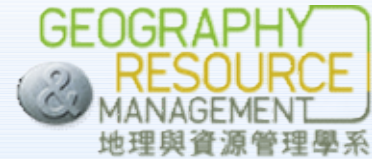




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Climate Change as a Great Villain

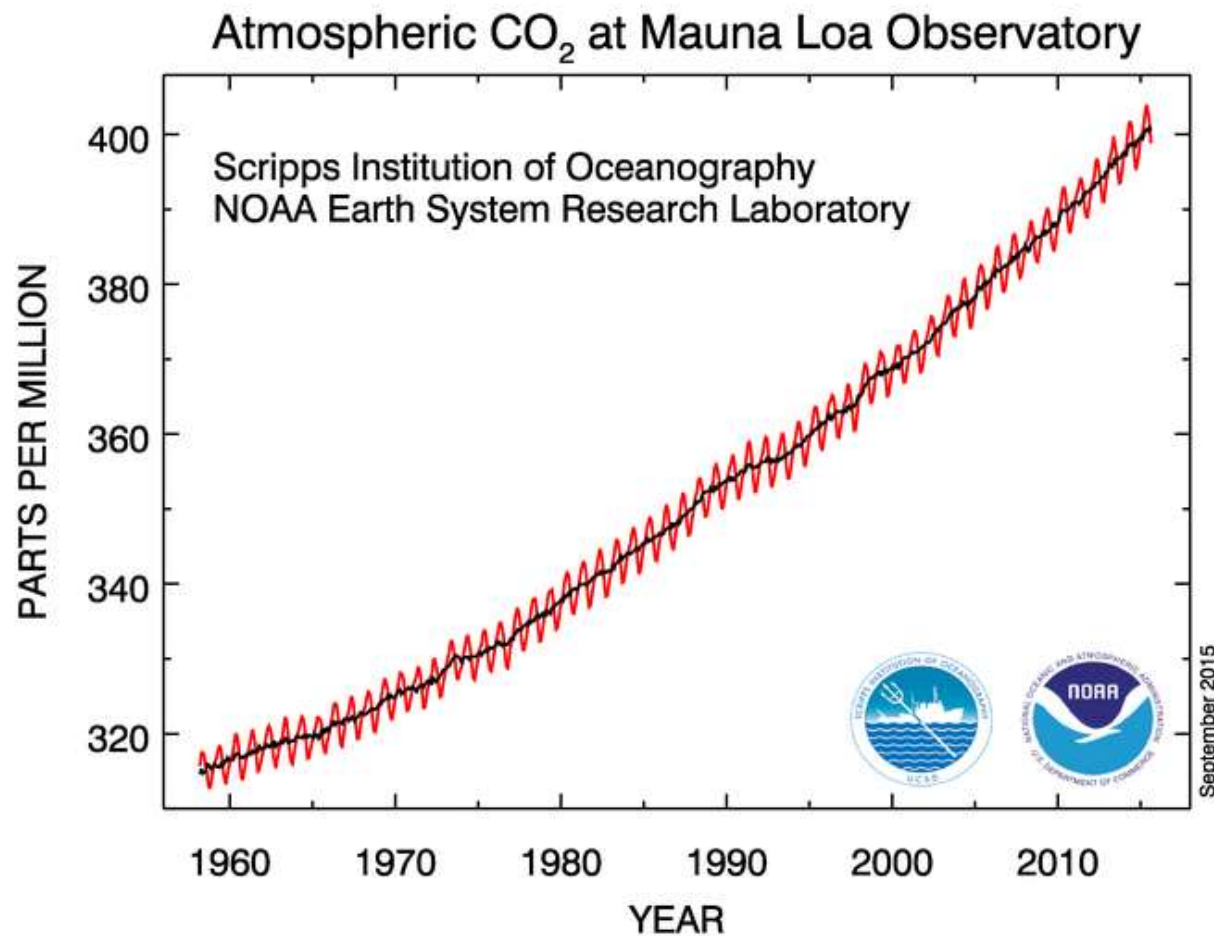
Xu Yuan

Department of Geography and Resource Management

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September 23, 2016

Atmospheric CO₂ concentration at Mauna Loa



1 ppm of CO₂
= 7.9 billion tons CO₂
= 2.1 billion tons C

About half of CO₂
emitted stay in the
atmosphere

What if we face such a villain?



