



Shale Revolution and Energy Security for Asia / APEC in the 21st Century

APERC Annual Conference 2013

February 27th, 2013, Tokyo

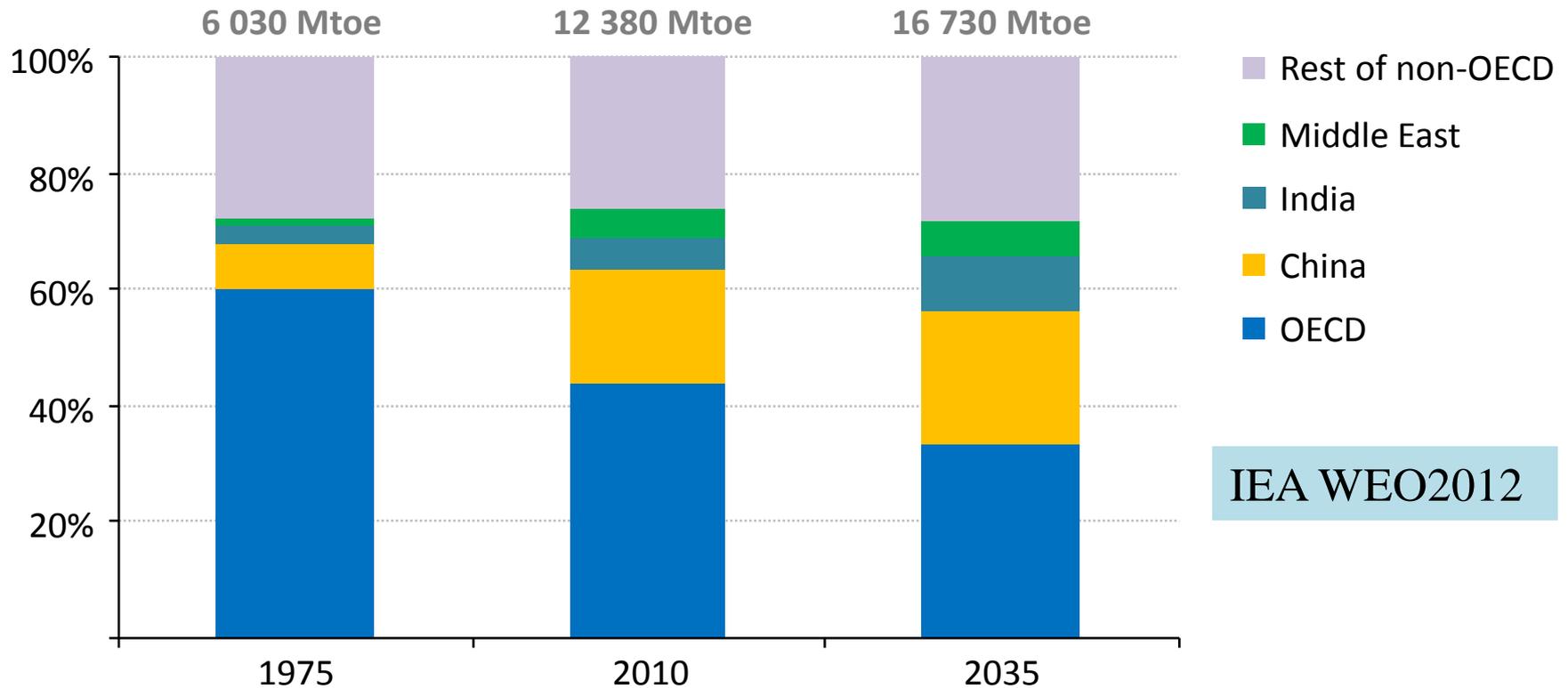
Nobuo TANAKA

Former Executive Director of the IEA

Global Associate of Energy Security and Sustainability, IEEJ

Emerging economies steer energy markets

Share of global energy demand



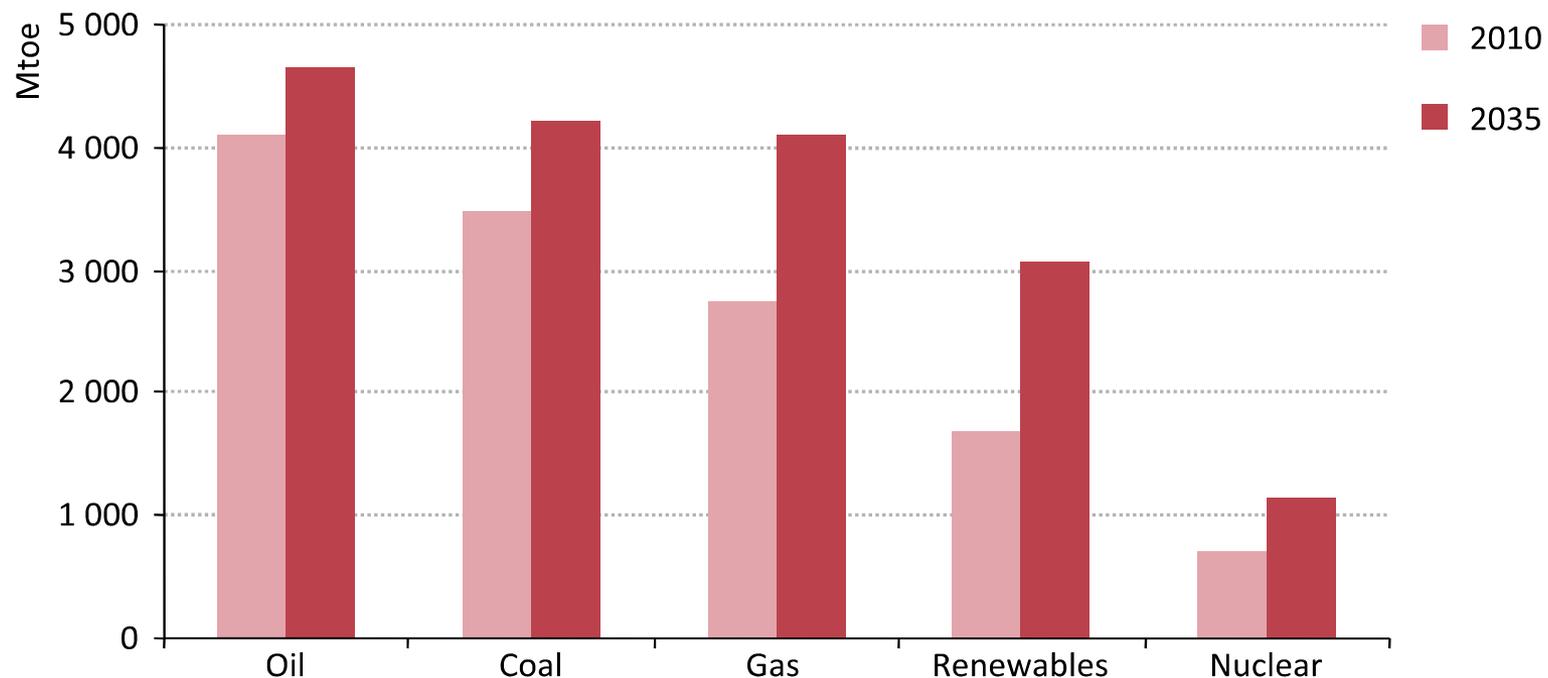
IEA WEO2012

Global energy demand rises by over one-third in the period to 2035, underpinned by rising living standards in China, India & the Middle East

Primary Energy Demand by Fuel

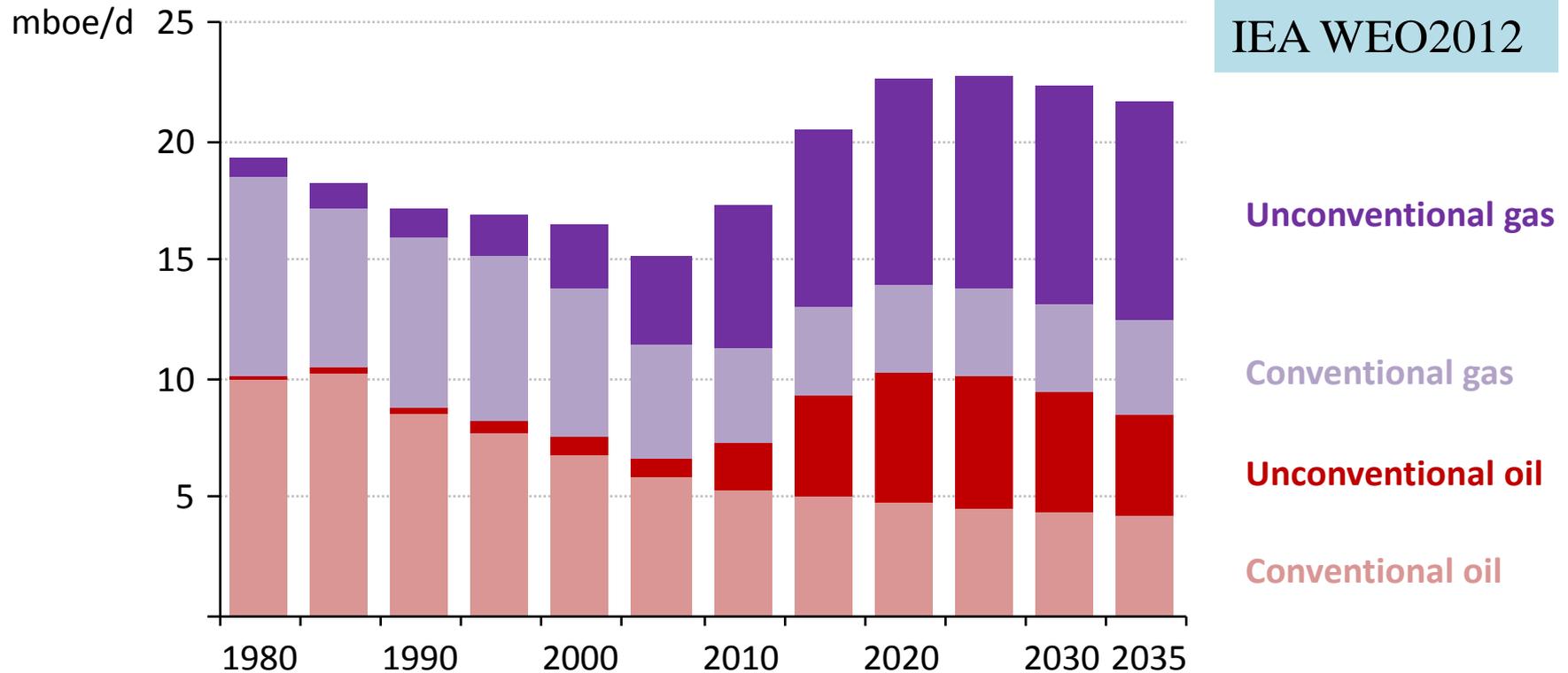
IEA WEO2012

Figure 2.3 ▶ World primary energy demand by fuel in the New Policies Scenario



A United States oil & gas transformation

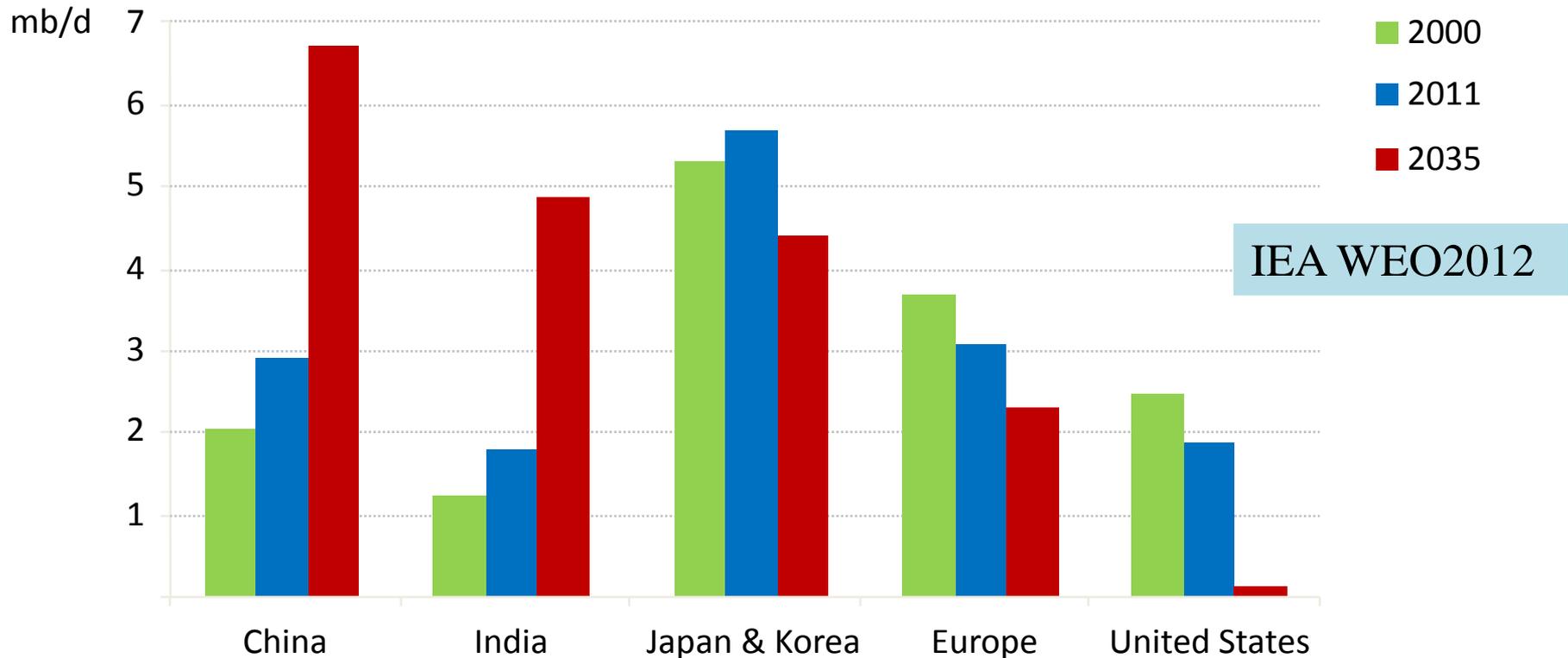
US oil and gas production



The surge in unconventional oil & gas production has implications well beyond the United States

Middle East oil to Asia: a new Energy Silk Road

Middle East oil export by destination

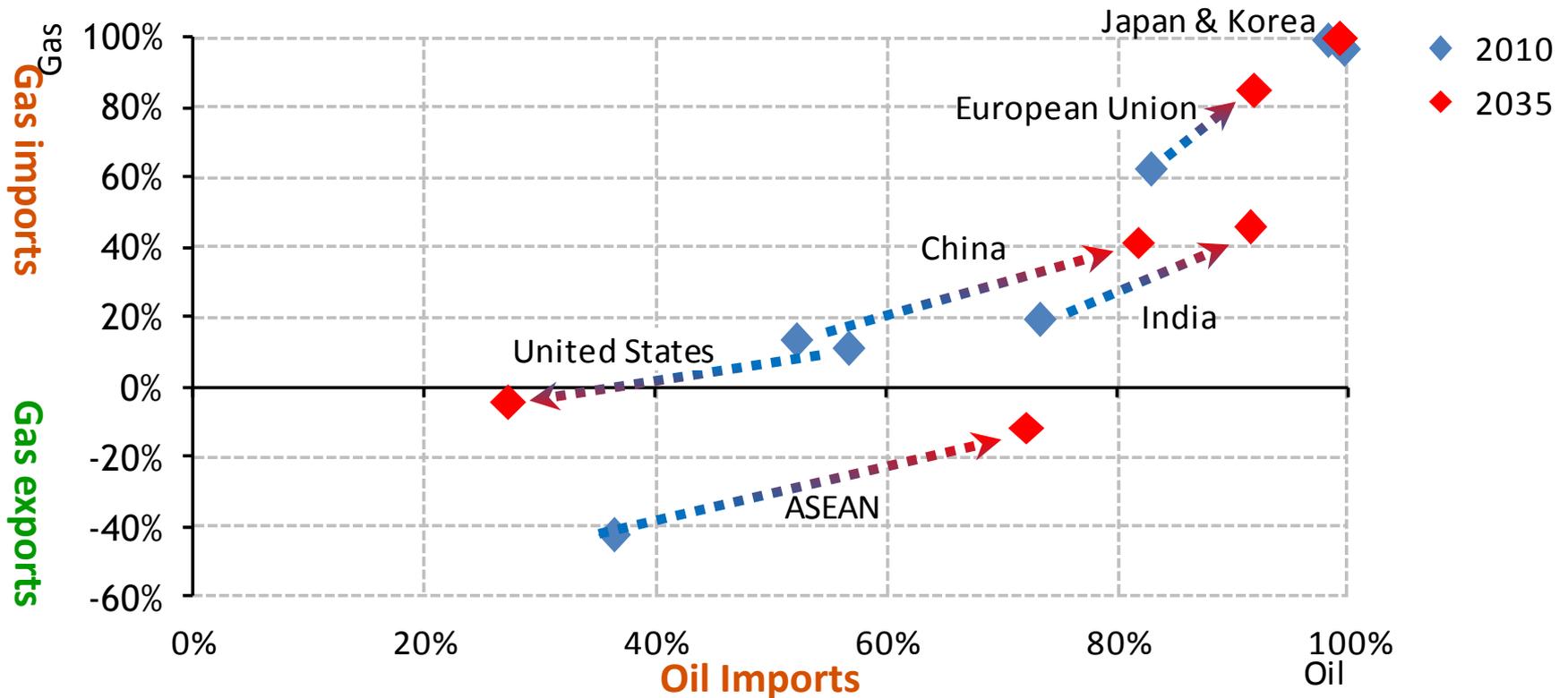


By 2035, almost 90% of Middle Eastern oil exports go to Asia; North America's emergence as a net exporter accelerates the eastward shift in trade

