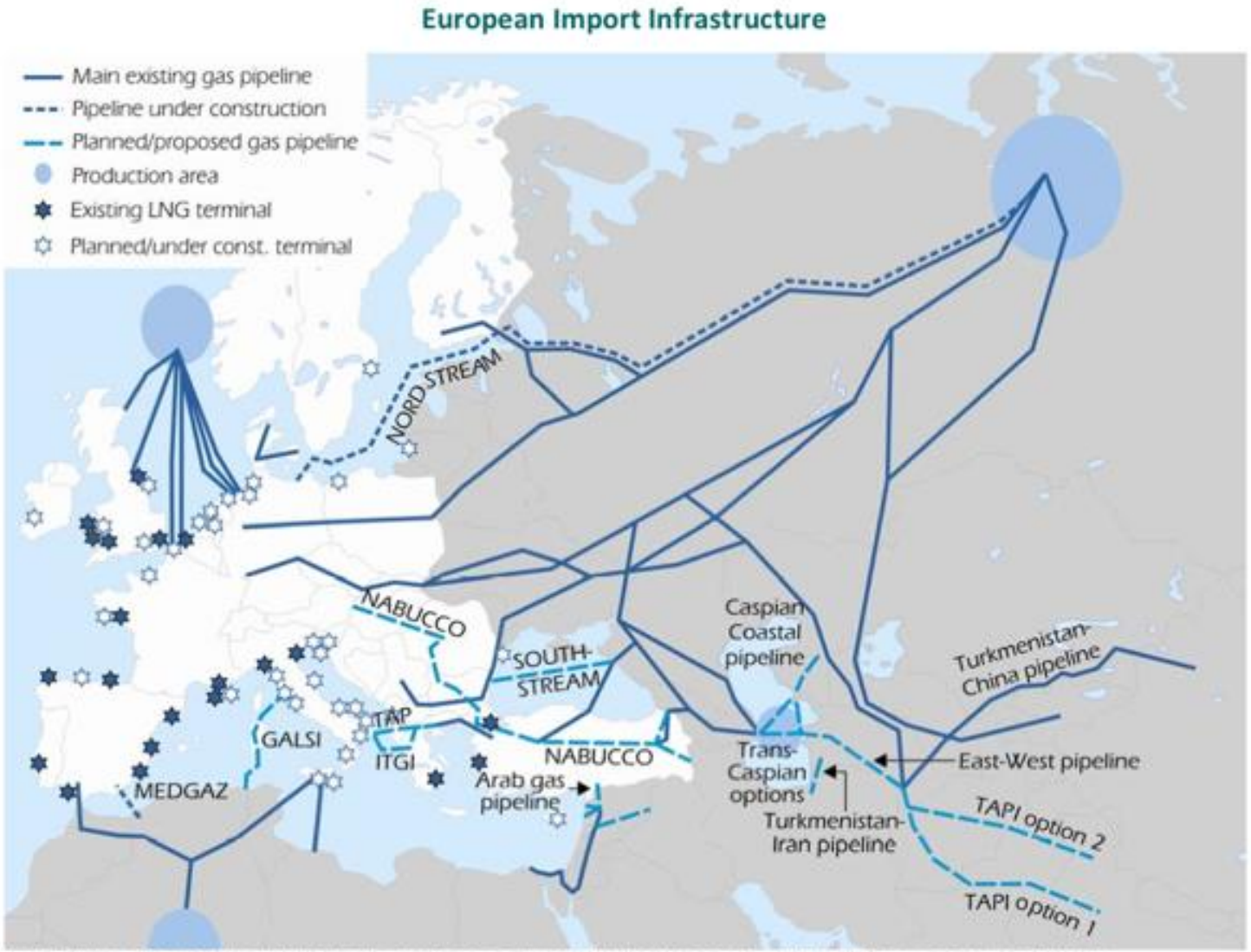
WEO 2013 basis

* Self-sufficiency = domestic production / total primary energy supply

Source: Energy Data Center, IEA.

Note: Does not include fuels not in the fossil fuels, renewables and nuclear categories.

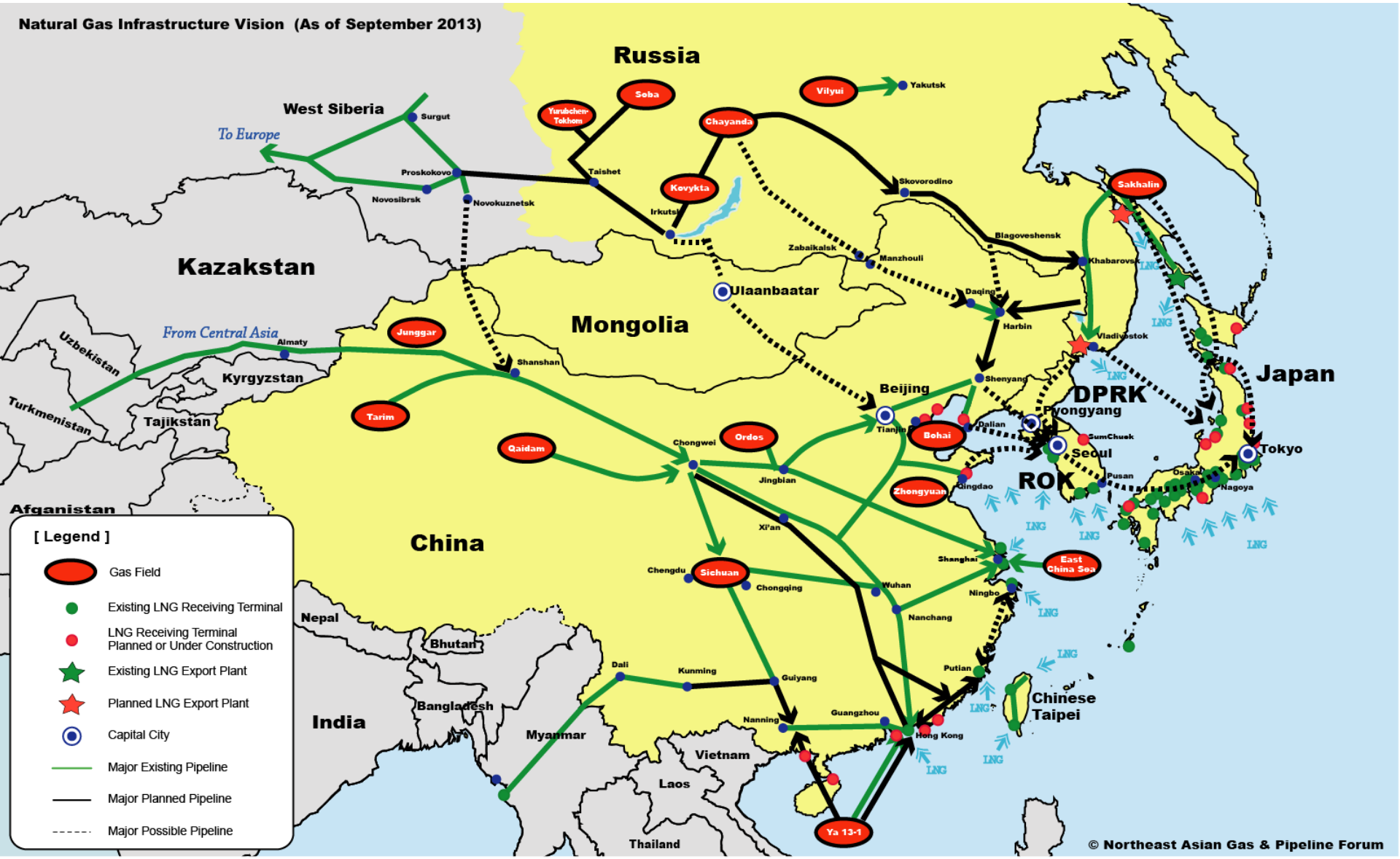
Natural Gas Import Infrastructure in Europe



Source: IEA.

