

Alternative Energy Sector: Context, Issues and Challenges

Presentation to:

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Outline

- ▣ **Alternative Energy Context**
- ▣ **Resource Depletion: A Game Changer**
- ▣ **The Role of Regulation**
- ▣ **Solving the Carbon Puzzle**
- ▣ **Potential Financing Constraints**
- ▣ **Sustainability of Biofuels**
- ▣ **Conclusions**

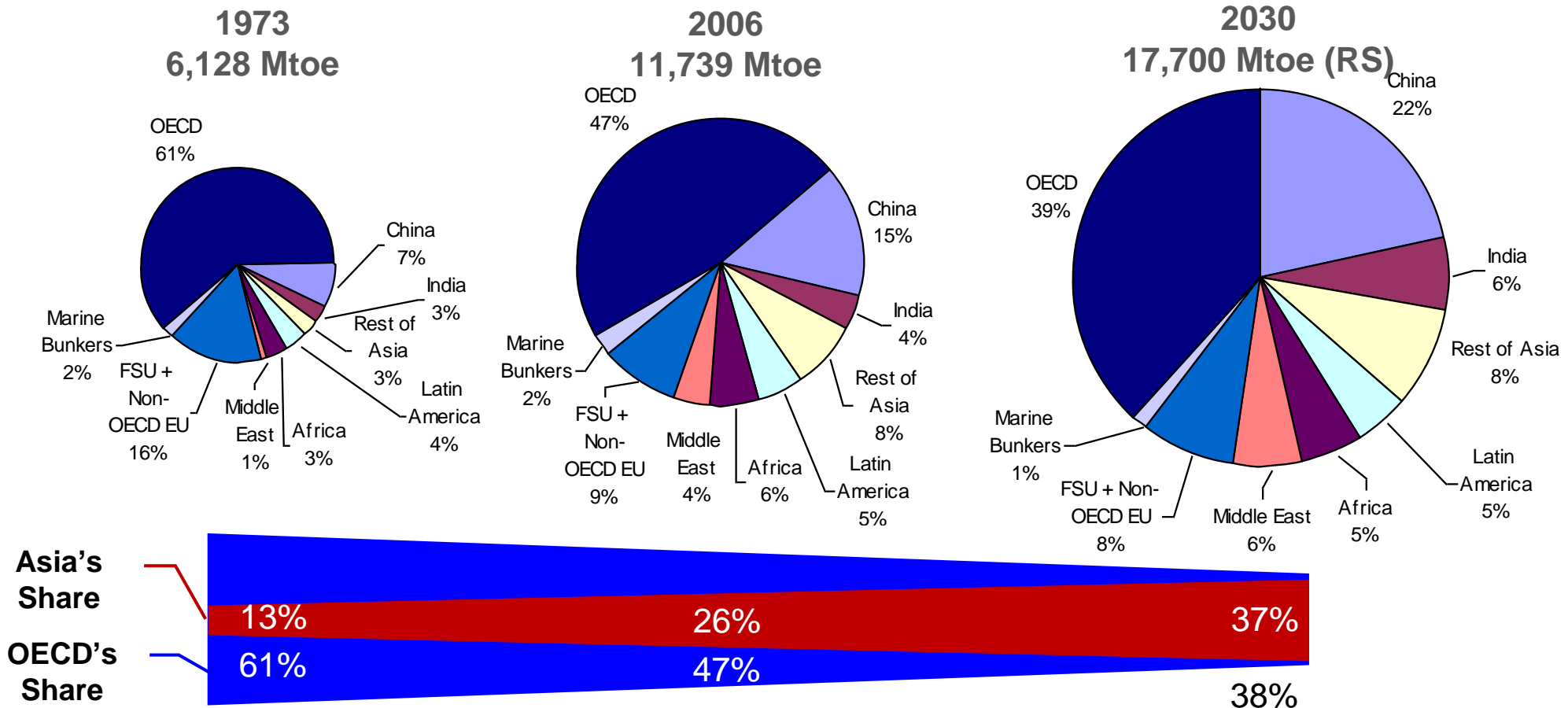


Alternative Energy Context



Image Source: www.forbes.com – Off-shore wind farm in the North Sea off Norway.

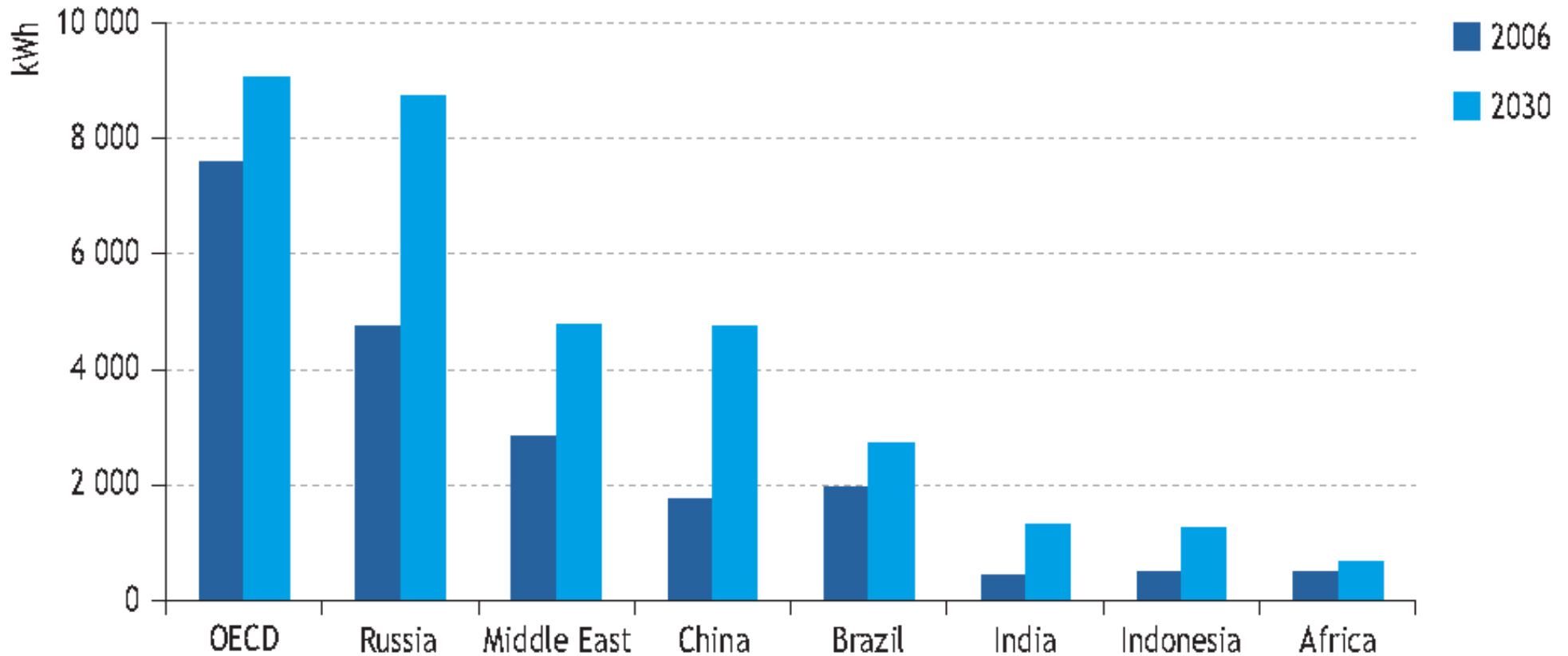
Asia's Increasing Demand for Energy



Source: IEA Key Energy Statistics 2008. RS refers to the business as usual Reference Scenario. APS is the 'alternative policy scenario' that sets Asia on a cleaner energy pathway.

Per-Capita Electricity Usage

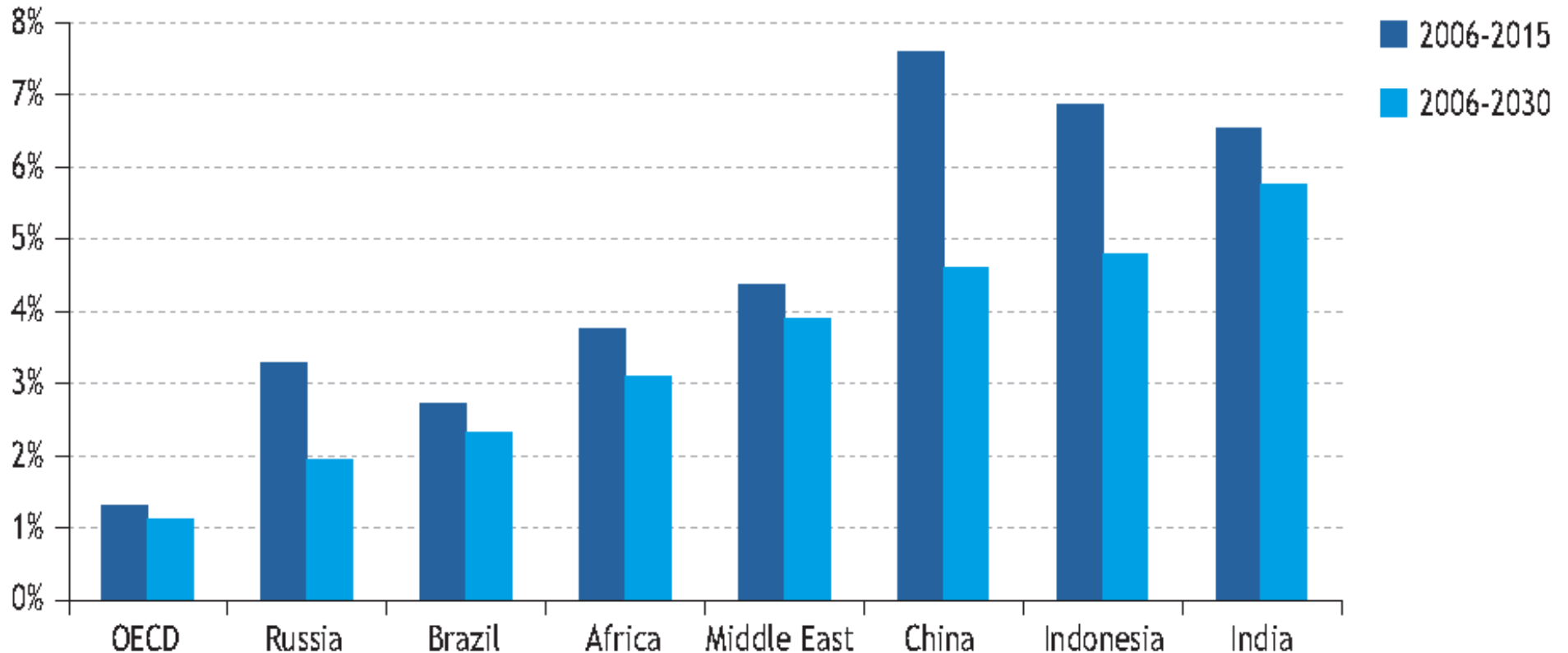
Per-Capita Electricity Demand by Selected Region,
IEA Reference Scenario



Source: IEA WEO 2008.

Electricity Demand Growth

Electricity Demand growth by Selected Region,
IEA Reference Scenario



Source: IEA WEO 2008.

IEA Fossil Fuel Price Assumptions

Fossil Fuel Price Assumptions in Reference Scenario (US\$/unit)

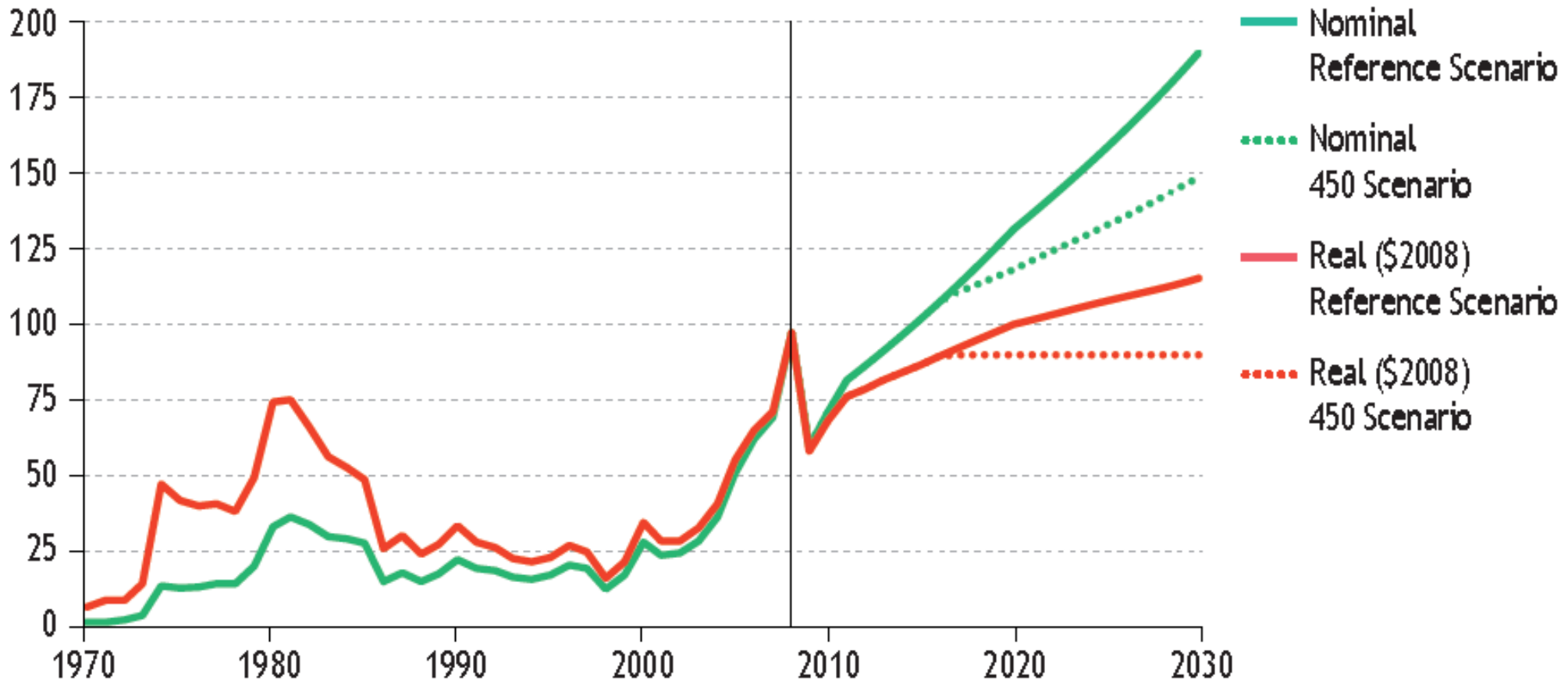
	Unit	2000	2008	2015	2020	2025	2030
Real terms (2008 prices)							
IEA crude oil imports	barrel	34.30	97.19	86.67	100.00	107.50	115.00
Natural gas imports							
<i>United States</i>	MBtu	4.74	8.25	7.29	8.87	10.04	11.36
<i>Europe</i>	MBtu	3.46	10.32	10.46	12.10	13.09	14.02
<i>Japan LNG</i>	MBtu	5.79	12.64	11.91	13.75	14.83	15.87
OECD steam coal imports	tonne	41.22	120.59	91.05	104.16	107.12	109.40
Nominal terms							
IEA crude oil imports	barrel	28.00	97.19	101.62	131.37	158.23	189.65
Natural gas imports							
<i>United States</i>	MBtu	3.87	8.25	8.55	11.66	14.78	18.73
<i>Europe</i>	MBtu	2.82	10.32	12.27	15.89	19.27	23.11
<i>Japan LNG</i>	MBtu	4.73	12.64	13.96	18.07	21.83	26.17
OECD steam coal imports	tonne	33.65	120.59	106.77	136.84	157.67	180.42

Notes: Gas prices are expressed on a gross calorific-value basis. All prices are for bulk supplies exclusive of tax. Nominal prices assume inflation of 2.3% per year from 2008. Detailed price assumptions for the 450 Scenario can be found in Chapter 5.

