Stormy Energy Future : Japan's Energy Challenge

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SIEW ENERGY INSIGHTS

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International Energy Agency
Secure Sustainable Together

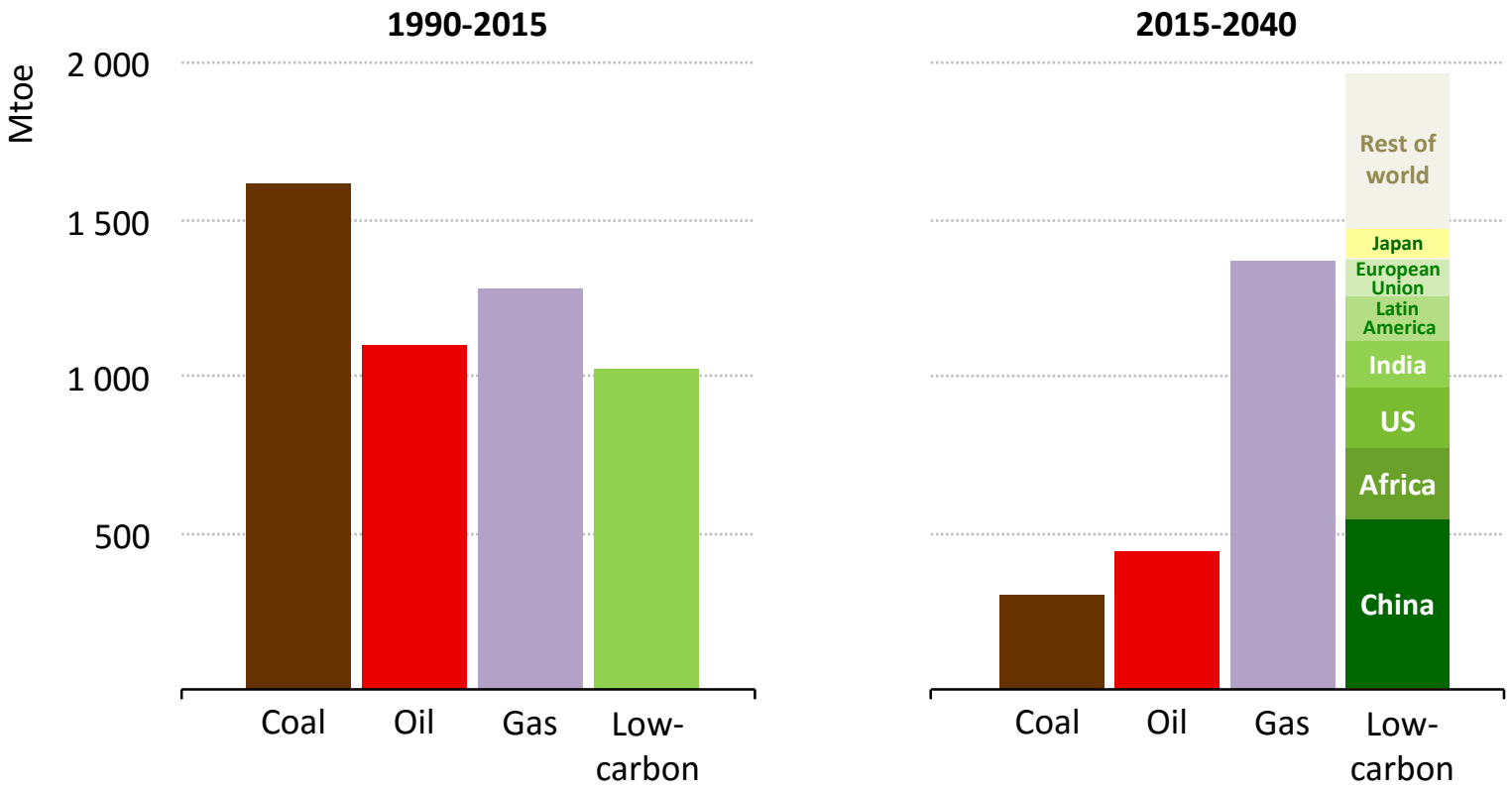
World Energy Outlook 2016

15 November 2016
Under embargo presentation to Ambassadors

A new ‘fuel’ in pole position

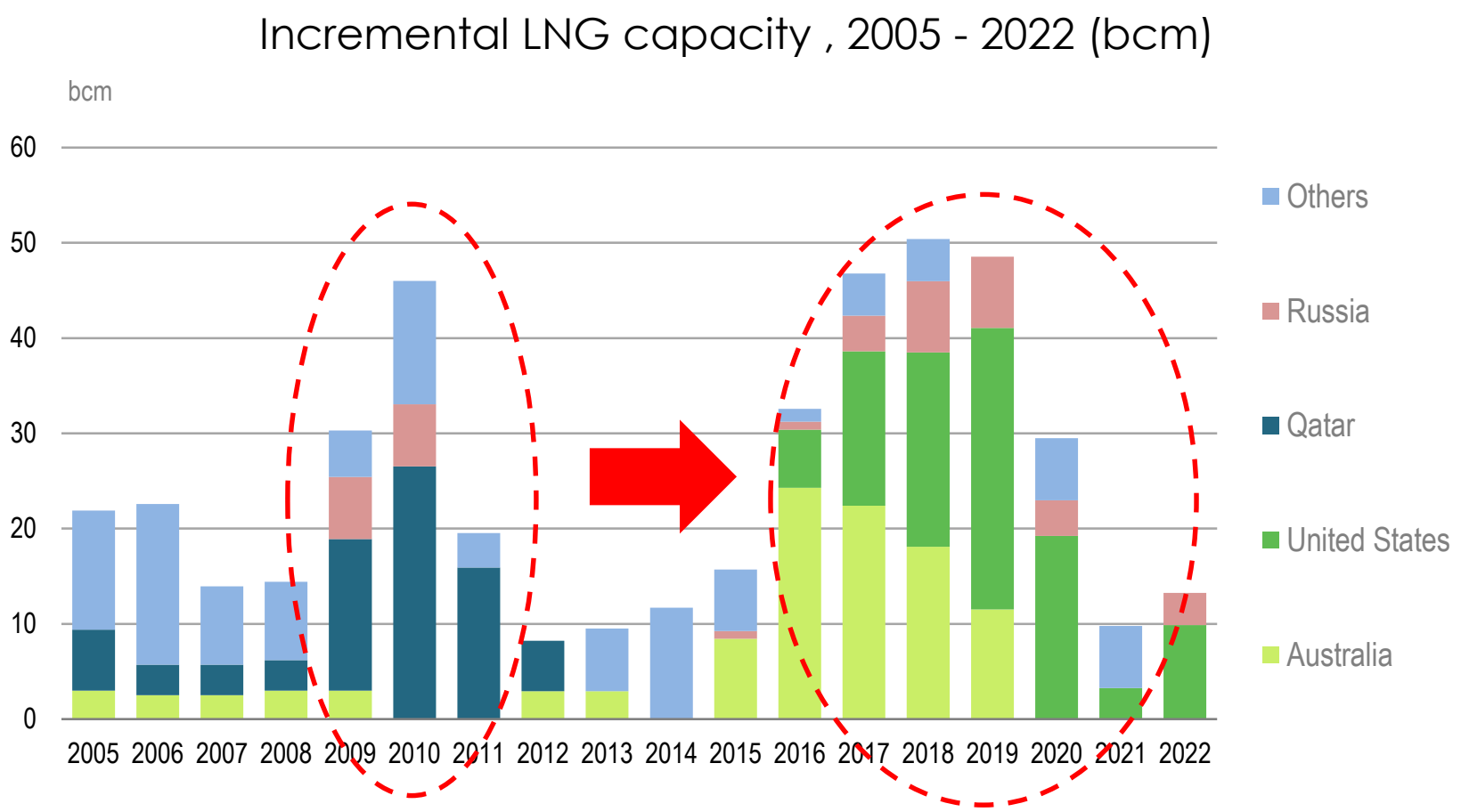
WEO2016

Change in total primary energy demand



Low-carbon fuels & technologies, mostly renewables, supply nearly half of the increase in energy demand to 2040

Second wave of additional LNG supply is already coming online



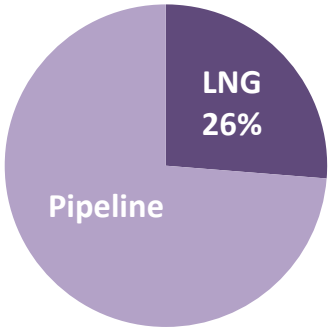
15 new projects with total export capacity of around 140 bcm are now under construction
Australia and the United States account for 75% of them