Against the common villain of climate change

- ▣ Air pollution
- ▣ Energy security
- ▣ Innovation and technology

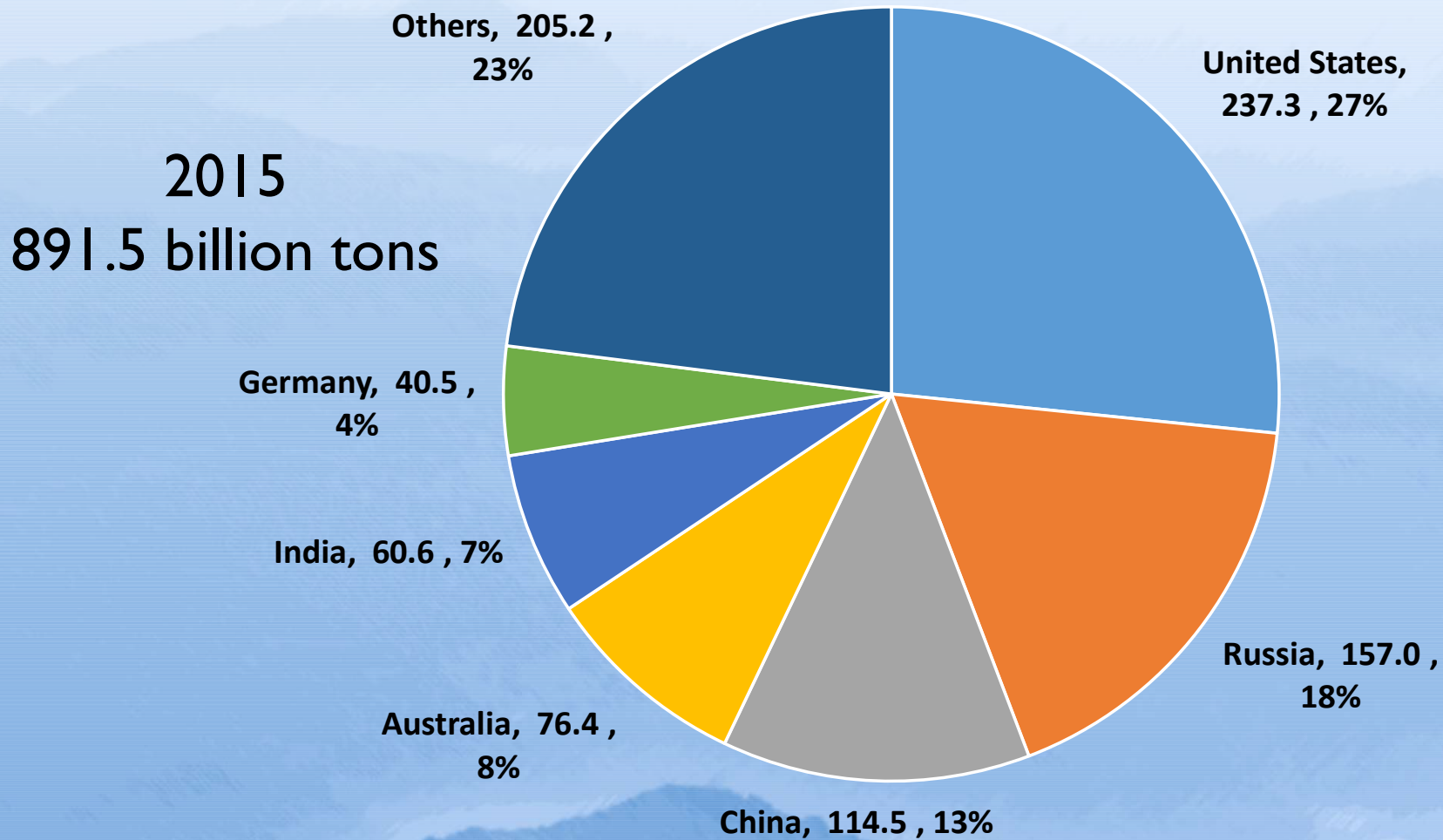
AIR POLLUTION