Different trends in oil & gas import dependency

IEA WEO 2012

Net oil & gas import dependency in selected countries

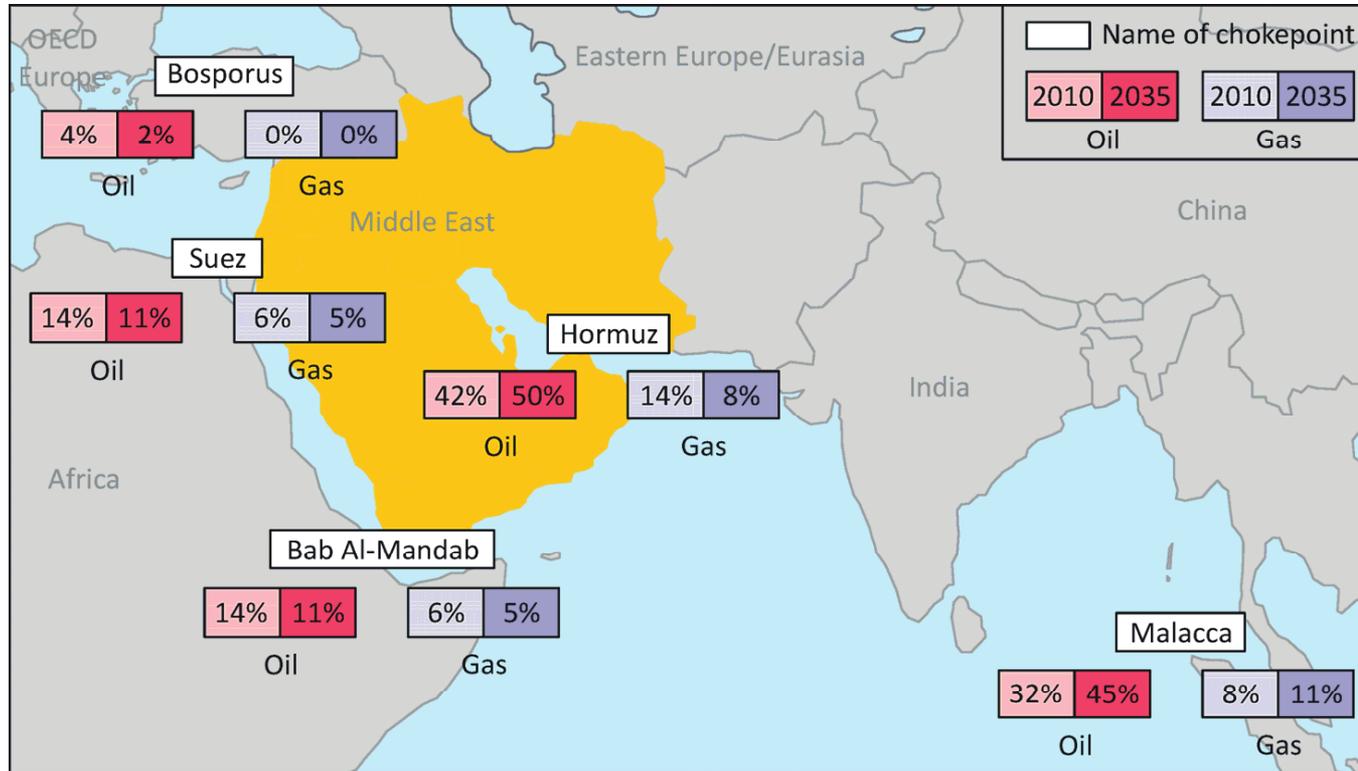


While dependence on imported oil & gas rises in many countries, the United States swims against the tide

Choke Points of New Energy Silk Road

IEA WEO2012

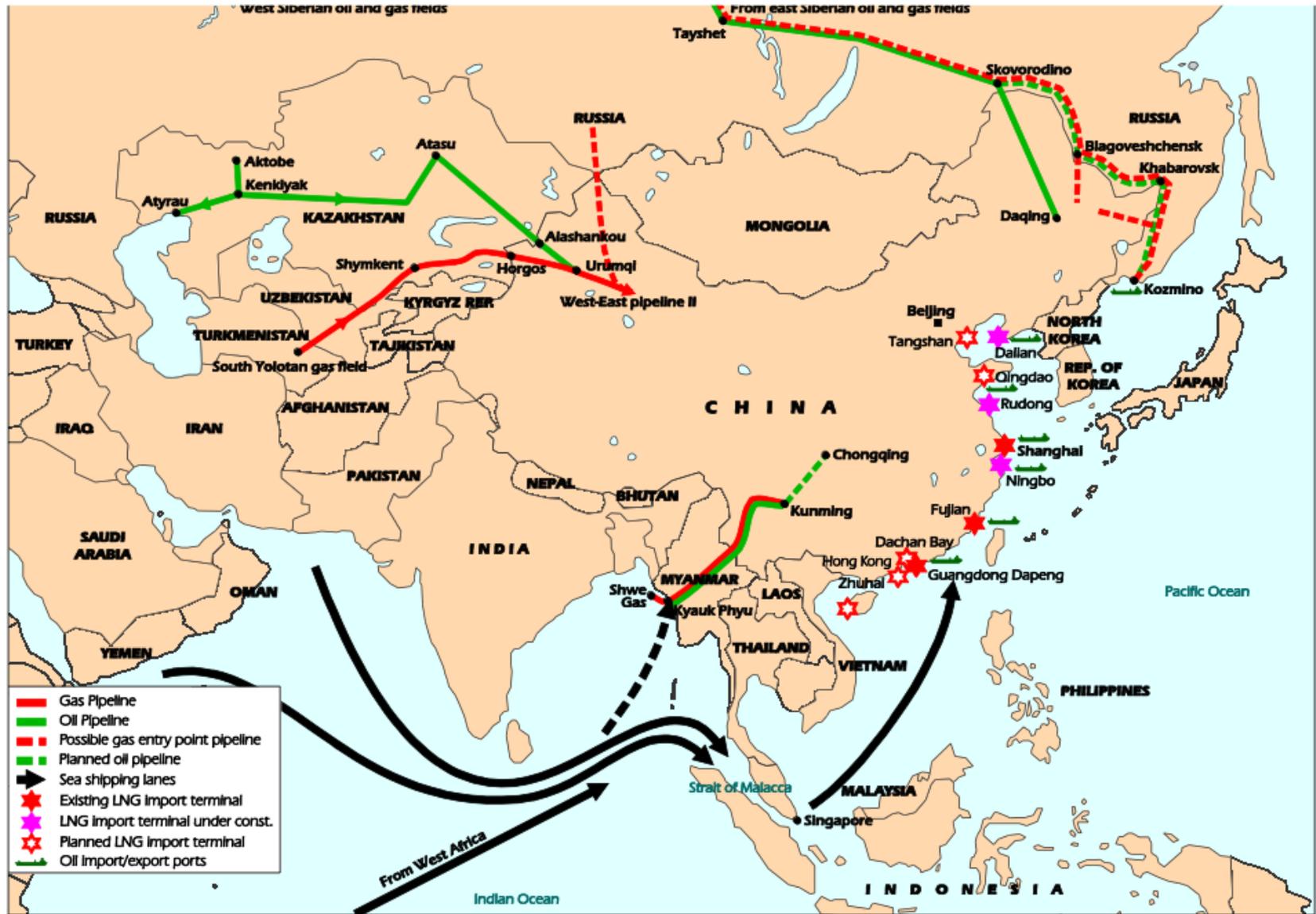
Figure 2.18 ▶ Share of inter-regional oil and gas trade through key choke points in the New Policies Scenario



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.

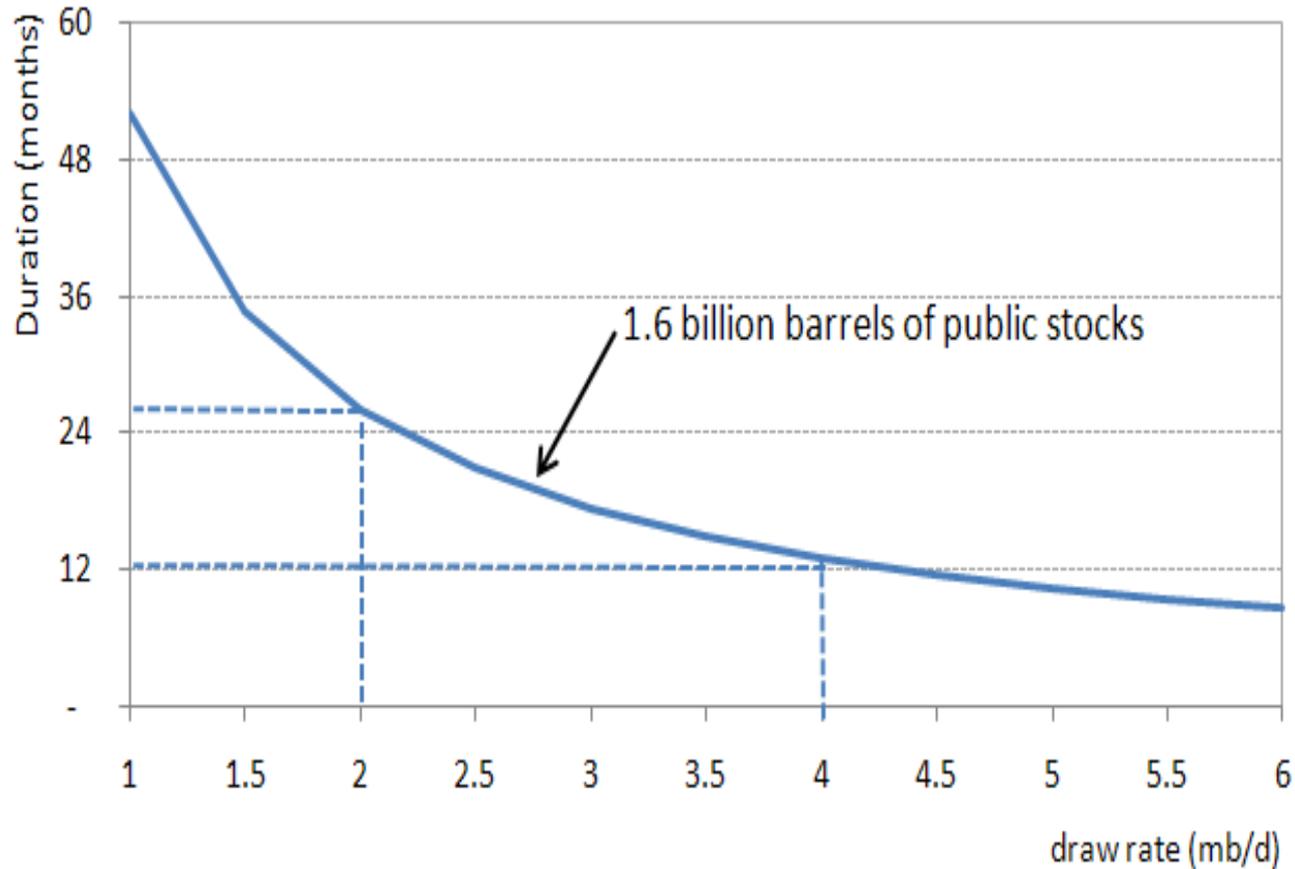
Note: Data is based on the volumes for which going through the chokepoints would be the shortest route; in reality not all trade takes (nor will take) the shortest route as other factors may result in flows in directions that are not consistent with relative transport costs. The above data include flows going through pipelines by-passing the chokepoints and not just those going through the shipping lanes.

Current and Future routes of China's Importation of Oil and Gas



Overseas Investments by Chinese National Oil Companies: Assessing the Drivers and Impacts

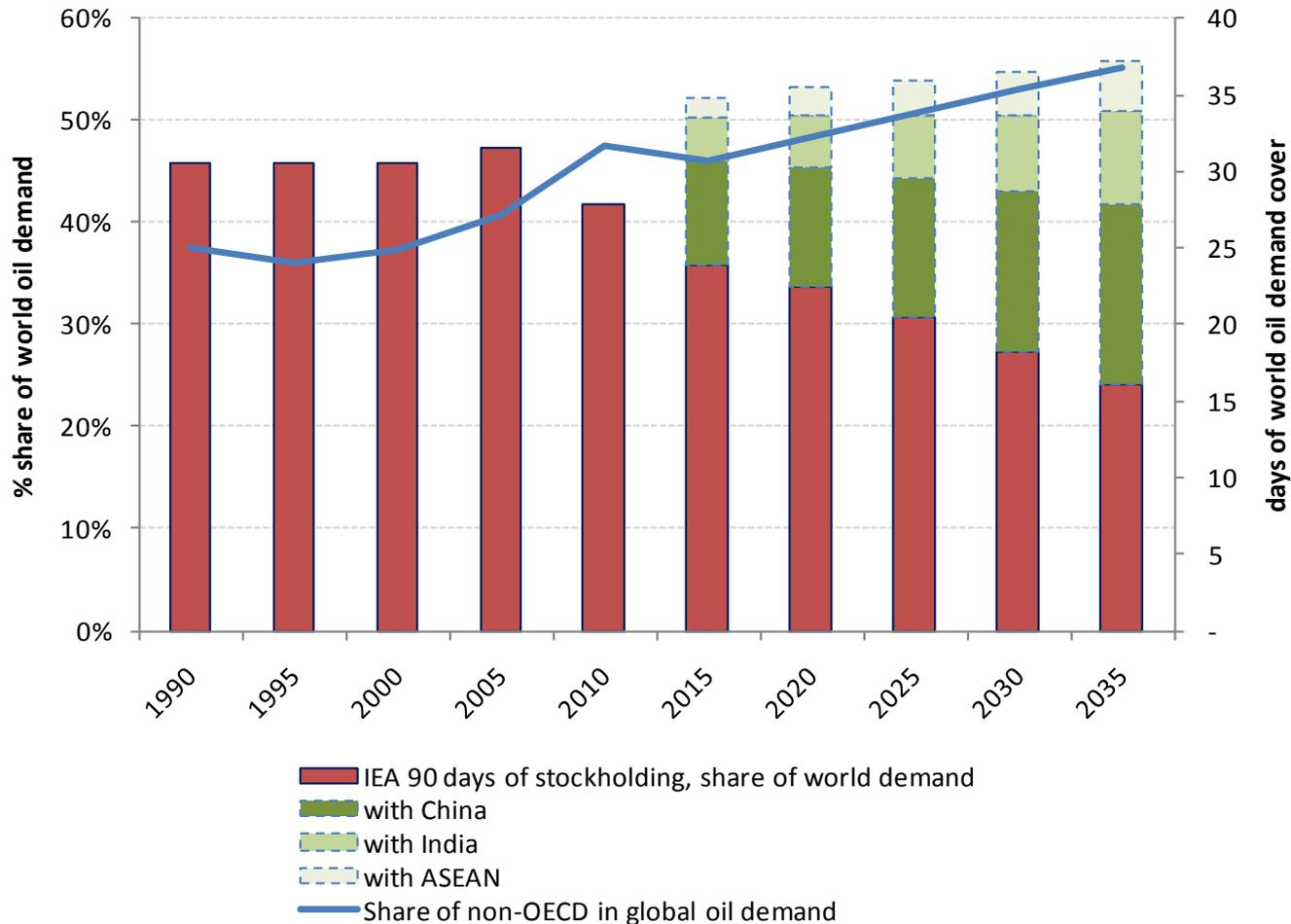
IEA Petroleum Strategic Stock can relieve 2mbd disruption for 24 months.