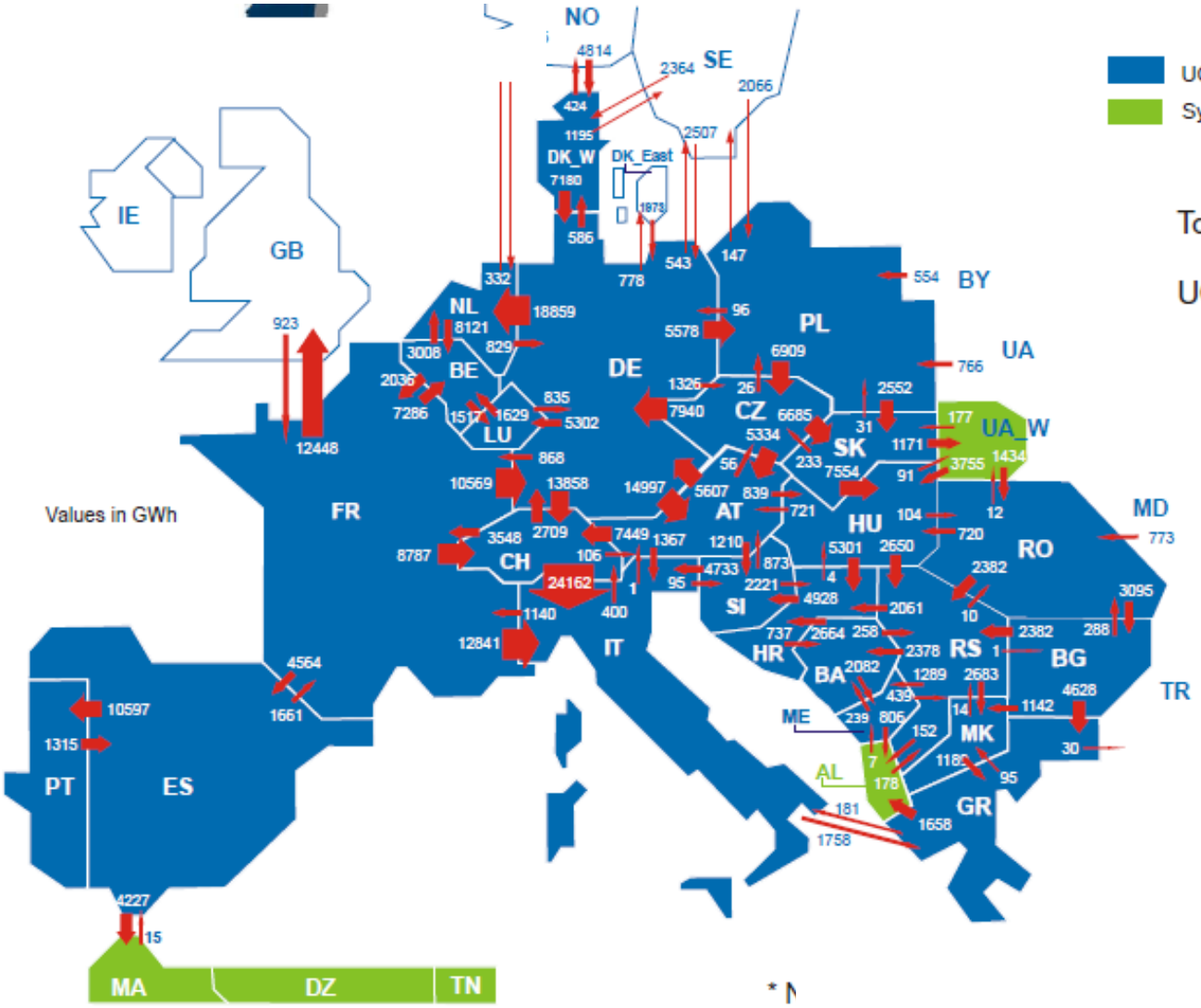
IEA Medium Term Oil and Gas Markets 2010

Blue Print for North East Asia Gas & Pipeline Infrastructure



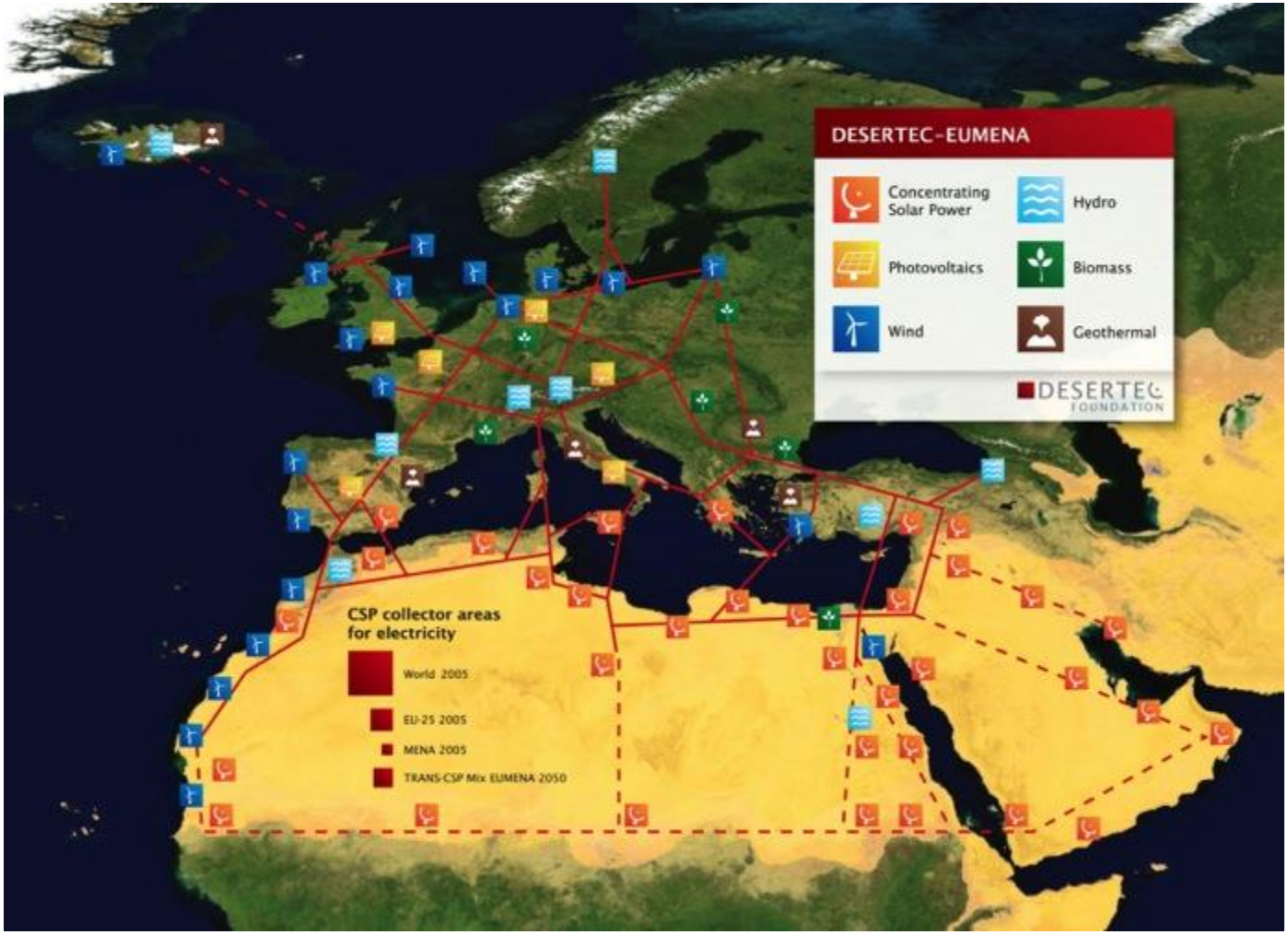
Power Grid Connection in Europe

Physical energy flows between European countries, 2008 (GWh)