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Proven coal reserves



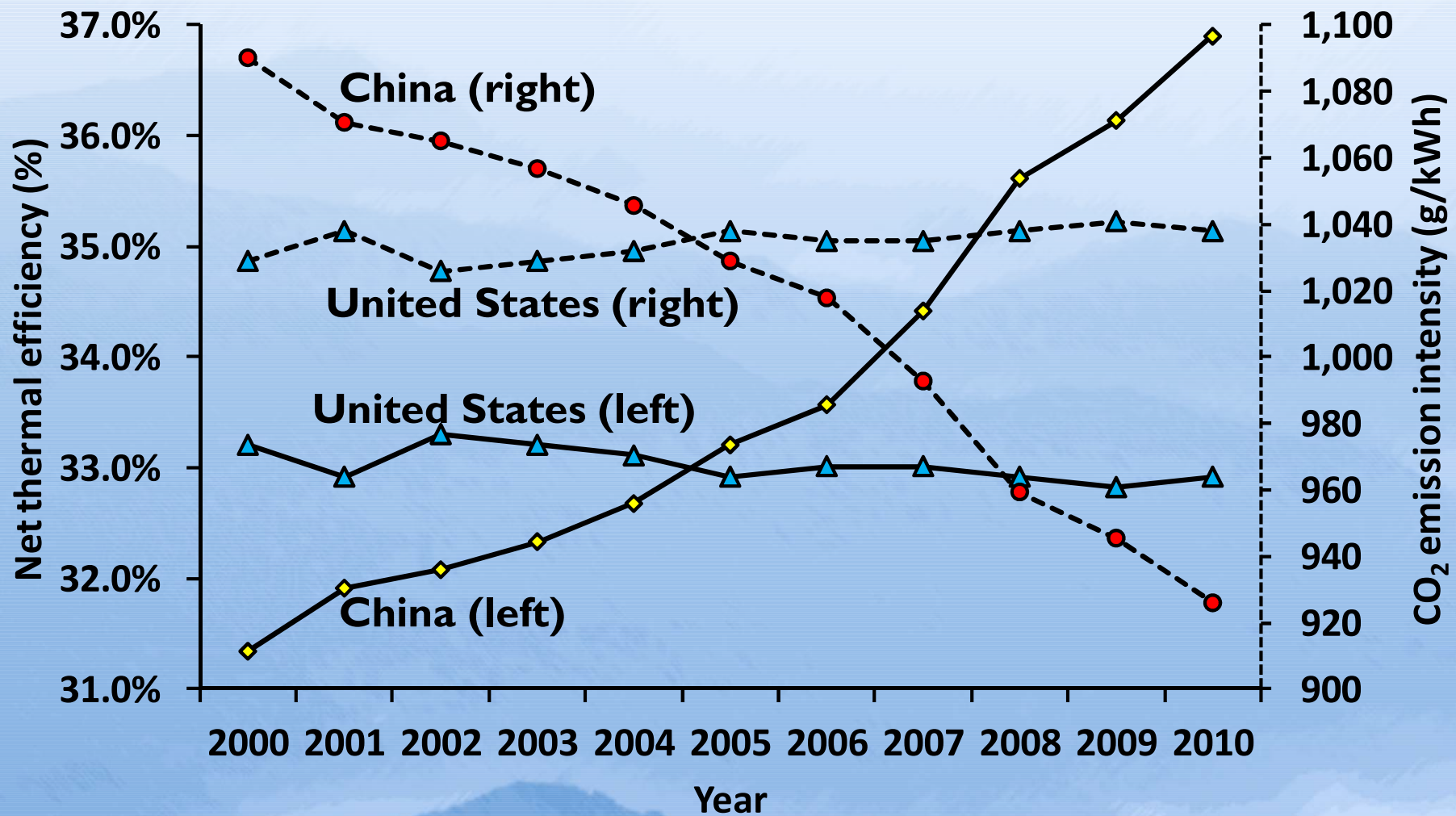
Source: BP, 2016



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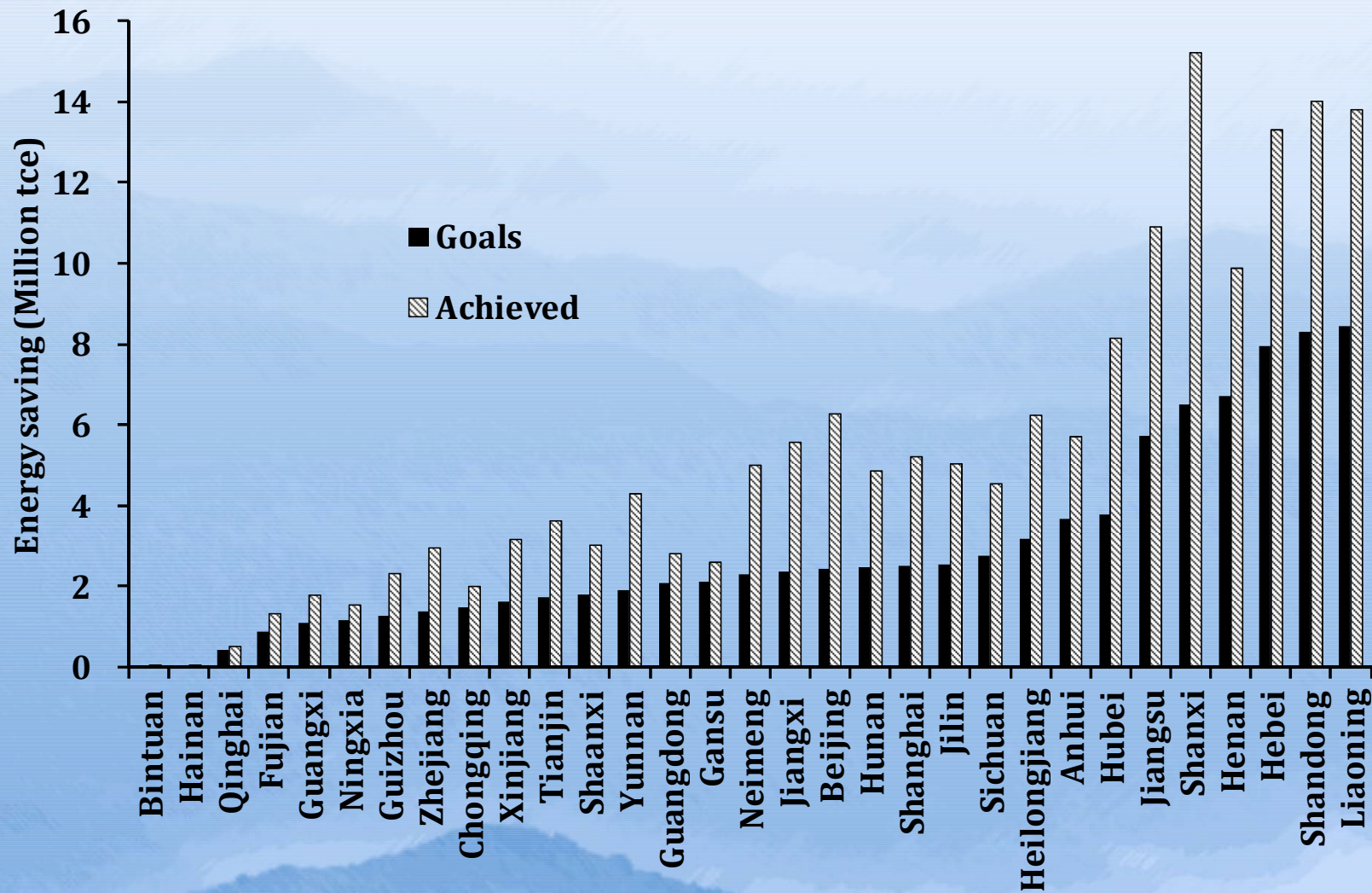