A wave of LNG spurs a second natural gas revolution

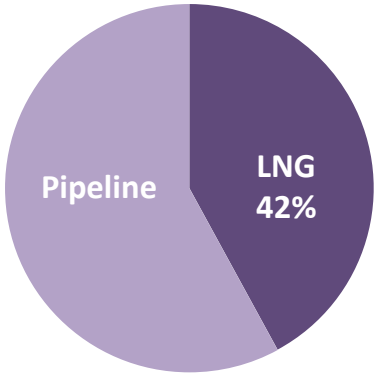
WEO2016

Share of LNG in global long-distance gas trade

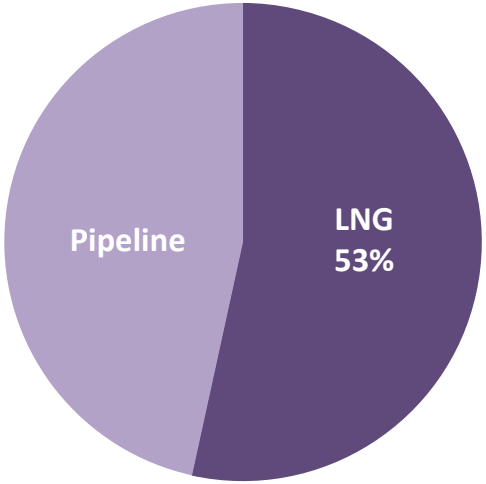
2000
525 bcm



2014
685 bcm

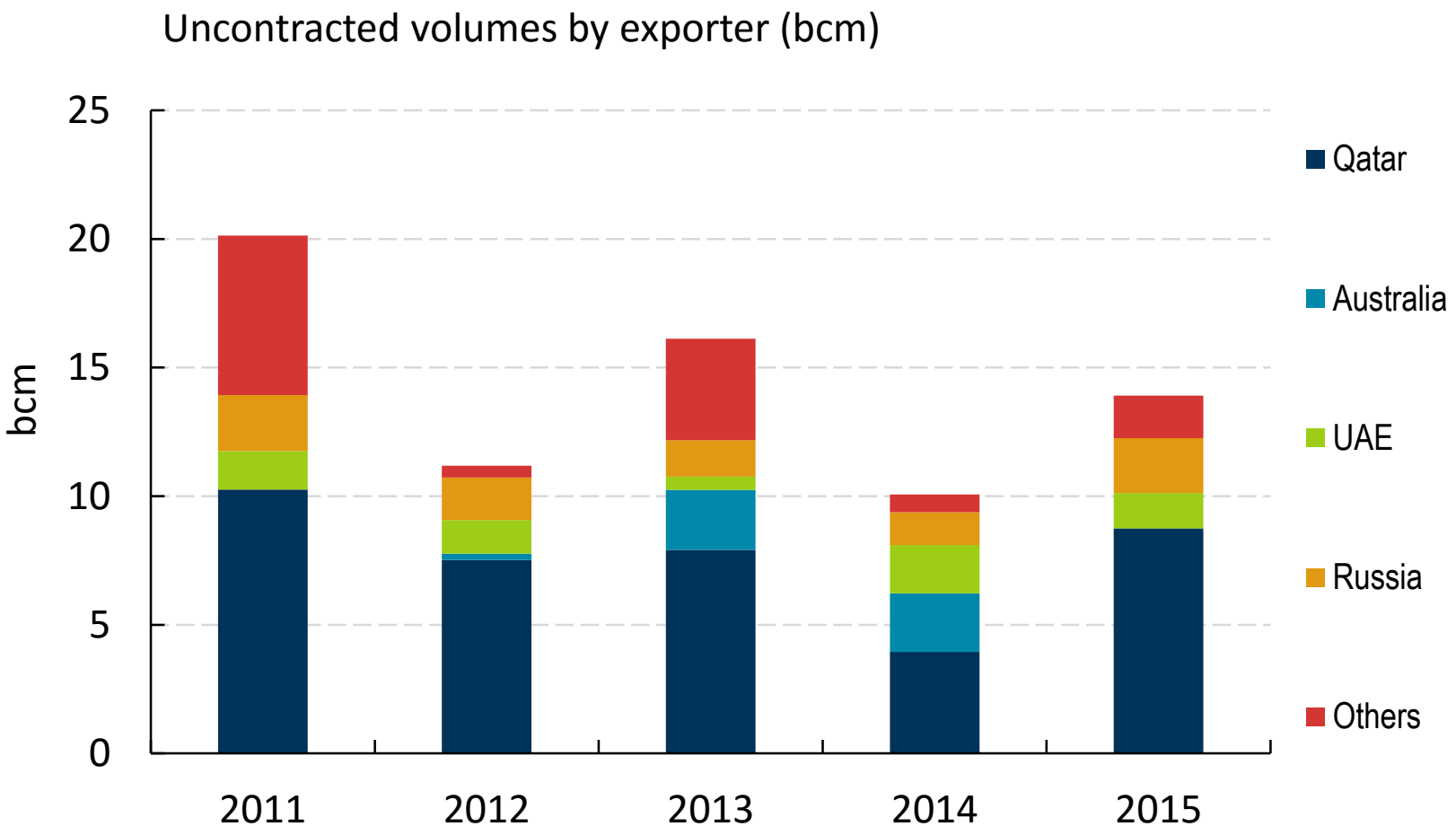


2040
1 150 bcm



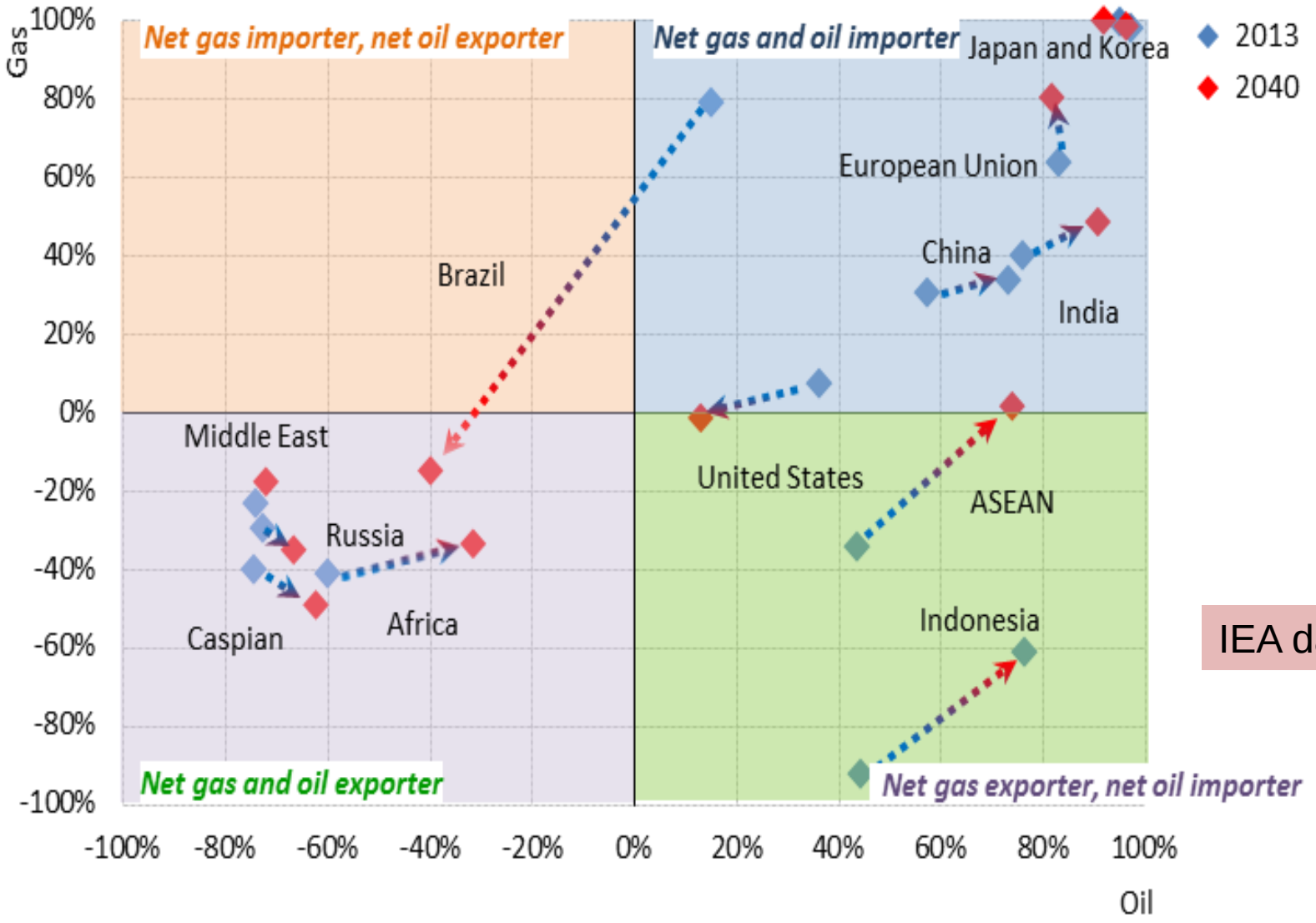
Contractual terms and pricing arrangements are all being tested as new LNG from Australia, the US & others collides into an already well-supplied market

Qatar plays a pivotal role in LNG security



Qatar provides more than half of global uncontracted LNG volumes; Flexibility comes from uncontracted LNG, diversions, re-loads & contracts with open destinations

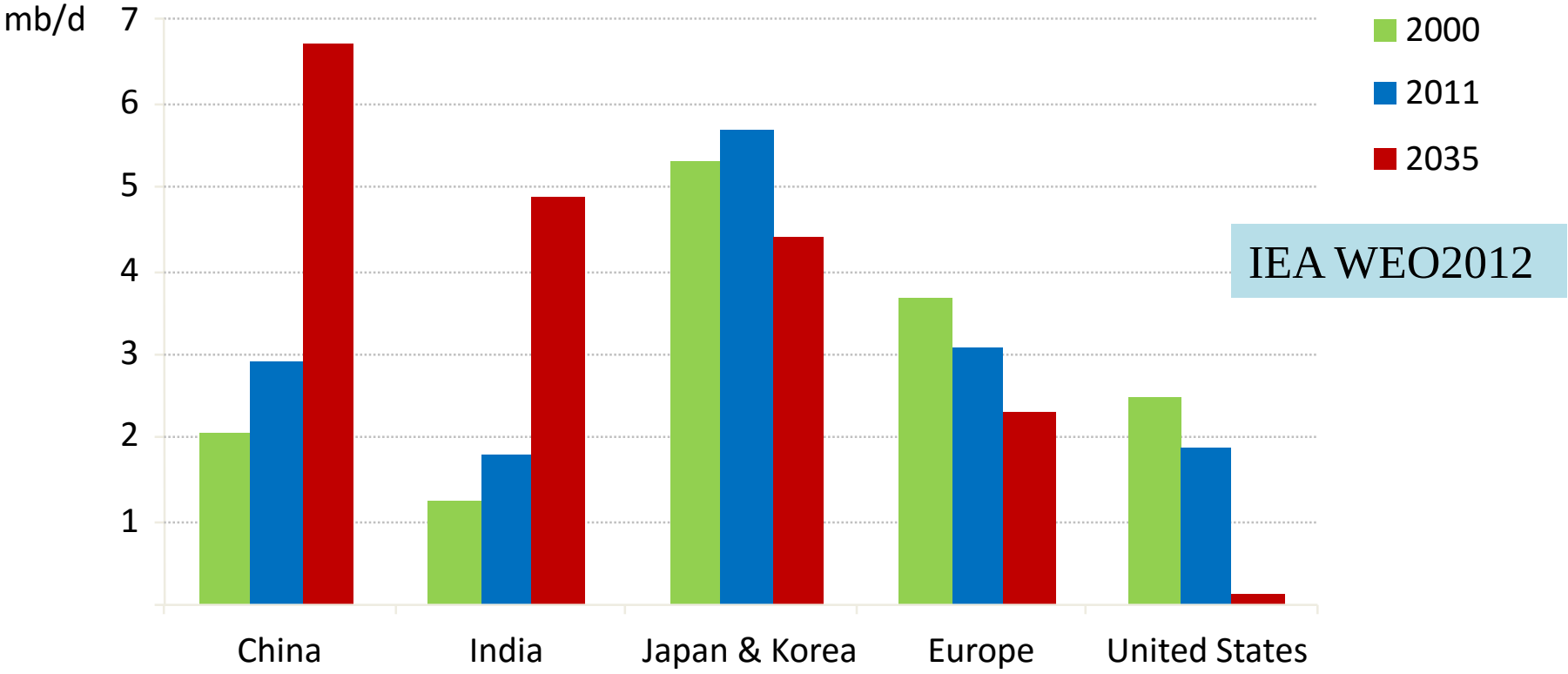
Geopolitics of the Shale Revolution: Strategic Positioning of Oil / Gas exporters and importers.



IEA data

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

The Choke Point: the Strait of Hormuz

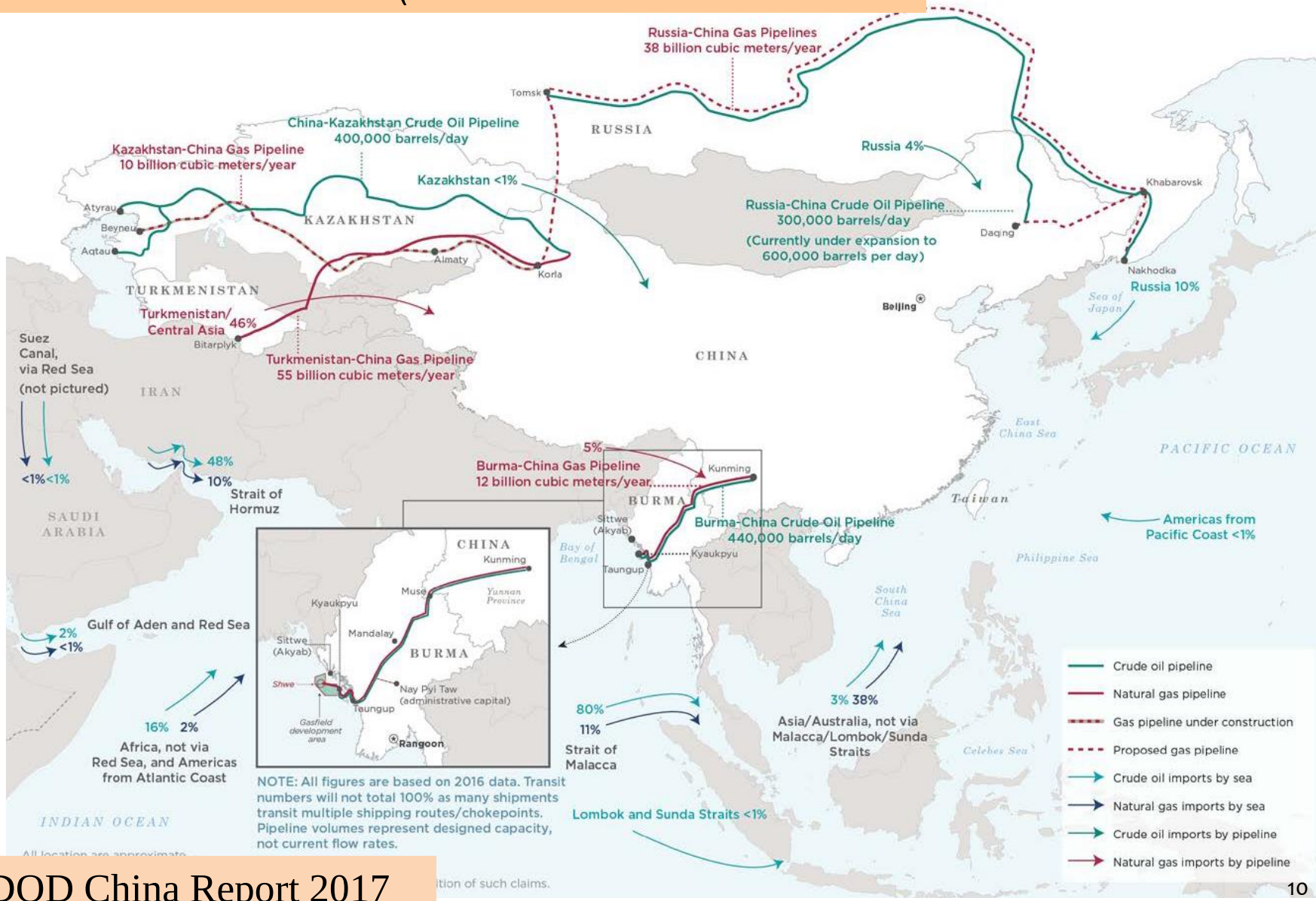
85% of Japanese oil import
20% of Japanese LNG import
Chubu Electric depends 40% of its power supply on one source: Qatar.