Source: IEA WEO 2009

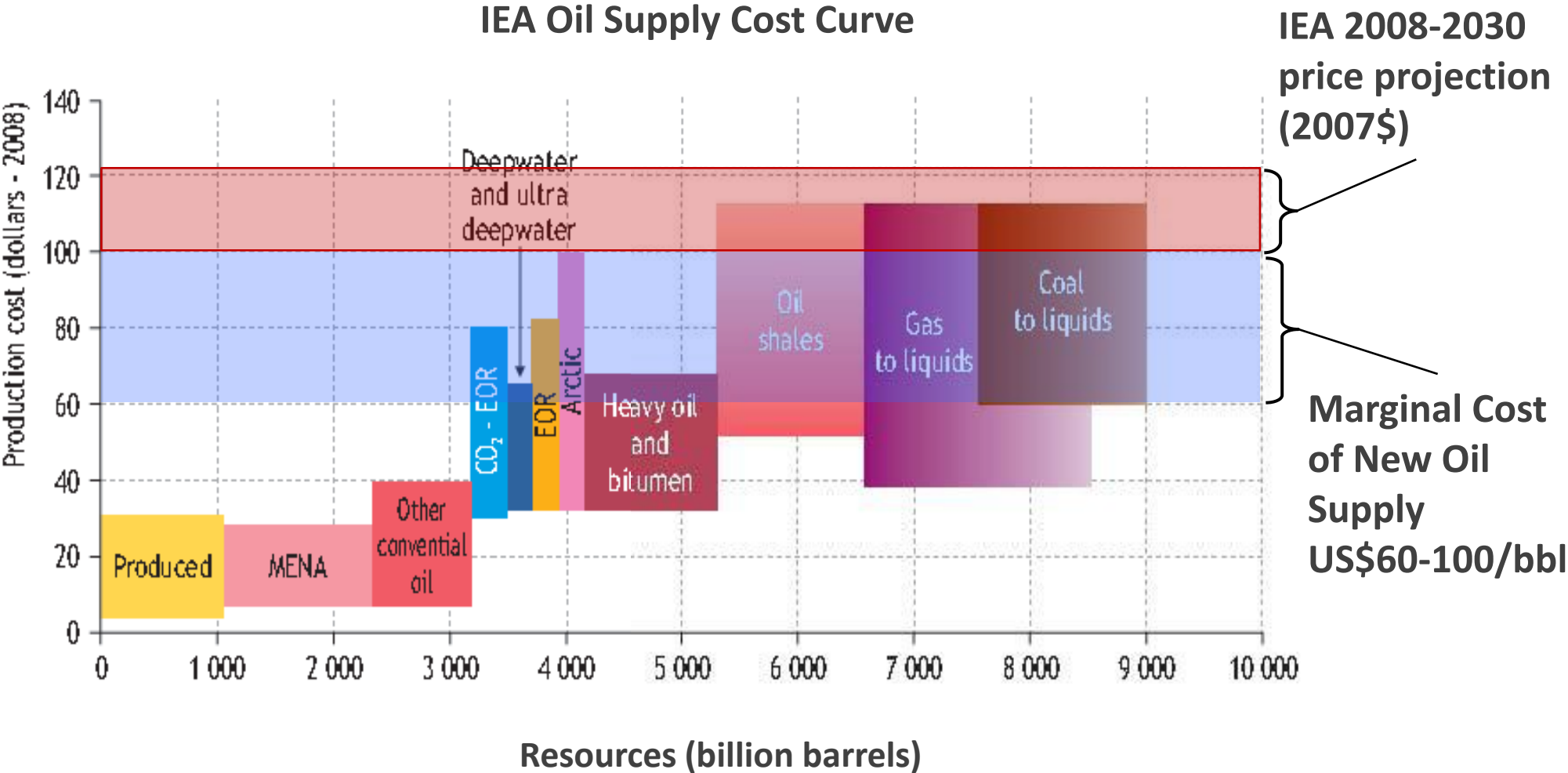
IEA Oil Price Assumptions

Average IEA Crude Oil Import Price (US\$/barrel – annual data)



Source: IEA WEO 2009

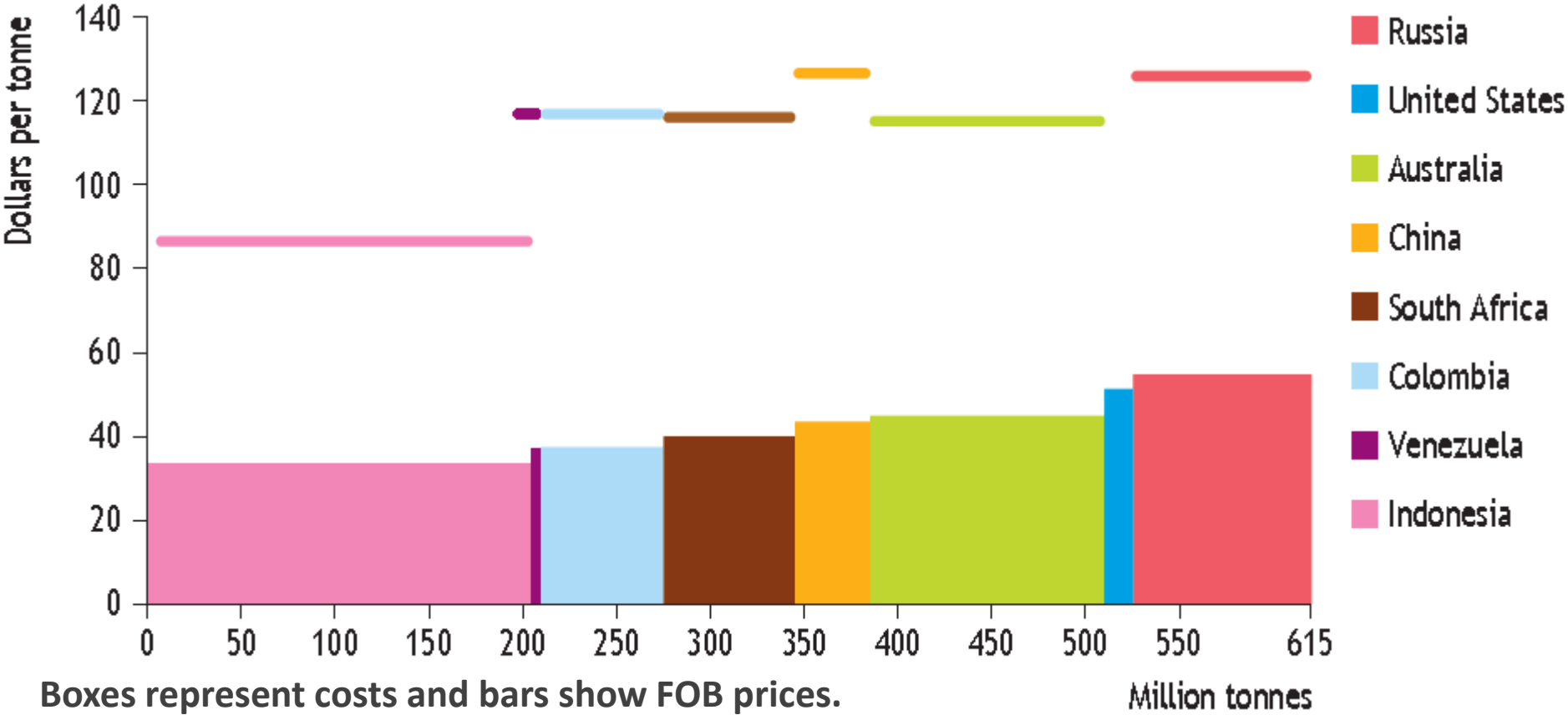
Increasing Cost of New Oil Supply



Source: IEA WEO 2008

Coal Cash-Cost Curve and FOB Prices

Coal Supply cash-cost curve for internationally traded steam coal for 2008 and average FOB price for 2008 and first half 2009



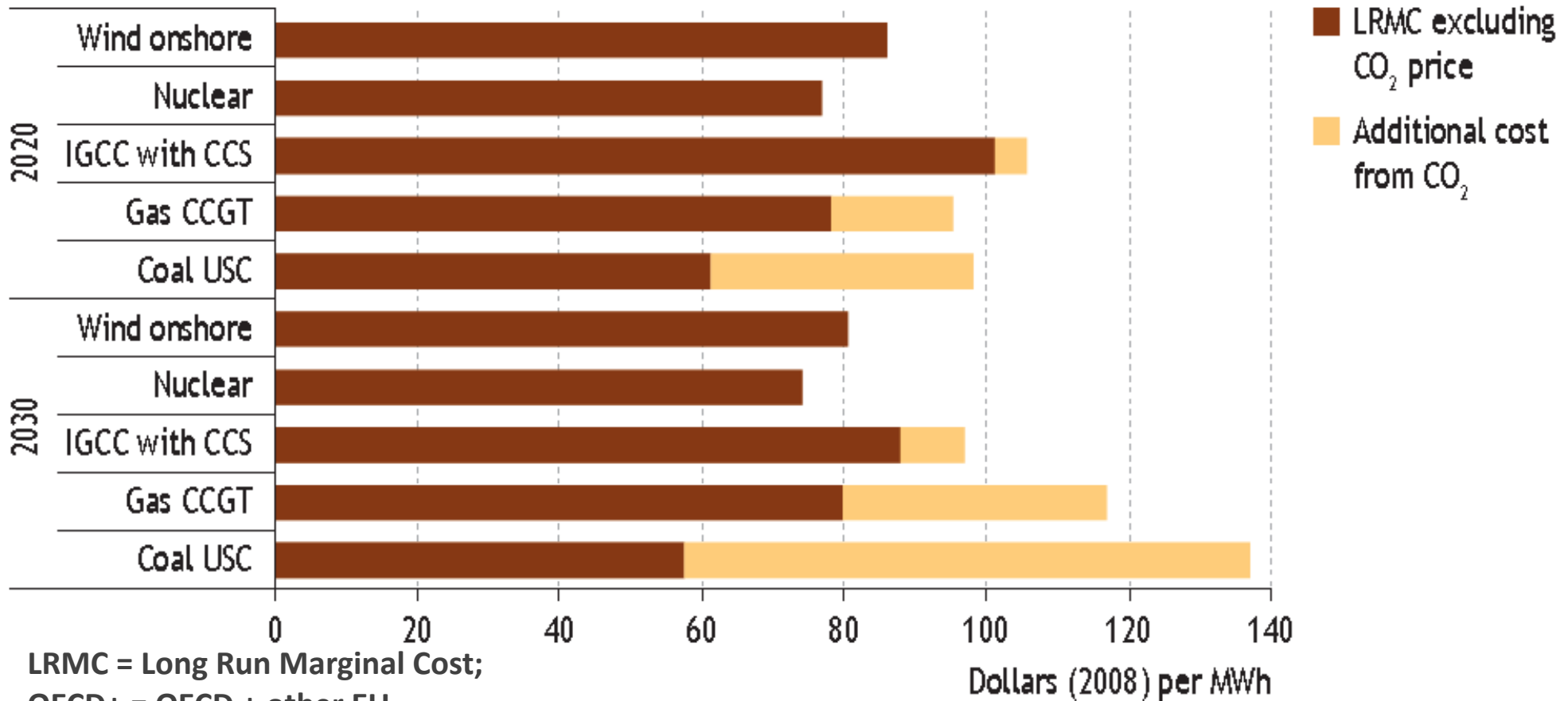
Boxes represent costs and bars show FOB prices.
Value adjusted to 6,000 kcal/kg.

Source: IEA WEO 2009 from IEA Clean Coal Centre citing data from Marston and HIS Global Insight



LRMC of Selected Technologies

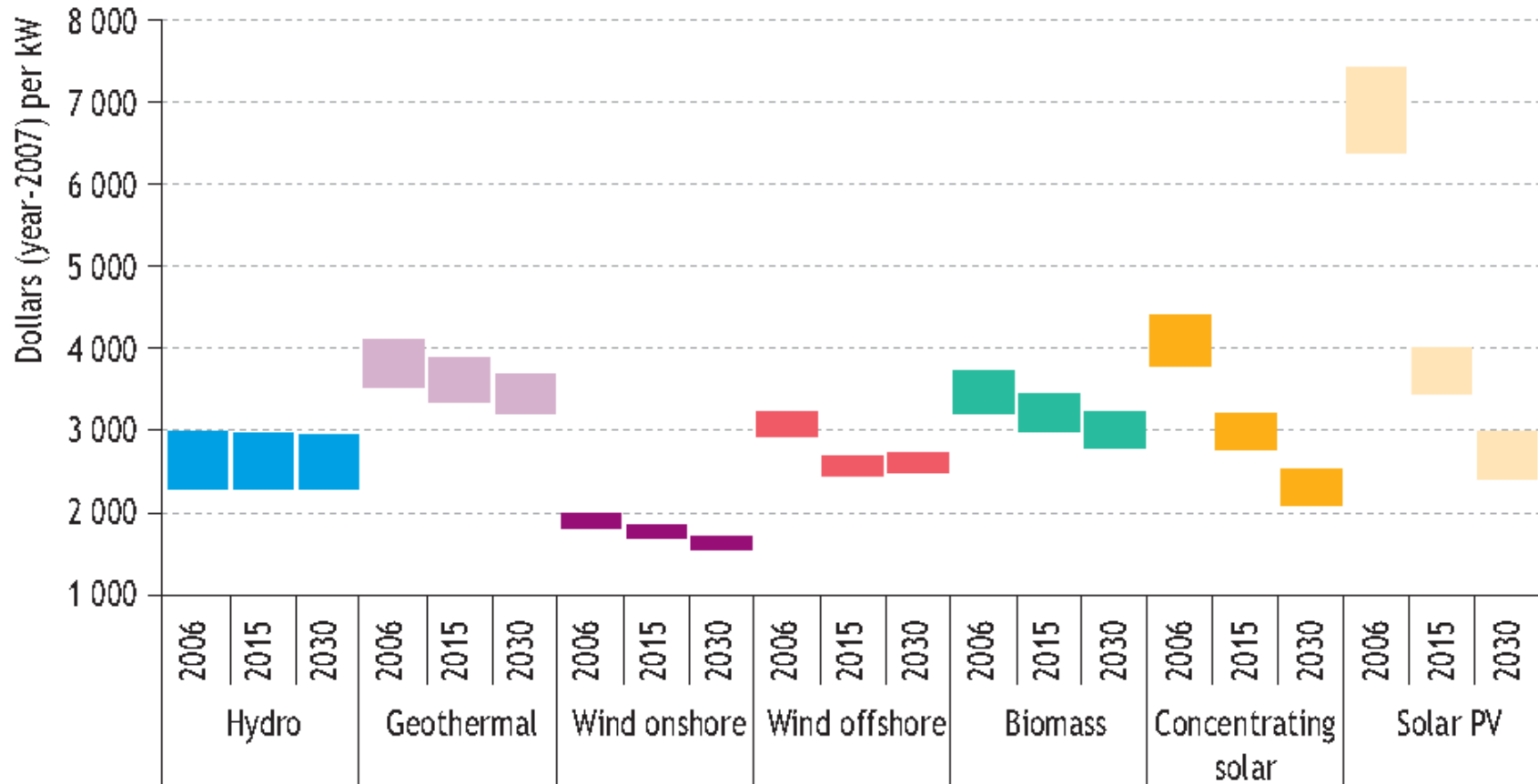
Average LRMC of selected power-generation technologies in OECD+, with and without CO₂ price