Net thermal efficiency of coal-fired power generation



Source: Xu, Yang & Xuan, 2013

Energy conservation of the “1000 energy-intensive firms” in the 11th Five-Year Plan



Source: Wu, Xu, Leung & Yung, 2015



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Air pollution and coal consumption

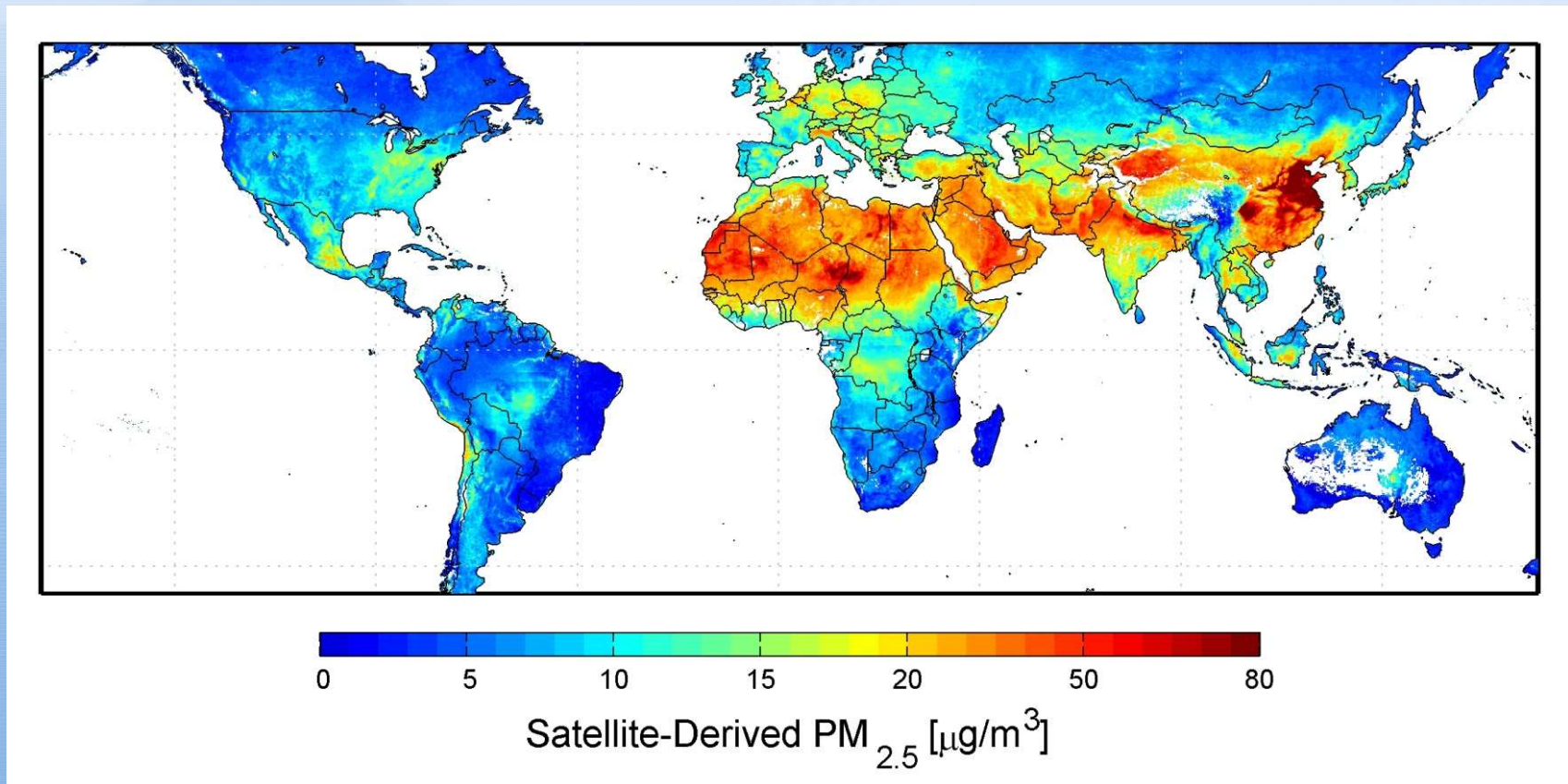
PM_{2.5}: 116.1 $\mu\text{g}/\text{m}^3$, 15 April 2013