17 mbd of petroleum
(20% of global demand
& 42% of trade)

82 million tons of LNG pa
(30% of global demand)

China's Oil and Gas Import Transit Routes:

One Belt and One Road（一带一路）



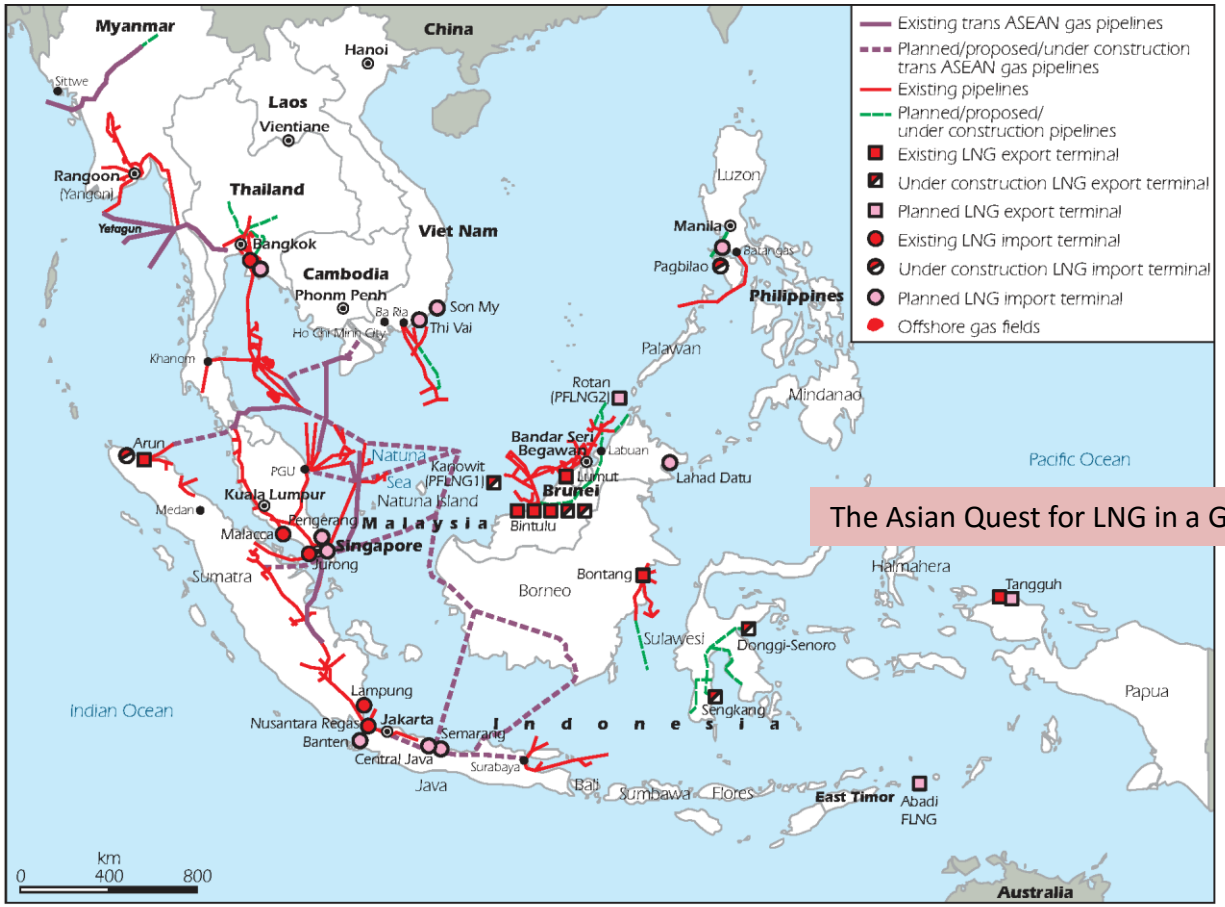
USDOD China Report 2017

Map 3.1 Asia-Pacific LNG infrastructure

This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Trading hub – Asian-tailored solution?

TAGP and LNG terminals in Southeast Asia



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The Asian Quest for LNG in a Globalising Market

- Southeast Asian countries are already interlinked by pipeline and plan to increase these linkages through Trans ASEAN Gas Pipeline (TAGP) and LNG.

Russian Gas Pipelines Will Extend to the East: Recent China Deal

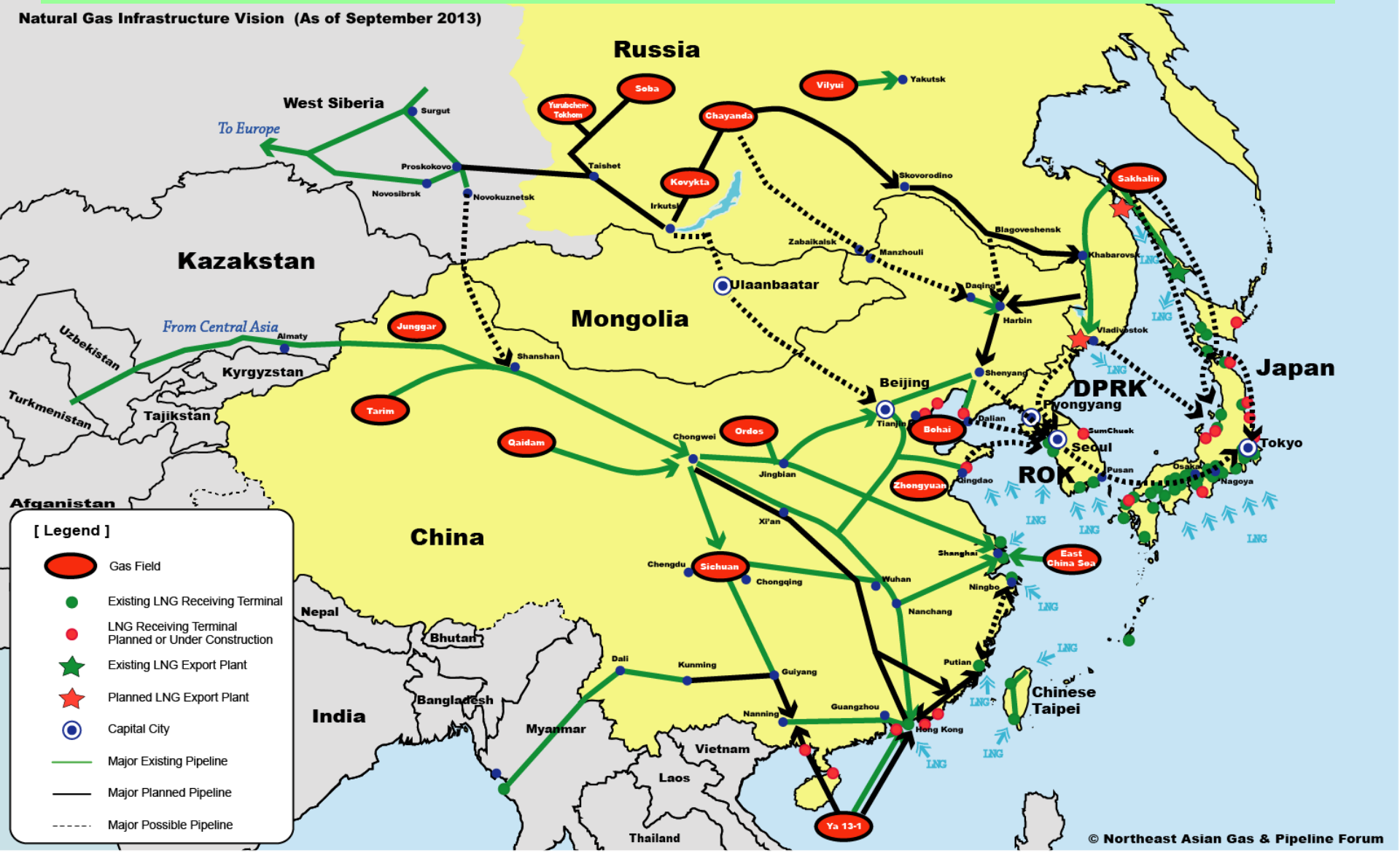
Russian Gas Infrastructure

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

Blue Print for North East Asia Gas & Pipeline Infrastructure: Dr. Hirata's Concept



Possible Pipeline Project from Russia to Japan

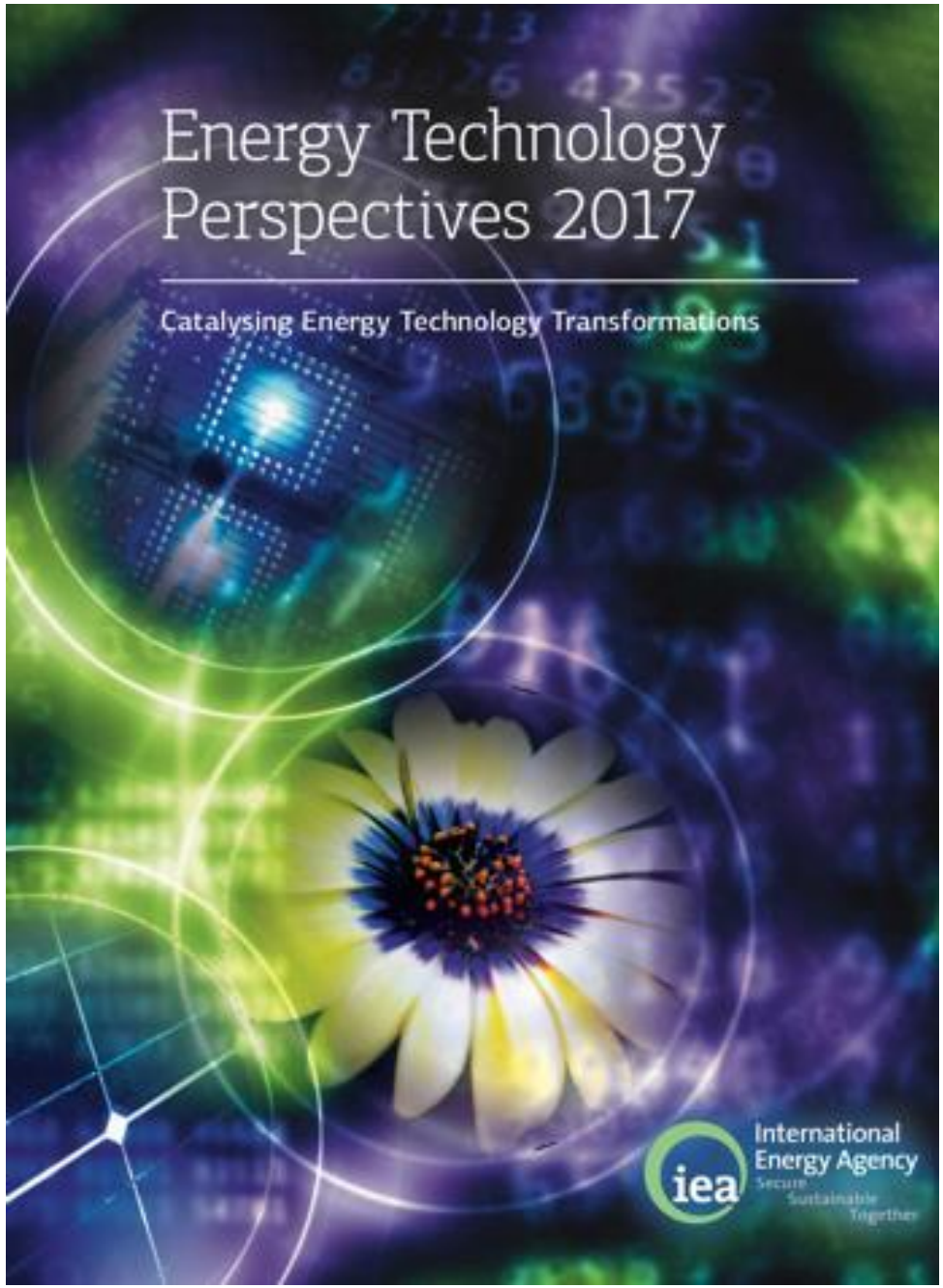
Figure 1. Proposed Subsea Pipeline Route*

* Only the Ishikari-Tomakomai section has onshore PL.