Source: IEA WEO 2009

Comparative Capital Cost of Renewables

Projected investment cost of renewable energy Technologies,
IEA Reference Scenario

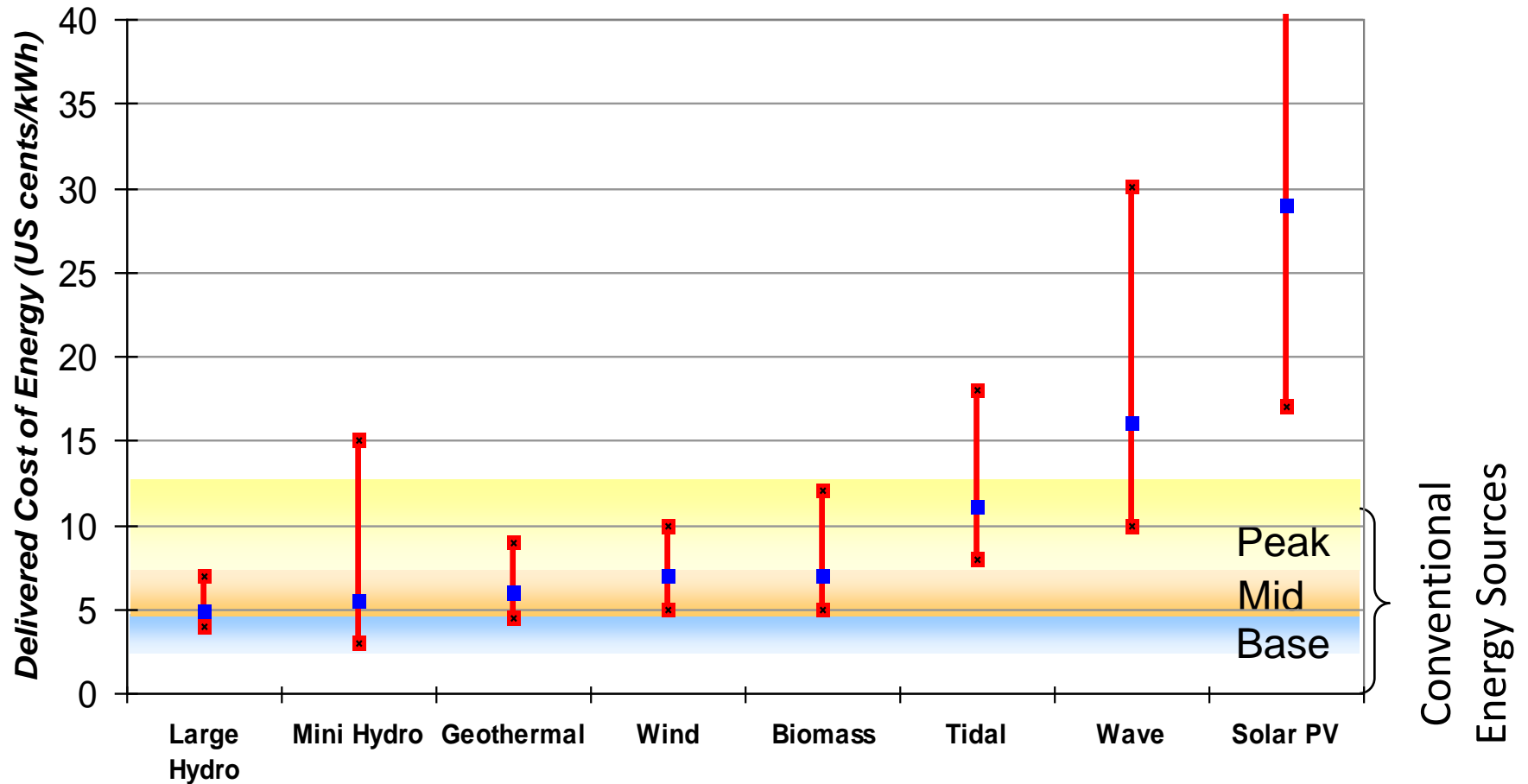


Offshore wind costs increase with greater depth and distance from the shore.

Source: IEA WEO 2008.

Comparative Cost of Delivered Energy

Representative Energy Costs for Various RE Technologies



Source: Aequero, industry sources. Indicative US market delivered energy costs, assuming no tax credits and typical construction costs over period 2006-2007.



Lessons, Challenges and Opportunities

- 🔺 Principles of investing in clean energy are fundamentally the same as for energy sector investments generally
- 🔺 Five key areas of difference:
 - ⇒ Reliance on policy and regulatory support
 - ⇒ Carbon assets create supplementary revenue streams
 - ⇒ Transaction size tends to be smaller than for conventional energy
 - ⇒ ...attracting non-traditional project developers who lack expertise and capital
 - ⇒ Technology (for certain investments – although most projects driven by proven technology)

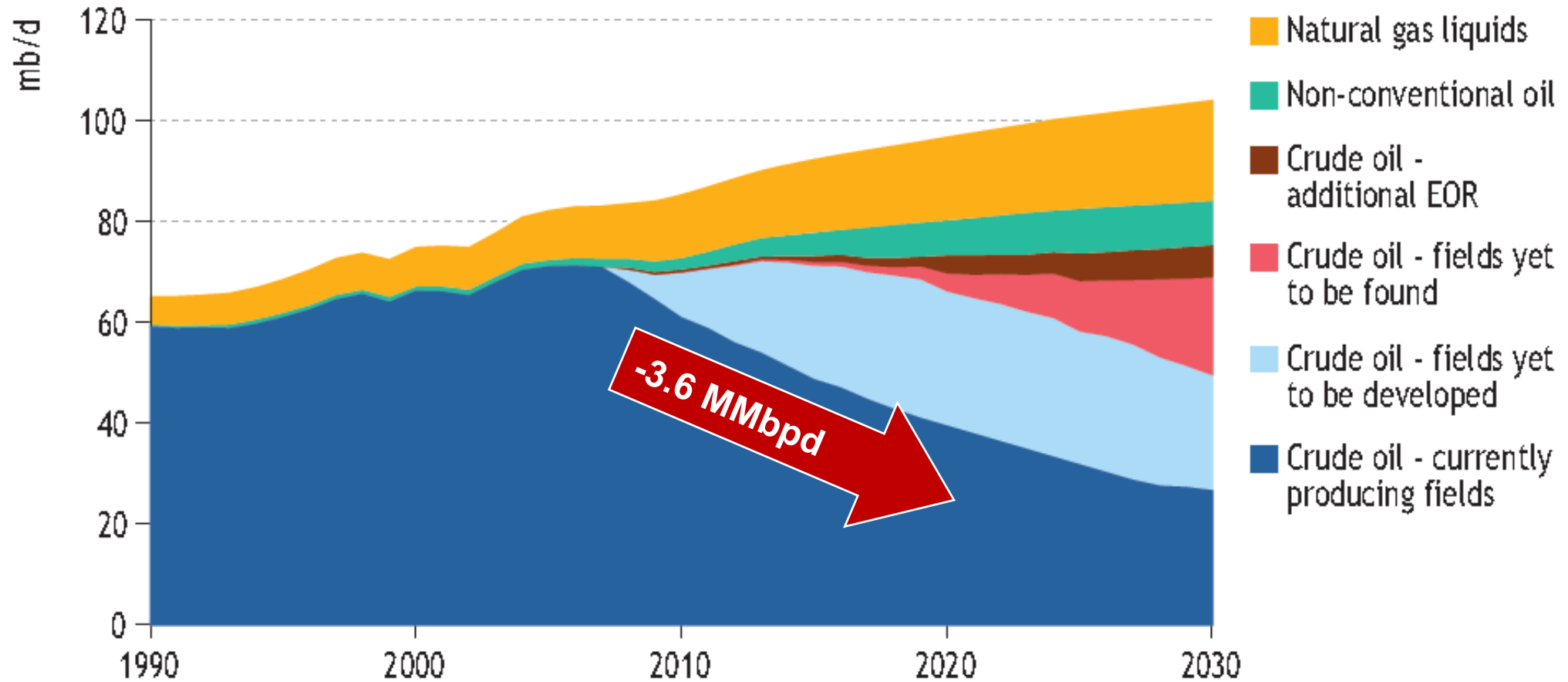
Resource Depletion: A Game Changer



Image Source: www.treehugger.com/files/2008/05/peak-everything-8-things-we-are-running-out-of.php

Running to Stand Still

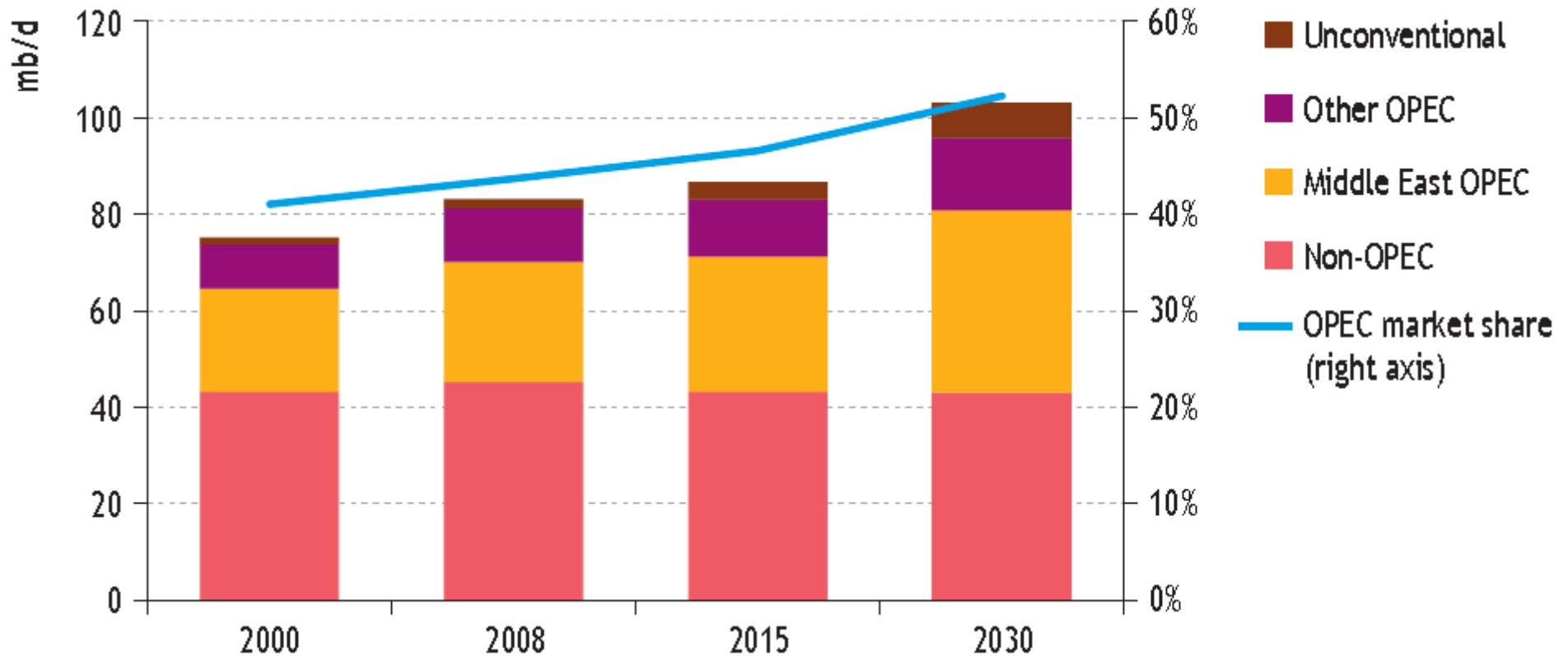
World Oil Production, IEA Reference Scenario



Source: IEA WEO 2008.

Increasing Reliance on OPEC

World Oil Production by Source, IEA Reference Scenario

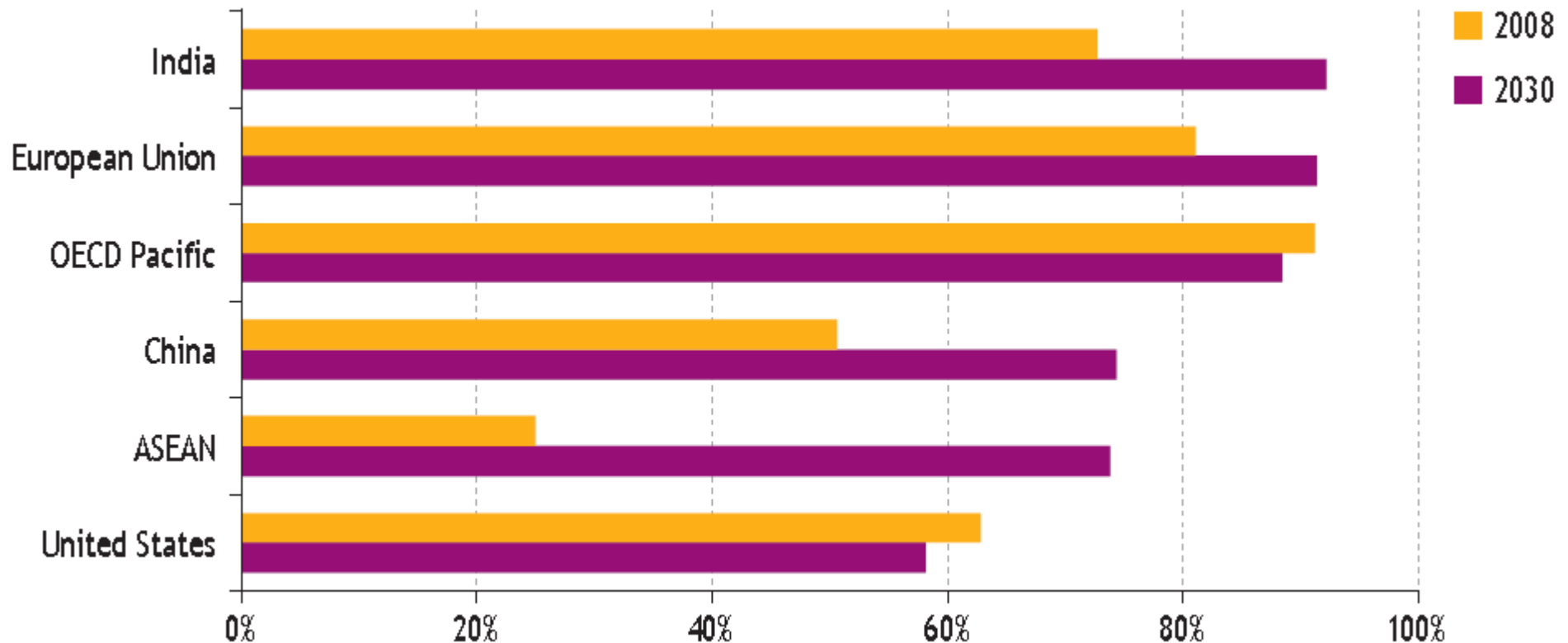


Excludes processing gains. Conventional oil includes crude oil, condensates, natural gas liquids (NGL) and extra-heavy oil from Venezuela