Source: ENTSO-E

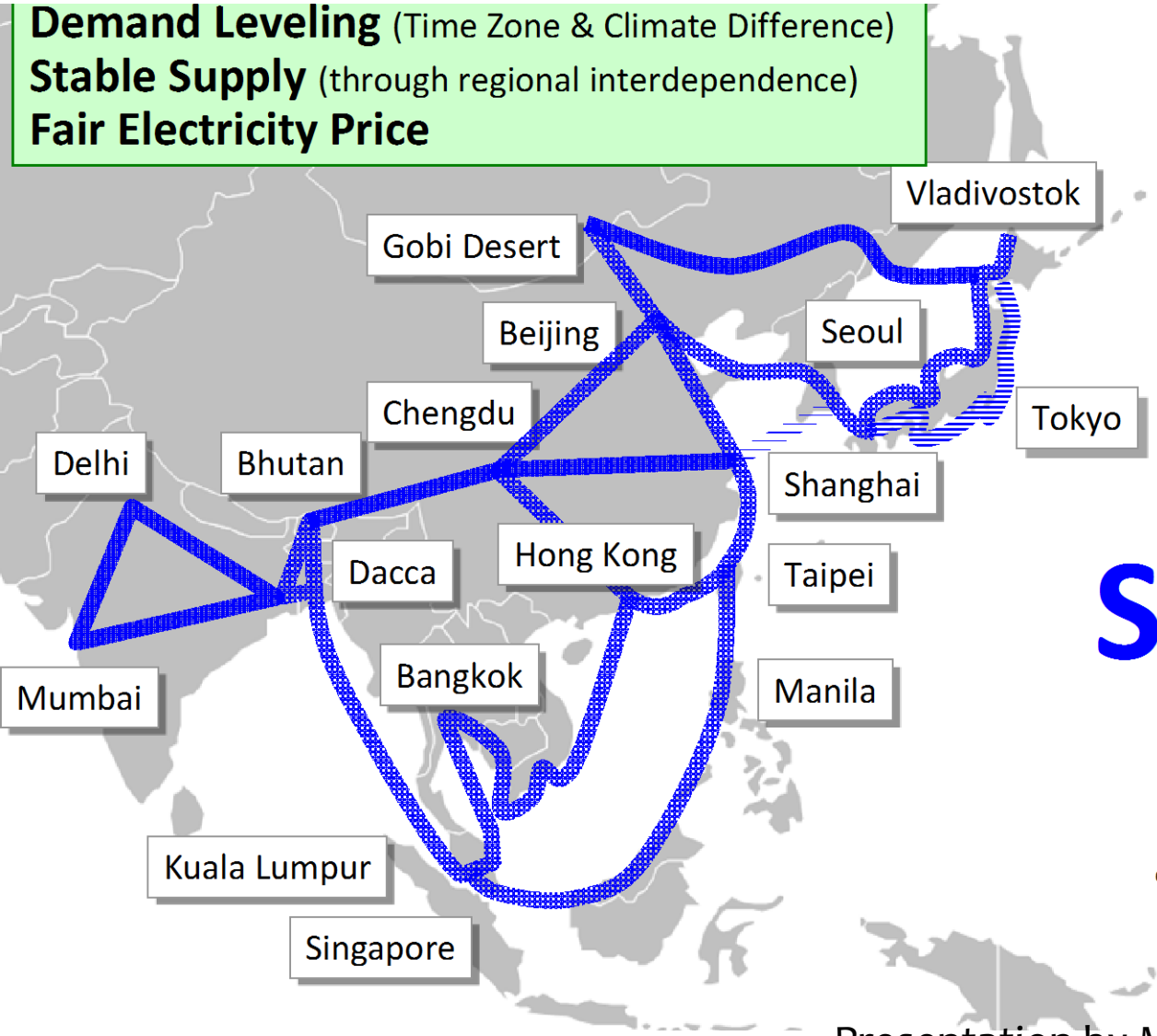
Connecting MENA and Europe: " Desertec" as visionary “Energy for Peace"



Source: DESRETEC Foundation

“Energy for Peace in Asia” New Vision?

Demand Leveling (Time Zone & Climate Difference)
Stable Supply (through regional interdependence)
Fair Electricity Price



Phase 3

Asia Super Grid

Total 36,000km

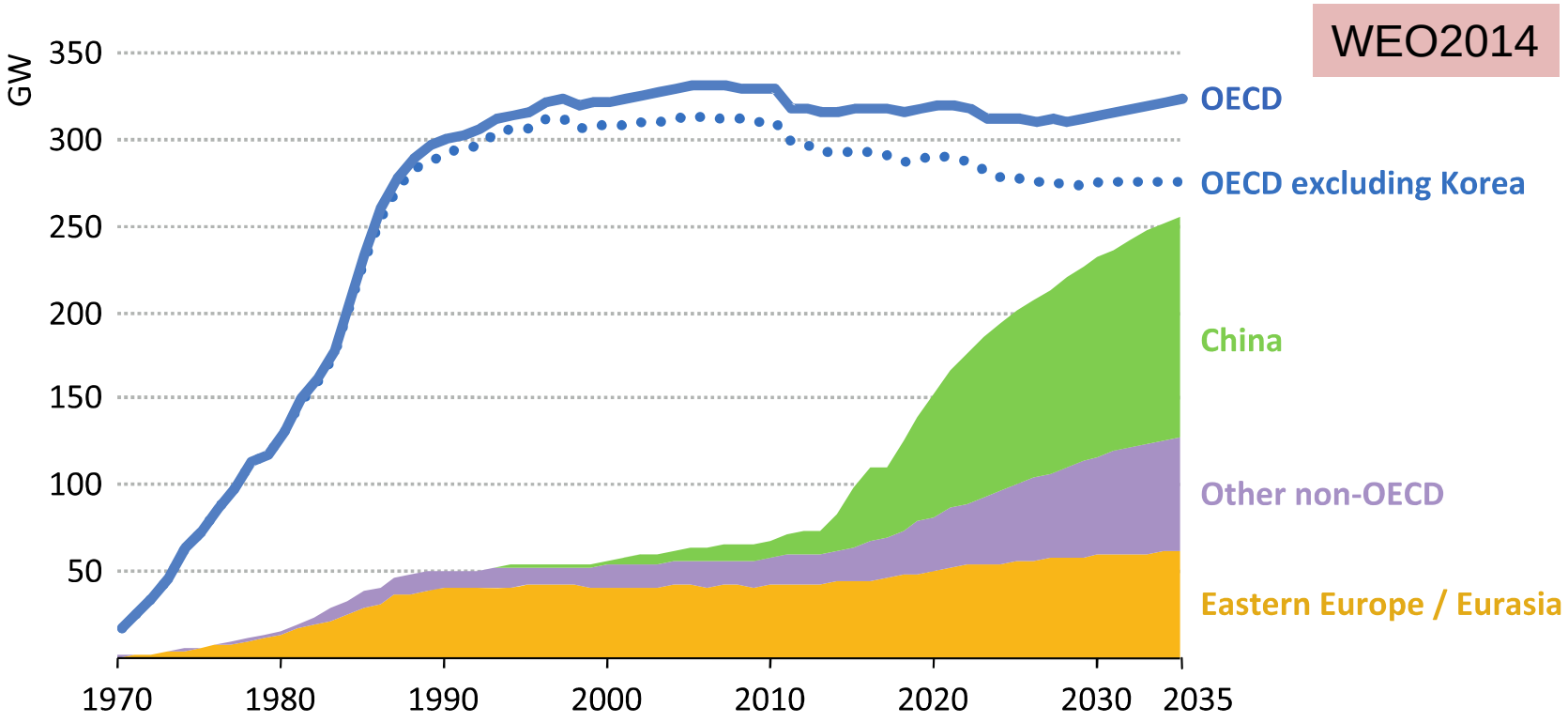
Presentation by Mr. Masayoshi SON

Japan-US Alliance in Energy Security

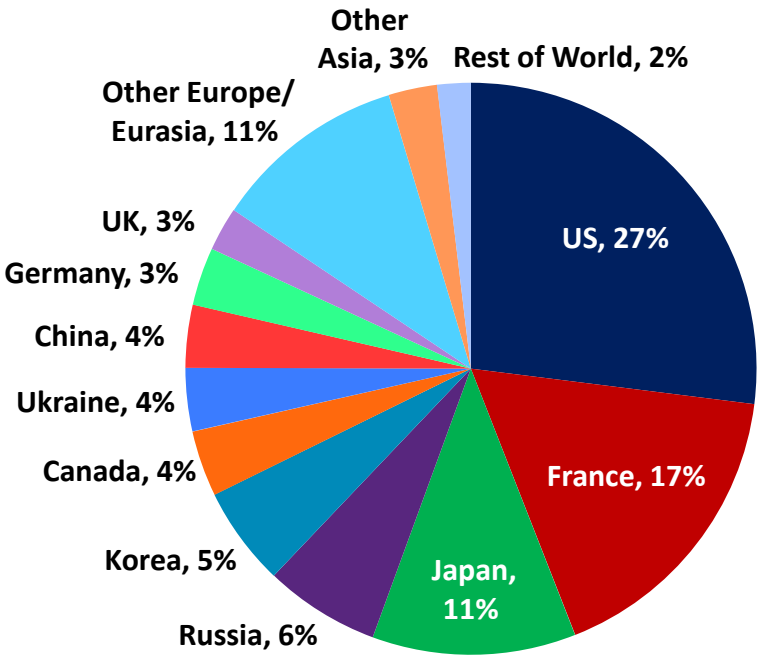
5. Nuclear cooperation in the new paradigm

Nuclear's future

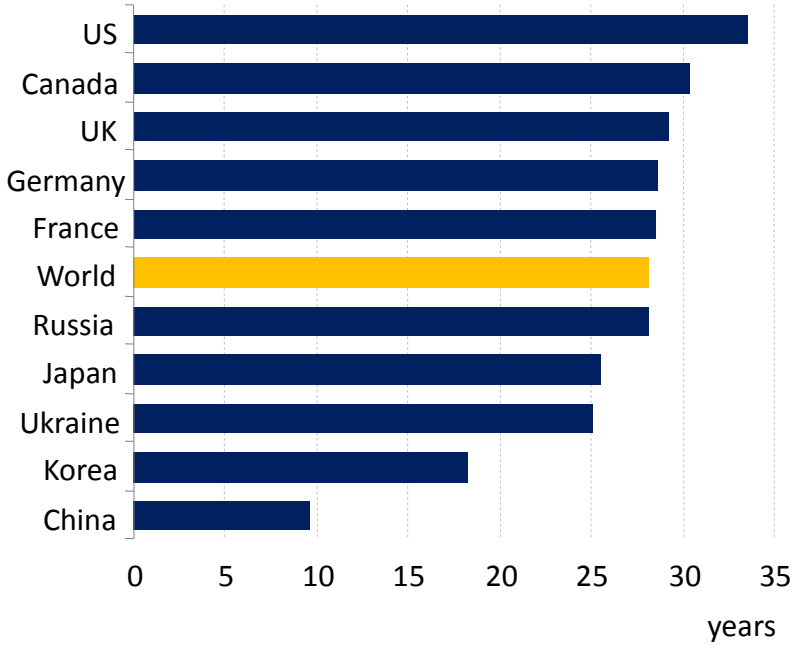
Figure 5.12 ▷ **Nuclear power installed capacity by region in the New Policies Scenario**