Estimated volume of 8bcm pa

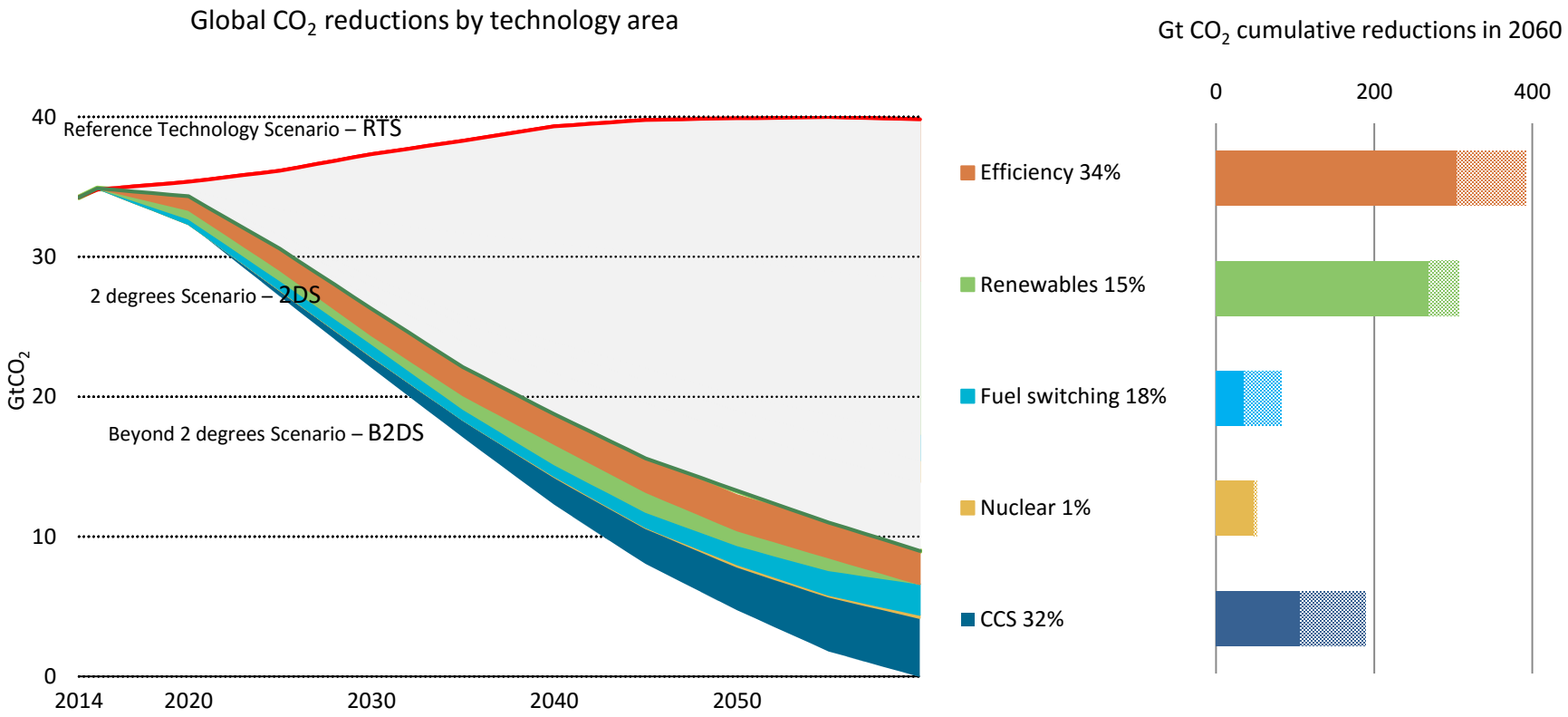
Energy Technology Perspectives 2017

Catalysing Energy Technology Transformations



How far can technology take us?

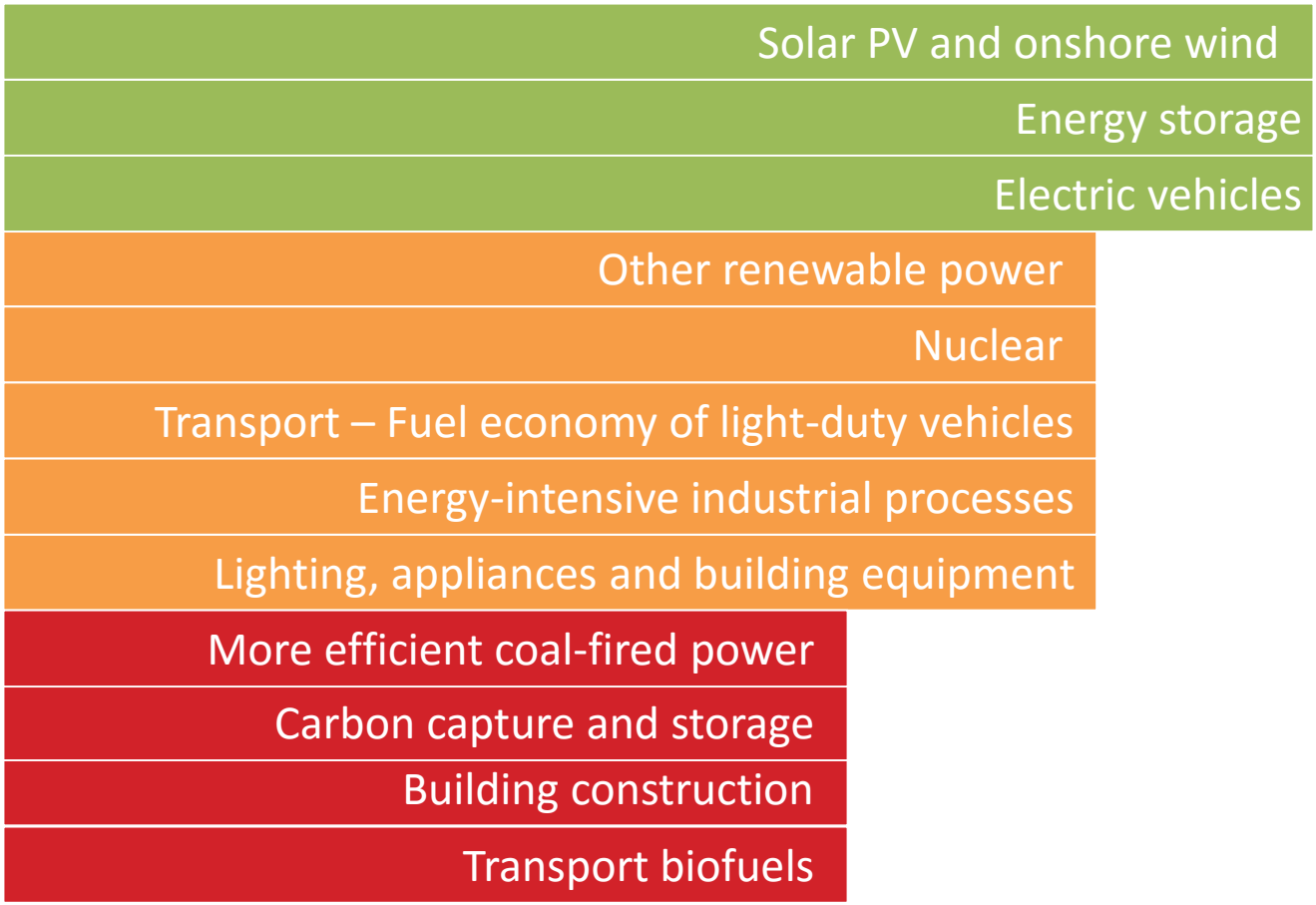
Technology area contribution to global cumulative CO_2 reductions



ETP2017

Pushing energy technology to achieve carbon neutrality by 2060 could meet the mid-point of the range of ambitions expressed in Paris

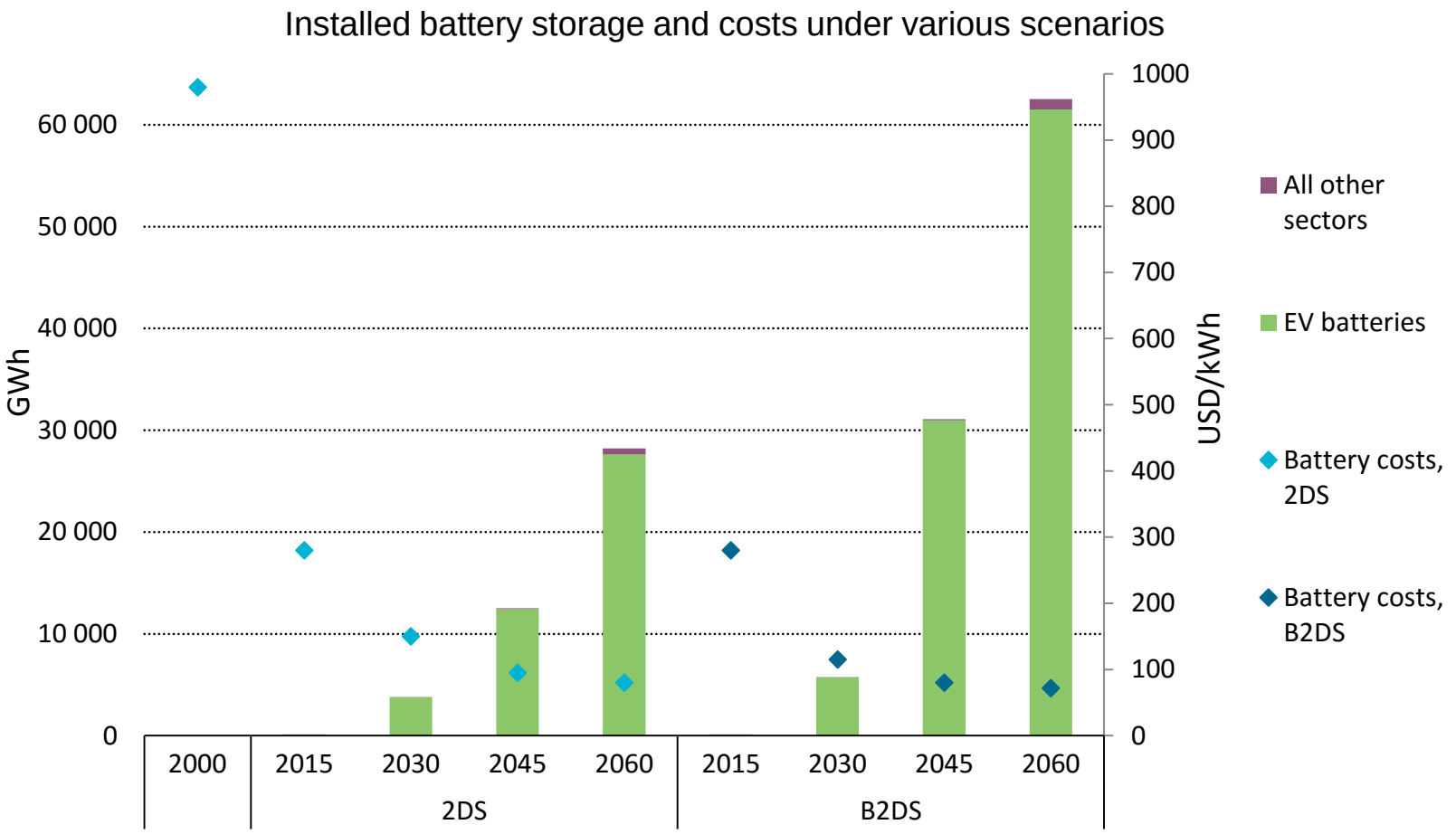
The potential of clean energy technology remains under-utilised



ETP2017

Recent progress in some clean energy areas is promising, but many technologies still need a strong push to achieve their full potential and deliver a sustainable energy future

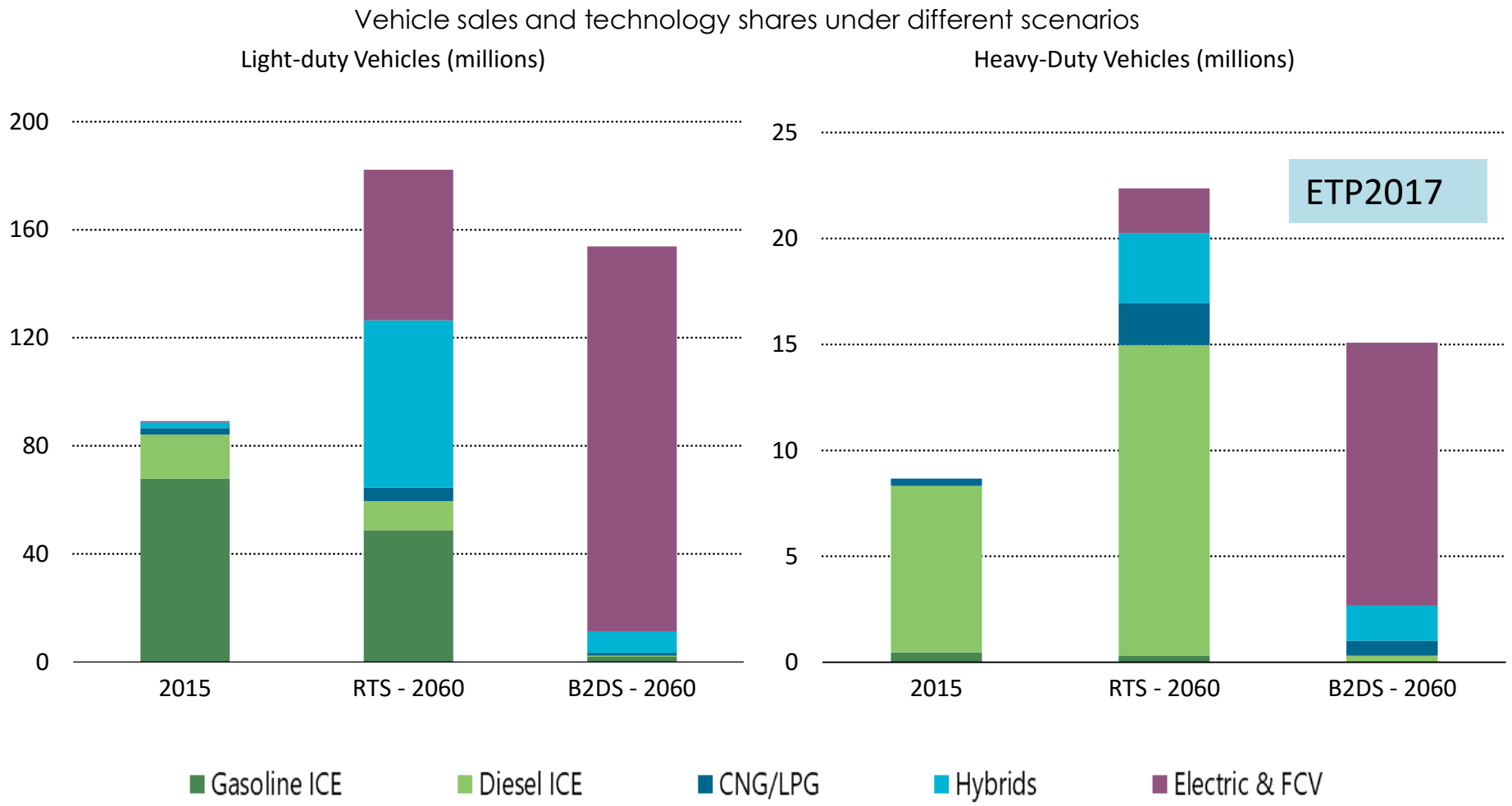
Can we enact a storage revolution



ETP2017

Batteries experience a huge scale-up in the B2DS, with EV battery markets leading other sectors in size

Can we change the landscape of transport ?



the B2DS would require strong policy signals, such as no emissions zone and bans on the sale of internal combustion engines (ICEs)

Challenge to Saudi Aramco: Is Peak Demand of Oil coming sooner?