Source: IEA WEO 2009

... and Imported Oil

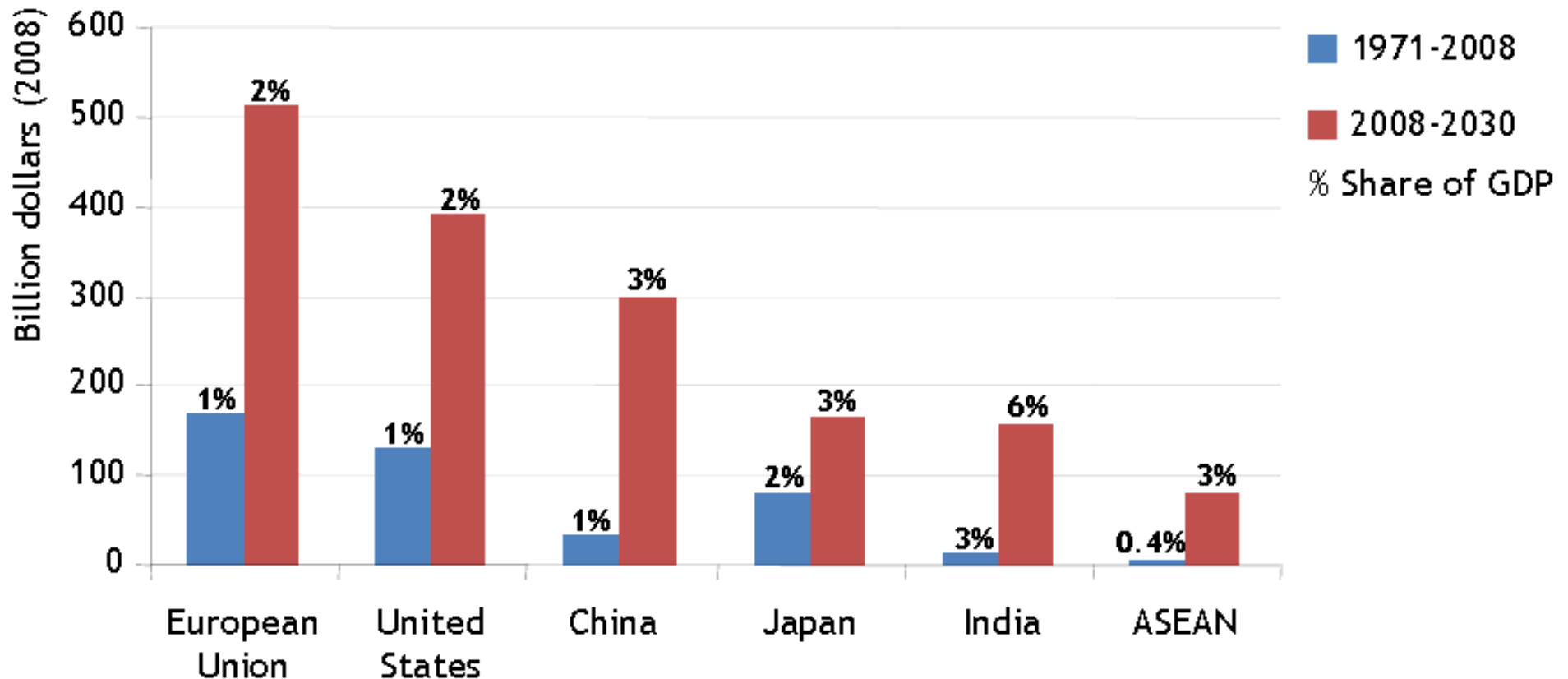
Dependence on net imports of oil by major importing region / country, IEA Reference Scenario



Source: IEA WEO 2009

Imported Oil in US\$ and Share of GDP

Average annual expenditure on net imports of oil by major importing region / country, IEA Reference Scenario



Source: IEA WEO 2009

The Role of Regulation



Image: Coal-fired power station

Policy Drivers

- 🔺 Energy policy decision-making focuses on:
 - ⇒ Economic development
 - ⇒ Energy security – fuel mix
 - ⇒ Environmental sensitivity, including climate change policy

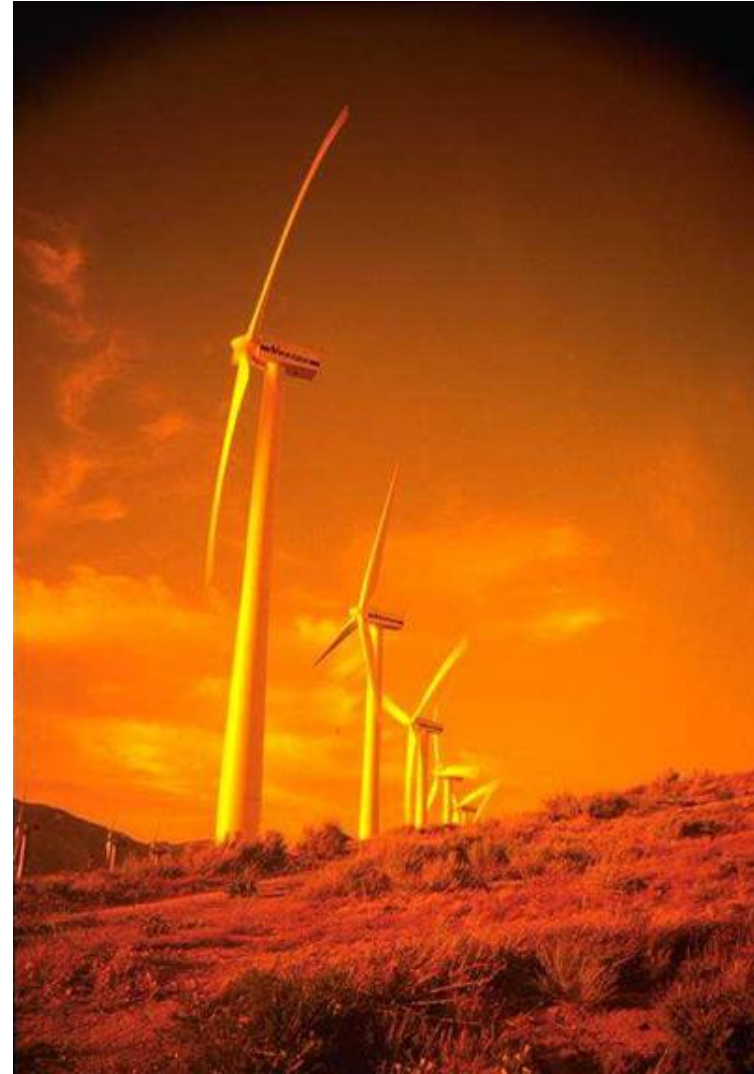


Image Source: www.flickr.com/photos/sorby/258577150/
(used with permission of the artist)

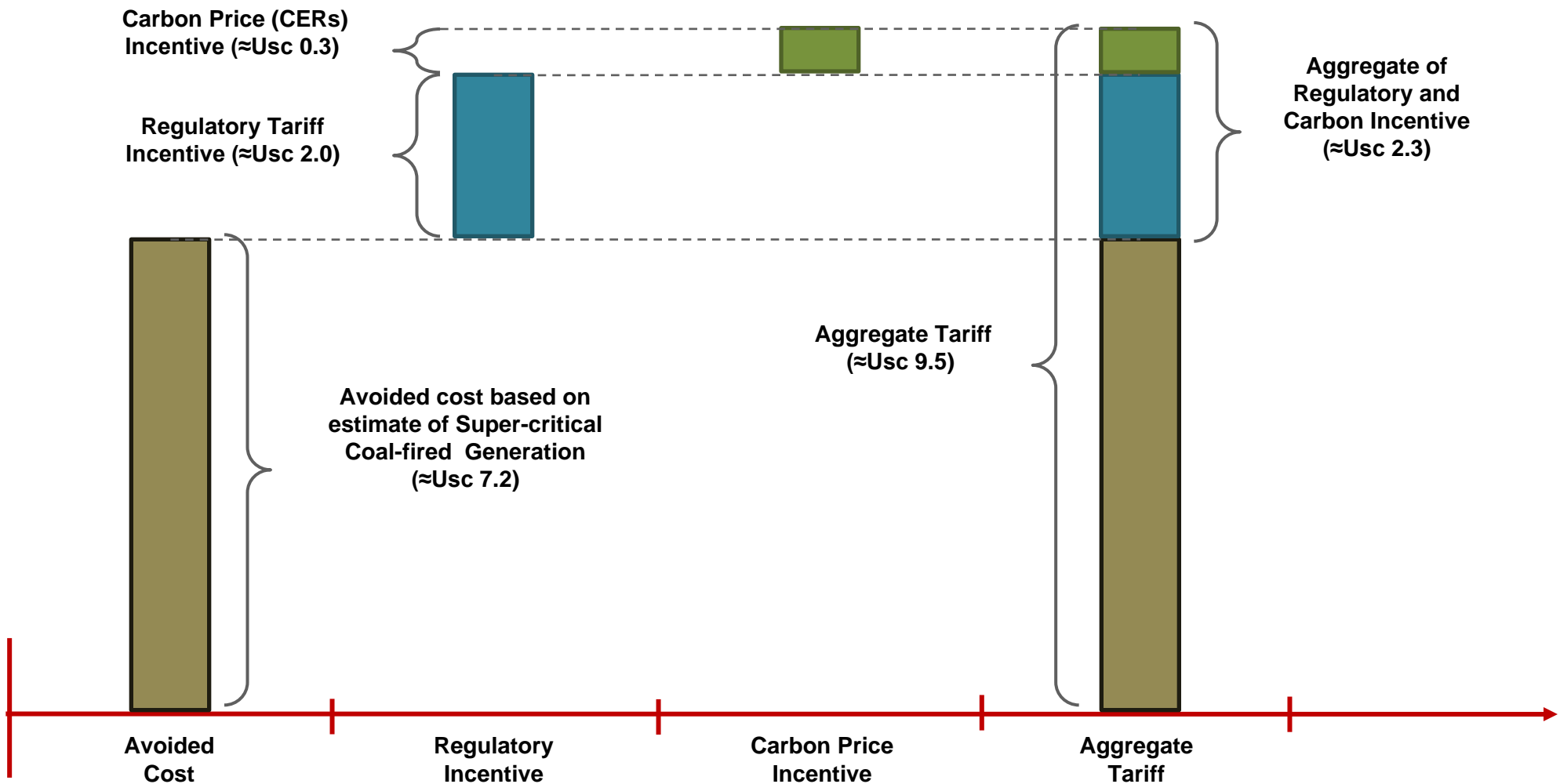
Why Regulate Energy Supply?

- 🔺 **Energy commodity price increases in 2008 created significant anxiety across the region, in particular for**
 - ⇒ Large importers of hydrocarbons
 - ⇒ Governments that subsidized energy usage
- 🔺 **Left Governments and industry with significant volatility in energy costs (and subsidy bills)**
 - ⇒ And concerns of a repeat in the future as energy supply concerns mount
- 🔺 **Governments have responded by increasing regulation to promote energy self-sufficiency / security**
 - ⇒ Generally means indigenous / renewable sources of energy
 - ⇒ India, China, Philippines and Thailand, in particular, are/have taken aggressive steps in this regard

Where to Regulate?

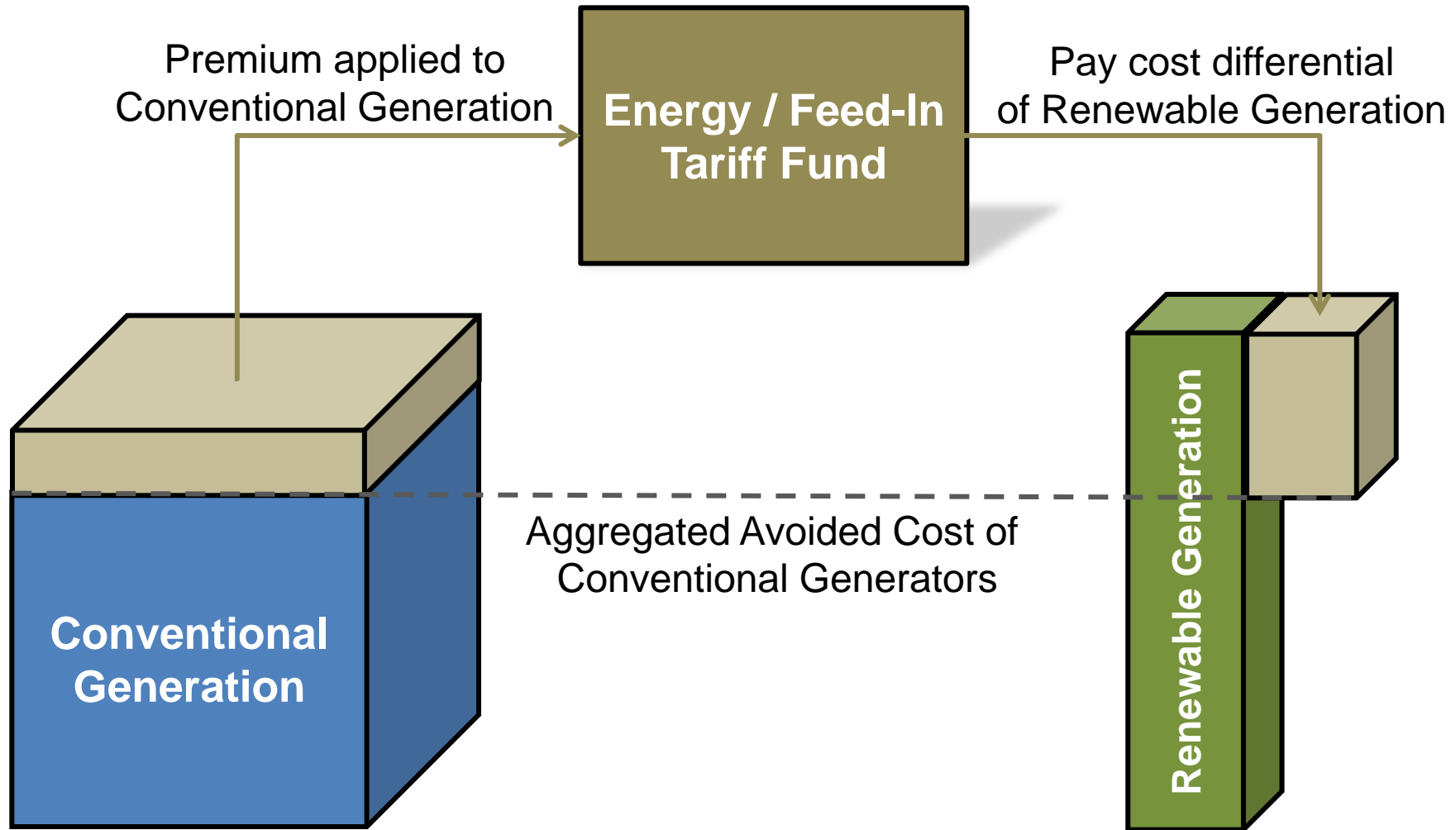
- 🔺 **Two principal areas where regulation is applied to promote alternative energy**
 - ⇒ The promotion of renewable / alternative energy in energy supply and usage
 - ⇒ The imposition of limits on emissions of carbon dioxide and other green-house-gases (GHG)
- 🔺 **In theory, the promotion of energy efficiency should take care of itself – generally, cash flow positive over relatively short term**
 - ⇒ However, structural impediments – small transaction size and exchange of capital cost for operating cost
 - ⇒ Thus a potential third area for regulation arises

Renewable Energy Tariff Construction



Source: Deploying Low Carbon Technologies: Costs of Readiness, Duncan Ritchie 2010 .