Global capacity (end-2013) = 392 GW gross



Average age of capacity by region



As the peak in nuclear new builds was in the 1970s, 75% of the fleet is already over 25 years old & many will be retired in the time horizon of our analysis

IEA WEO2014 workshop

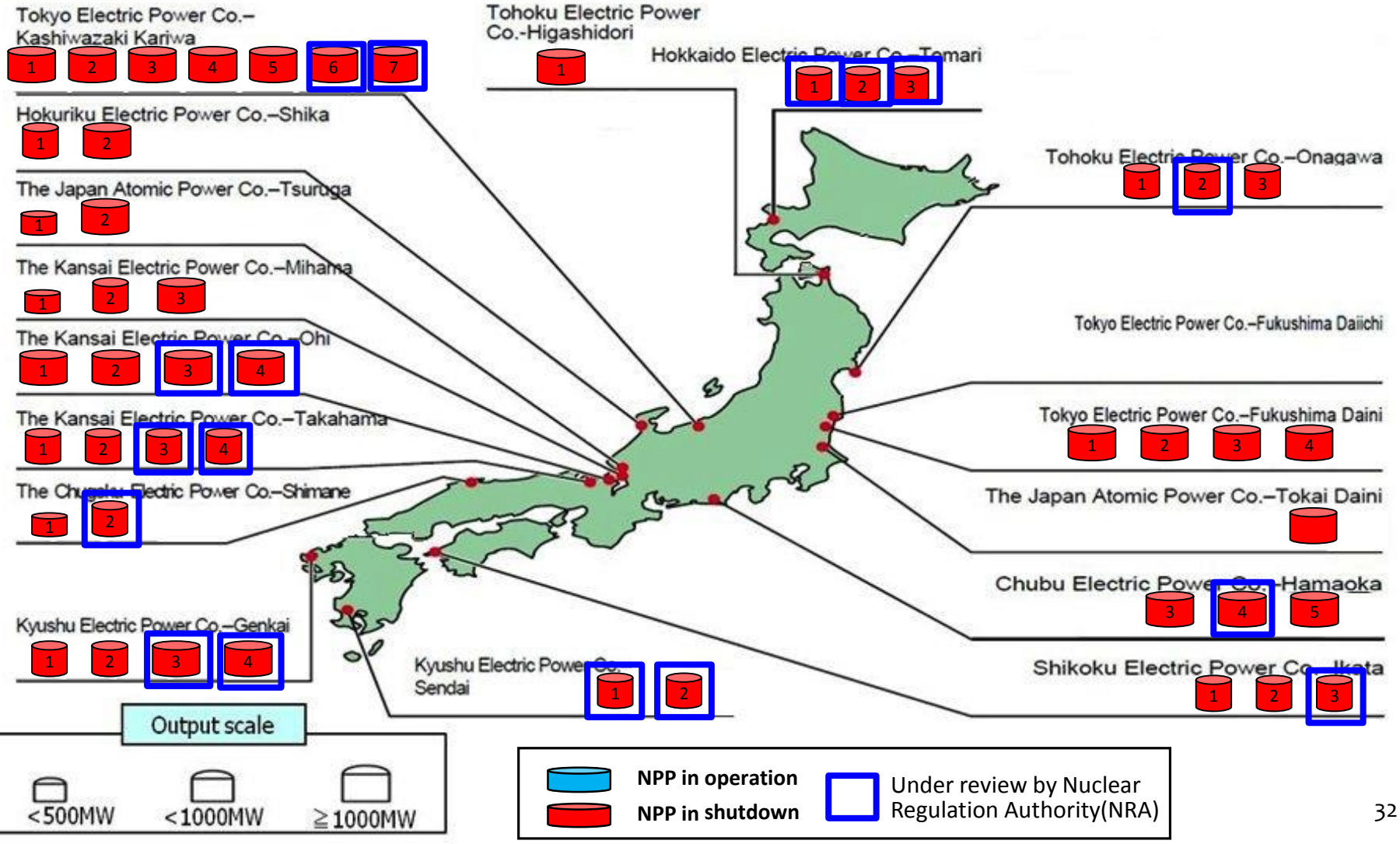
Share the Lessons of the Fukushima

- 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. NRC’s B-5-b clause was not accepted despite its suggestion.
  - Clarify why it happened only to Fukushima Daiichi and NOT to other sites like Fukushima Daini, Onagawa, Tokai-daini.
- Safety Principles
  - Fukushima accident was caused by human error and should have been avoided. (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.

Nuclear Power Plants in Japan

○There are 48 nuclear power plant units in Japan. All of them (in red) is in temporary shutdown as of February 17 2014.

○**17 units (in blue squares)** are under review for restart by the Nuclear Regulation Authority in accordance with its new safety standard.



Generations of Nuclear Energy

Generation I

Early Prototypes

- Shippingport
- Dresden
- Magnox

Generation II

Commercial Power

- PWRs
- BWRs
- CANDU

Generation III

Advanced LWRs

- CANDU 6
- System 80+
- AP600

Generation III+

Evolutionary Designs

- ABWR
- ACR1000
- AP1000
- APWR
- EPR
- ESBWR

Generation IV

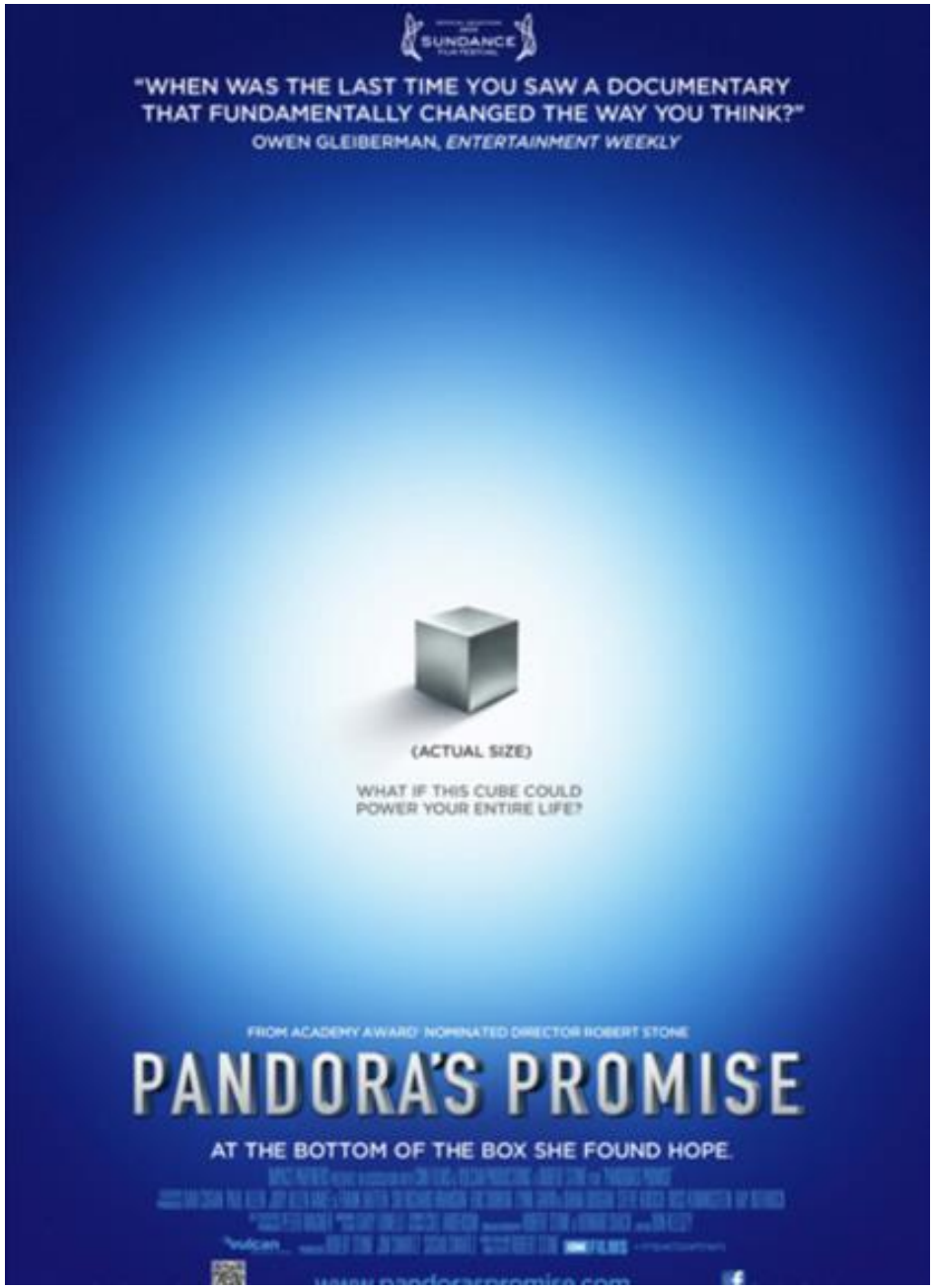
Revolutionary Designs

- Safe
- Sustainable
- Economical
- Proliferation Resistant and Physically Secure