1974 disruption was 4.3mbd. 1979 was 5.6mbd. Hormuz blockage is 13 mbd.

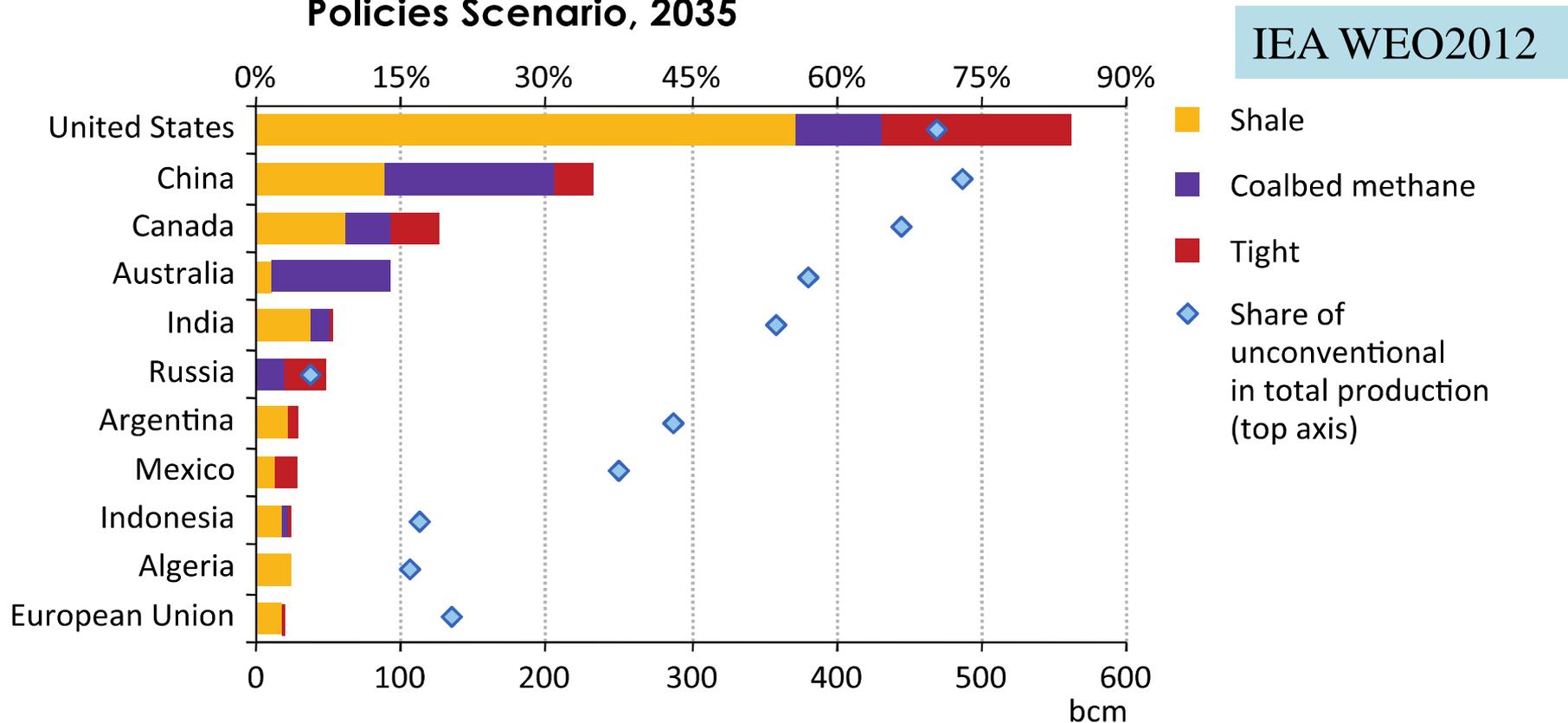
Strategic Petroleum Reserve: Does the current IEA system continue to work?

IEA stockholding cover of global oil demand



Golden Age for Natural Gas?

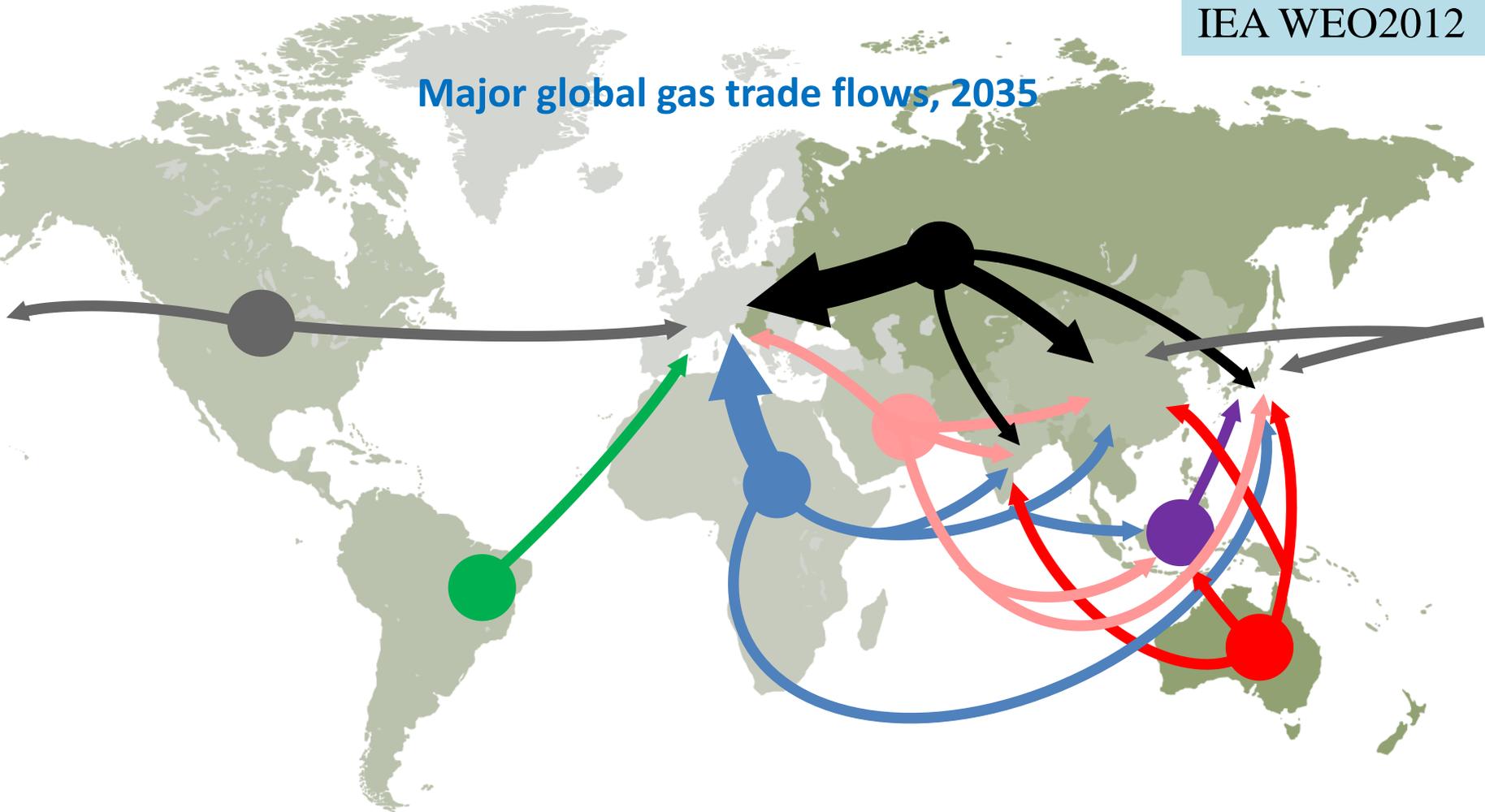
Figure 4.5 ▶ Unconventional gas production in leading countries in the New Policies Scenario, 2035



Natural gas: towards a globalised market

IEA WEO2012

Major global gas trade flows, 2035



Rising supplies of unconventional gas & LNG help to diversify trade flows, putting pressure on conventional gas suppliers & oil-linked pricing mechanisms

Russia goes to East : Russian Natural Gas Pipelines

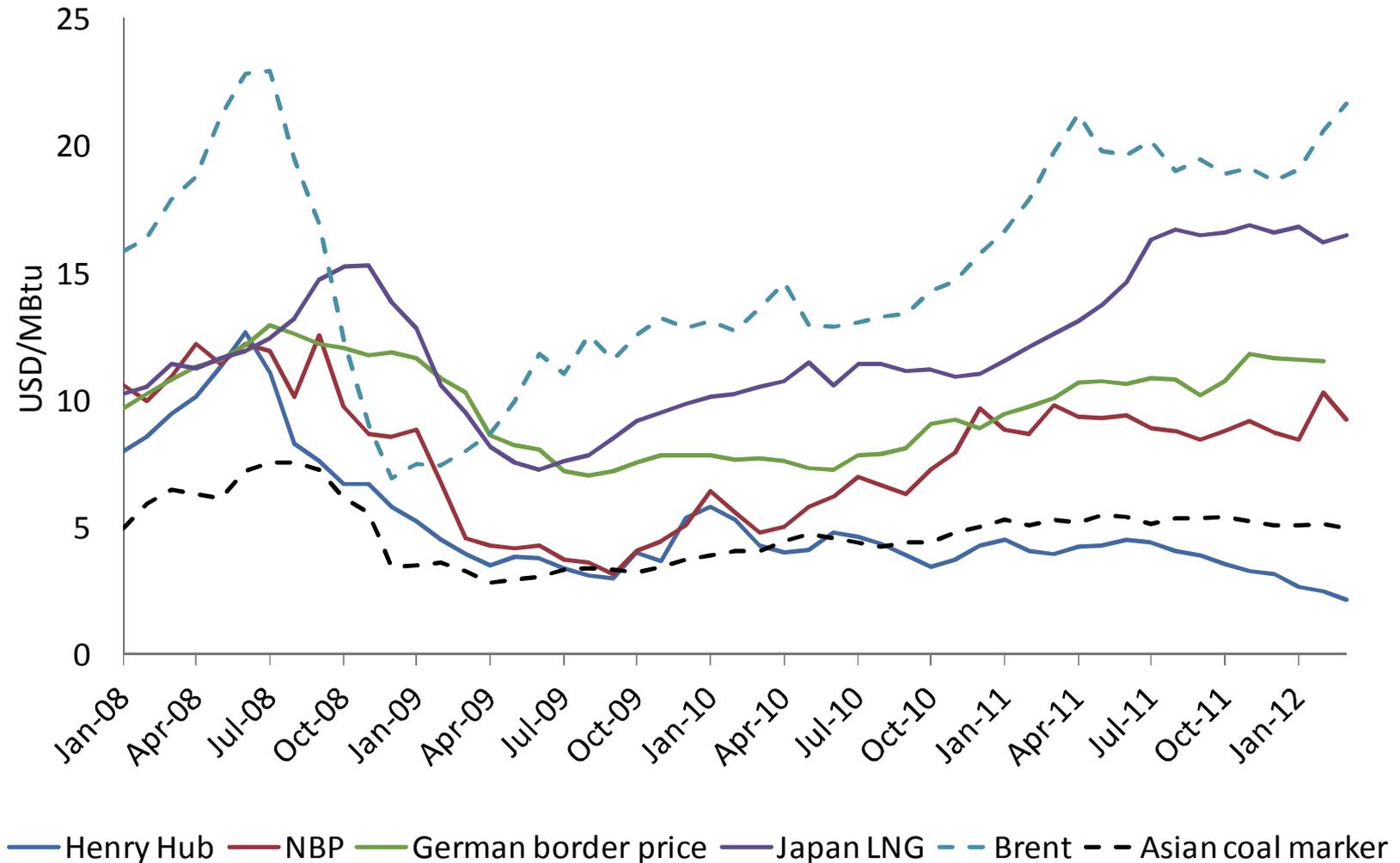
Figure 8.15 • Major gas fields and supply infrastructure in Russia



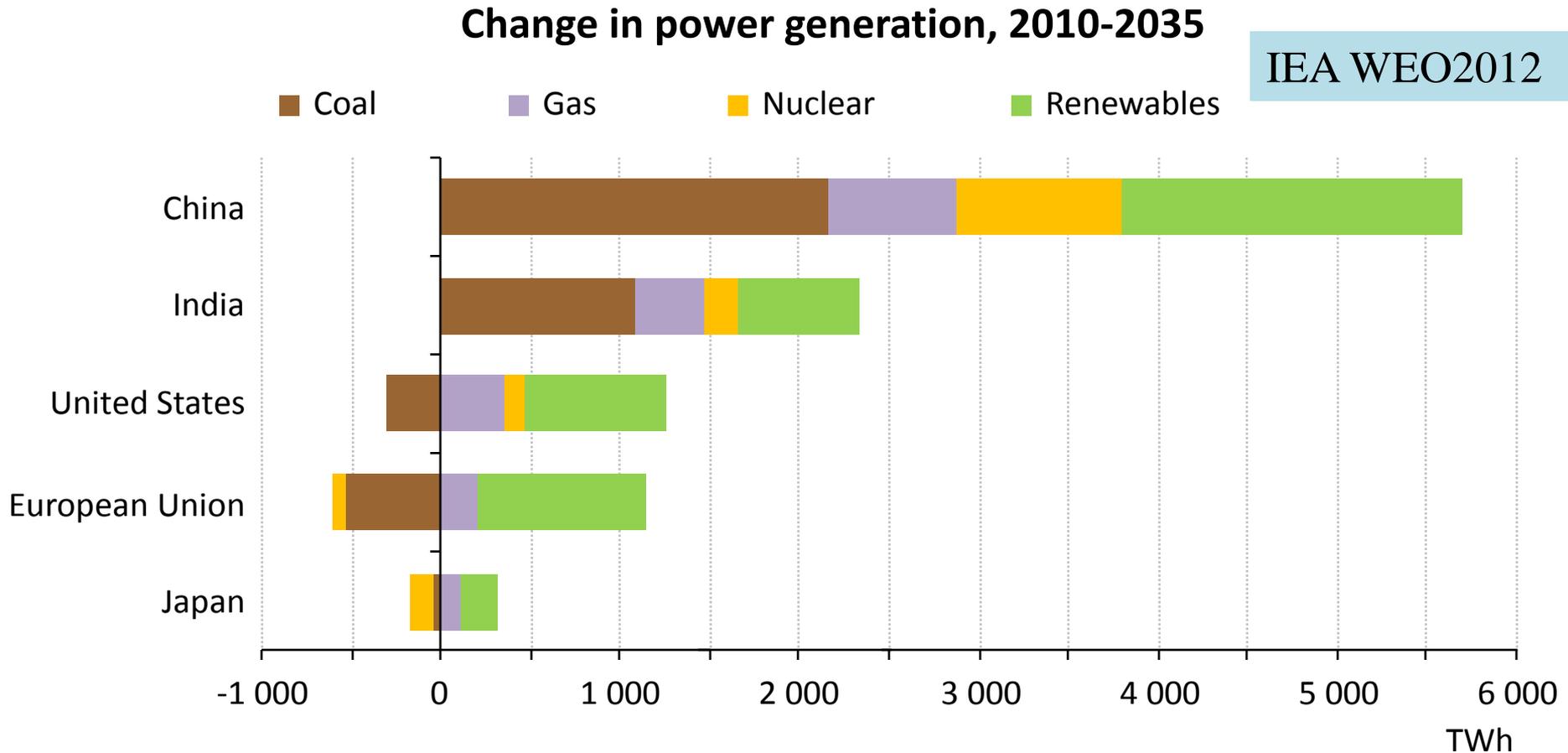
This map is for illustrative purposes and is without prejudice to the status of or sovereignty over any territory covered by this map.