WEO 2013

Figure 2.5 ▷ World primary energy demand by fuel in the New Policies Scenario

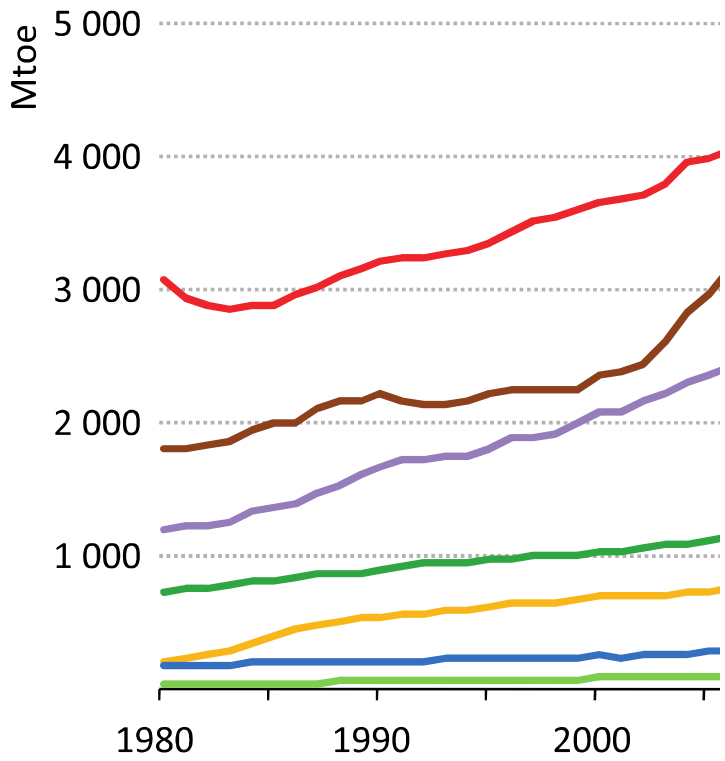
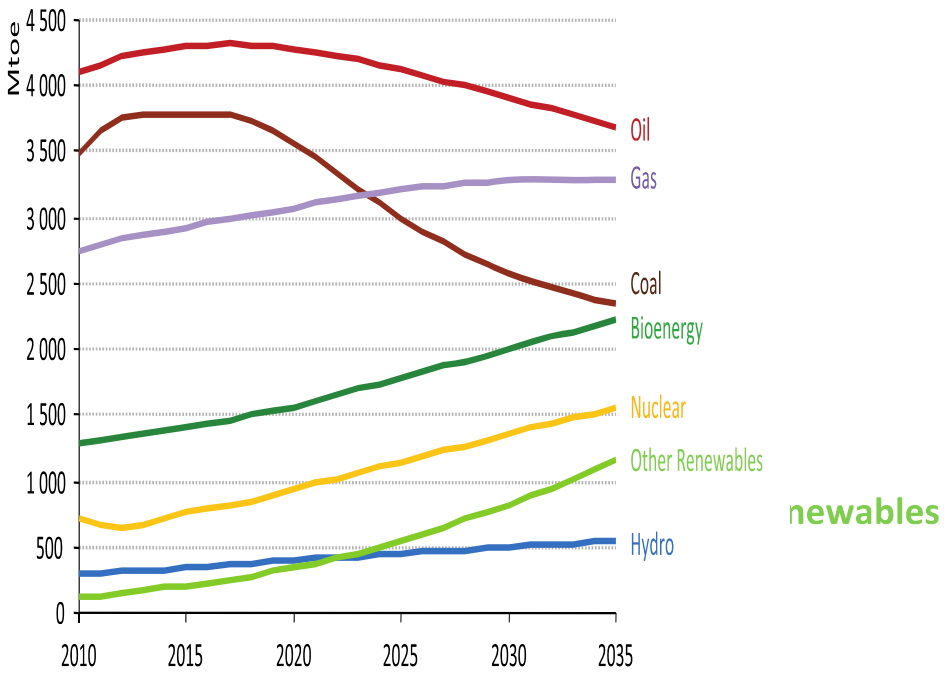


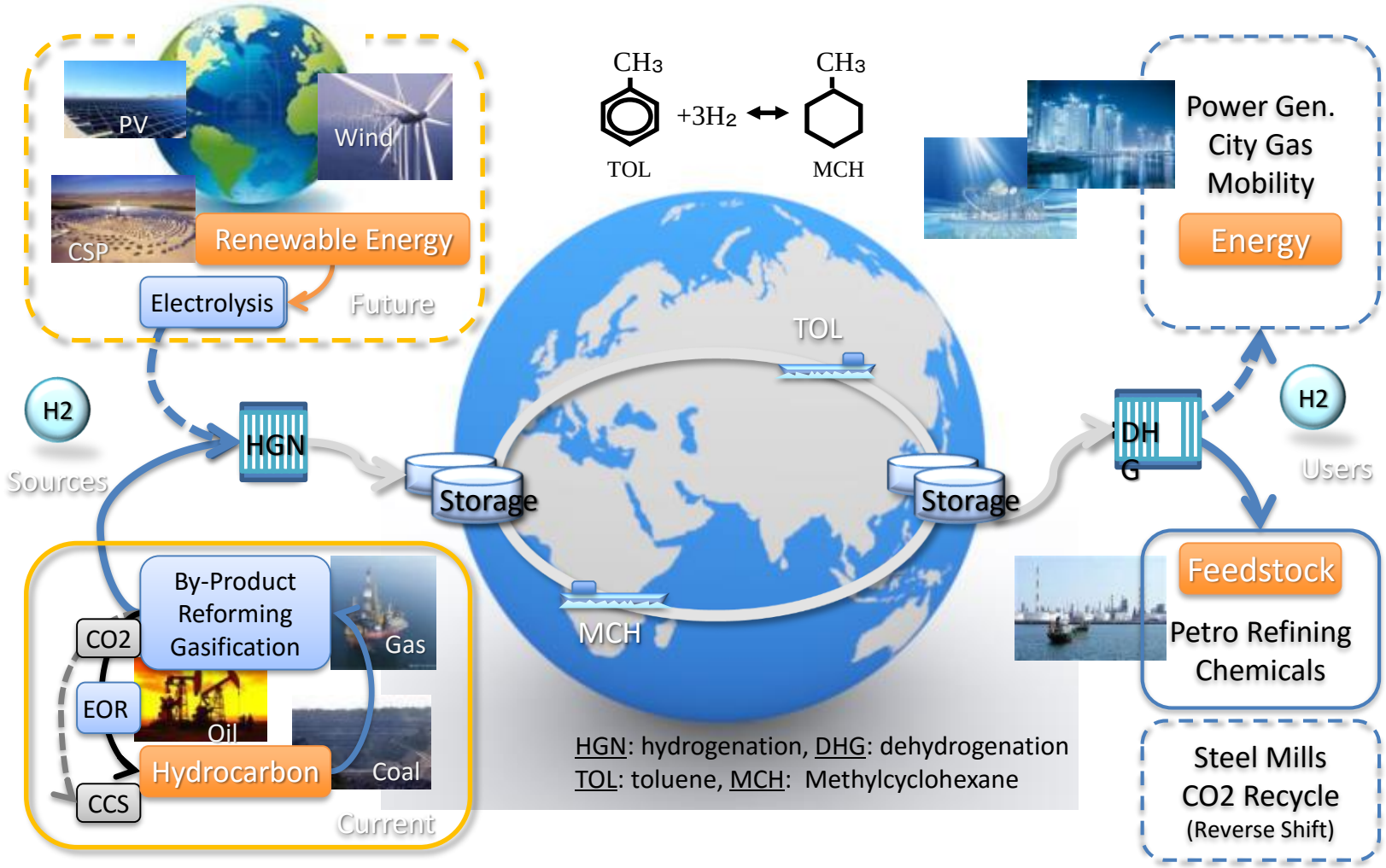
Figure 8.5 ▷ Primary energy demand in the 450 Scenario by fuel



The Stone Age didn't end because we ran out of stones.

Hydrogen as solution: Chiyoda's Supply Chain Proposal

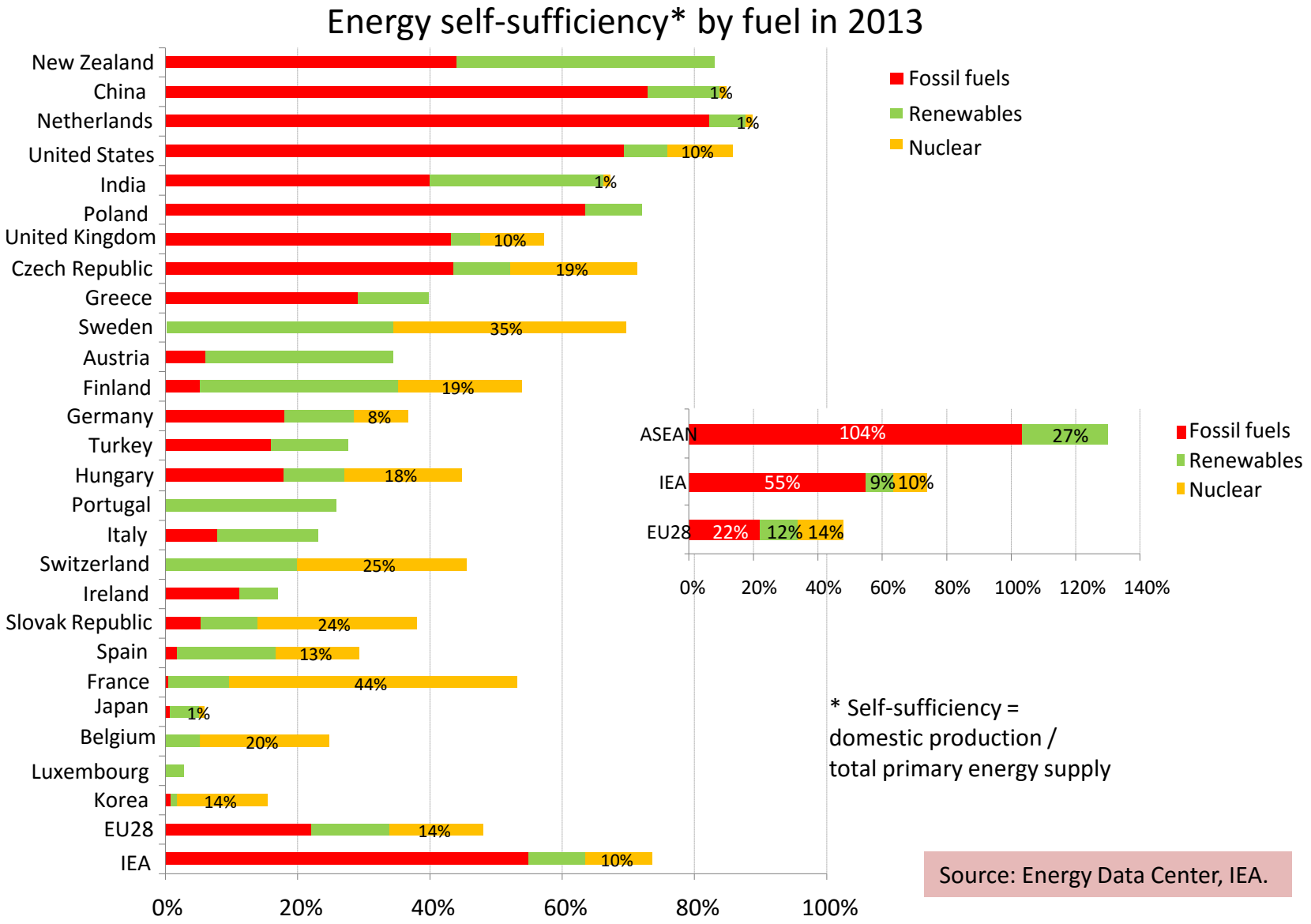
- Chiyoda established a complete system which enables economic H2 storage and transportation.
- MCH, an H2 carrier, stays in a liquid state under ambient conditions anywhere.