1950 1960 1970 1980 1990 2000 2010 2020 2030

Gen I | Gen II | Gen III | Gen III+ | Gen IV

http://www.gen-4.org/Technology/evolution.htm

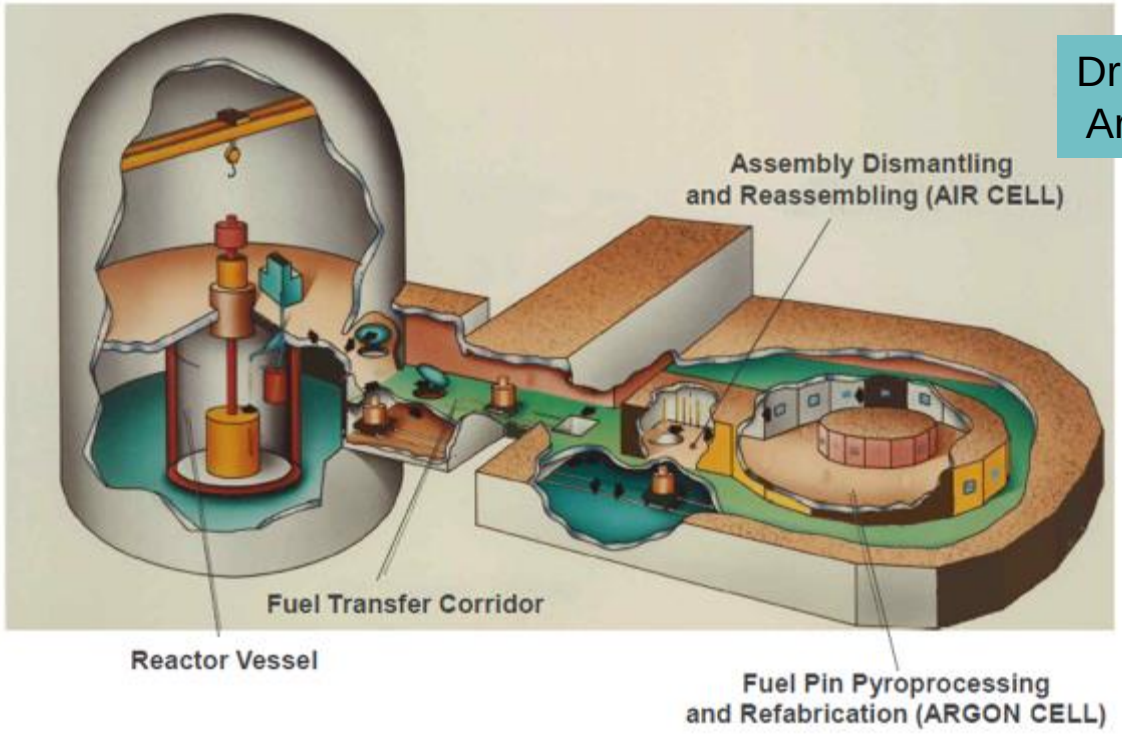


"Pandora's Promise", a movie directed by Robert Stone, is a documentary of environmentalists who changed their views about Nuclear Power.

You can see it at Youtube-> https://www.youtube.com/watch?v=F0esvuLeRFI

Time for Safer, Proliferation resistant and Easier Waste Management Paradigm: Integral Fast Reactor and Pyroprocessing

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



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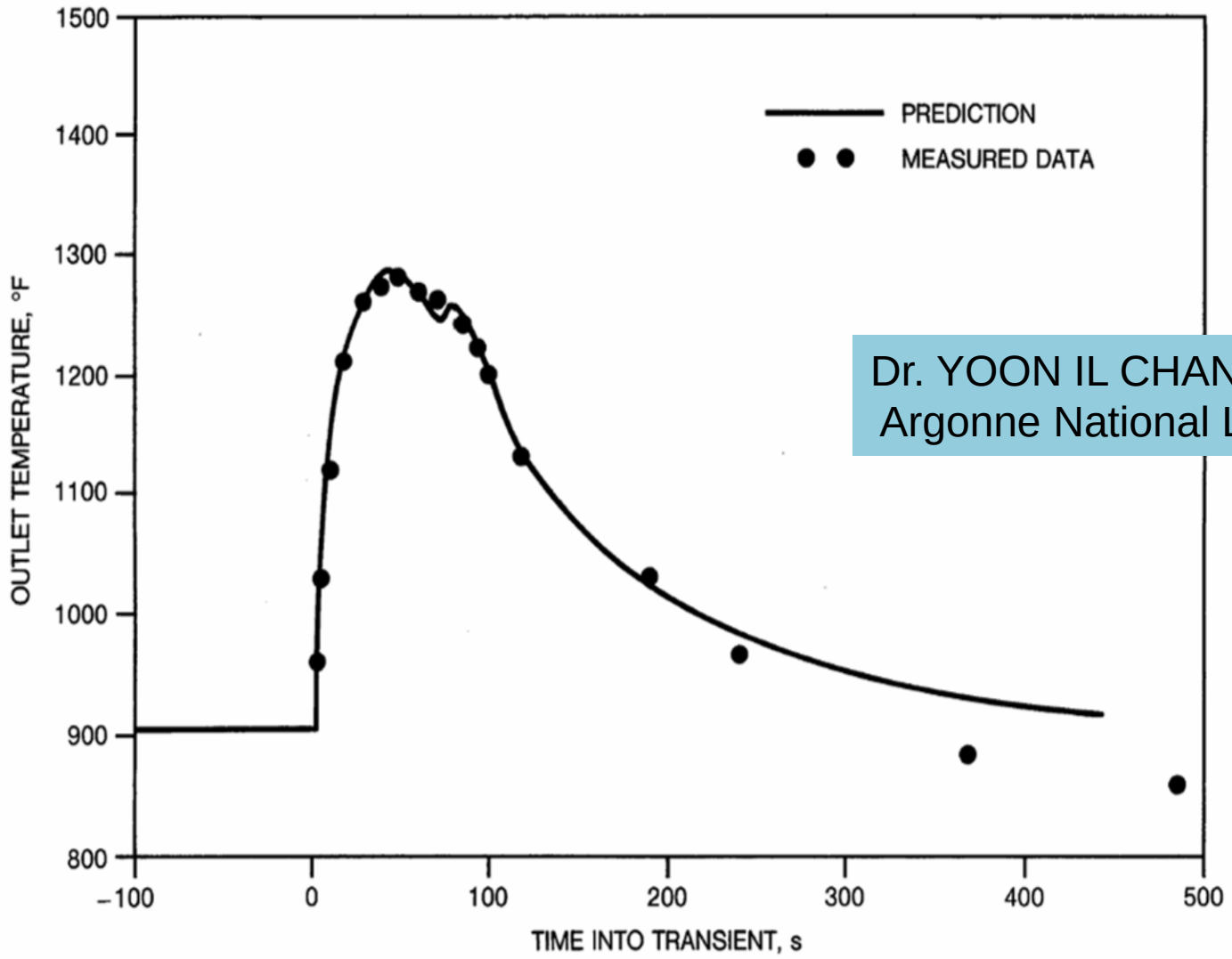
Argonne National Laboratory

IFR has features as Inexhaustible Energy Supply ,Inherent Passive Safety ,Long-term Waste Management Solution , Proliferation-Resistance , Economic Fuel Cycle Closure.
High level waste reduces radioactivity in 300 years while LWR spent fuel takes 100,000 years.

Loss-of-Flow without Scram Test in EBR-II



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Technical Rationale for the IFR

✓ Revolutionary improvements as a next generation nuclear concept:

- Inexhaustible Energy Supply
- Inherent Passive Safety
- Long-term Waste Management Solution
- Proliferation-Resistance
- Economic Fuel Cycle Closure

✓Metal fuel and pyroprocessing are key to achieving these revolutionary improvements.