PM_{2.5}: 6.0 $\mu\text{g}/\text{m}^3$, 6 February 2013



PM_{2.5} concentration



Source: NASA, 2010

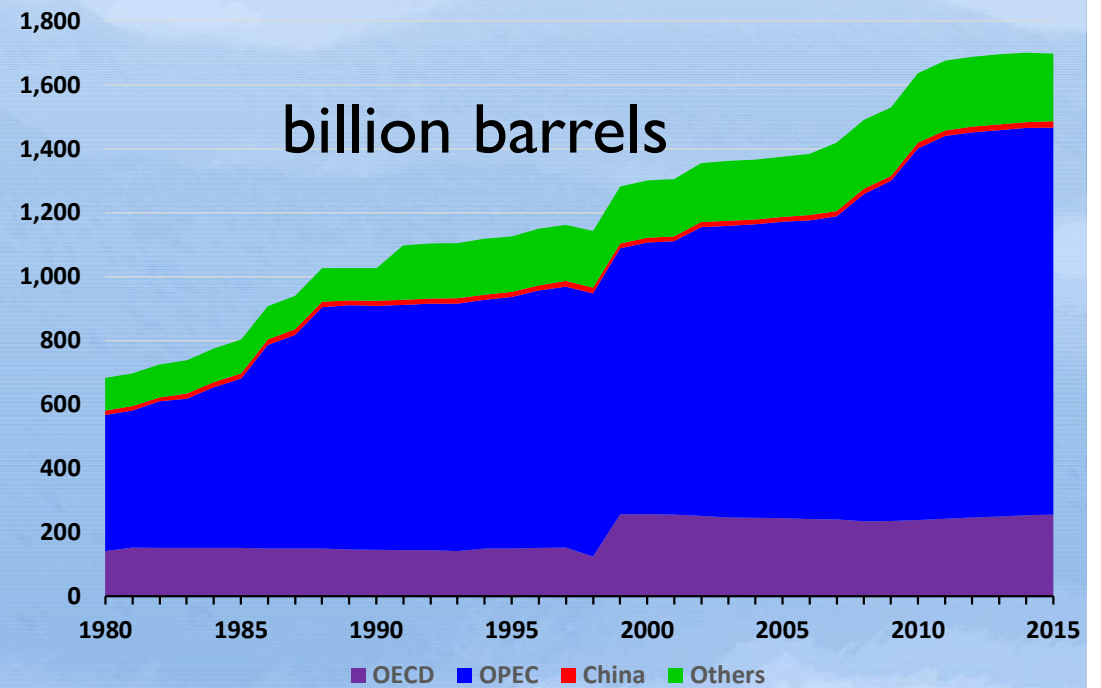
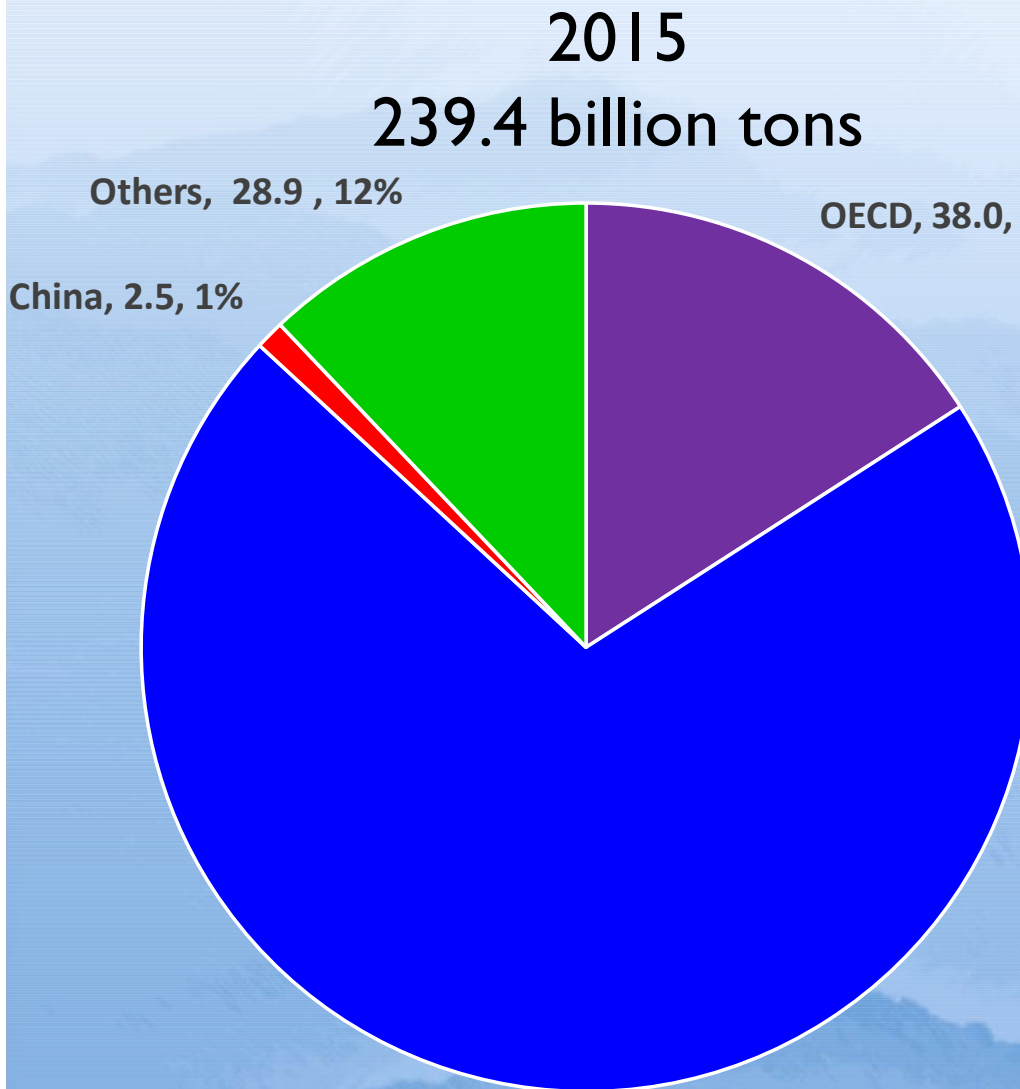
ENERGY SECURITY