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

CHIYODA CORPORATION

Collective Energy Security and Sustainability by Diversity, Connectivity and Nuclear

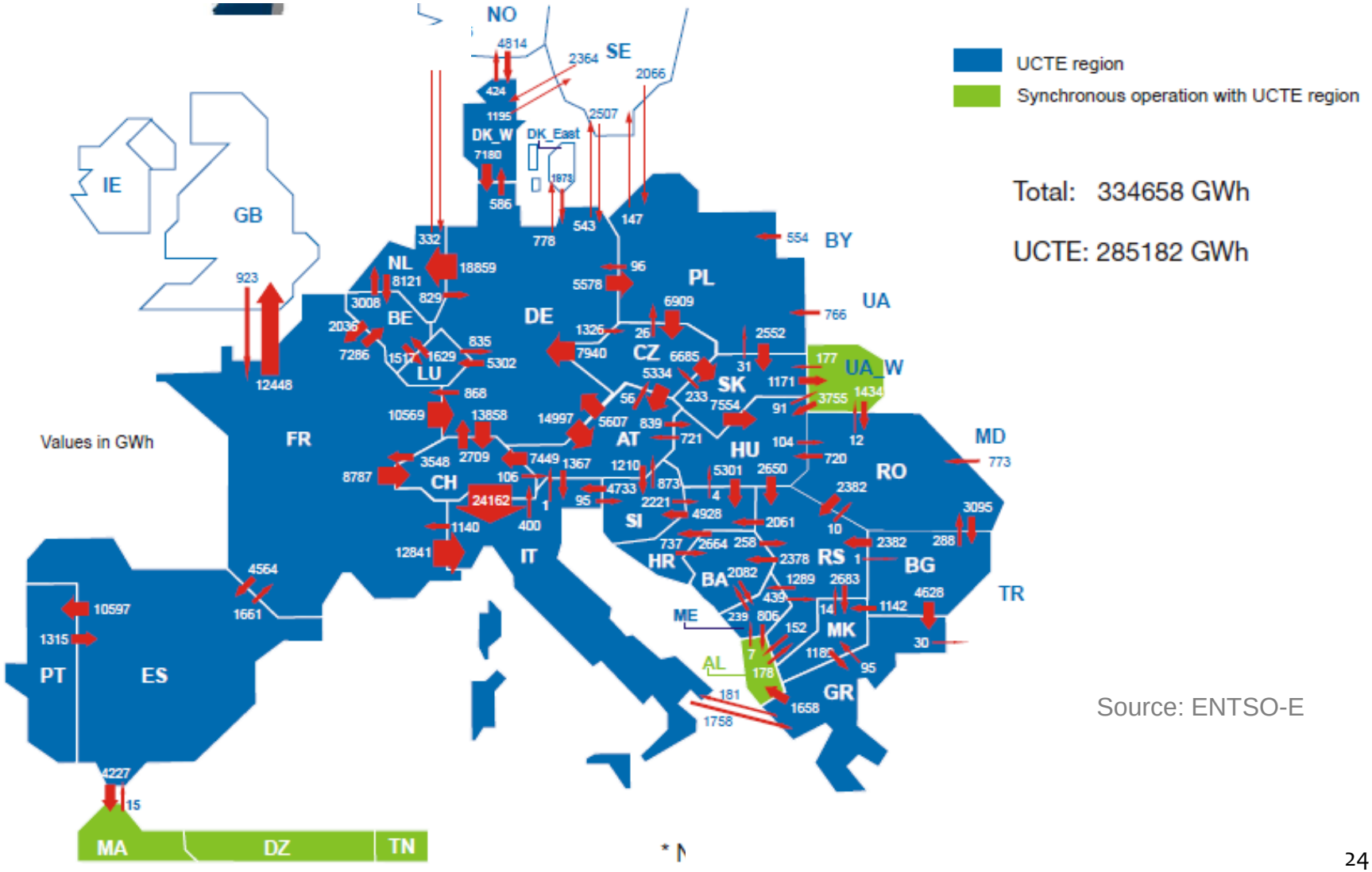


Source: Energy Data Center, IEA.

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

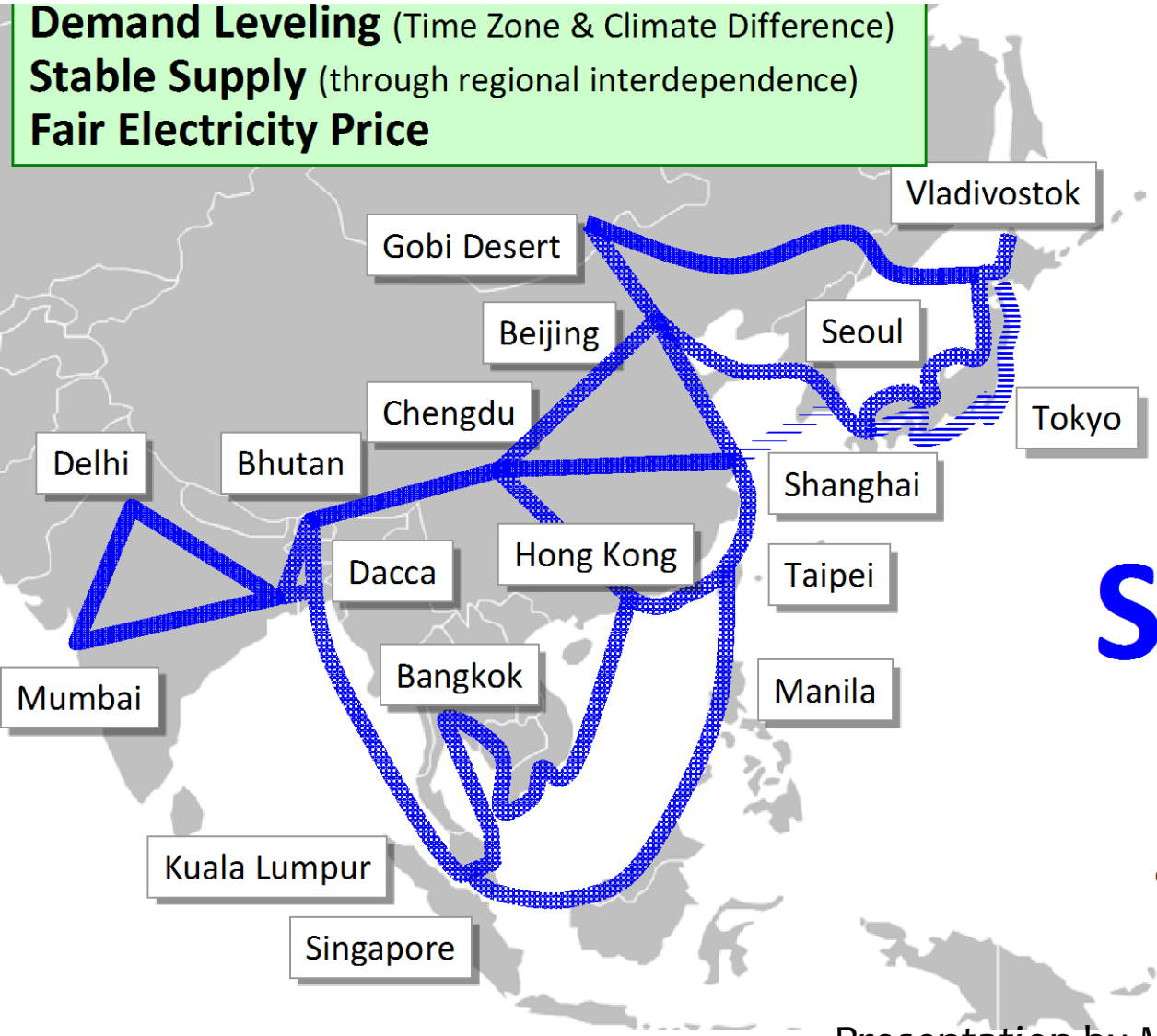
Power Grid Connection in Europe: Collective Energy Security and Sustainability

Physical energy flows between European countries, 2008 (GWh)



“Energy for Peace in Asia” New Vision?