✓Implications on LWR spent fuel management

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Uranium utilization is <1% in LWR

Uranium Ore

170 tons

Enrichment

150 tons

Depleted Uranium

20 tons

1000 MWe
LWR

18.73 tons U

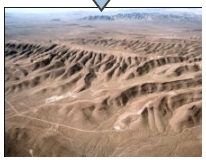
0.25 tons Pu

Used Uranium Reserve

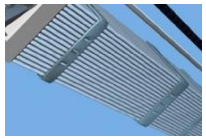
1.00 tons F.P.
0.02 tons M.A.

Reprocessing

18.73 tons Uranium
1.00 tons Fission Products
0.25 tons Plutonium
0.02 tons Minor Actinides



Disposal
(300,000 years)



Spent Fuel

Disposal
(300,000 years)

European recycle
- Saves 15% uranium
- But no reduction in waste life

Direct disposal is
the current U.S. policy

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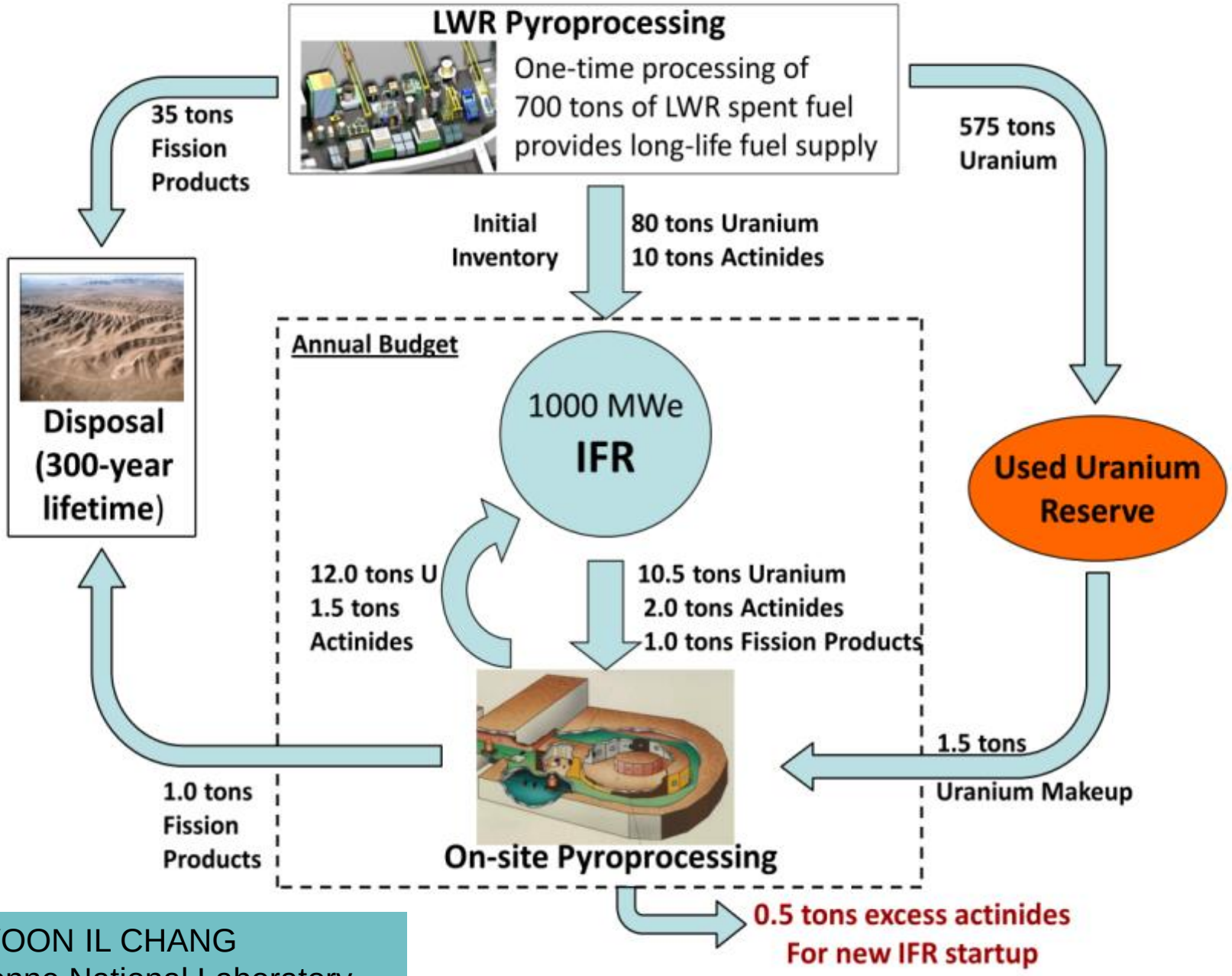

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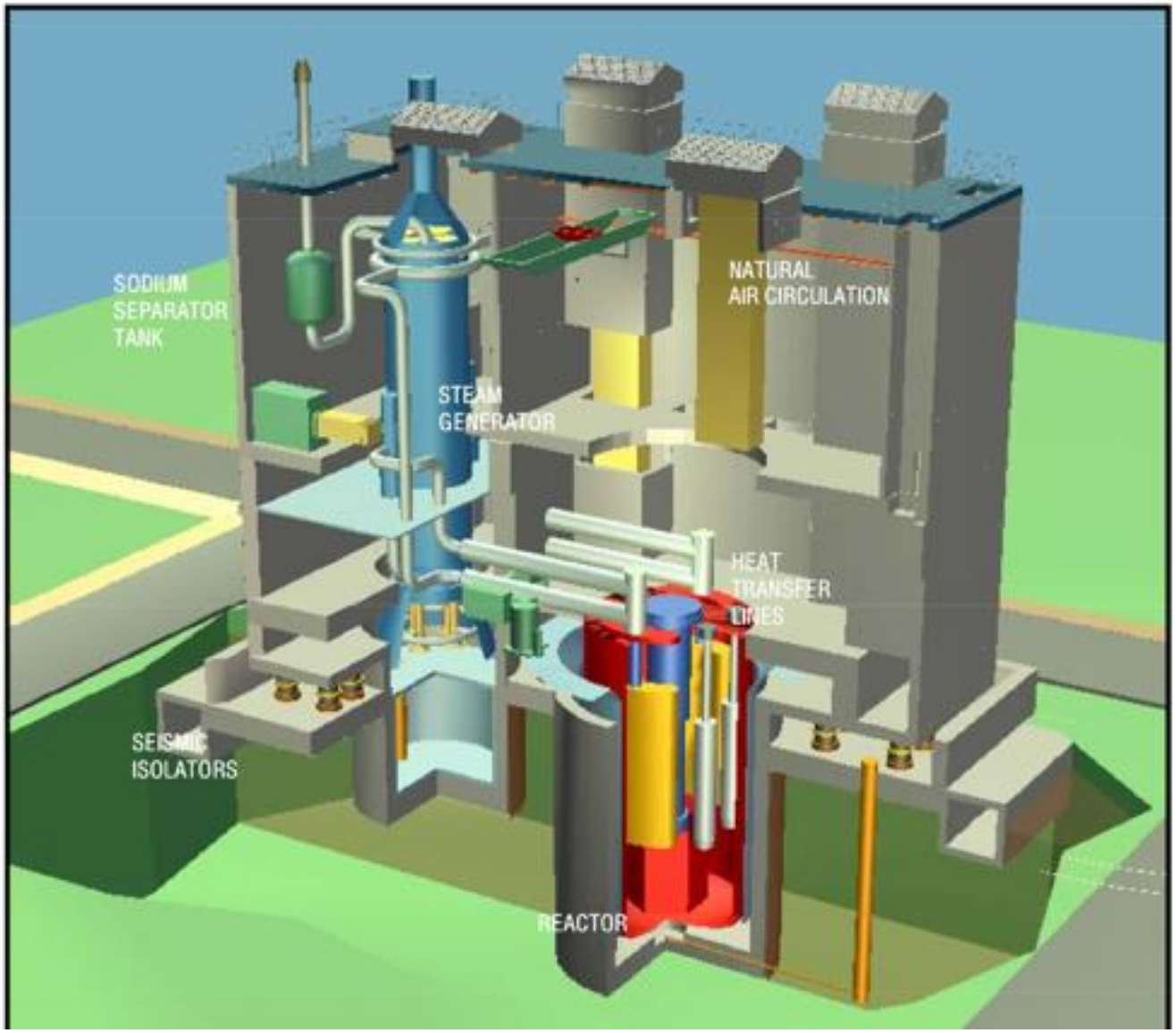
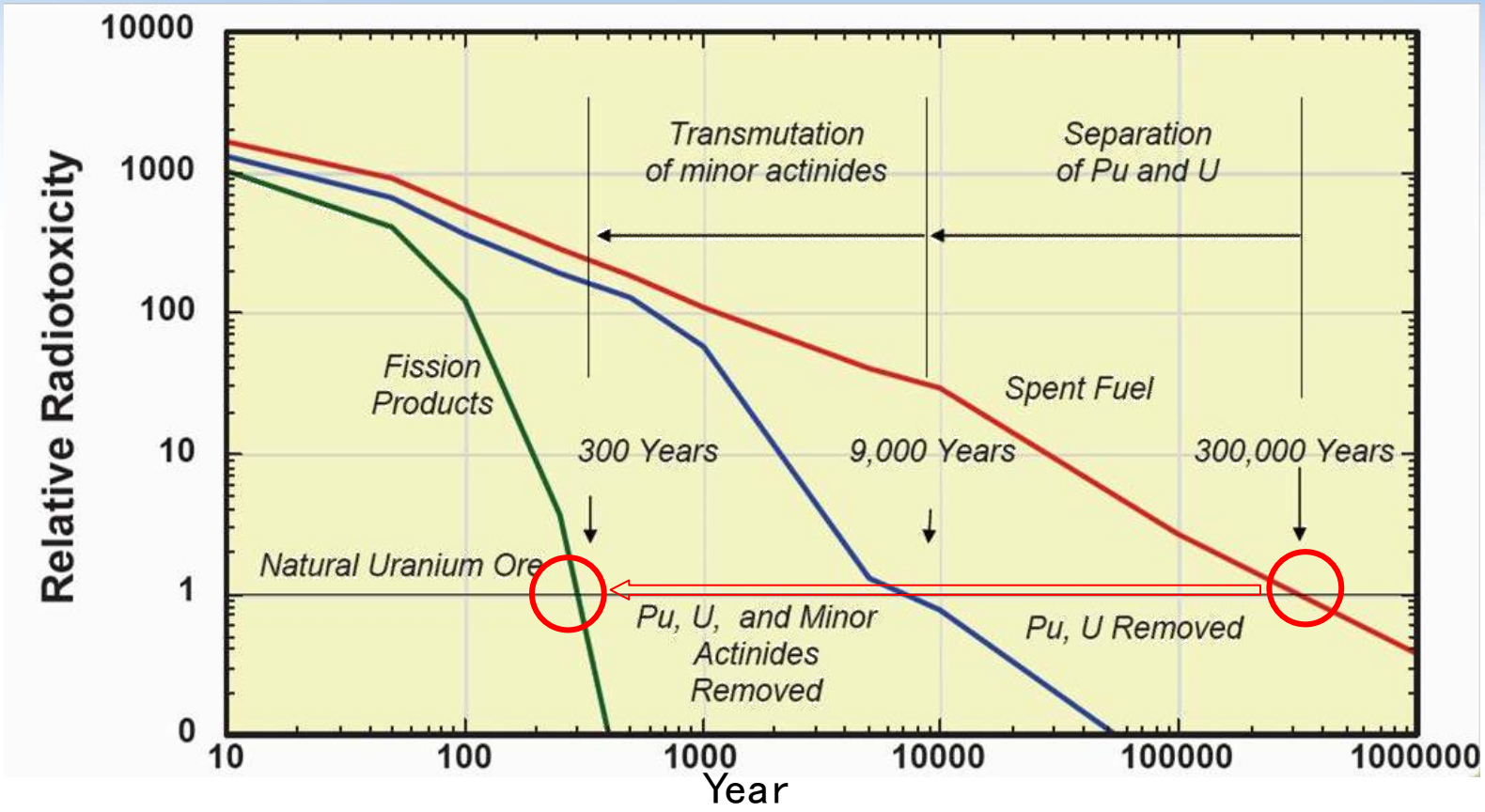
S-PRISM Nuclear Steam Supply System