International Gas Prices

How can Asia reduce Asian Premium?



A power shift to emerging economies

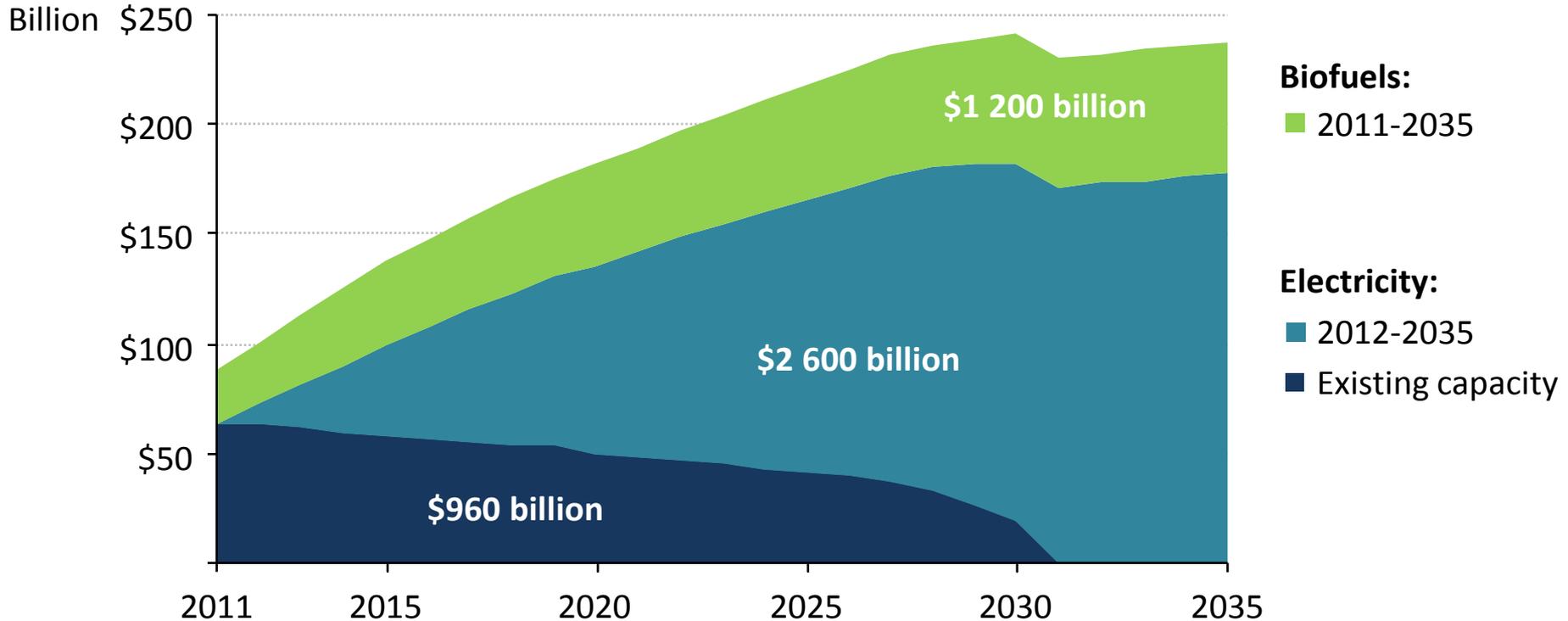


The need for electricity in emerging economies drives a 70% increase in worldwide demand, with renewables accounting for half of new global capacity

The multiple benefits of renewables come at a cost

Global renewable energy subsidies

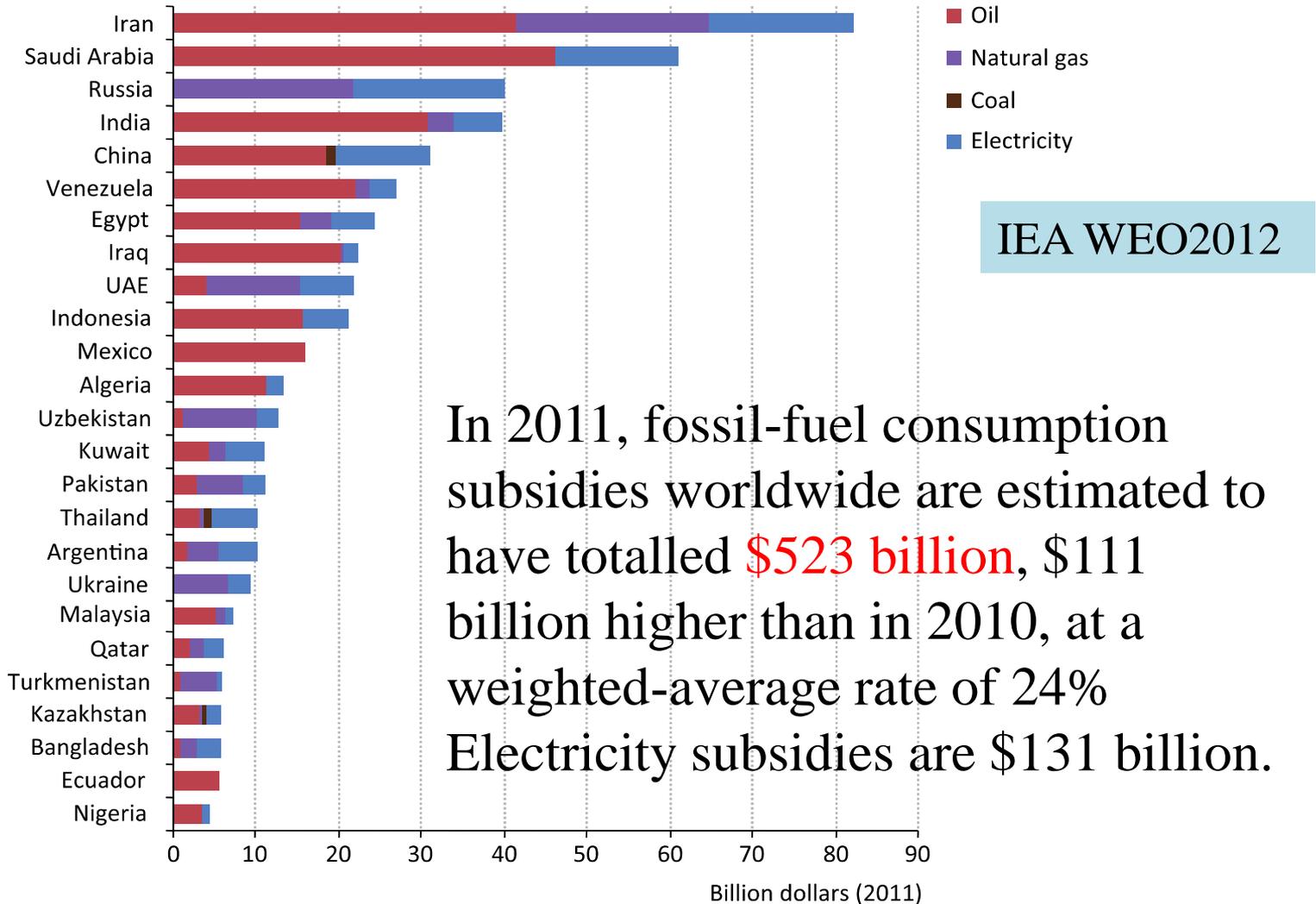
IEA WEO2012



Renewable subsidies were \$88 billion in 2011; over half the \$4.8 trillion required to 2035 has been committed to existing projects or is needed to meet 2020 targets

Fossil Fuel Consumption Subsidies

Figure 2.13 ▶ Economic value of fossil-fuel consumption subsidies by fuel for top 25 countries, 2011



In 2011, fossil-fuel consumption subsidies worldwide are estimated to have totalled **\$523 billion**, \$111 billion higher than in 2010, at a weighted-average rate of 24%
Electricity subsidies are \$131 billion.

Power Grid Connection in Europe

Physical energy flows between European countries, 2008 (GWh)

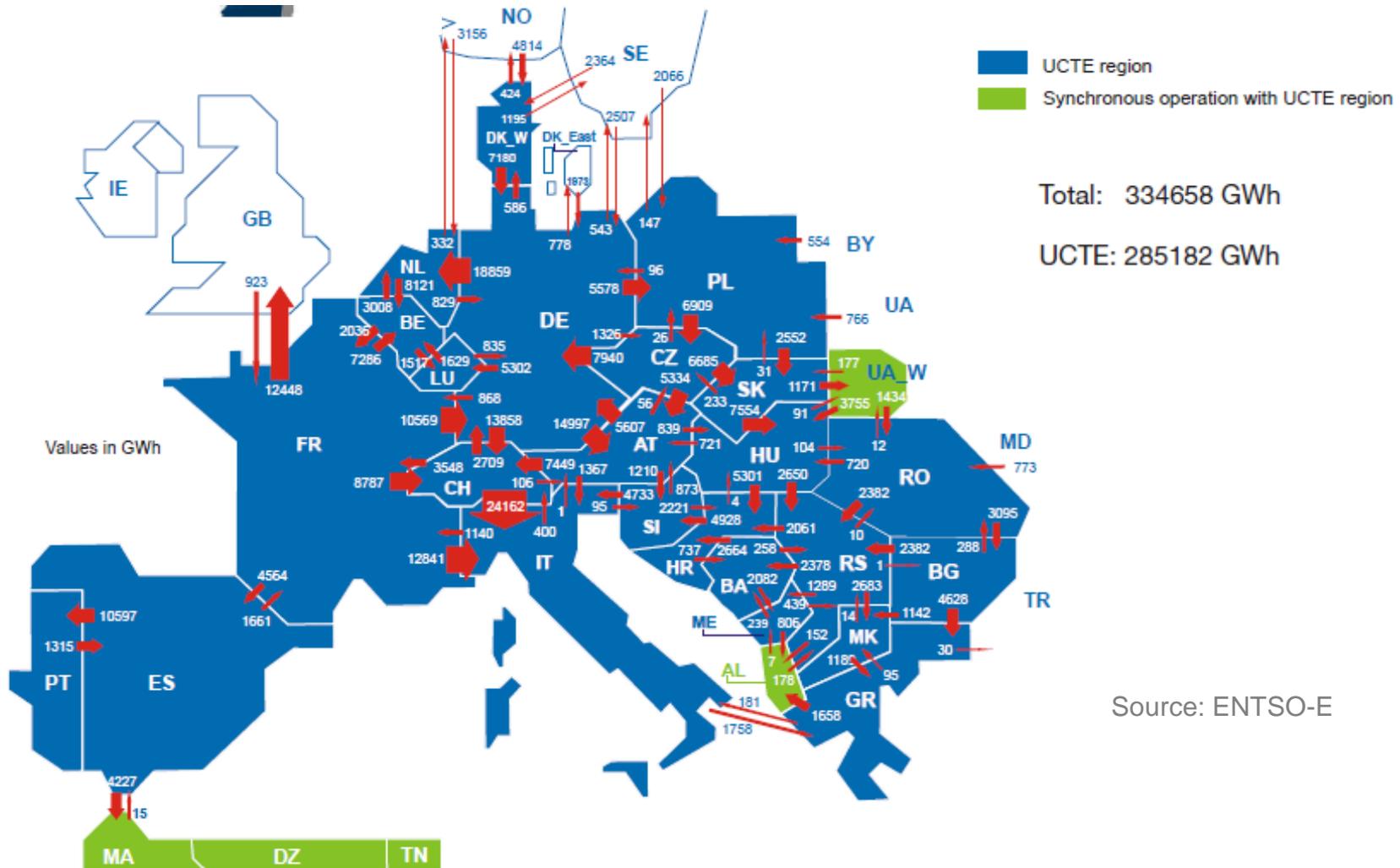
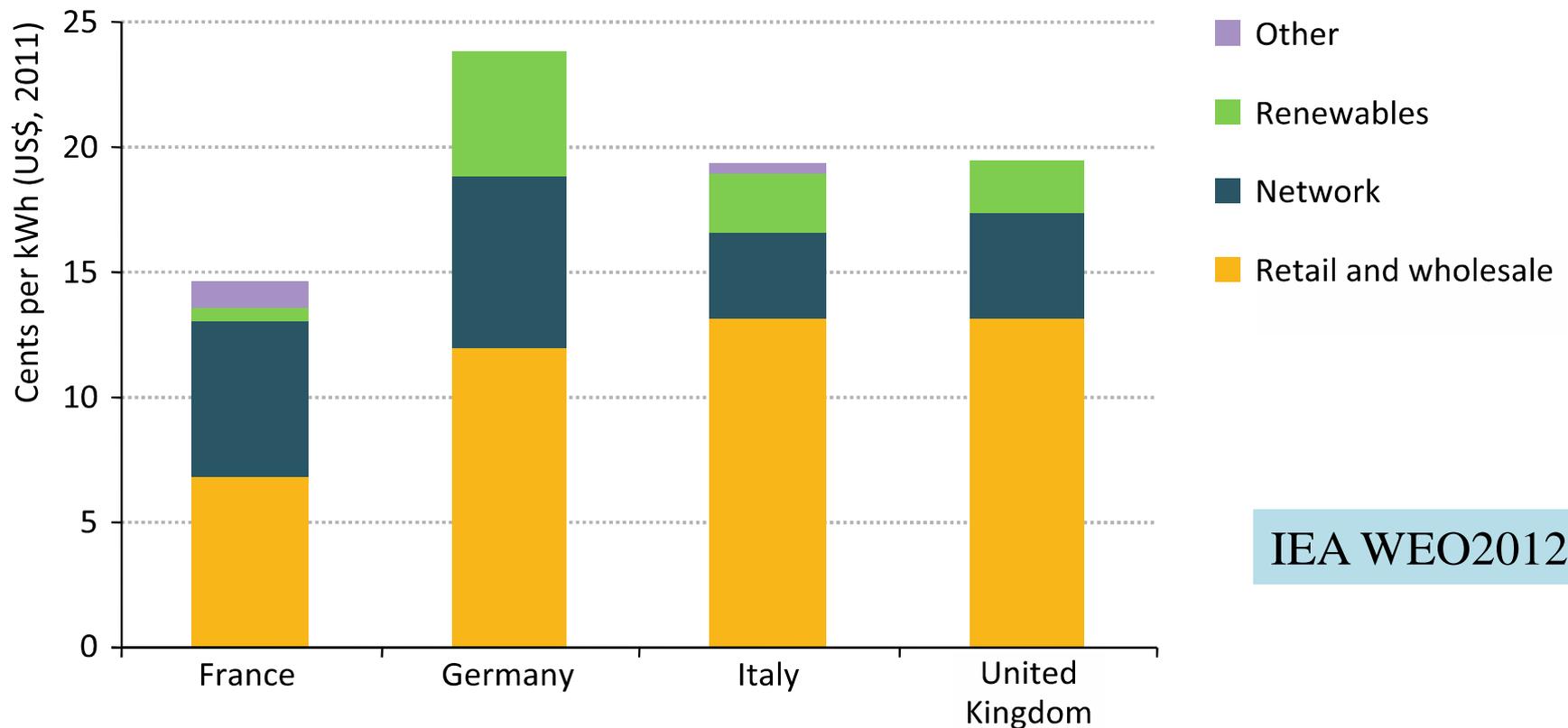


Figure 6.18 ▶ Average electricity price to households in selected European countries by cost component, excluding taxes, 2011