Feed-in Tariff Mechanism



Solving the Carbon Puzzle

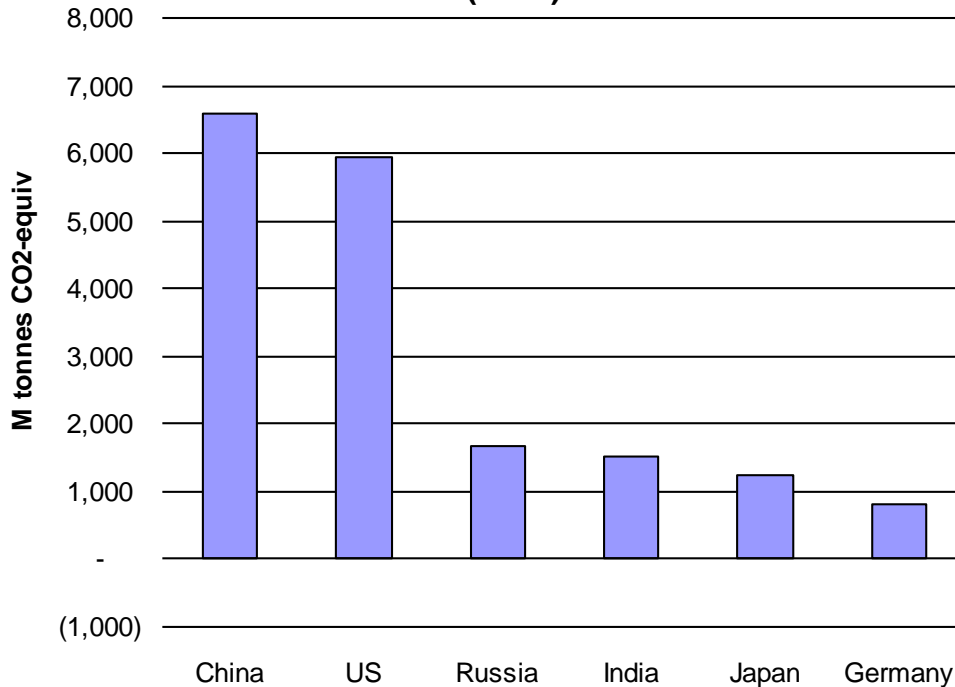


Image Source: www.treehugger.com/files/2008/05/peak-everything-8-things-we-are-running-out-of.php

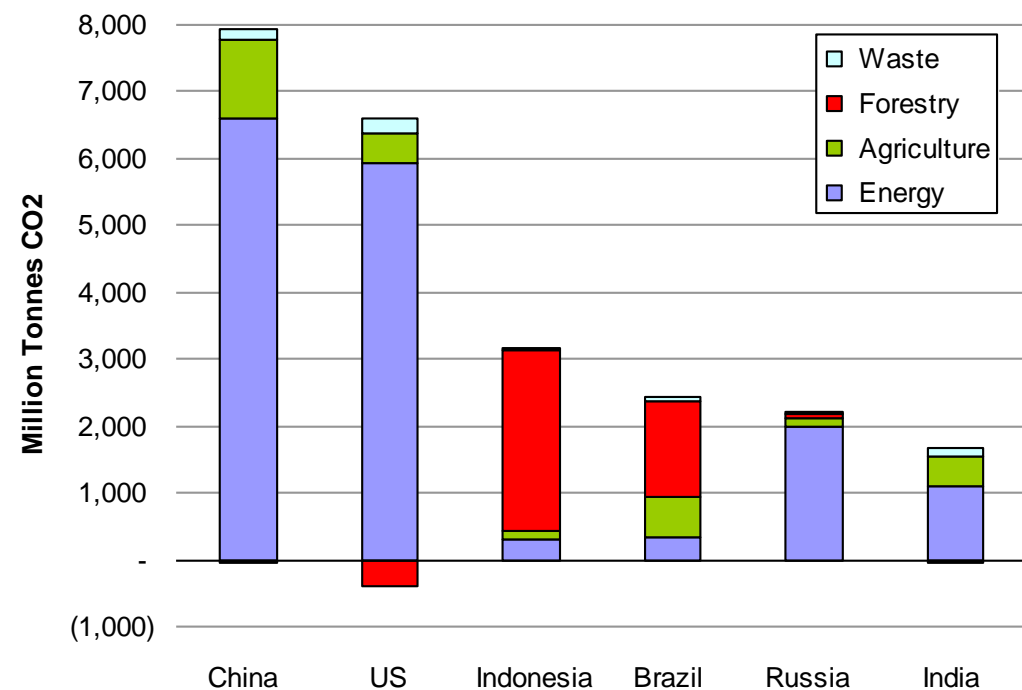
Driver: Growing Carbon Emissions

Developing nations have ascended to the ranks of the world's top greenhouse gas emitters

Largest Carbon Emitters, Fossil Fuels Use Only (2007)



Largest Carbon Emitters Counting Forests/Agri (2007)

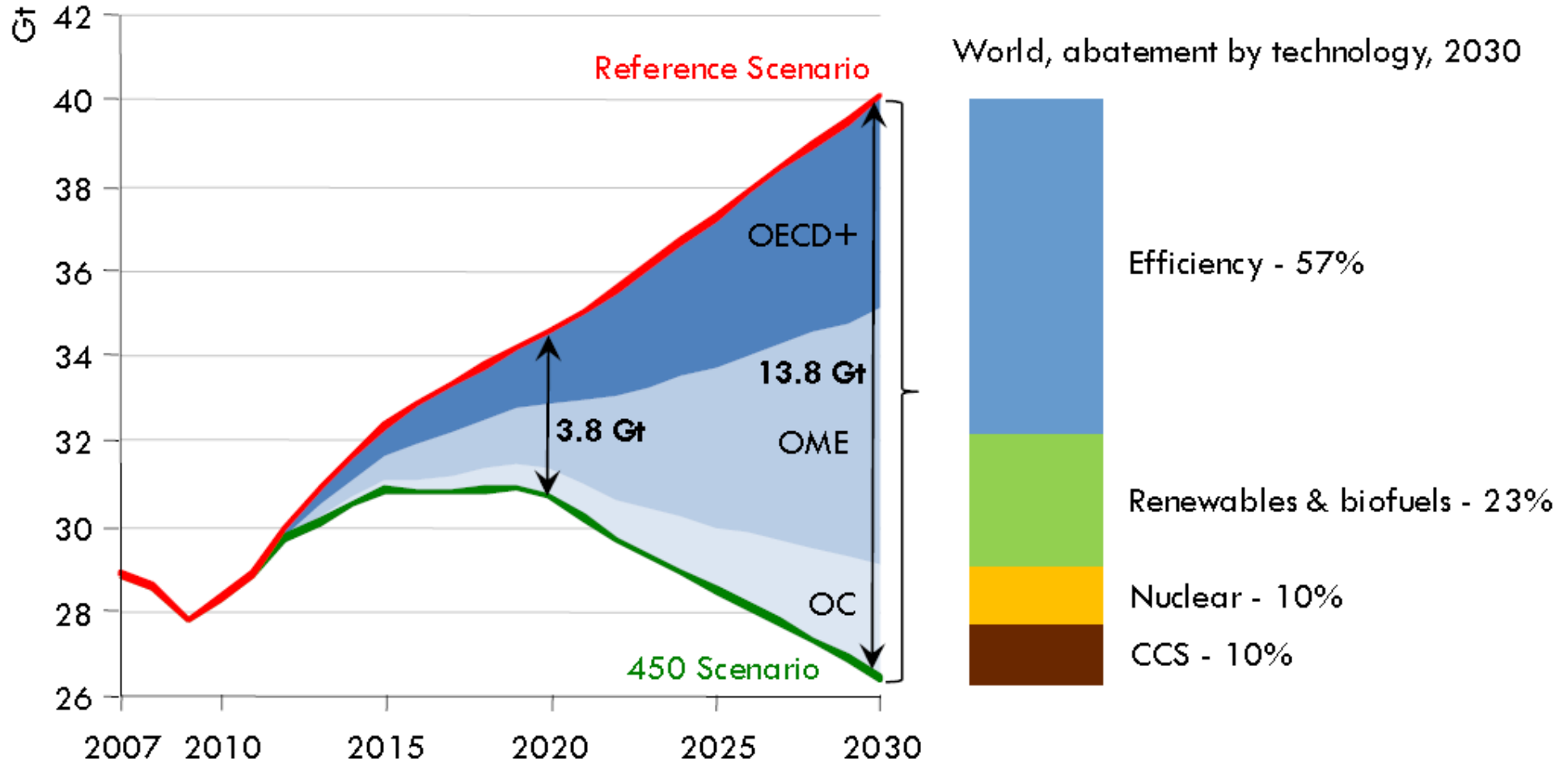


Source: World Bank, DFID, March 2007, "Indonesia and Climate Change" provides 2004 base. Emissions adjusted from figures for energy emissions from CDIAP, US DOE Oak Ridge National Laboratory, 2008 and long-term afforestation/deforestation rates from the "Forest Resources Assessment, 2005", FAO, Butler. Note, the European Union as a whole would comprise the third largest polluter behind US and China.