Transuranic disposal issues

The 1% transuranic (TRU) content of nuclear fuel is responsible for 99.9% of the disposal time requirement and policy issues



Removal of uranium, plutonium, and transuranics makes a 300,000 year problem a 300 year problem

Application of an IFR cycle to the existing Japanese nuclear fuel cycle

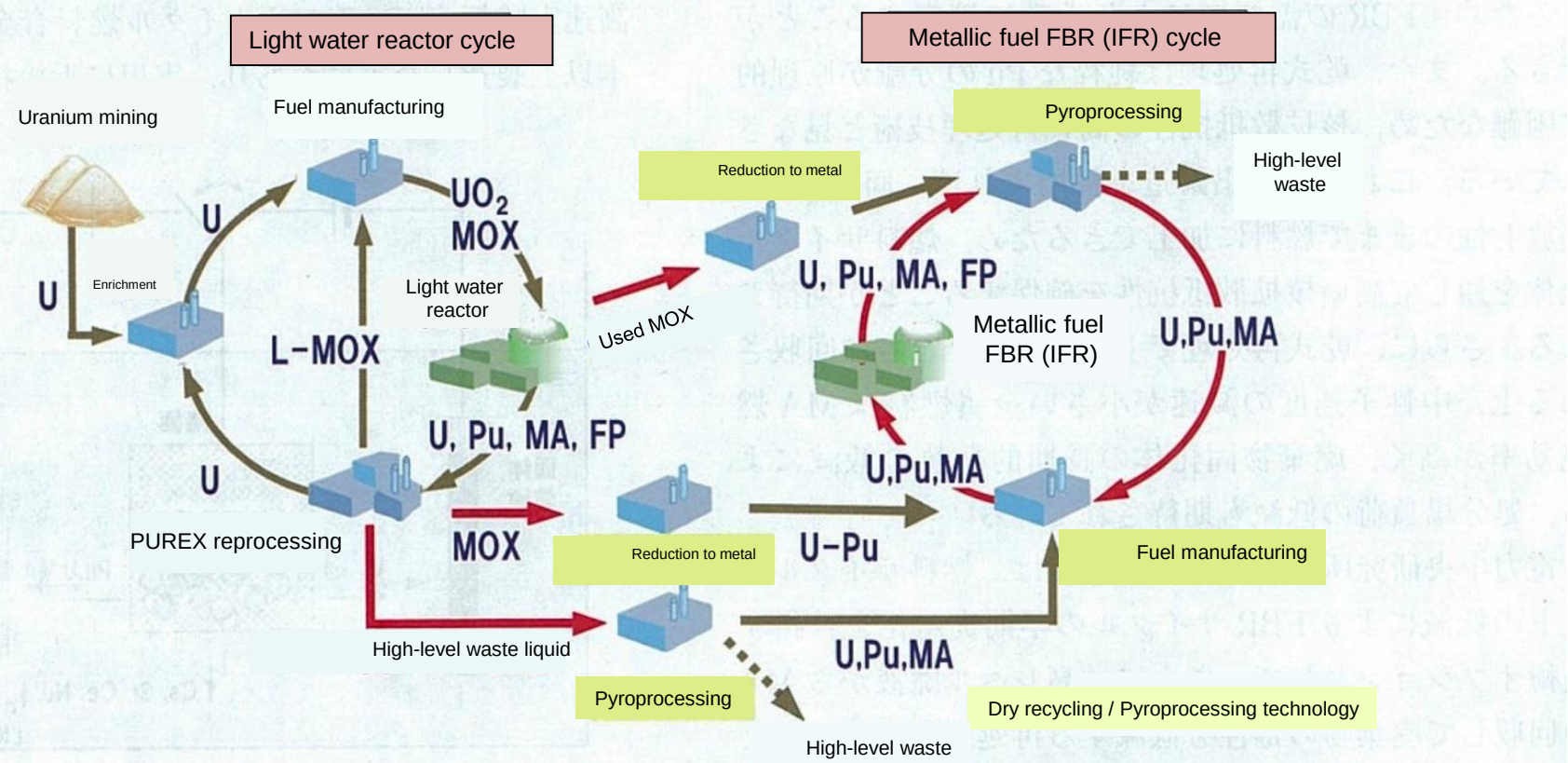
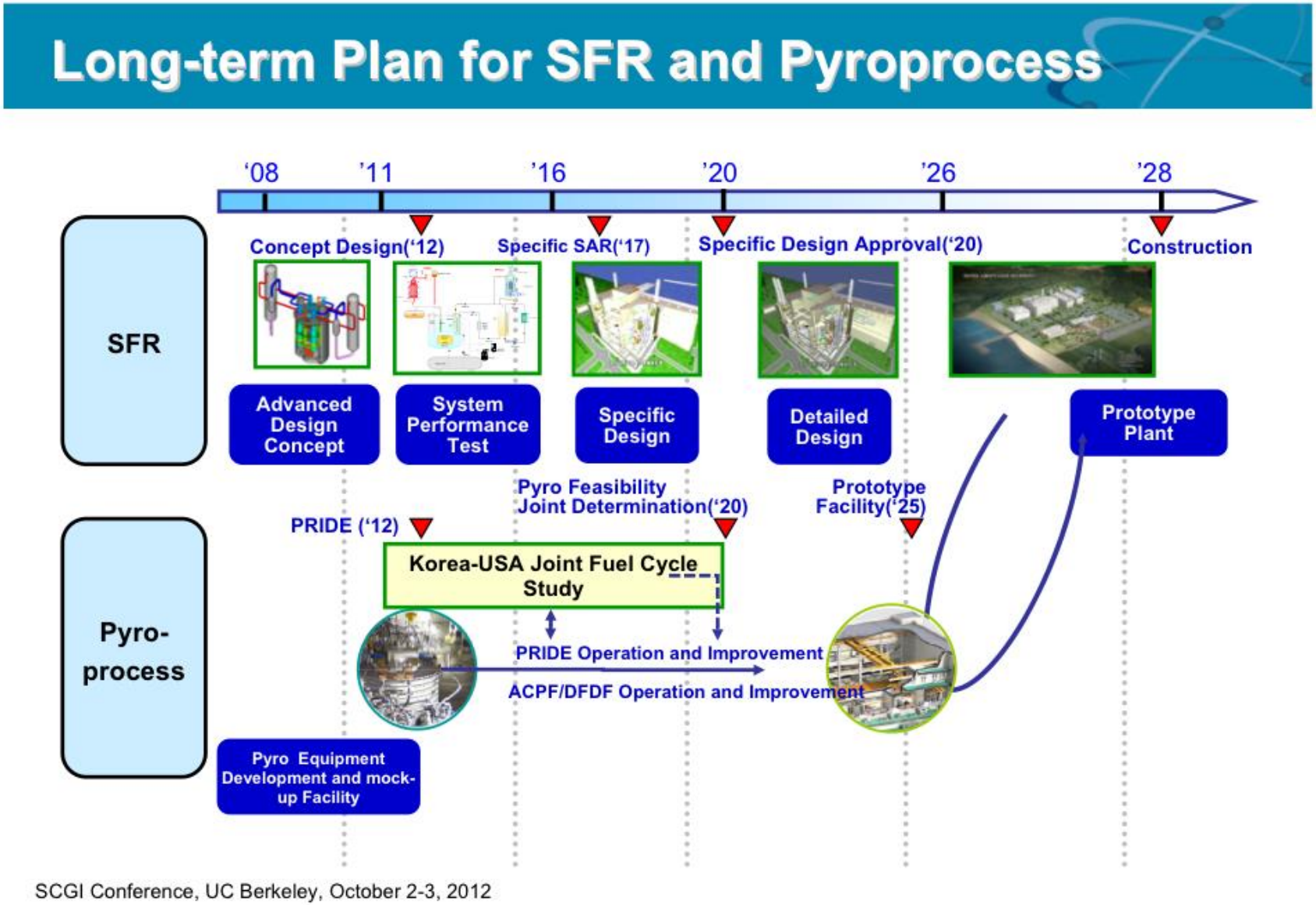