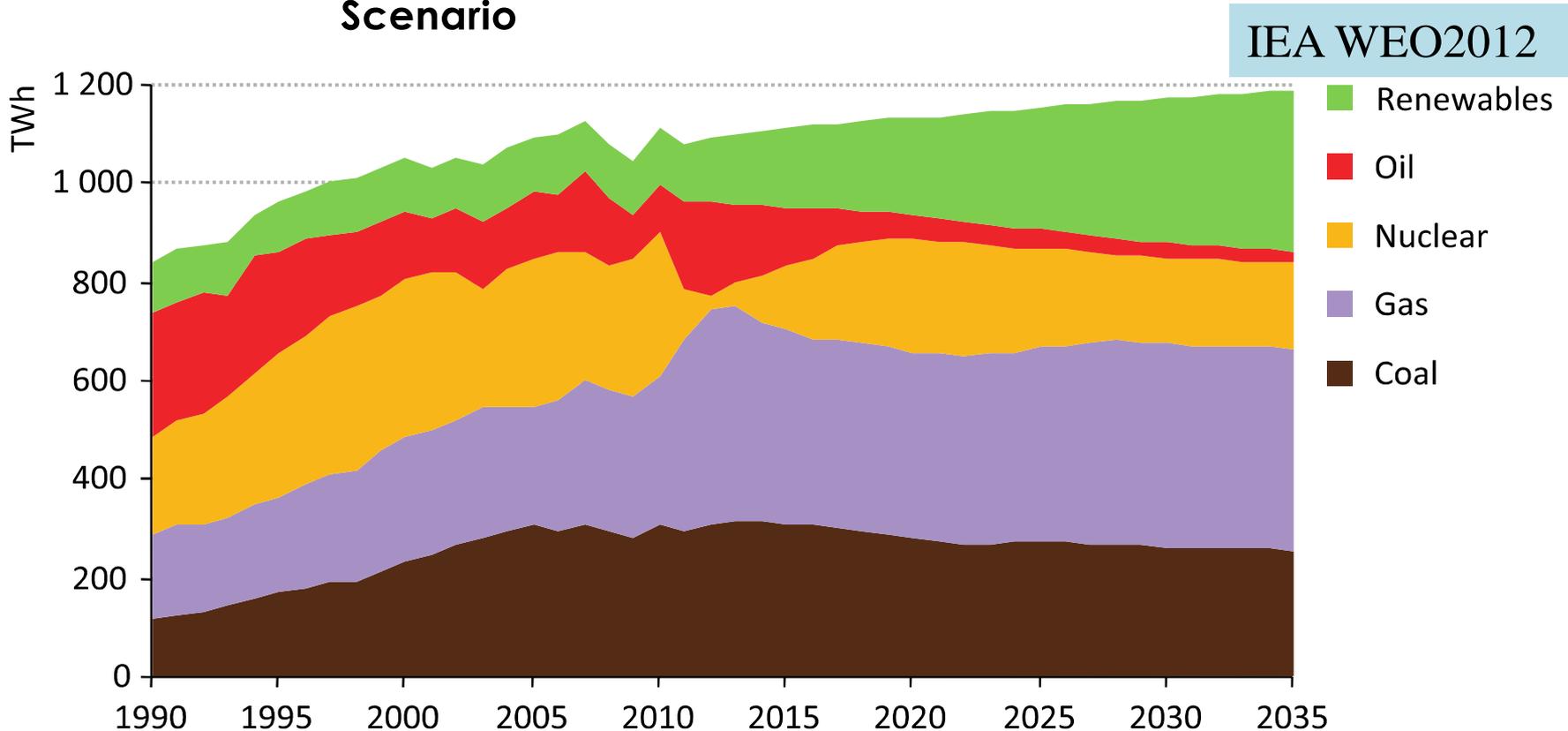
IEA WEO2012

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.

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

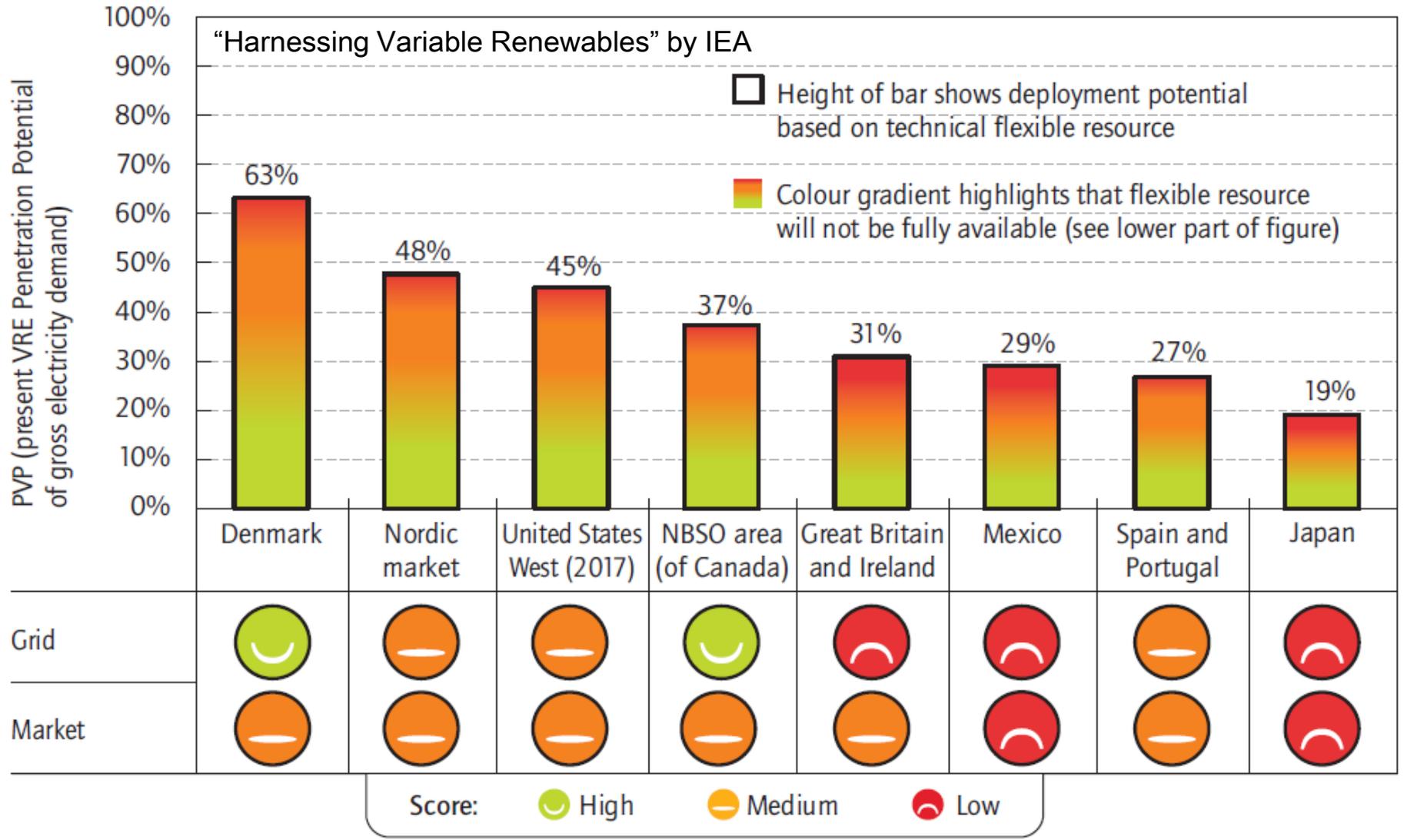
Figure 6.13 ▶ Japan electricity generation by source in the New Policies Scenario



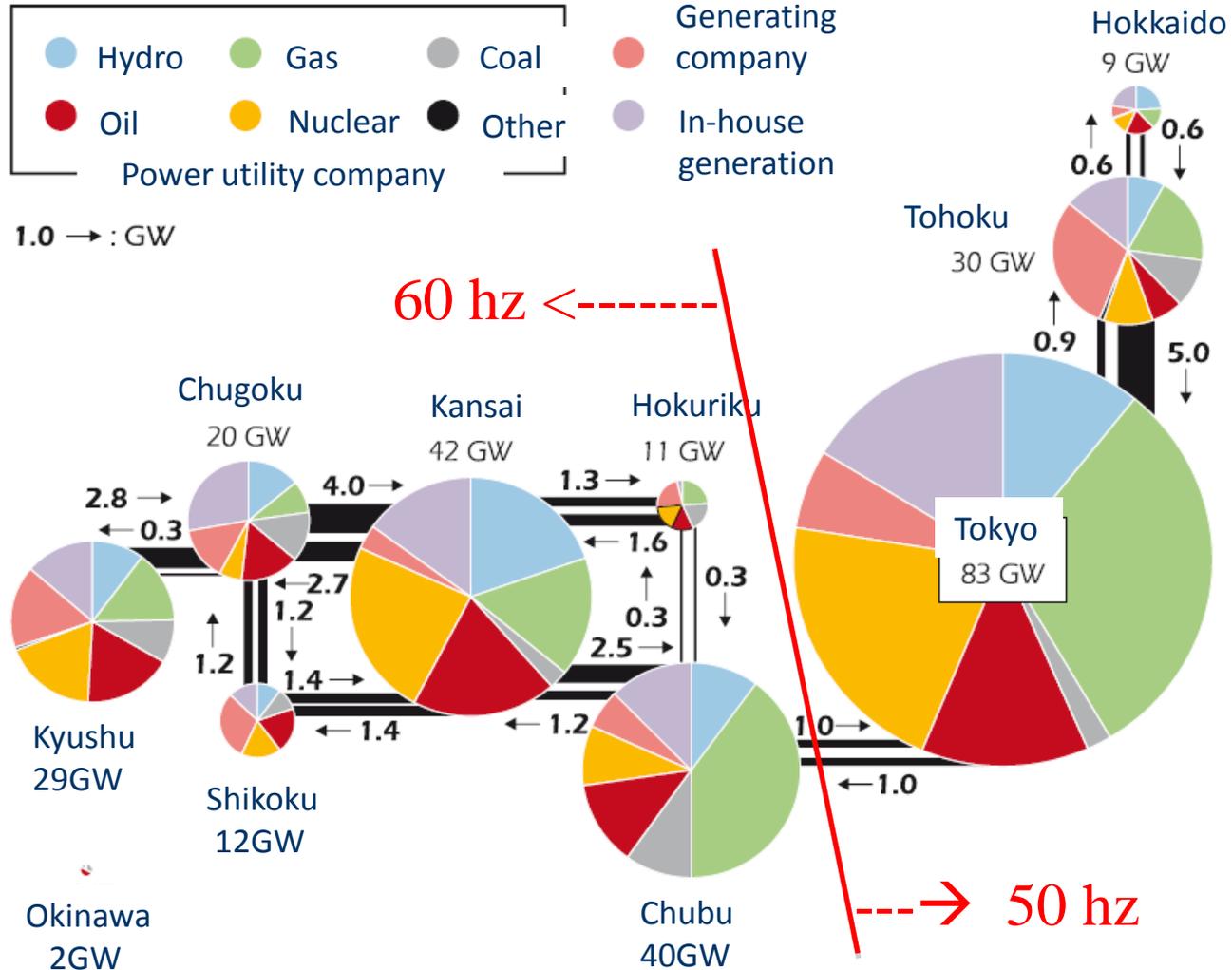
A decline in nuclear is compensated by a 3-fold increase in electricity from renewables, a continued high reliance on LNG imports & improvements in efficiency

Not only Feed-in-tariffs but Grid integration !

Snapshot of present penetration potentials



Power grid in Japan

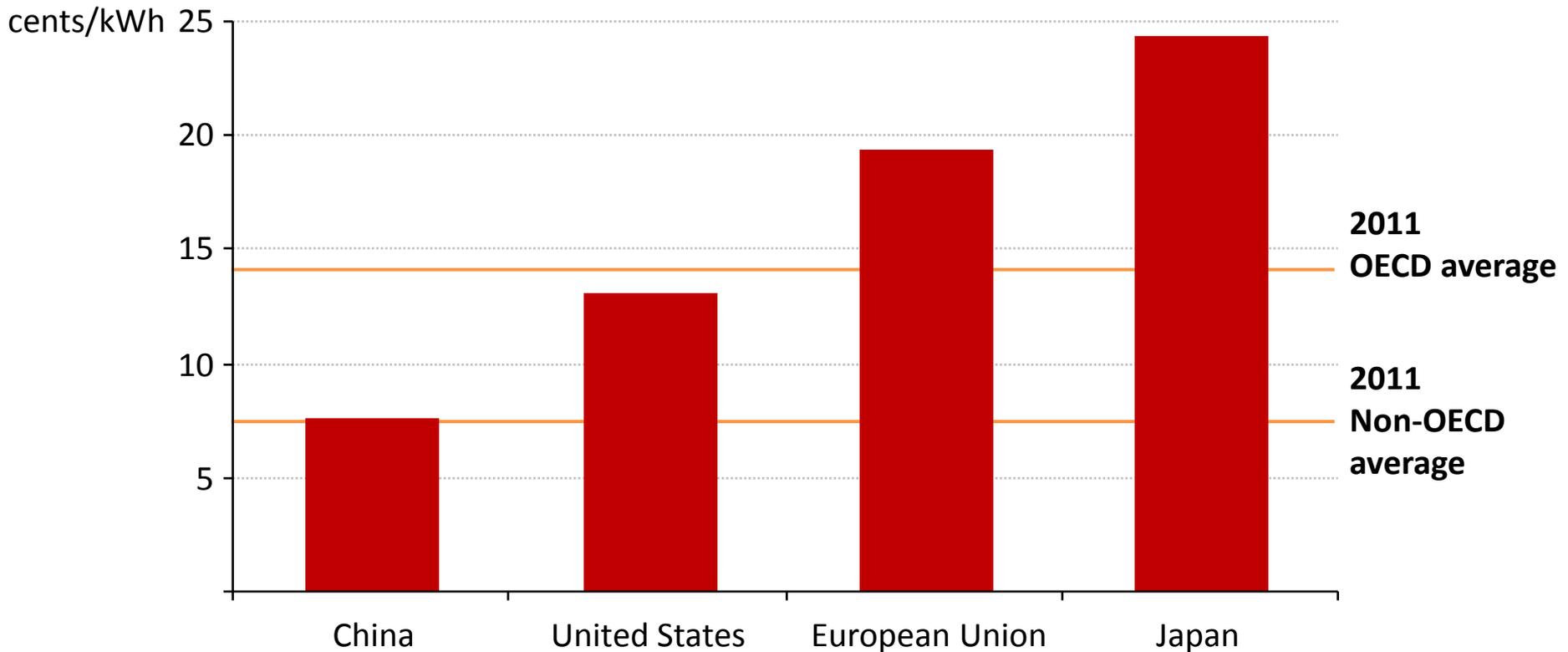


Source: Agency for Natural Resources and Energy, The Federation of Electric Power Companies of Japan, Electric Power System Council of Japan, The International Energy Agency

Wide variations in the price of power

IEA WEO2012

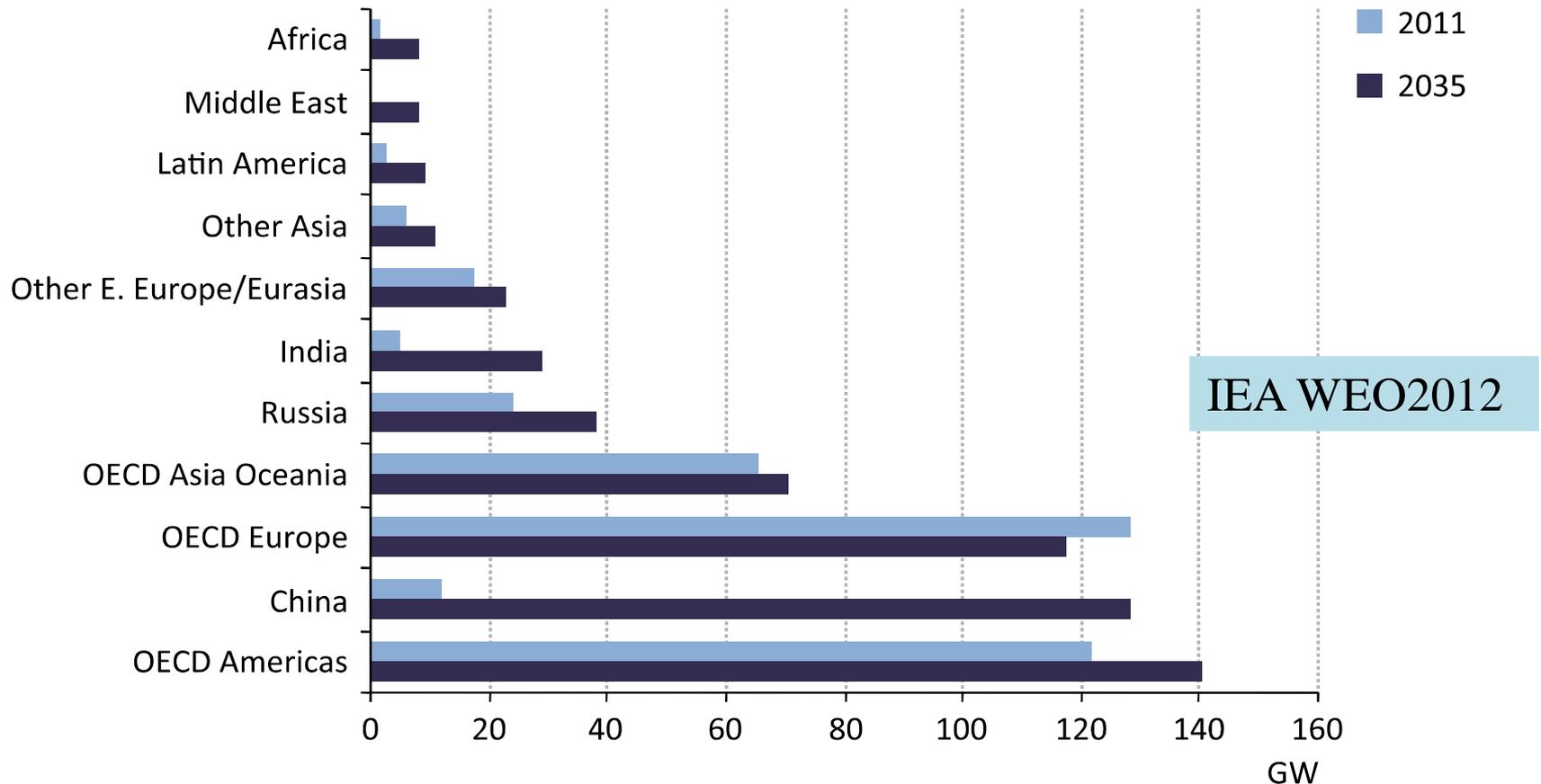
Average household electricity prices, 2035



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%.