IEA Scenarios & Abatement Technologies

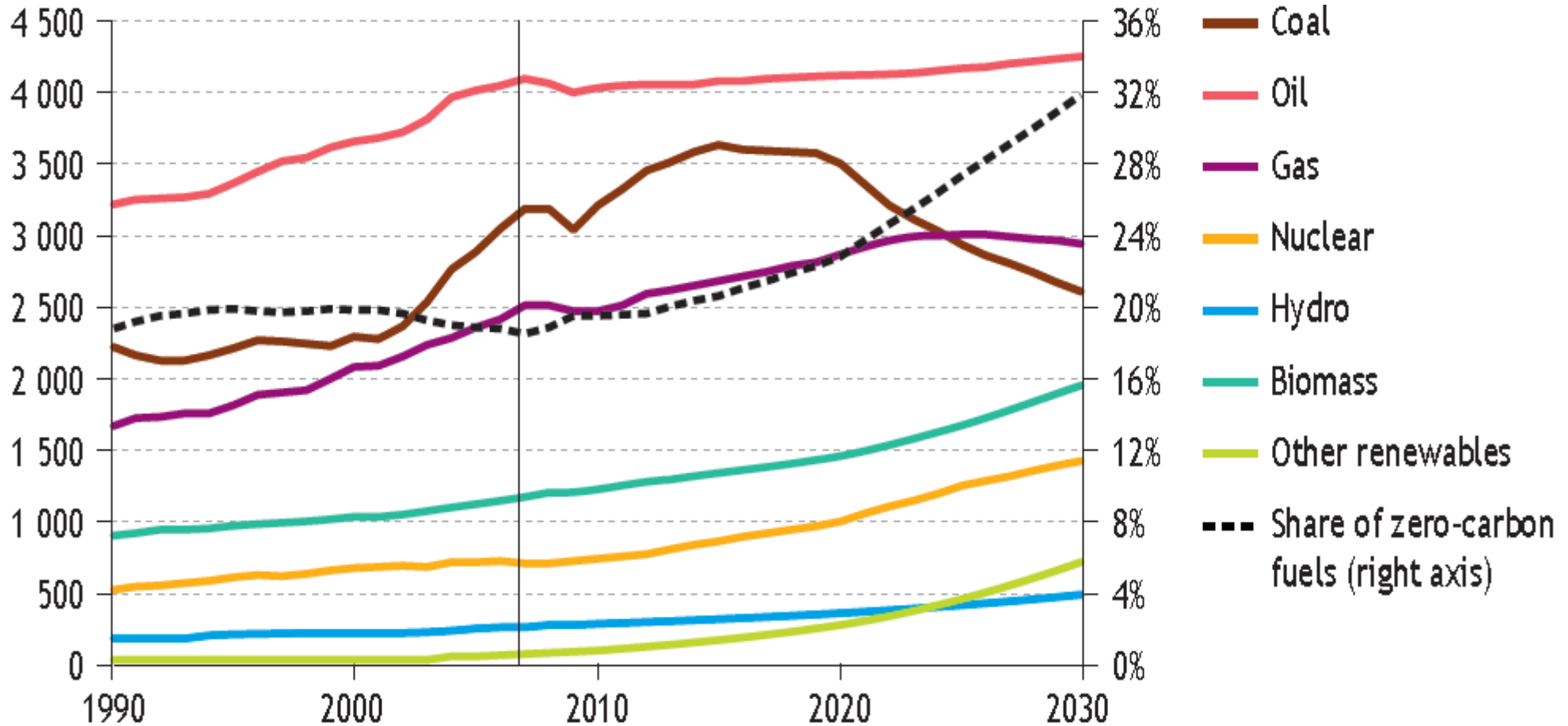
Everybody needs to play a part



Source: IEA WEO 2009

Primary Energy Demand by Fuel

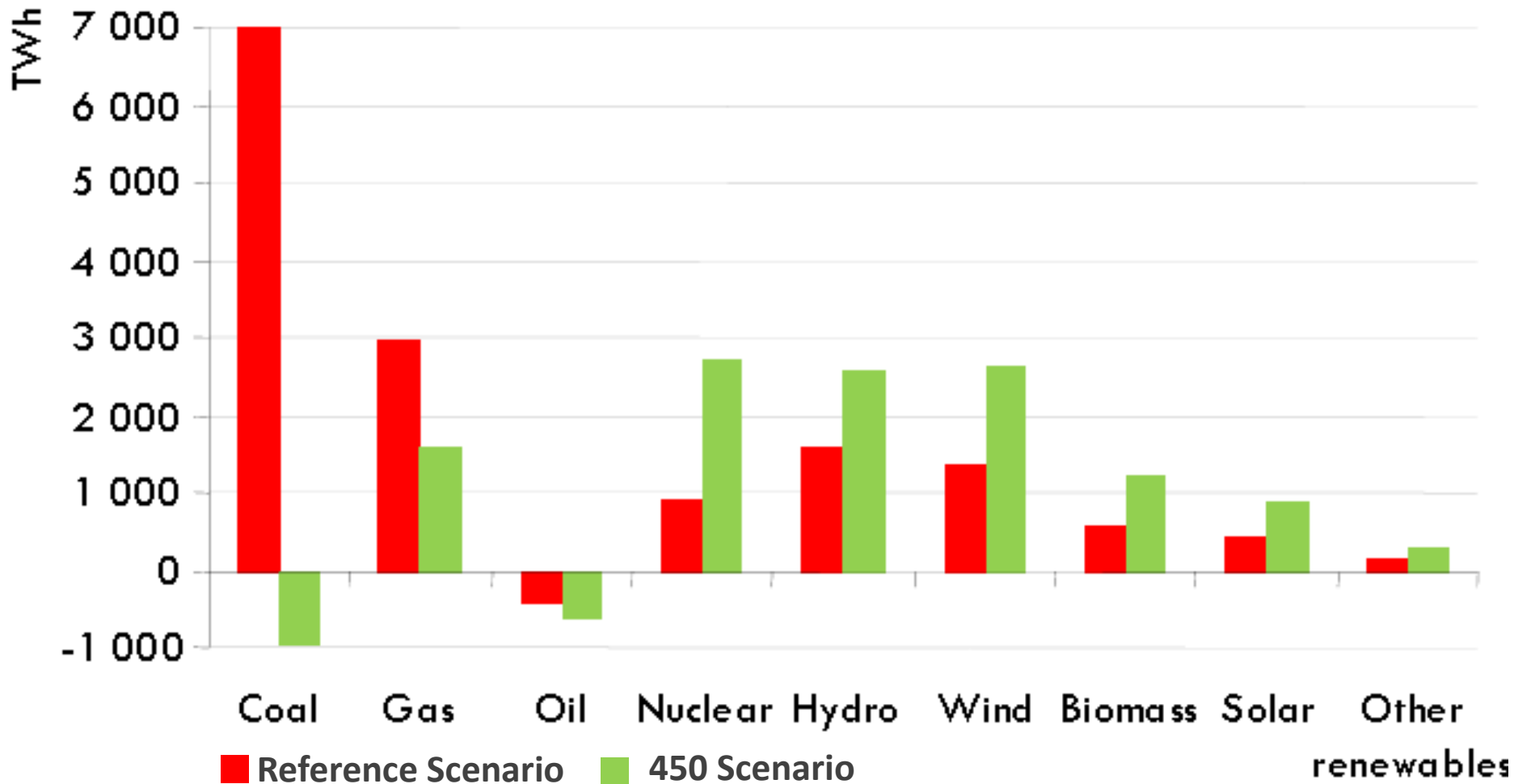
World Primary energy demand by fuel in 450 Scenario (2007-2030, Mtoe)



Source: IEA WEO 2009

Incremental Electricity Production

Incremental World Electricity Production, Reference vs. 450 Scenario (2007-2030)



Source: IEA WEO 2009

Policy Initiatives to Abate CO₂

International Carbon Markets

Cap & Trade

⇒ Power, Industrial and Transport Sectors

International Sectoral Standards

⇒ Industry and Transport Sectors

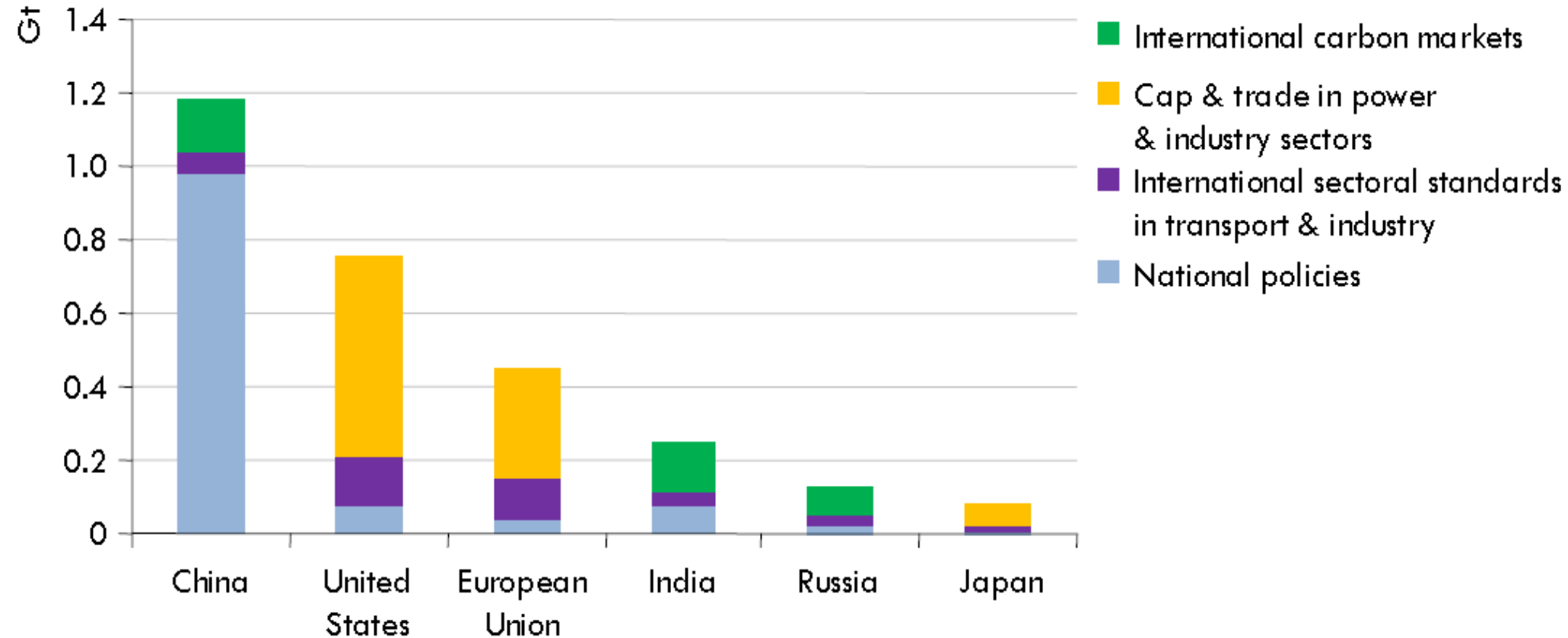
National policies

⇒ Feed-in tariffs

⇒ Renewable portfolio standards

Achieving a 450 Scenario

IEA Hypothesis: Targeted policy initiatives to achieve emissions reduction in selected countries



Source: IEA WEO 2009

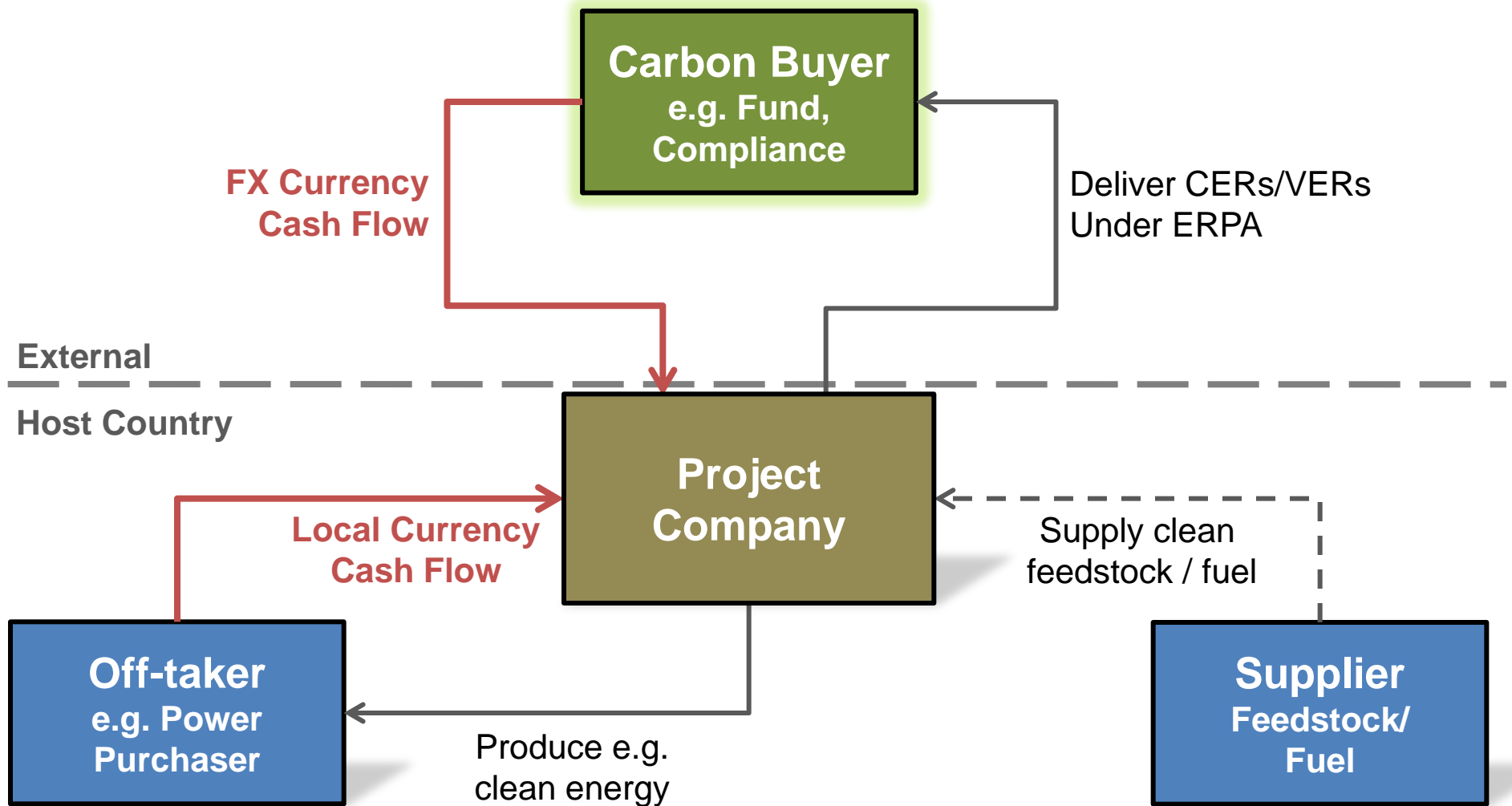
Taxing Carbon vs. Carbon Markets

- 🔺 Fundamentally two ways to contain carbon emissions – both involve a form of “user pays”
 - ⇒ Tax emissions
 - ⇒ Cap-and-trade
- 🔺 Taxing emissions sets a fixed price on emissions – probably country specific
 - ⇒ Weakness is that it is imprecise – if the tax is set incorrectly emissions may over / undershoot
- 🔺 Cap-and-trade employs a market mechanism
 - ⇒ Regulation places a constraint on CO₂ emissions
 - ⇒ The market determines the price of regulated CO₂ emissions

An International Climate Agreement?

- 🔺 **Missed opportunity in Copenhagen**
- 🔺 **“Climategate” scandal has provided opportunity to obfuscate**
 - ⇒ In reality probably 99%+ of science is robust
- 🔺 **Emergence of bilateral arrangements**
 - ⇒ E.g., on financing for developing countries
- 🔺 **CDM needs a major overhaul**
 - ⇒ ... but some form of international carbon market needed
 - ⇒ Does the Indonesia approach on geothermal offer a model?
- 🔺 **Carbon market needs to be global**
 - ⇒ ... with a fungible carbon product