Figure 6: Fuel cycle concept using Pyroprocessing technology

(30) Journal of the Atomic Energy Society of Japan Vol. 52, No. 7 (2010)

Central Research Institute of Electric Power Industry: Tadafumi Koyama, Takanari Ogata

Korea seeks to change the 1-2-3 Agreement



SCGI Conference, UC Berkeley, October 2-3, 2012

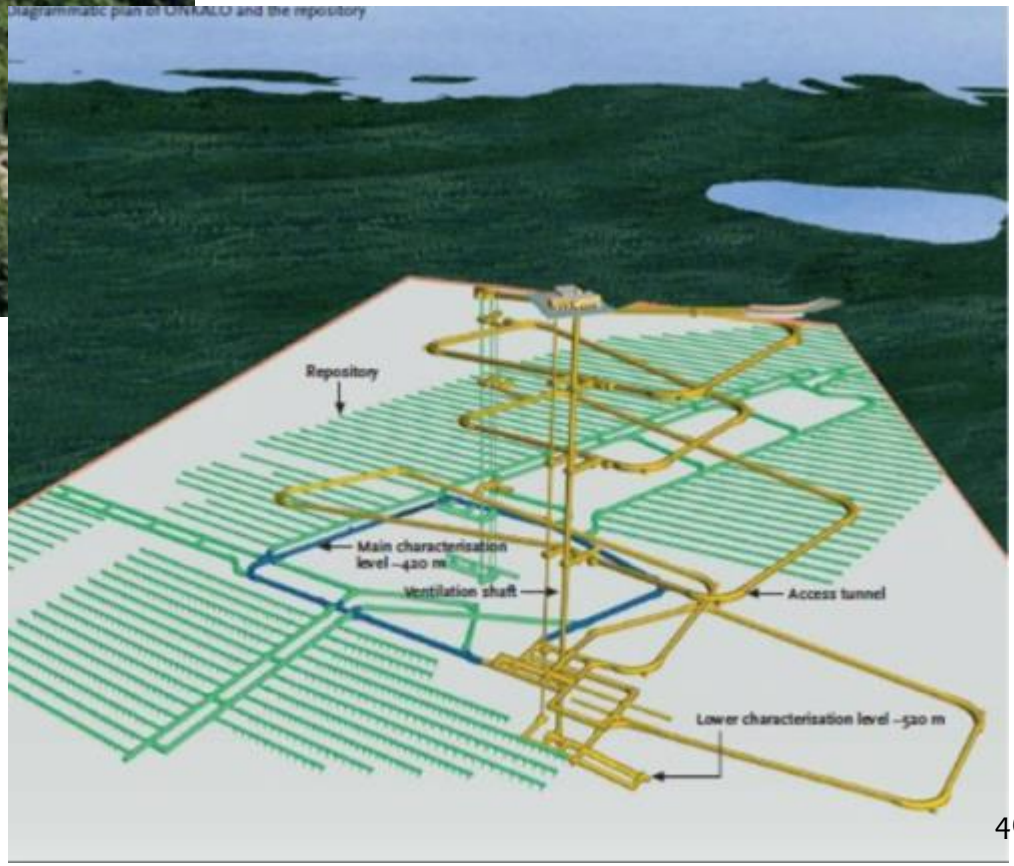
U.S.-Japan Alliance Report by Nye & Armitage (2012/8/10)

For such an alliance to exist, the United States and Japan will need to come to it from the perspective, and as the embodiment, of tier-one nations. In our view, tier-one nations have significant economic weight, capable military forces, global vision, and demonstrated leadership on international concerns. Although there are areas in which the United States can better support the alliance, we have no doubt of the United States' continuing tier-one status. For Japan, however, there is a decision to be made. Does Japan desire to continue to be a tier-one nation, or is she content to drift into tier-two status?

Energy Security
(Nuclear)
Understandably, the Fukushima nuclear disaster dealt a major setback to nuclear power. The setback reverberated not only throughout Japan, but also around the world. Japan has made tremendous progress in boosting energy efficiency and is a world leader in energy research and development. While the people of Japan have demonstrated remarkable national unity in reducing energy consumption and setting the world's highest standards for energy efficiency, a lack of nuclear energy in the near term will have serious repercussions for Japan.

Issue of High-level Waste Disposal

Finland Model:
Olkiluotp Nuclear Power Plant and Onkalo nuclear spent fuel repository



HQ of Teollisuuden Voima Oyj Utility which owns Olkiluoto Nuclear Power Plant exists in the Plant site.

Comprehensive Energy Security and Sustainability Strategy for Japan–US Alliance

1. Japan needs to restart nuclear power plants. Prepare scenarios for Iranian Crisis. Jointly design Collective Self Defense Plan for Sea-lane Protection. China and India should join the IEA.

2. Golden Age of Natural Gas will come with golden rules including sustainability requirements and a new pricing formula. LNG exports from North America may be a game-changer. Need of Asian Gas Trading Hub. Russia remains being key player with pipelines and LNG facilities.

3. Energy Security for the 21st Century must be Collective and Comprehensive Electricity Supply Security under Sustainability constraints. EU`s connectivity approach can be a model especially for Asia. Need the North East Asian Energy Security Forum; US should be there.

4. Japan needs domestic reform of power market: 50-60 hrz problem, FIT reform, unbundling of utilities, international grid connection with Korea and Russia. New technologies help; Hydrogen economy, Methane-hydrate, Super-conductivity grid, Smart grid and EVs, Storage, Cleaner Coal Tech with CCS.

5. 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. Need Paradigm shift from the LWR to the Safer, More proliferation resistant and Easier HLW management Nuclear system. Demonstrate International (US-Japan-Korea) collaborative project on IFR technology (GE's PRISM) at Fukushima.

Thank you for your attention

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