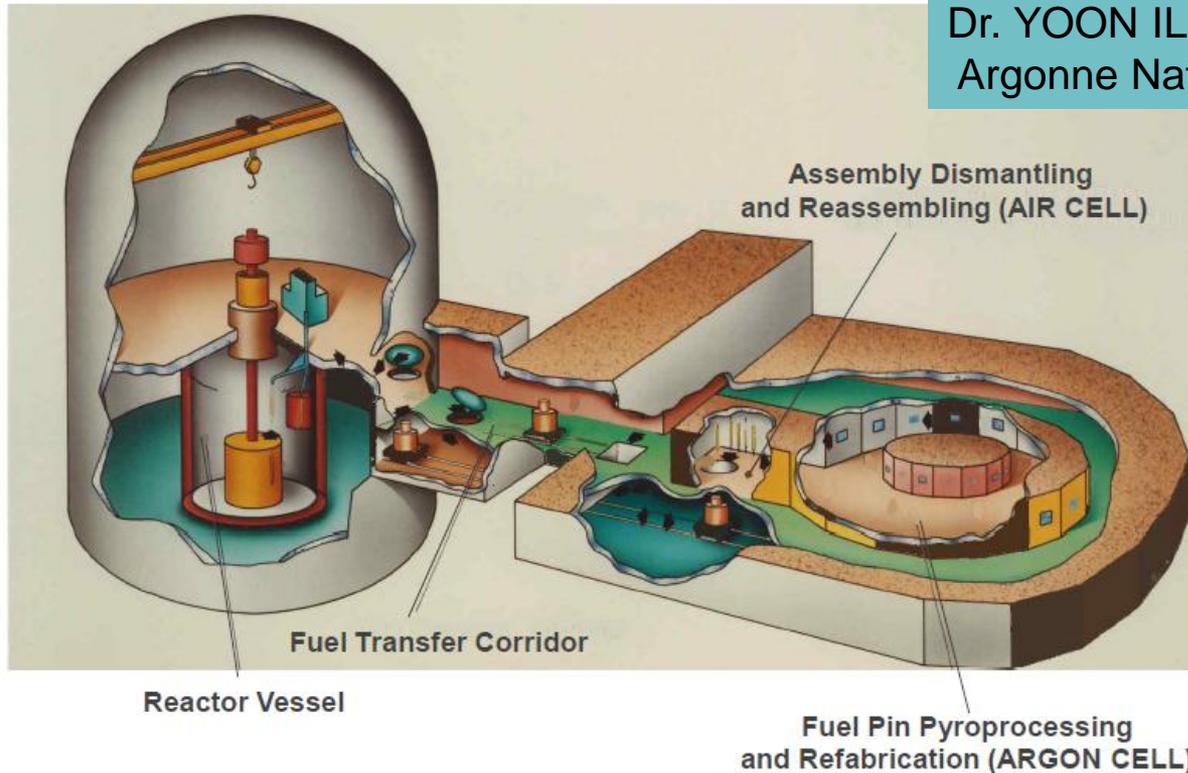
Lessons of the Fukushima

- 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 other sites.
- 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, Thorium Reactor**

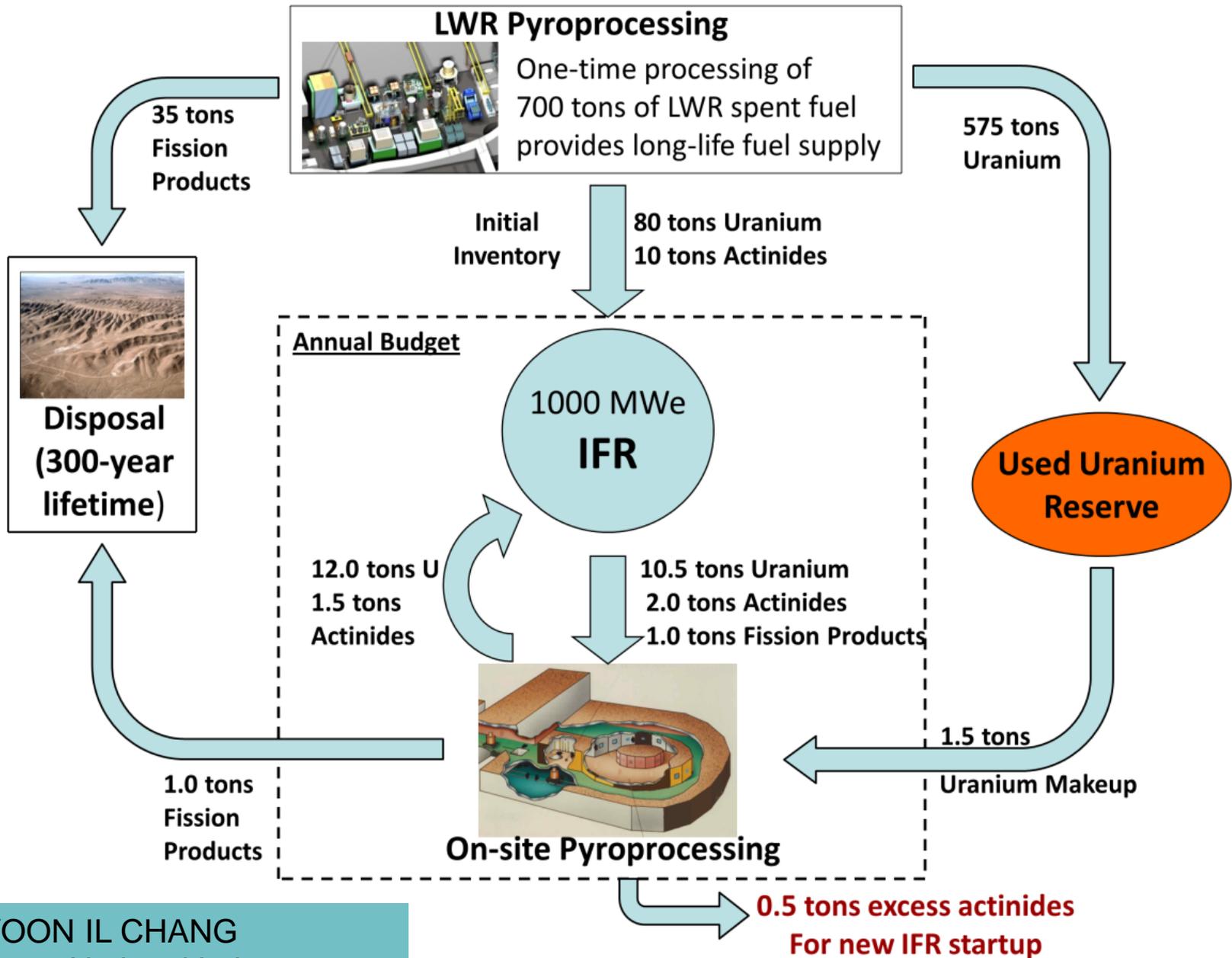
Integral Fast Reactor and Pyroprocessing

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

Dr. YOON IL CHANG
Argonne National Laboratory



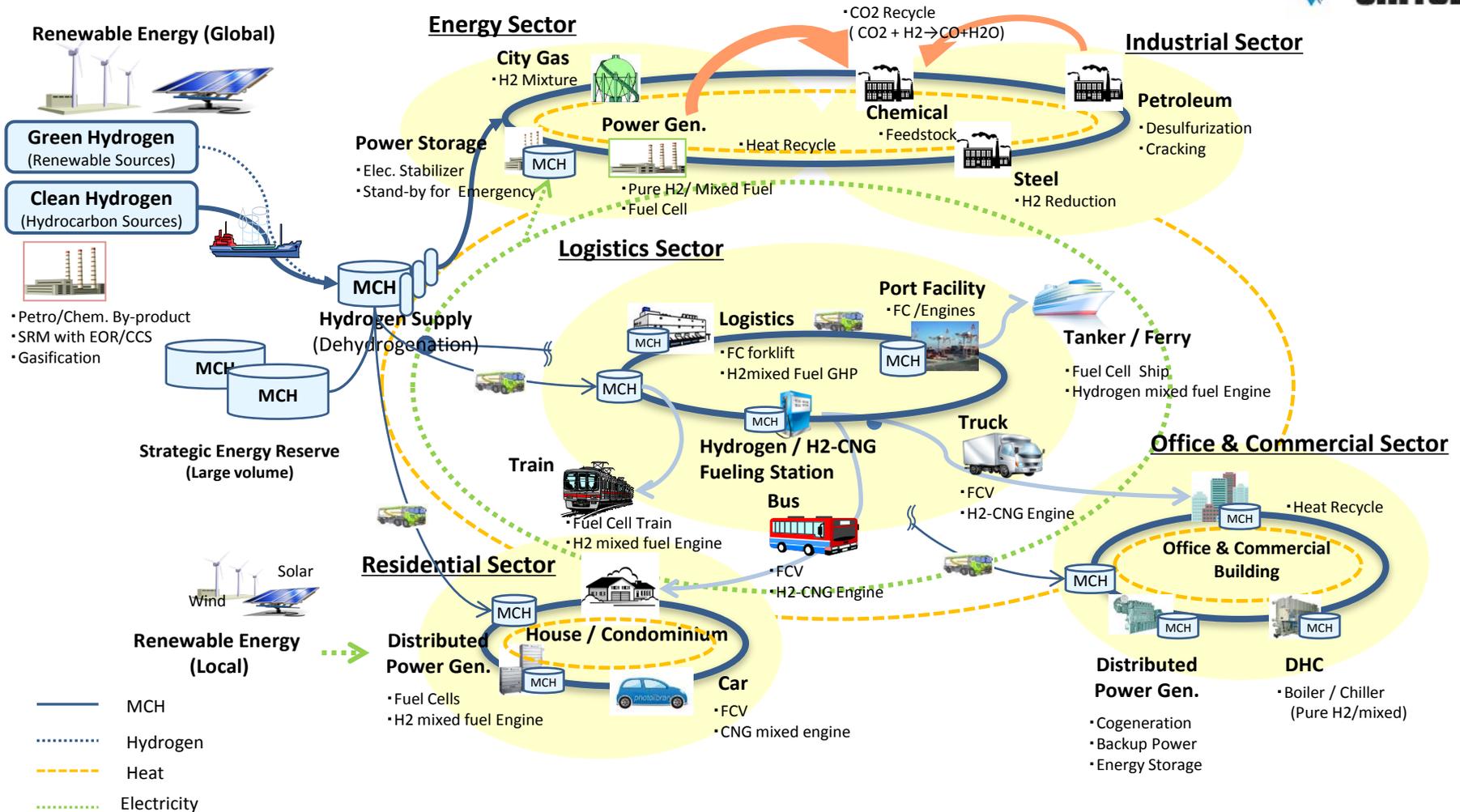
IFR has features as Inexhaustible Energy Supply ,Inherent Passive Safety ,Long-term Waste Management Solution , Proliferation-Resistance , Economic Fuel Cycle Closure.



Dr. YOON IL CHANG
 Argonne National Laboratory

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.



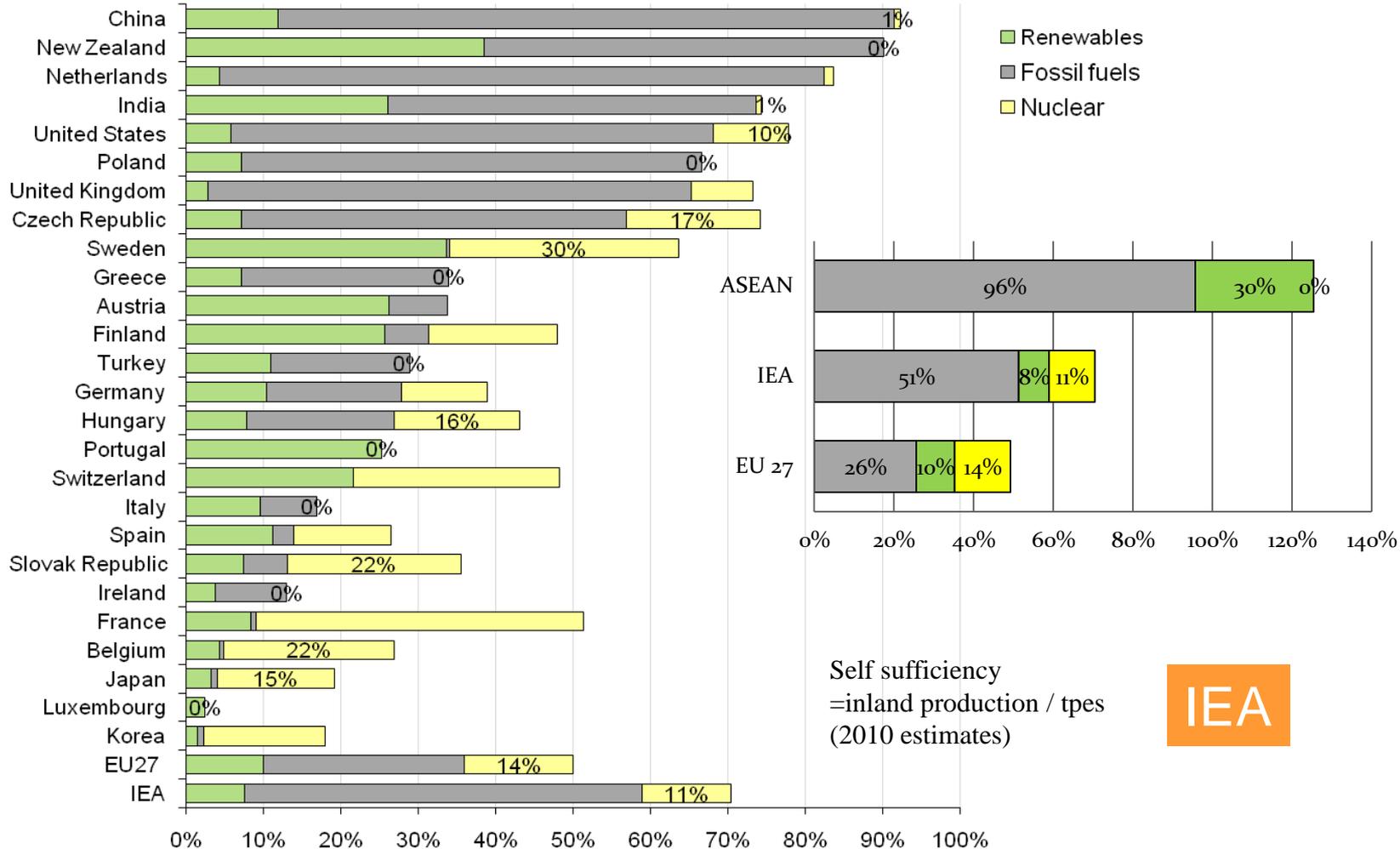
(Note) MCH : Methylcyclohexane FC : Fuel Cell FCV : Fuel Cell Vehicle GHP : Gas Heat Pump DHC : District Heating and Cooling

What is Energy Security in the 21st Century?