Carbon is Another Cash Flow Stream / Asset



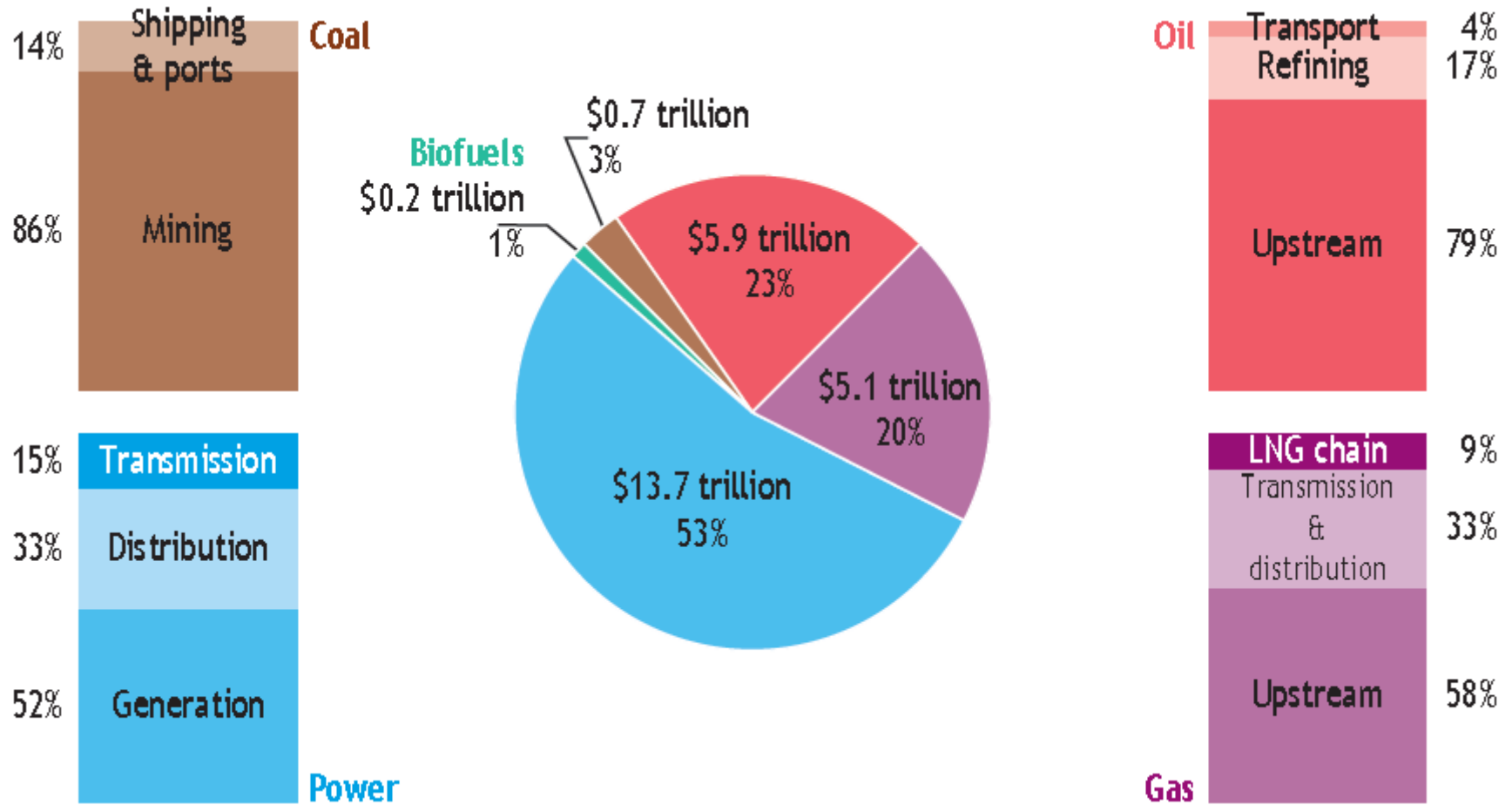
Potential Financing Constraints



Image Source: ABC News

Investment in Energy-Supply Infrastructure

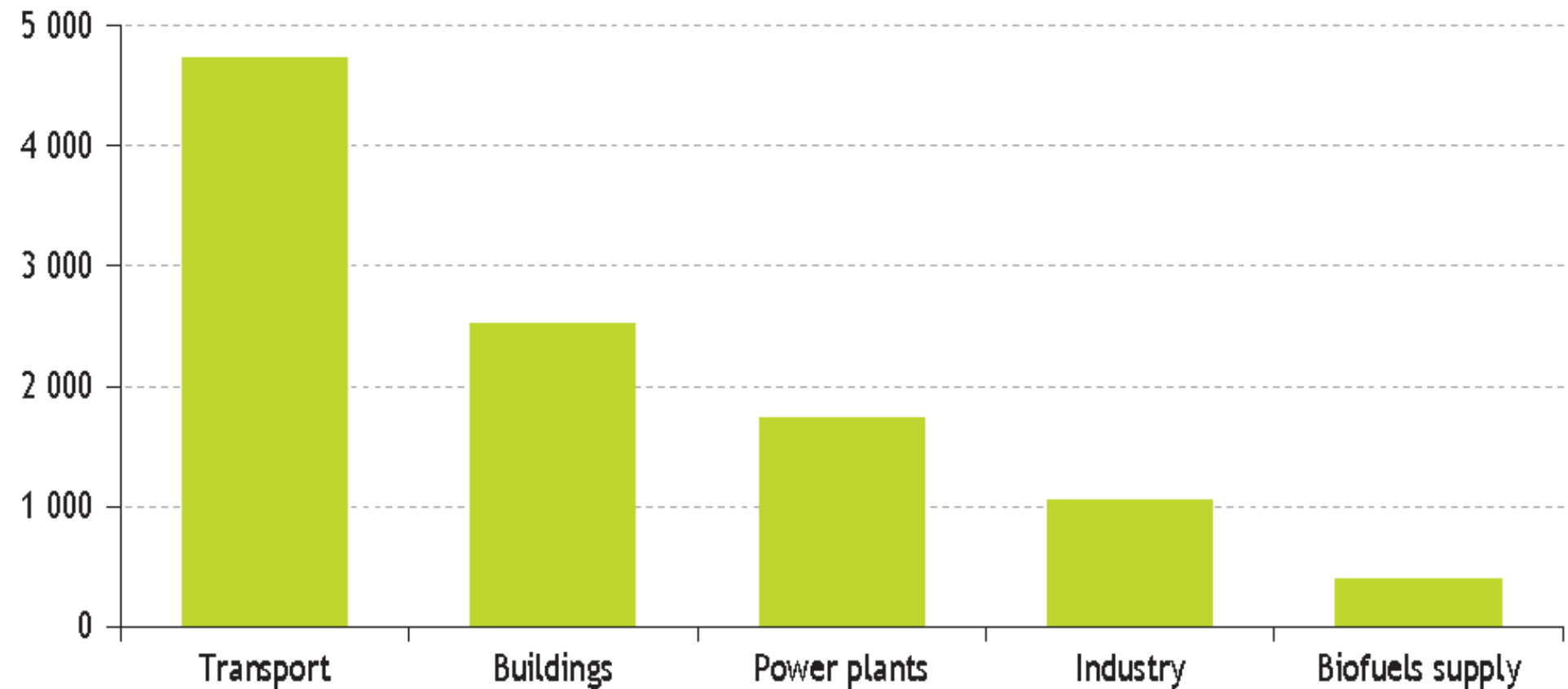
Cumulative investment in energy-supply Infrastructure, IEA Reference Scenario (2008-2030) - Total Investment = US\$25.6 trillion (in 2008 US\$)



Source: IEA WEO 2009

Investment in Energy-Supply Infrastructure

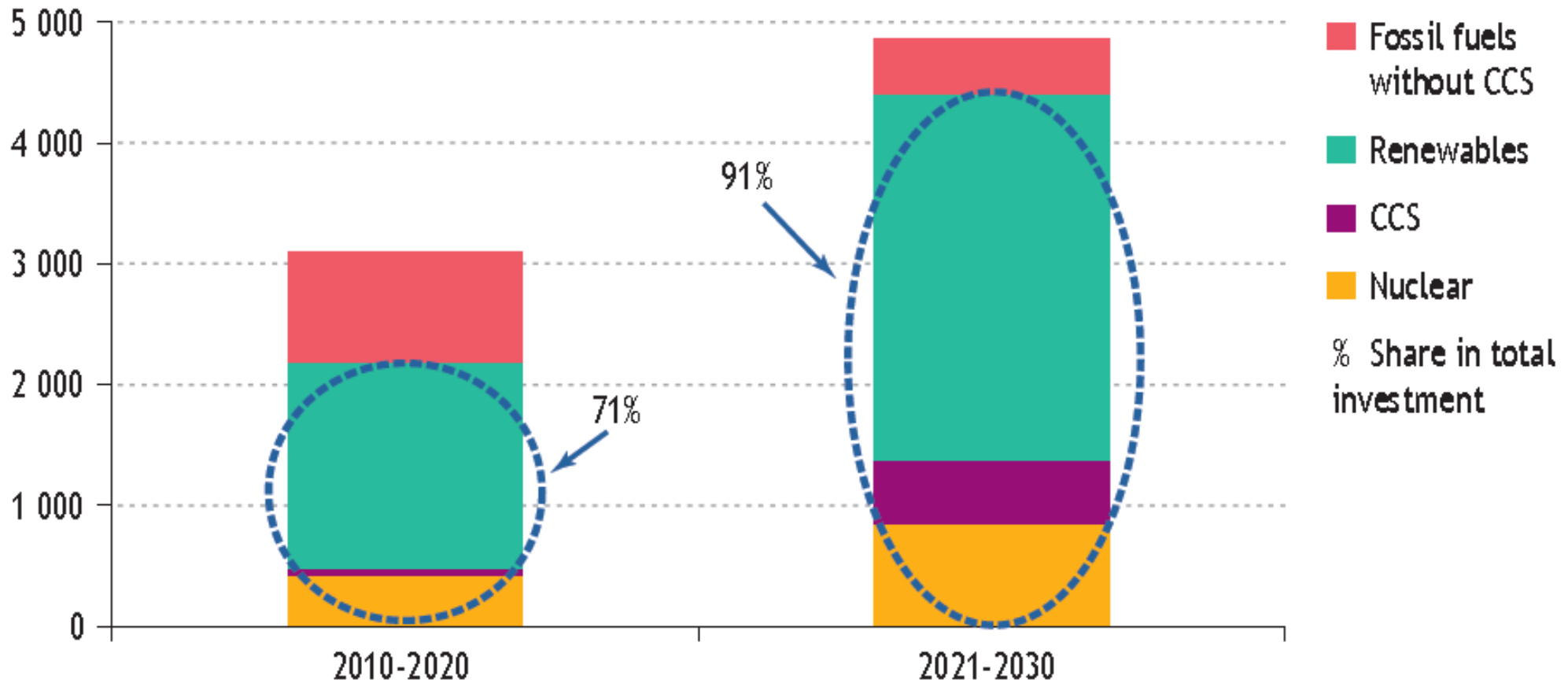
Cumulative additional investment by sector in 450 Scenario ,
relative to Reference Scenario 2010-2030, (US\$ billions, in 2008 dollars)



Source: IEA WEO 2009

Investment in Power Generation

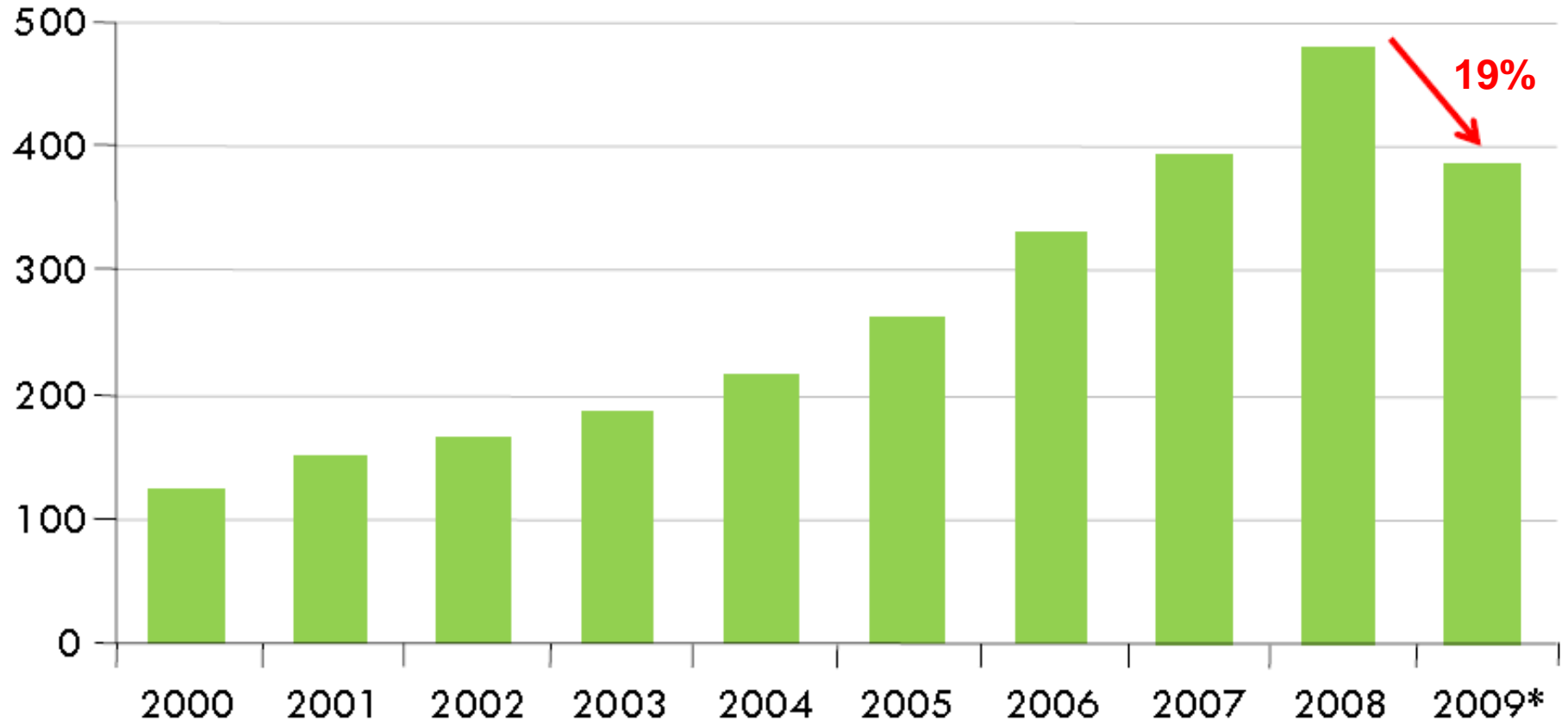
Total global investment in renewables, nuclear, CCS and fossil fuels for power generation in the 450 Scenario, (US\$ billions, in 2008 dollars)



Source: IEA WEO 2009

Investment in Upstream Impacted

Worldwide Upstream Expenditure (US\$ billions)