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



Phase 3

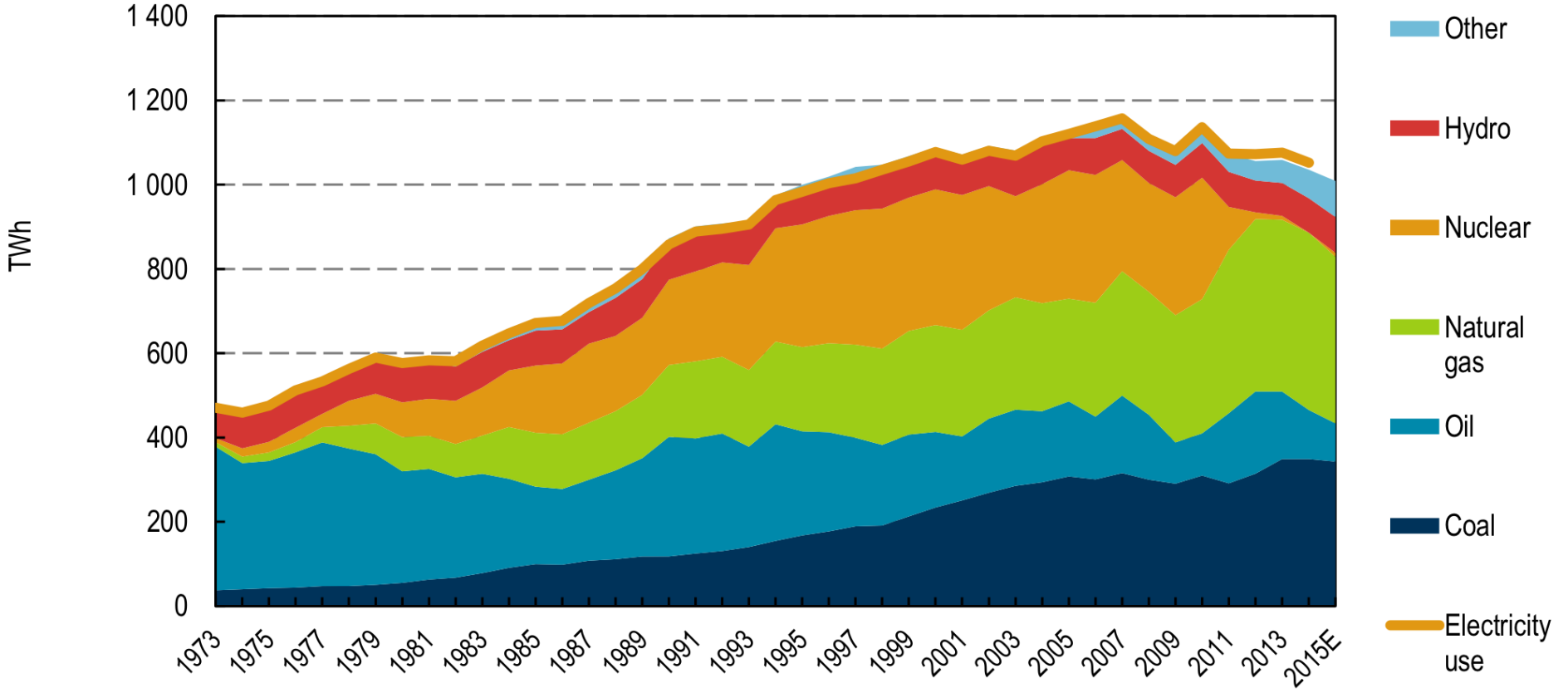
Asia Super Grid

Total 36,000km

Presentation by Mr. Masayoshi SON

Historical Trend of Power Mix in Japan

Figure 3 • Electricity generation in Japan, 1973-2015

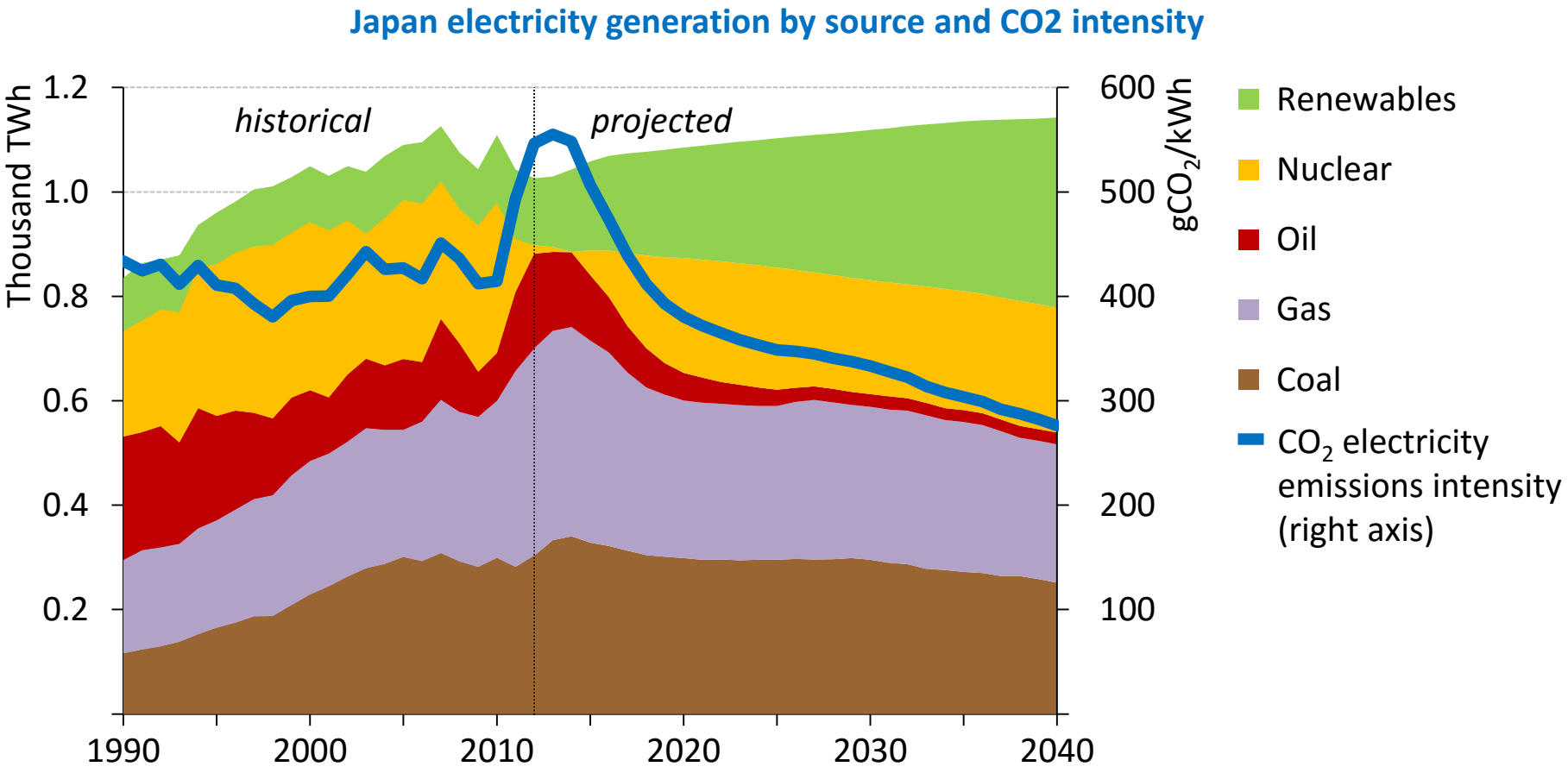


Note: E = estimate.

Source: IEA (2016d), *Electricity Information*, (database), www.iea.org/statistics/.

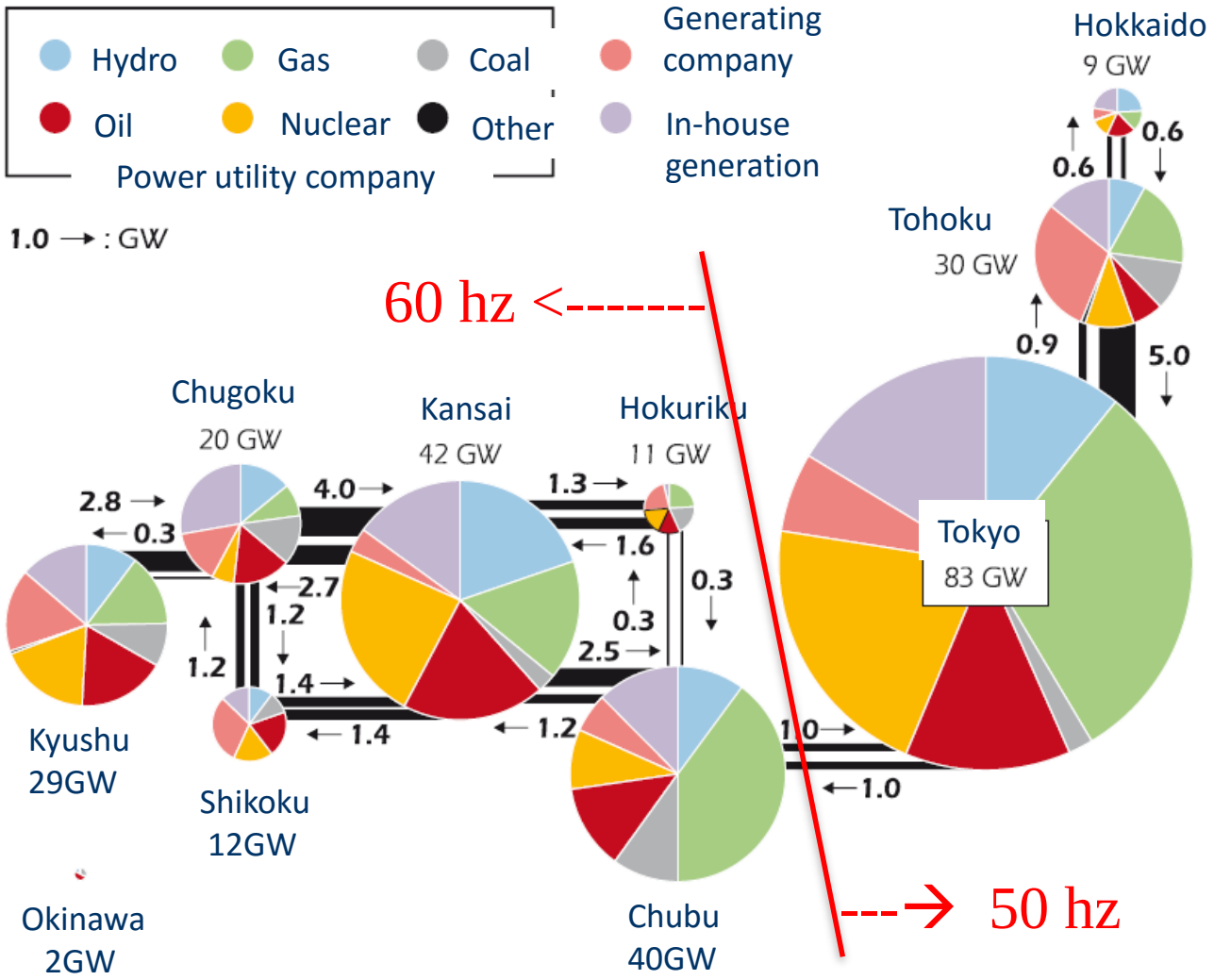
Japan's power system: moving to a more diverse & sustainable mix

WEO2014



With nuclear plants expected to restart & increased use of renewables, Japan's electricity mix becomes much more diversified by 2040 (Renewables 32%, Nuclear 21%, gas 23%, coal 22%)

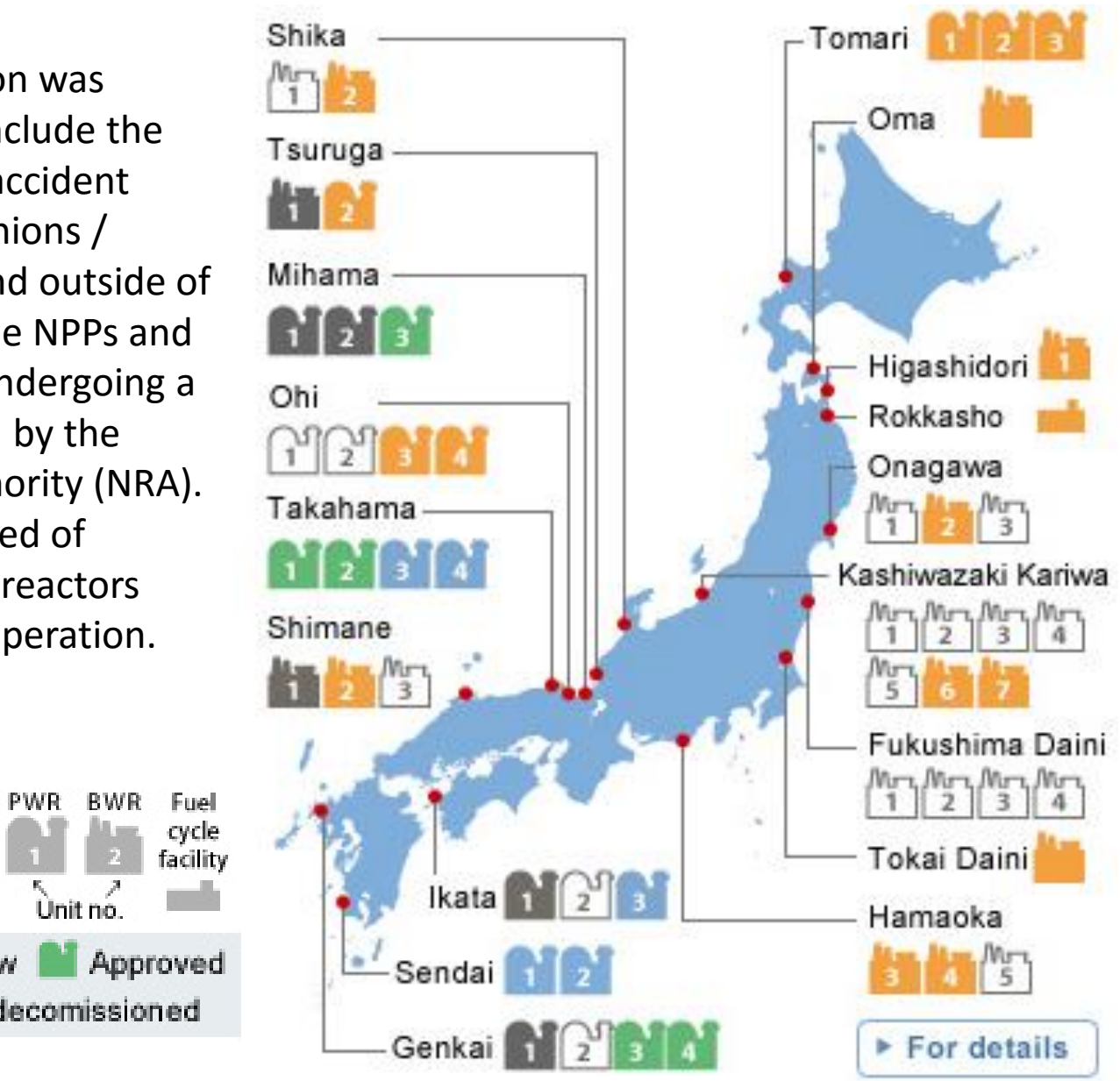
Lack of Grid connectivity in Japan

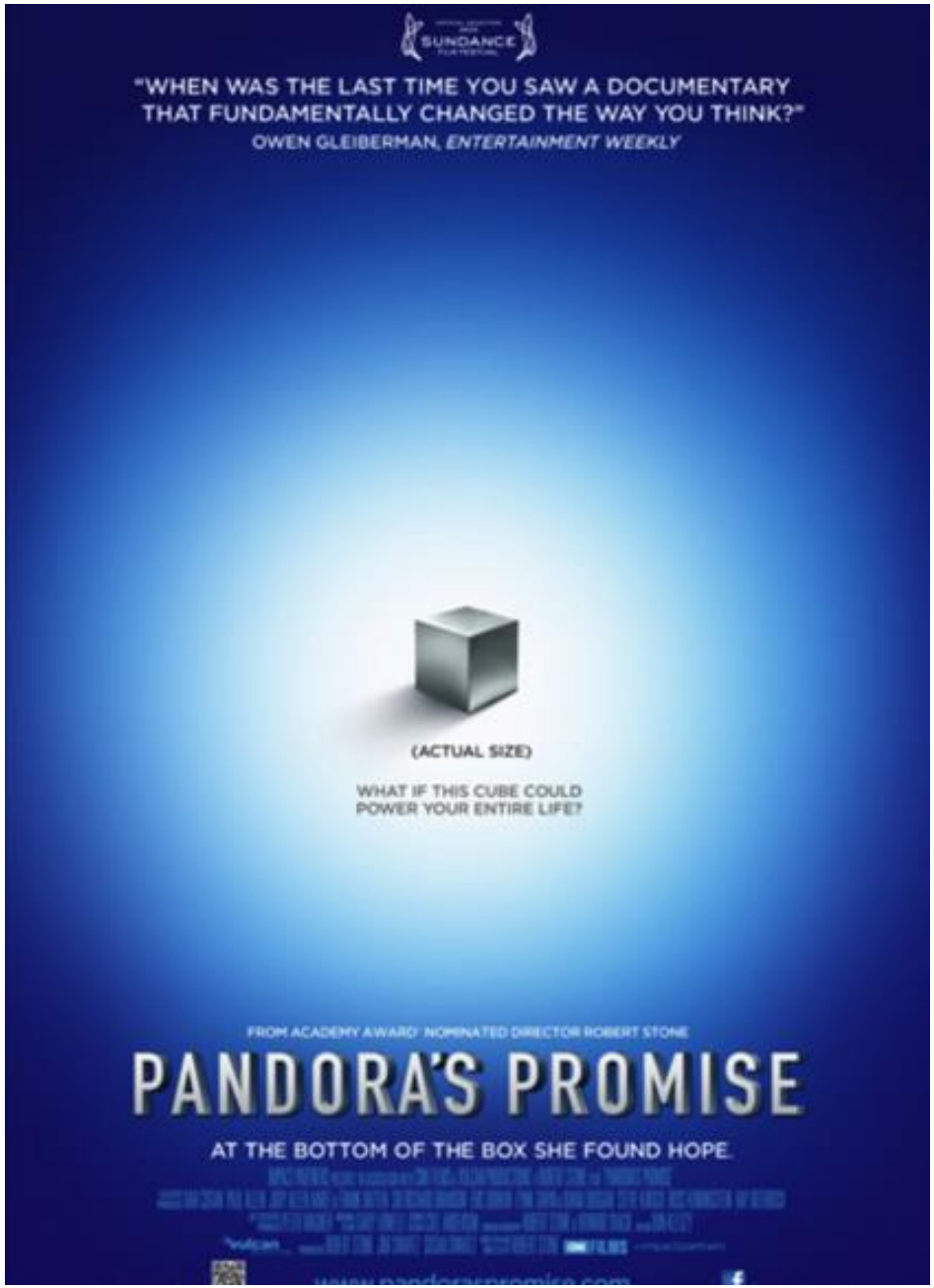


Source: Agency for Natural Resources and Energy, The Federation of Electric Power Companies of Japan, Electric Power System Council of Japan, The International Energy Agency

Licensing status of the Japanese nuclear facilities

The new safety regulation was established in 2013 to include the Fukushima Daiichi NPP accident lessons learned and opinions / proposals from inside and outside of Japan. Currently, multiple NPPs and fuel cycle facilities are undergoing a safety review conducted by the Nuclear Regulation Authority (NRA). 10 reactors have approved of restarting by NRA and 5 reactors have already restarted operation.