Diversity means Energy Security .

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

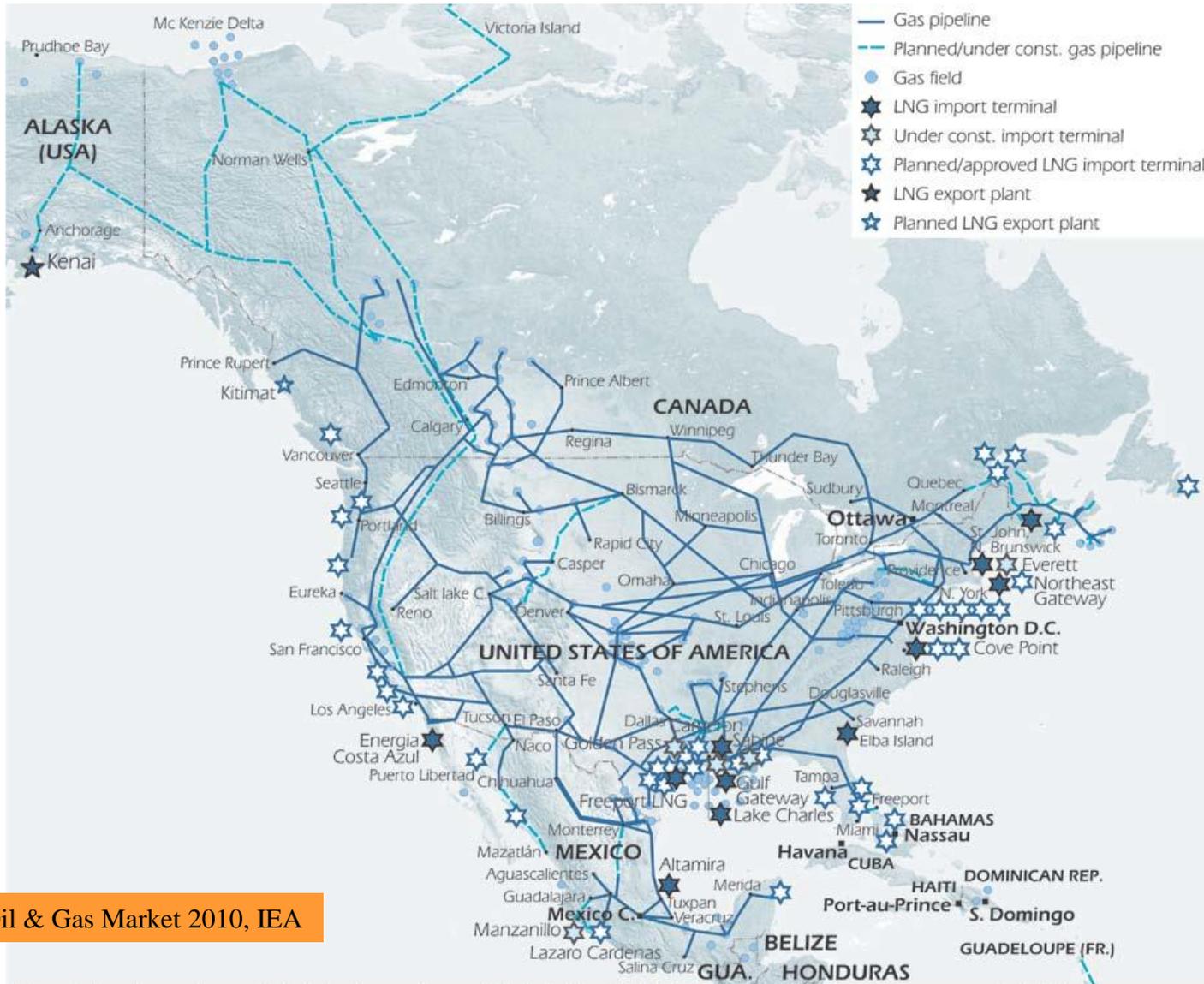
Energy Self -Sufficiency rates by fuels in 2010



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

North American Gas Infrastructure

North America Gas Infrastructure

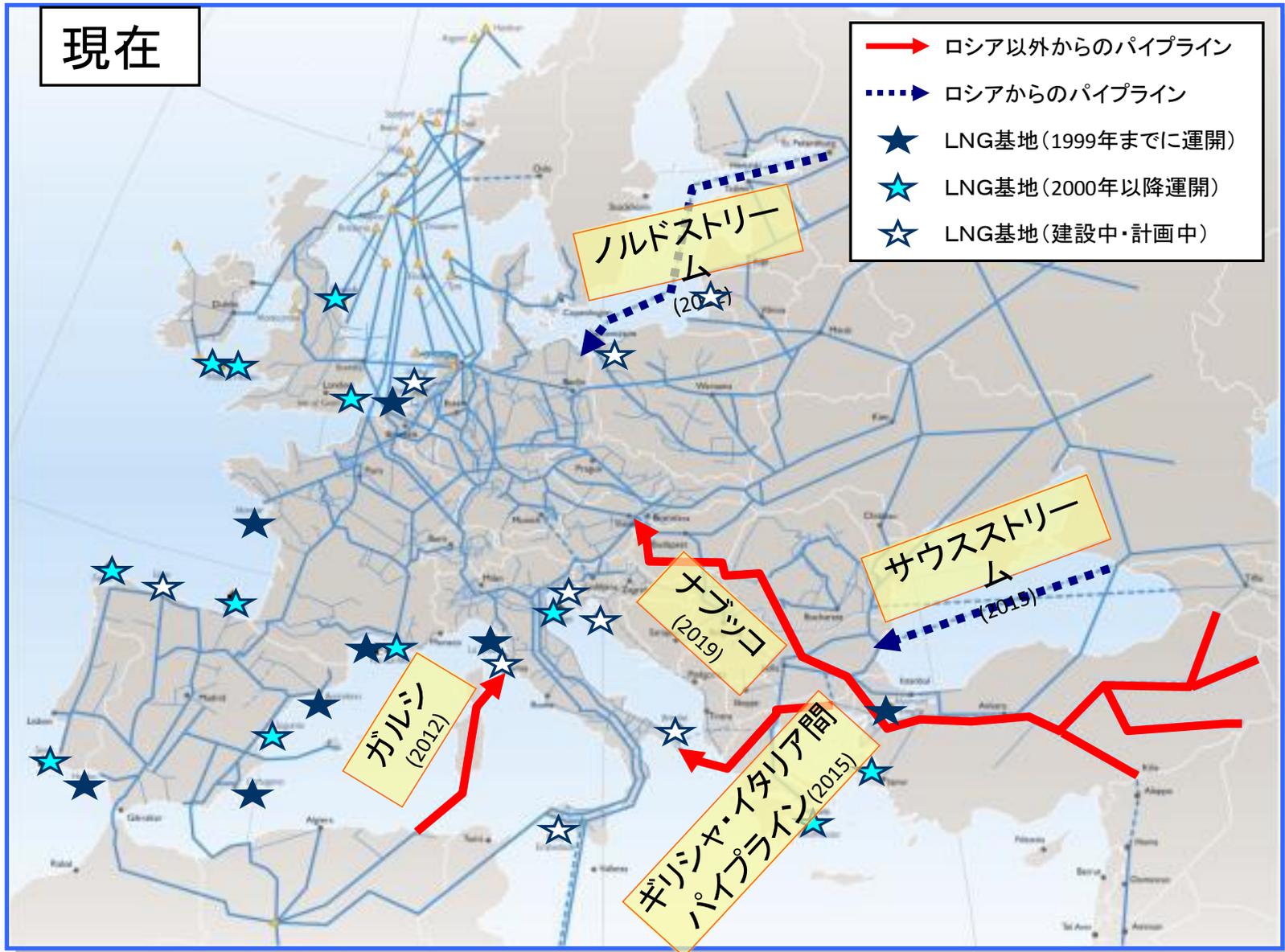


Mid-Term Oil & Gas Market 2010, IEA

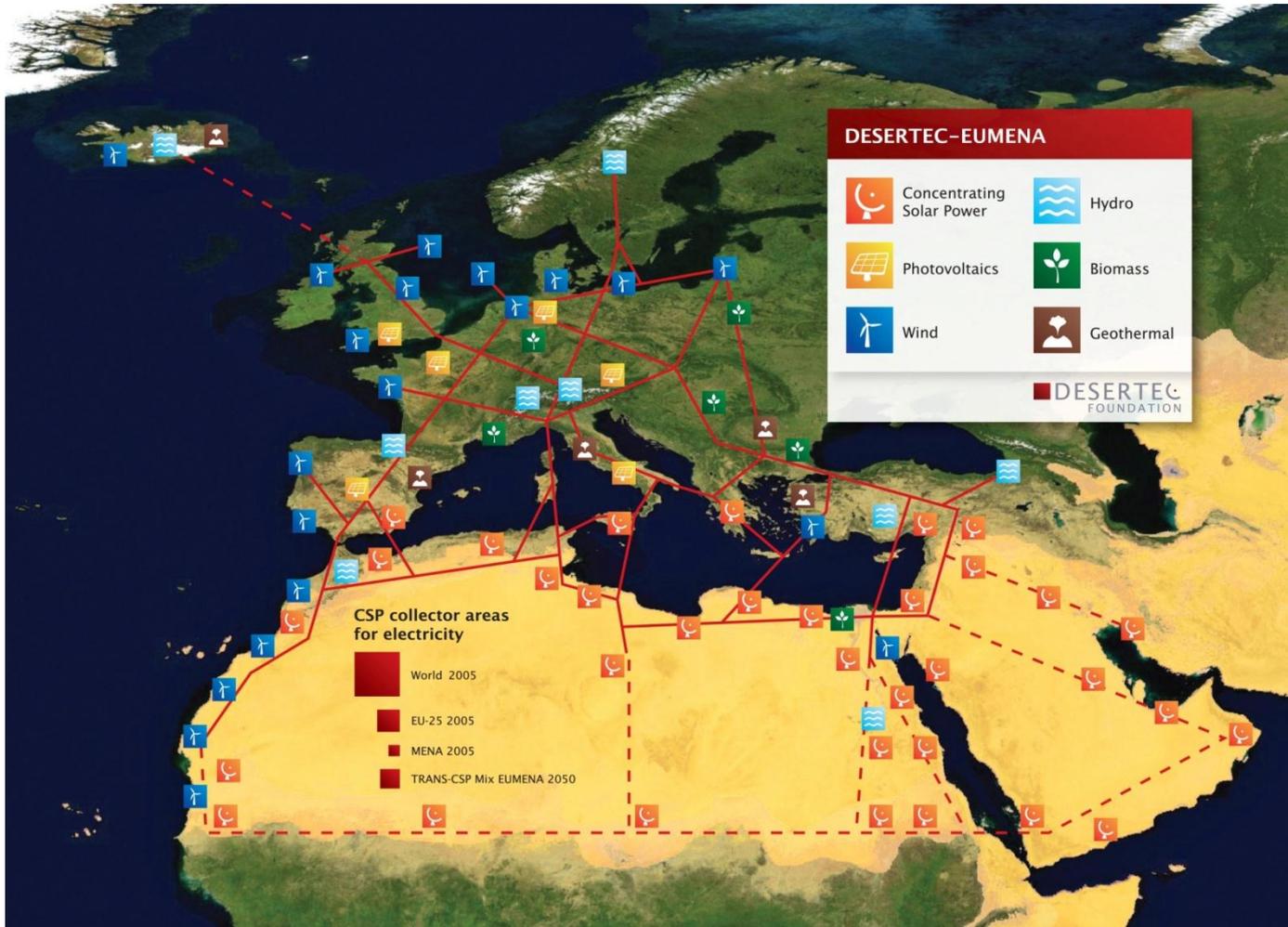
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Source: IEA.

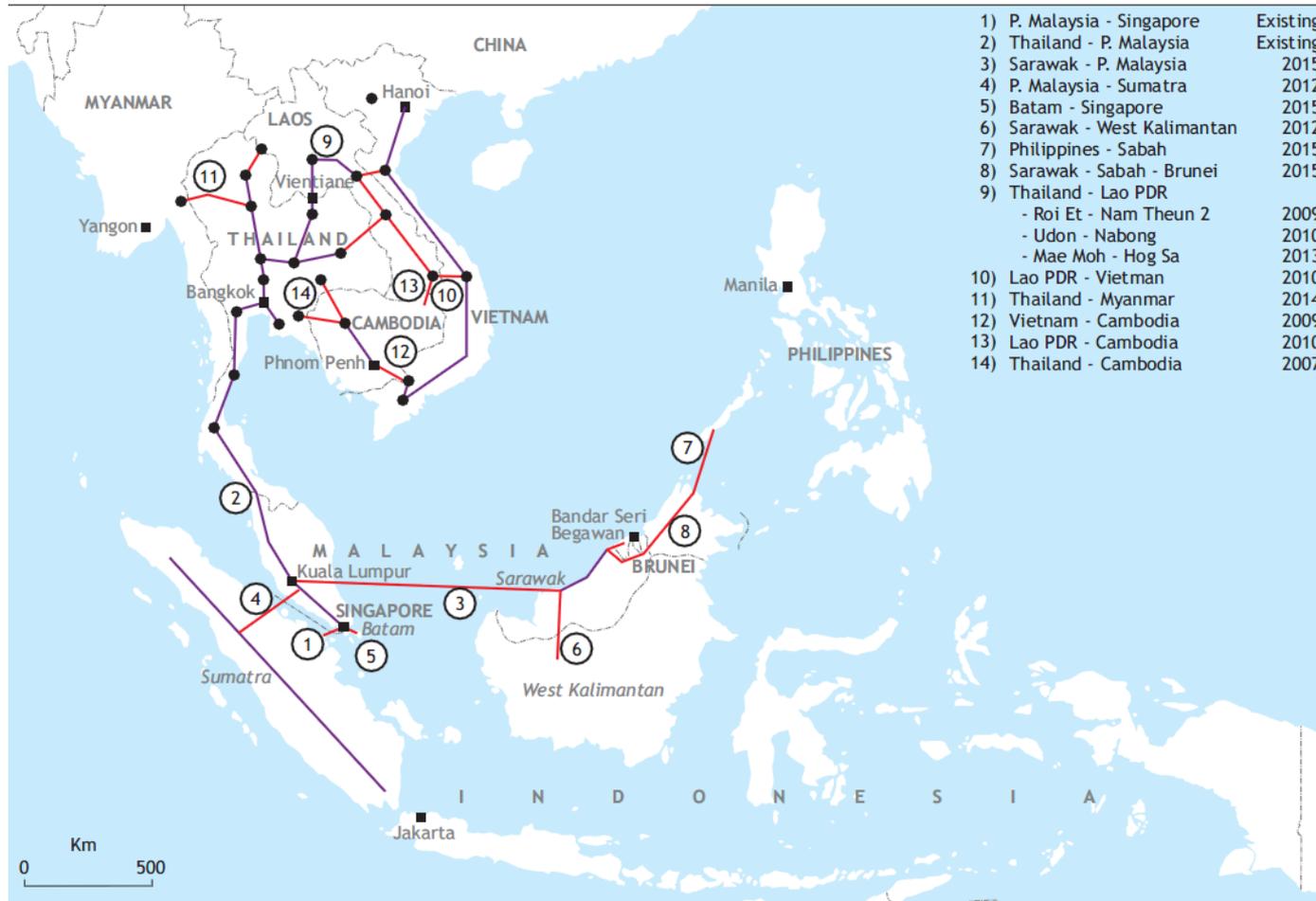
Gas Infra in Europe: New Pipelines and LNG ports.