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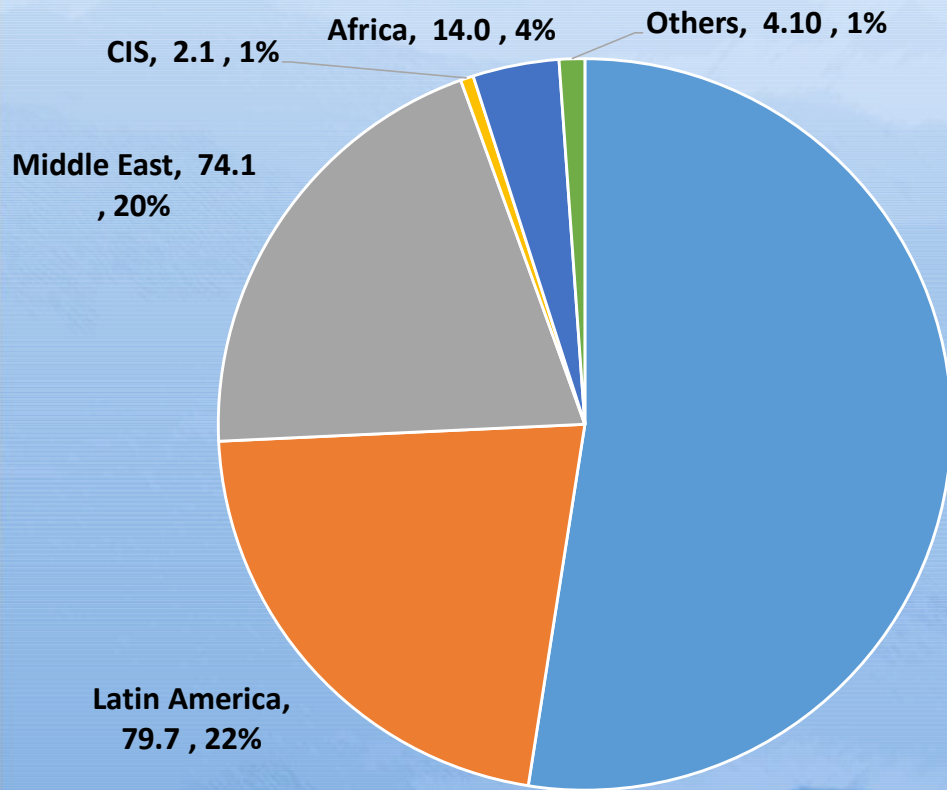
Proven oil reserves