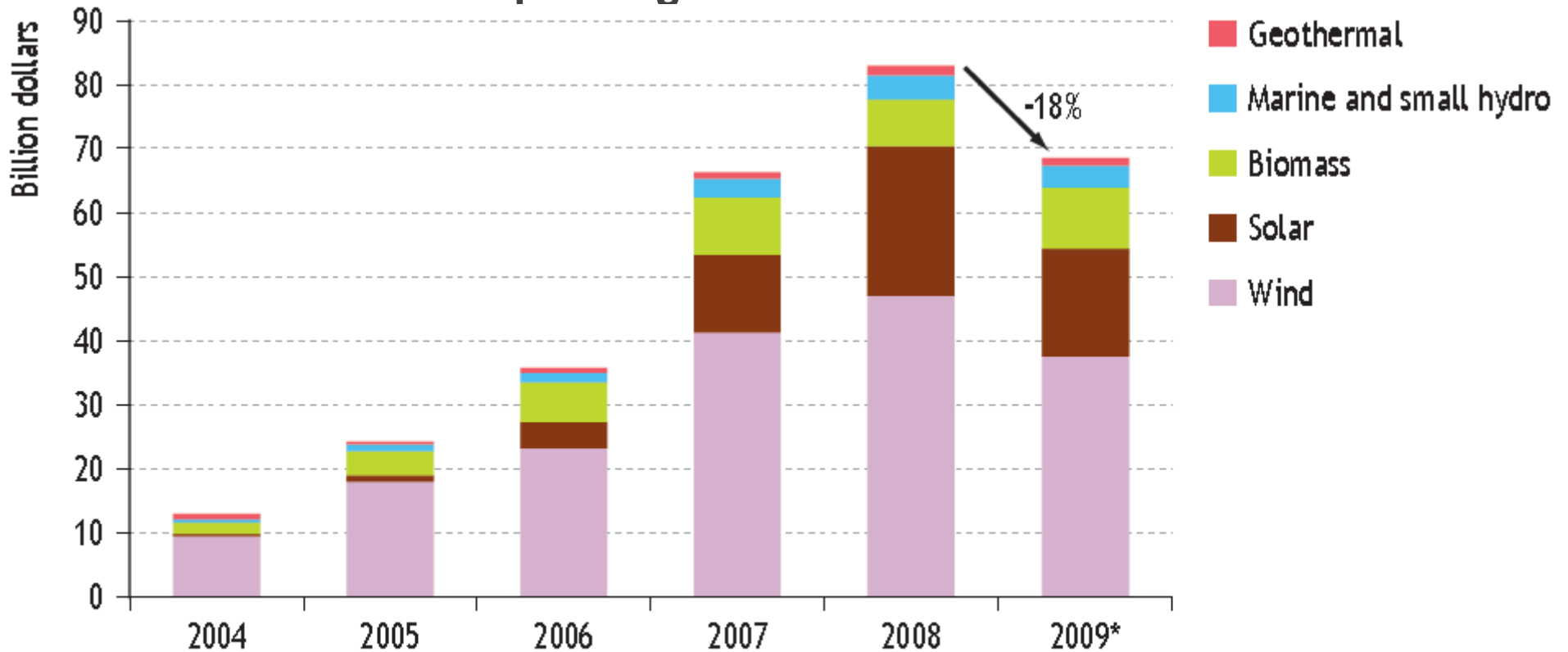


* Budgeted spending

Source: IEA WEO 2009

Investment in Renewable Impacted

Global investment in new renewables-based power generation assets



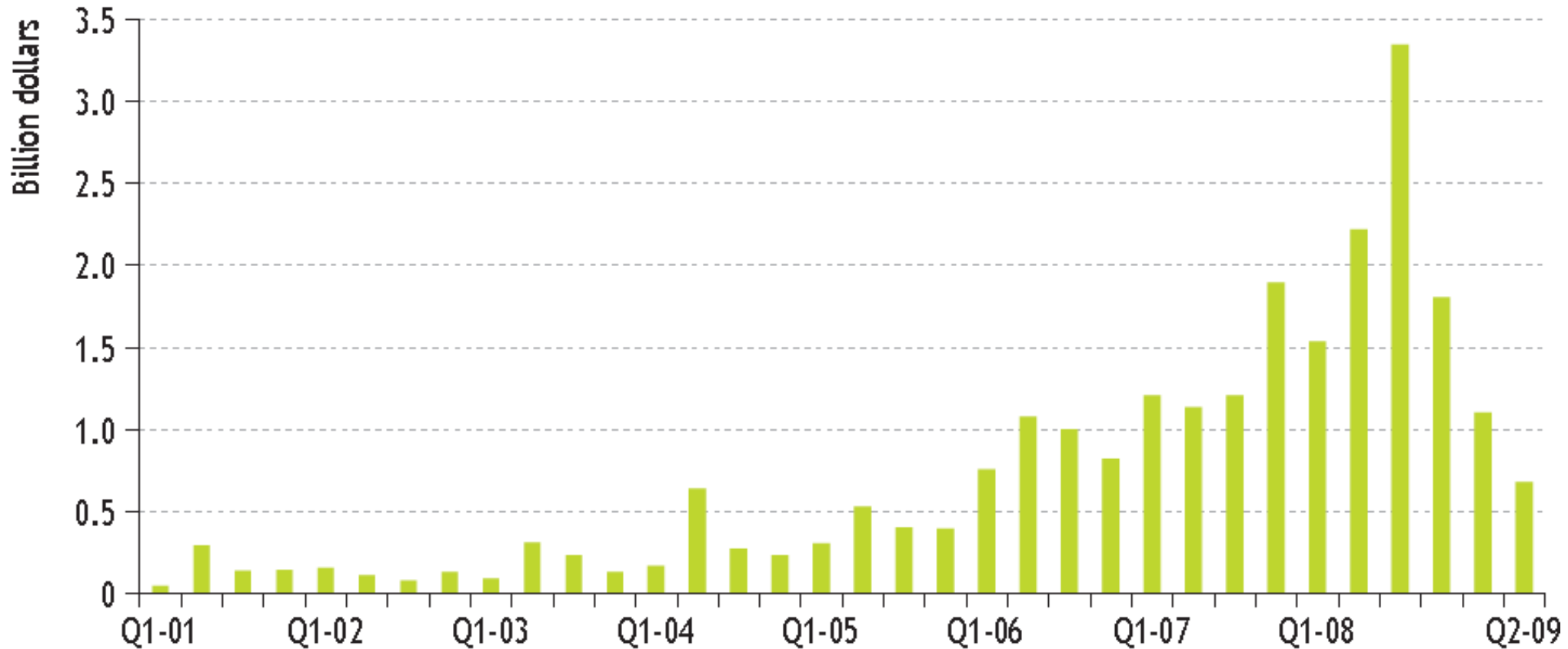
* IEA projection taking account of preliminary data for the first half of the year and the impact of fiscal stimulus packages.

Source: IEA WEO 2009



Investment in CleanTech Impacted

Venture capital and private equity new investment in clean energy companies (2001-2009)



Source: New Energy Finance Database, IEA WEO 2009

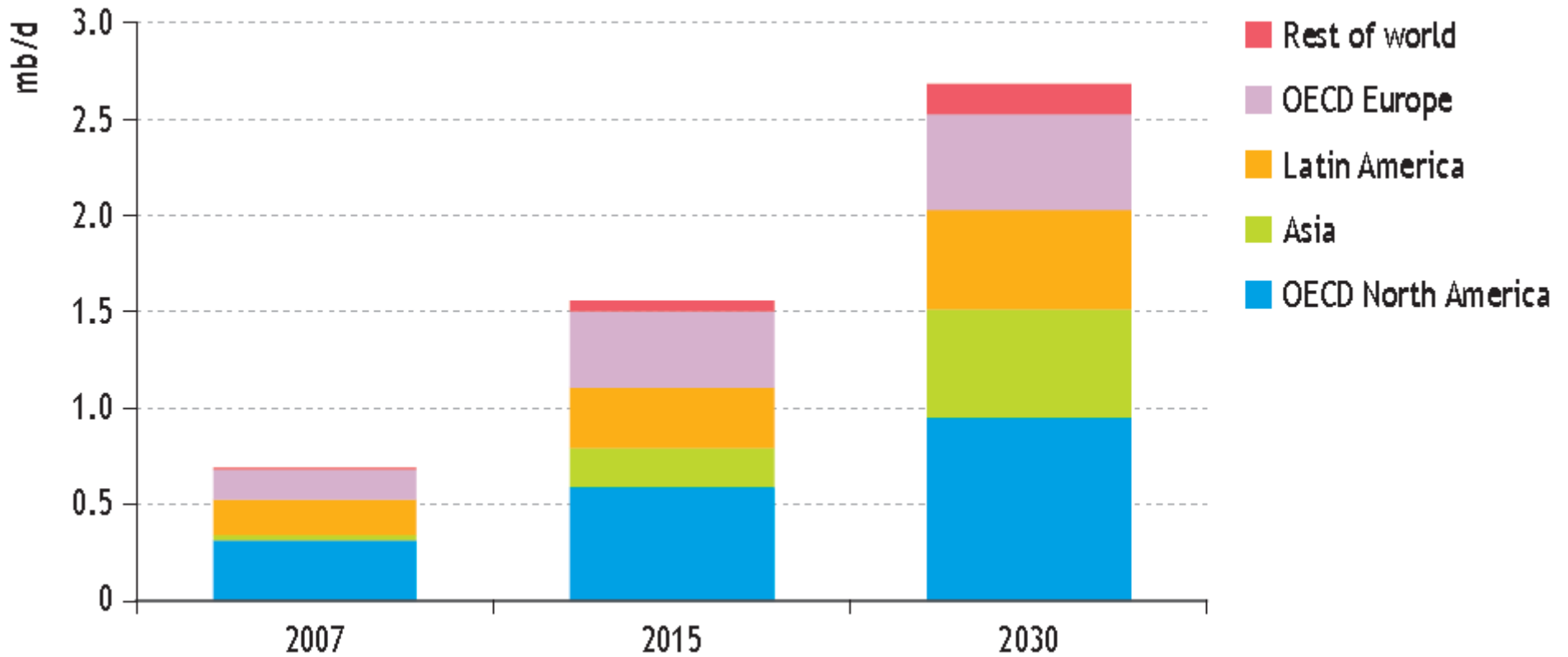
Sustainability of Biofuels



Image Source: www.nytimes-se.com

World Biofuel Consumption

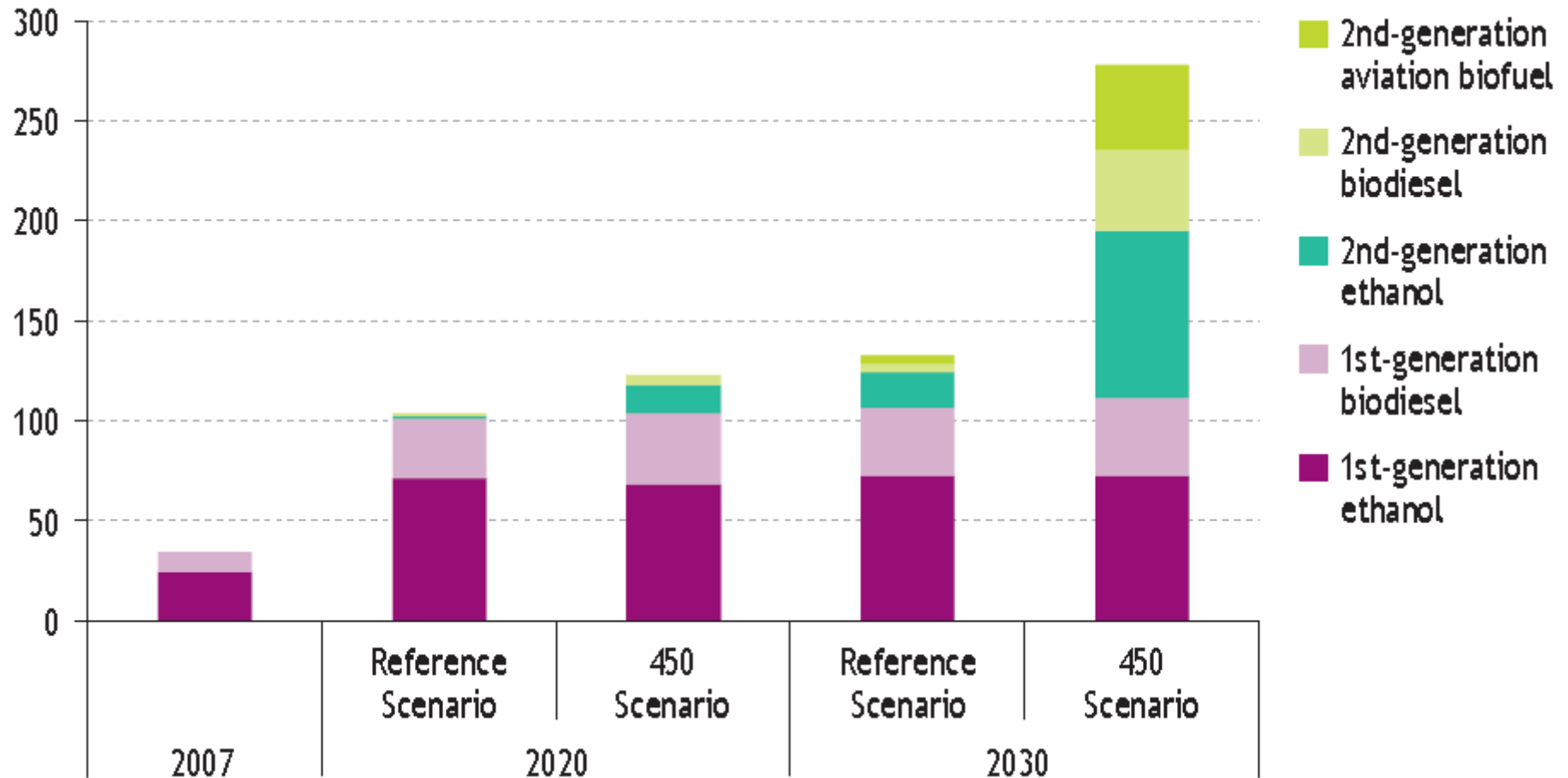
World Biofuel Demand by Region,
IEA Reference Scenario



Source: IEA WEO 2009

World Biofuel Demand by Type

World biofuel demand by type and scenario (Mtoe)



Source: IEA WEO 2009

The Food vs. Fuel Debate

- 🔺 **Use of biofuels can contribute to rising food prices where crops and/or land are diverted from food production to biofuel production e.g. corn ethanol**
- 🔺 **However, a multiplicity of factors are responsible for food price increases**
 - ⇒ **Changing dietary requirements**
 - ⇒ **Higher input prices e.g. energy**
 - ⇒ **Poor harvests due to extreme weather events**
 - ⇒ **Changing value of the US dollar**
 - ⇒ **Export restrictions imposed by some countries, impacting global supply**
- 🔺 **Need for policies that support sustainable biofuel production not at the expense of the food supply**

Conclusions

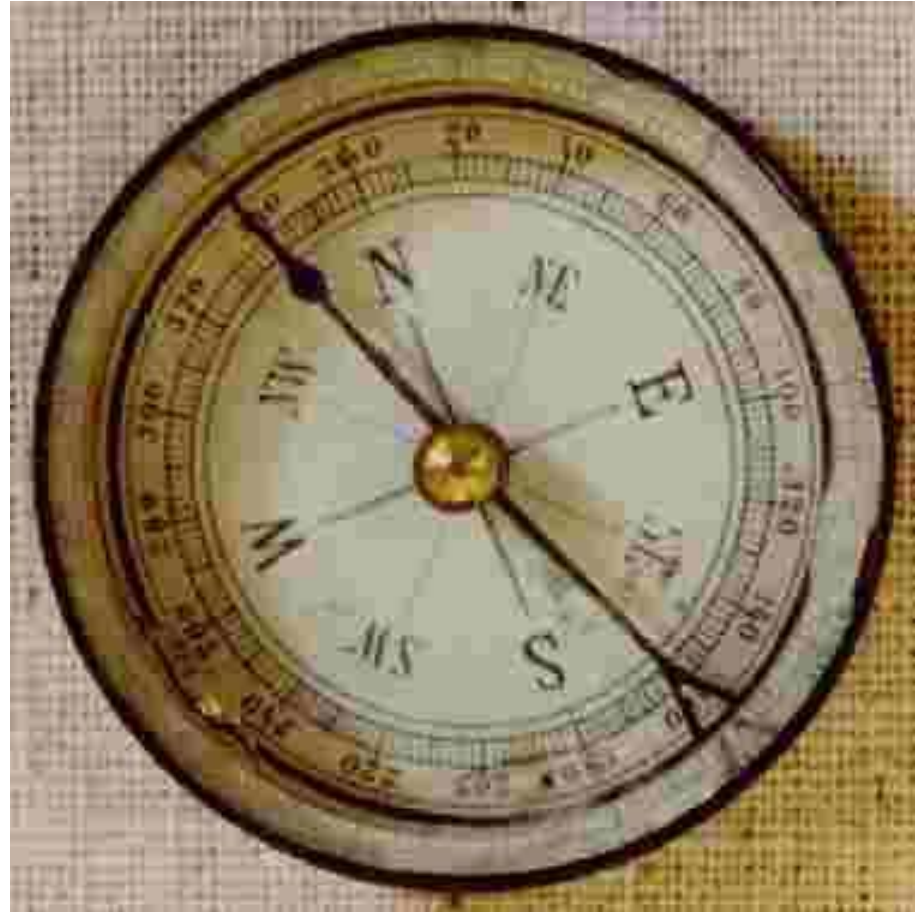
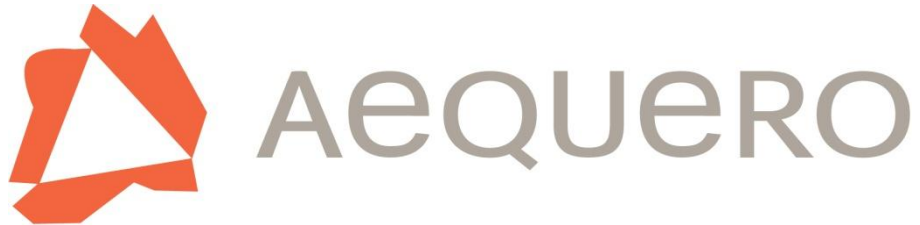


Image Source: www.solarnavigator.net/compass .

Conclusions

- 🔺 **Refocus of energy demand activity on Asia**
 - ⇒ Increasing reliance on imported energy
 - ⇒ Energy security and price stability are key drivers
- 🔺 **Conventional energy maintains a short-term price advantage over alternative energy**
 - ⇒ But convergence expected for some technologies
 - ⇒ Regulatory / carbon price interventions can redirect capital
- 🔺 **Massive investment required in alternative energy**
 - ⇒ 70-90% of total power generation investment in 450 Scenario
- 🔺 **Urgent need for international agreement on Climate Change**

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