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



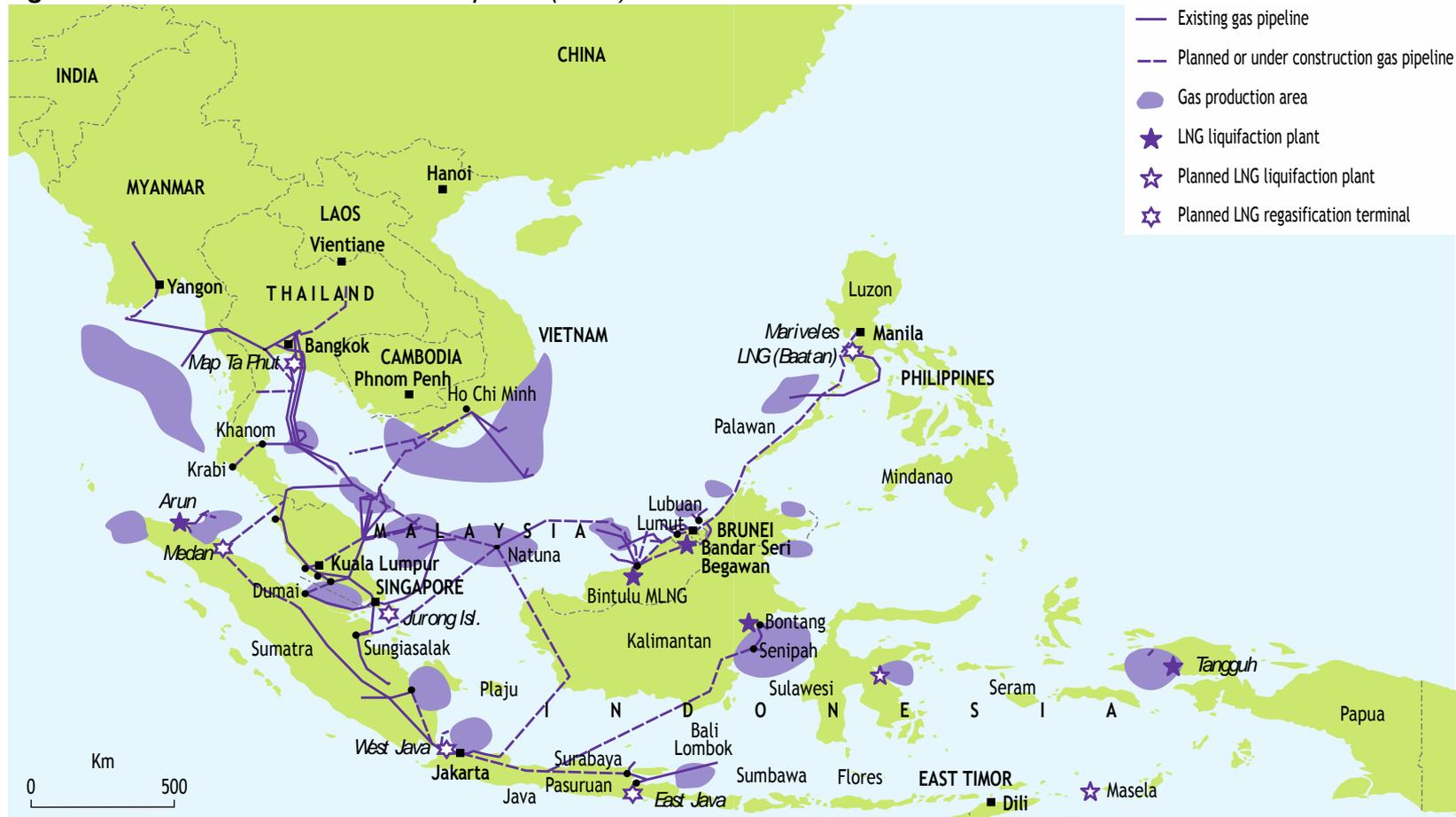
ASEAN is working on Power Grid Interconnections.



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ASEAN is working on Gas Pipeline System.

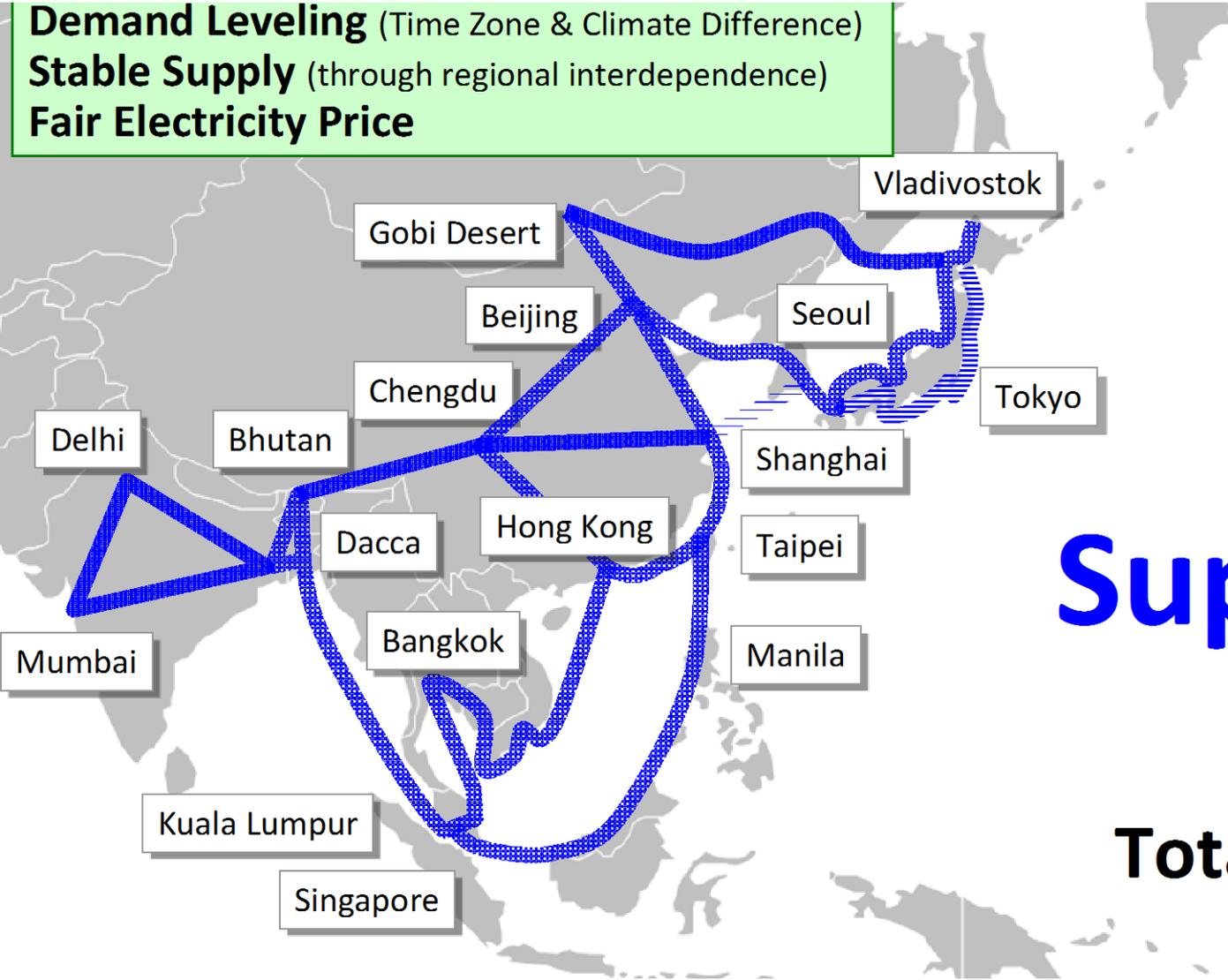
Figure 15.16 • The Trans-ASEAN Gas Pipeline (TAGP)



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 Source: ASCOPE Secretariat

Energy for Peace in Asia. A New Asian 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

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

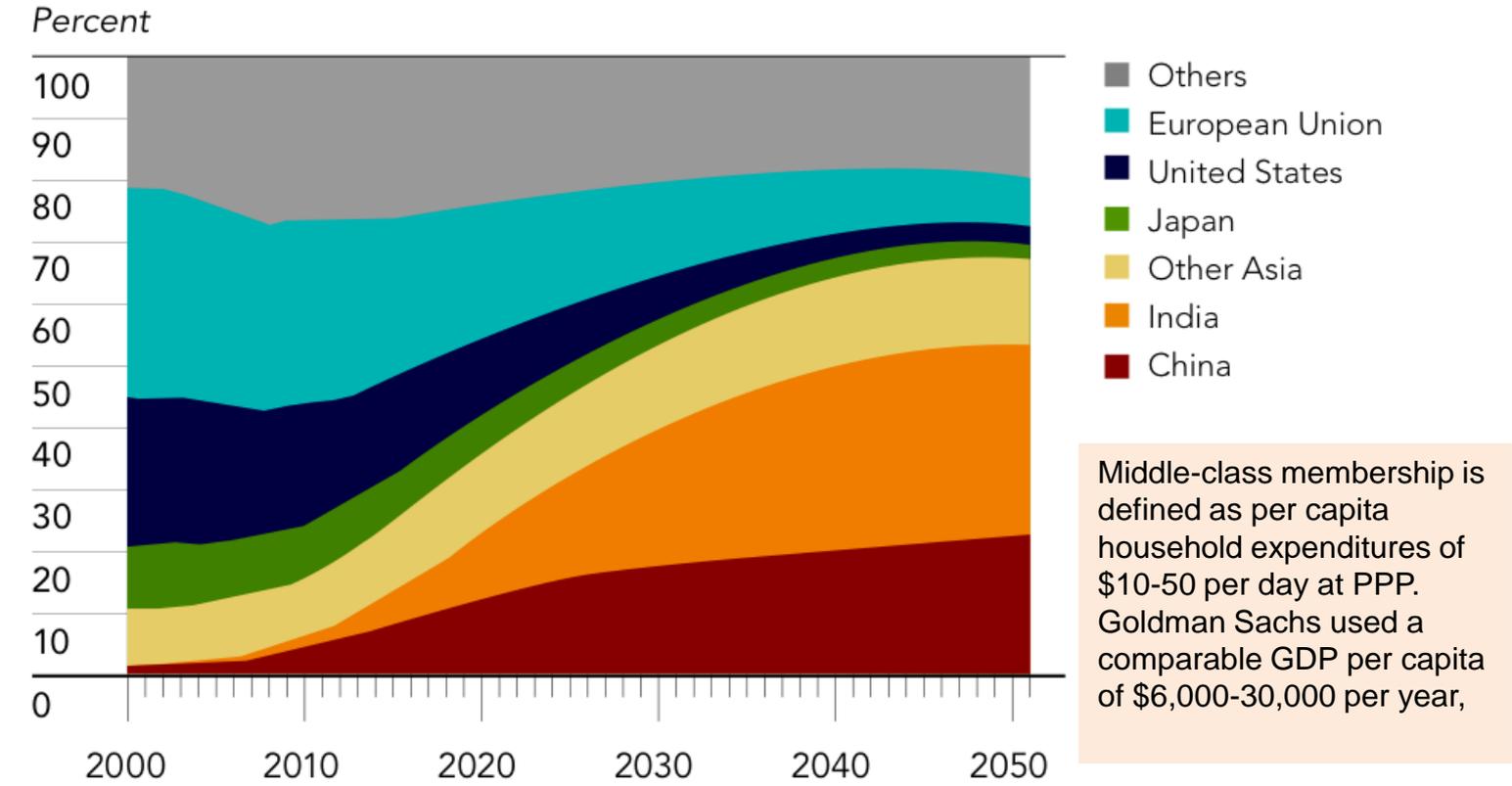
- Energy Security for the 21st Century must be Comprehensive Electricity Supply Security under sustainability constraints. **EU Model of Collective Energy Security** be applied to the growing Asia. Develop Regional Power Grid interconnection & Gas Pipelines including Russia. Expand the IEA by engaging China and India. Create North East Asian Energy Security Forum? ASEAN's role as a hub.
- Develop **gas** resources and infrastructure. Diversify supply and demand. Russia remains as a key player. New LNG export from North America to Asia Pacific. Australia and Africa increase weights.
- For **coal** to remain the backbone of power supply, CCS readiness & highly efficient power plants are needed. Hydrogen technology may help?
- 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 jointly 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. Efficiency, Decentralized Renewables, EVs, Smart Grids, Storage, etc.

ANNEX

Global Middle-class expands from 1 to 3 billion by 2030

(Global Trends 2030 by National Intelligence Council)

SHARES OF GLOBAL MIDDLE-CLASS CONSUMPTION, 2000-2050



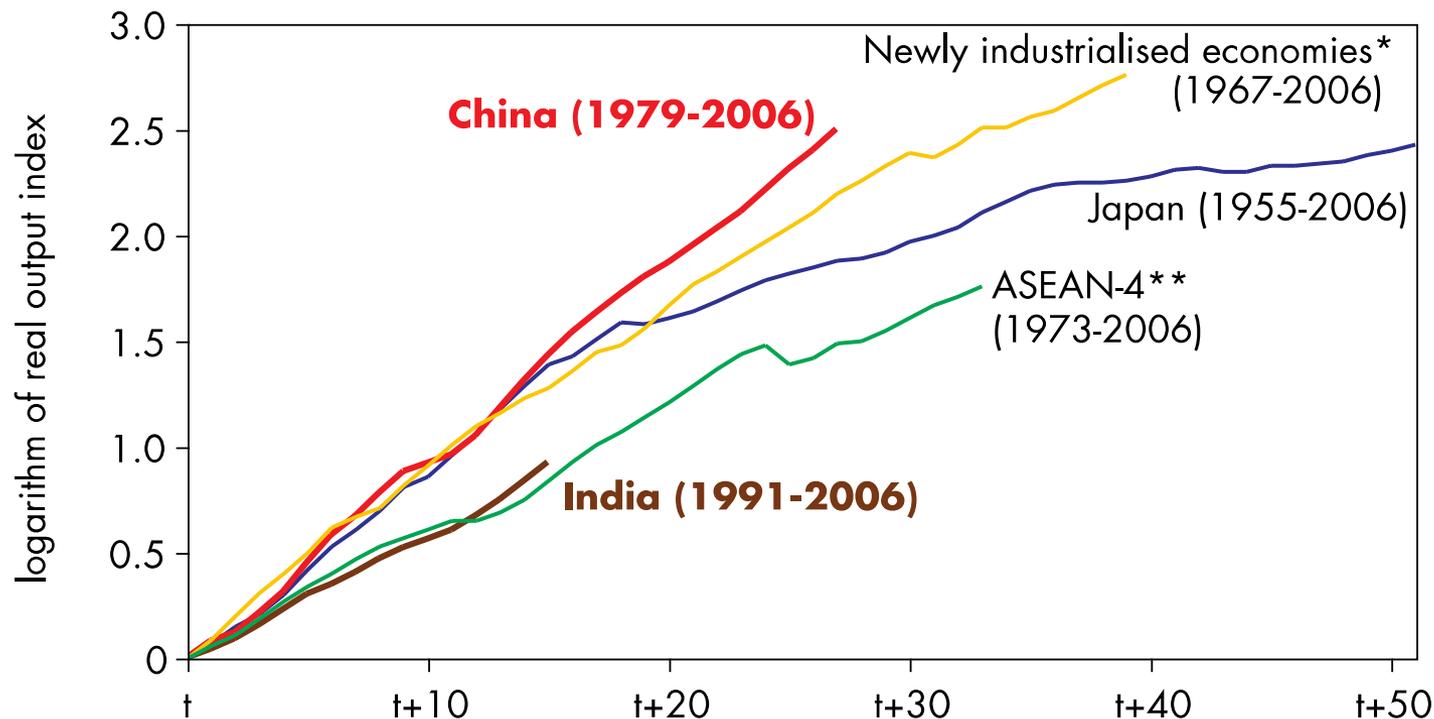
Middle-class membership is defined as per capita household expenditures of \$10-50 per day at PPP. Goldman Sachs used a comparable GDP per capita of \$6,000-30,000 per year,

Source: OECD.

Addition of 2 billion people triggers the price revolution in commodities, labor, etc.

Game changers : China then India. 6 billion people join 1 billion.

Figure 3.1: Real Output in China, India, Other Asian and Newly Industrialised Economies



* Chinese Taipei, Hong Kong, Korea and Singapore. ** Indonesia, Malaysia, Philippines and Thailand.

Note: The starting point, t , is defined by when the three-year moving average of constant-price export growth first exceeded 10%. For China, it is 1979, and for India, 1991, when major economic reforms began. Real output is GDP expressed in constant prices, indexed at the beginning of the period of rapid growth and expressed in logarithmic form.

Source: IMF *World Economic Outlook* database.