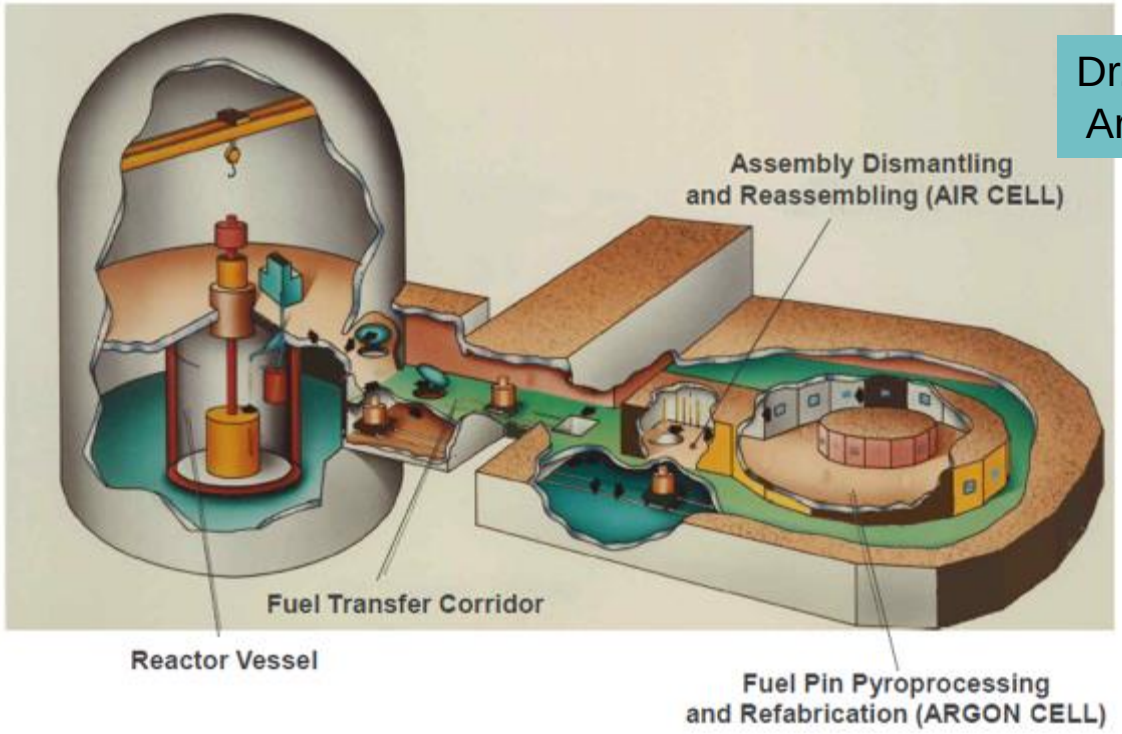




"Pandora's Promise", a movie directed by Robert Stone, is a documentary of environmentalists who changed their views about Nuclear Power.
IFR (EBR2) story comes up as missed opportunity.

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

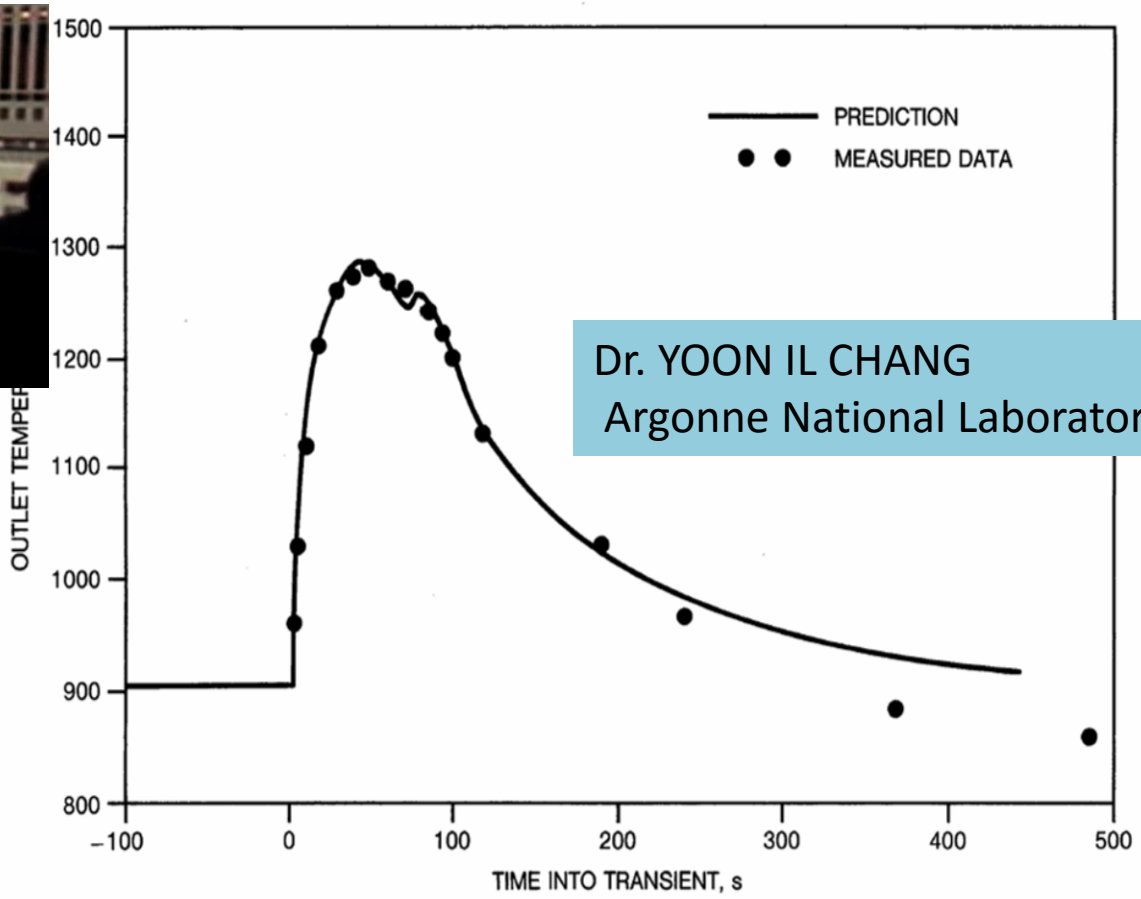


Dr. YOON IL CHANG
Argonne National Laboratory

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

Passive Safety was proven by the 1986 Experiment very similar to the Fukushima event.

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



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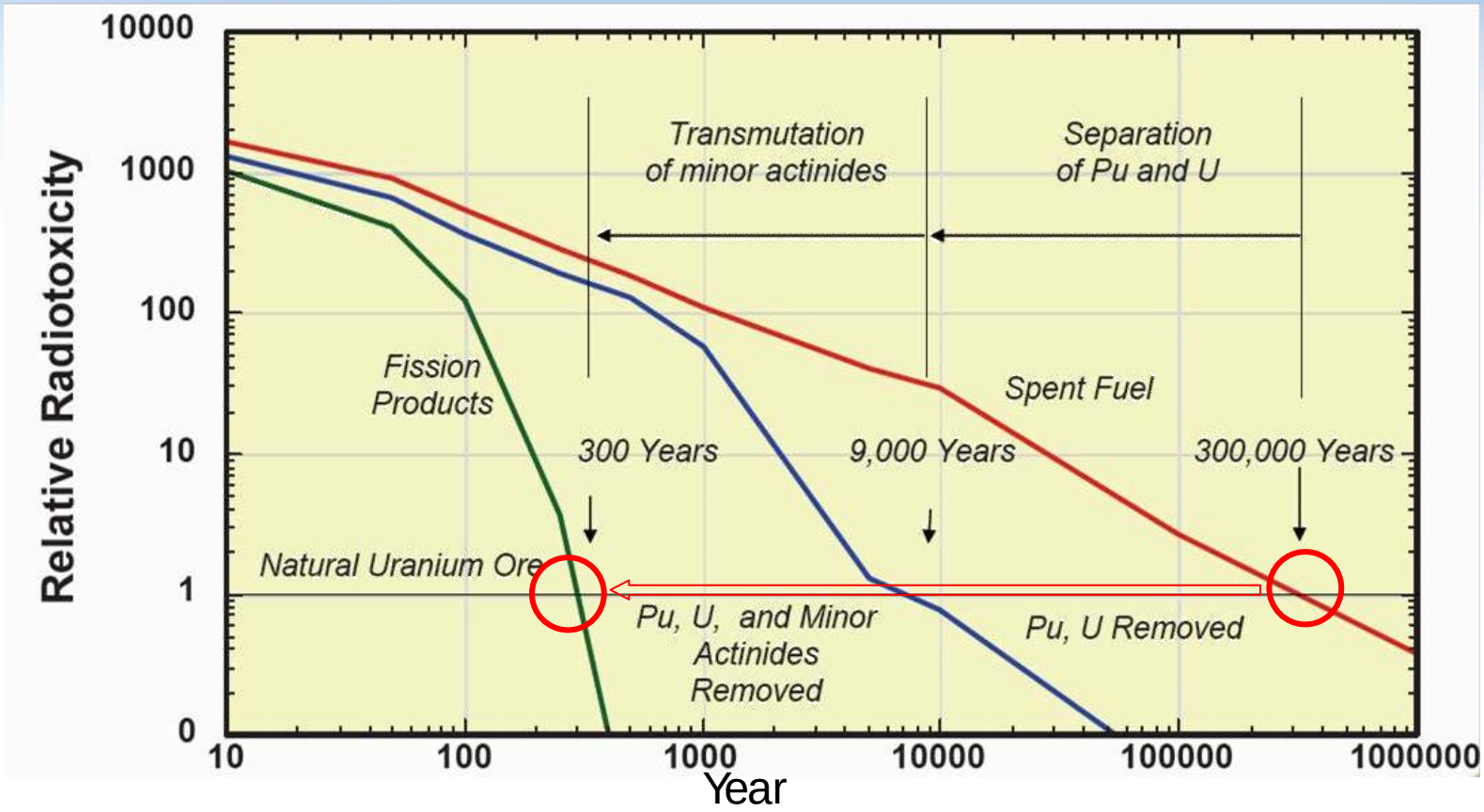
Argonne National Laboratory

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

Does Japan desire to continue to be a tier-one nation, or is she content to drift into tier-two status?

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.

Statement by Dr. Takashi NAGAI after Nagasaki atomic bomb. "How to turn the devil to the fortune."

Dr. Takashi Nagai, a Professor at Nagasaki University in 1945 when the atomic bomb was dropped, exemplifies the resilience, courage and believe in science of the Japanese people. Despite having a severed temporal artery as a result of the bomb, he went to help the victims even before going home. Once he got home, he found his house destroyed and his wife dead. He spent weeks in the hospital where he nearly died from his injuries. But just months after the atom bomb dropped, he said:

"Everything was finished. Our mother land was defeated. Our university had collapsed and classrooms were reduced to ashes. We, one by one, were wounded and fell. The houses we lived in were burned down, the clothes we wore were blown up, and our families were either dead or injured. What are we going to say? We only wish to never repeat this tragedy with the human race. We should utilize the principle of the atomic bomb. Go forward in the research of atomic energy contributing to the progress of civilization. Devil will then be transformed to fortune.(Wazawai tenjite Fukutonasu) The world civilization will change with the utilization of atomic energy. If a new and fortunate world can be made, the souls of so many victims will rest in peace."