Source: BP, 2016

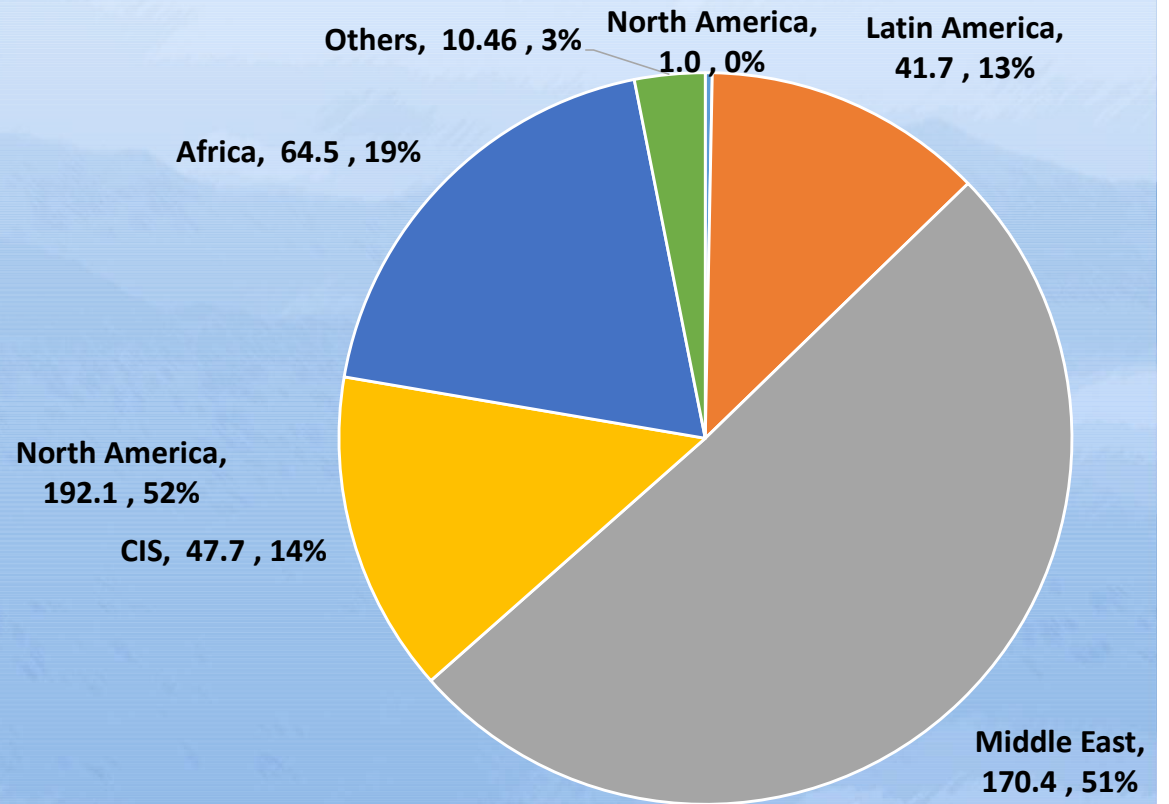
Oil import origins

United States



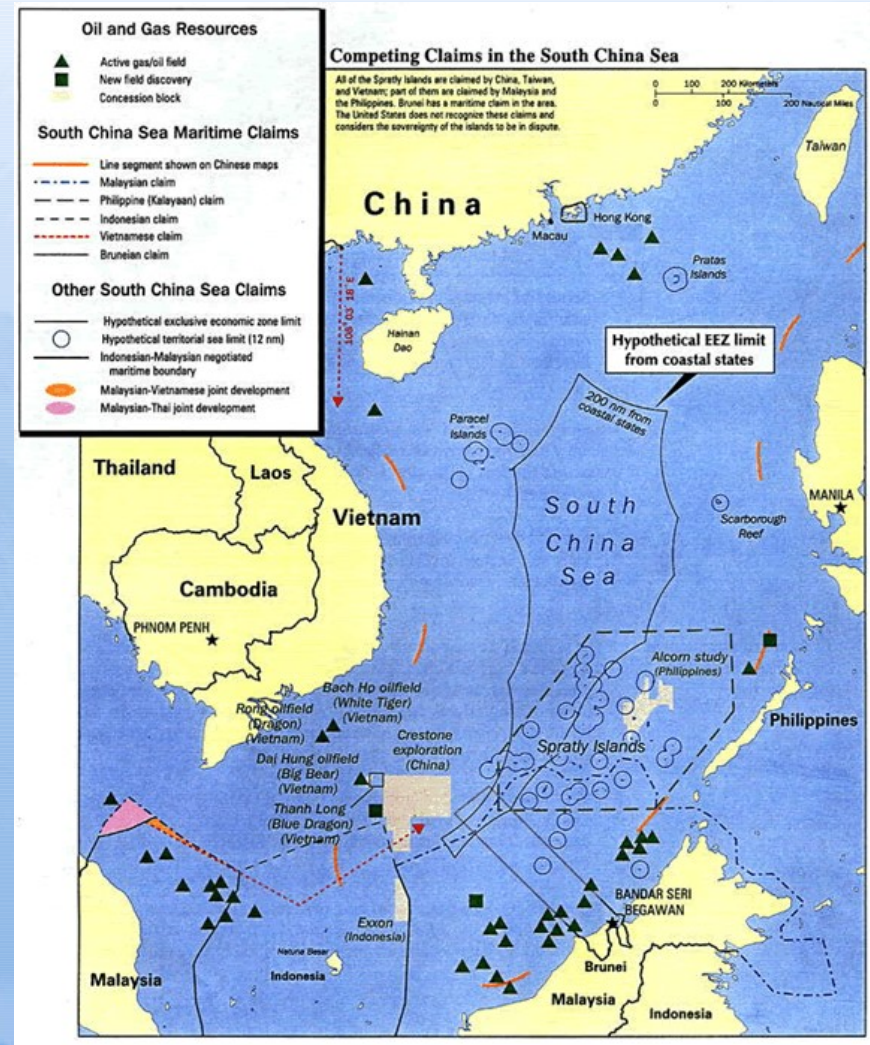
2015

China



Source: BP, 2016

East China Sea and South China Sea



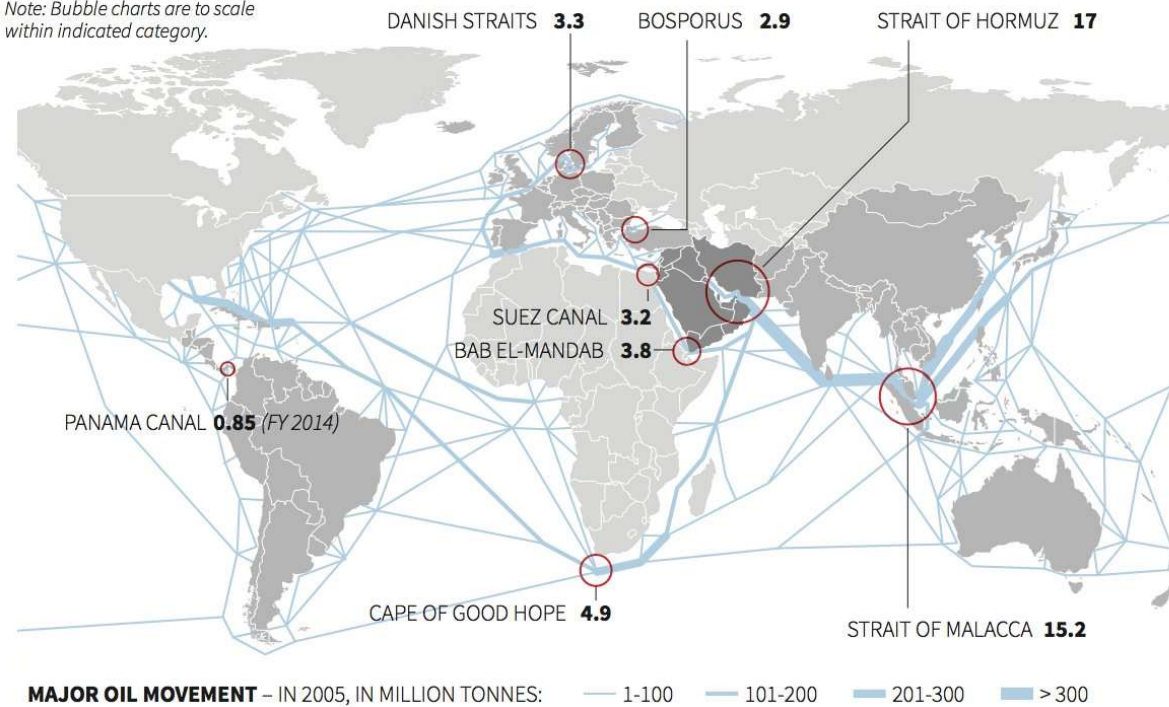
Oil transport chokepoints

Oil transit chokepoints

About half of the world's oil production is moved by tankers on fixed maritime routes. The blockage of a chokepoint, even temporarily, can lead to substantial increases in total energy costs. Oil transit chokepoints are therefore a critical part of global energy security.

OIL TRANSIT CHOKEPOINTS
Million of barrels of oil moved per day, 2013 (unless otherwise indicated)

Note: Bubble charts are to scale within indicated category.

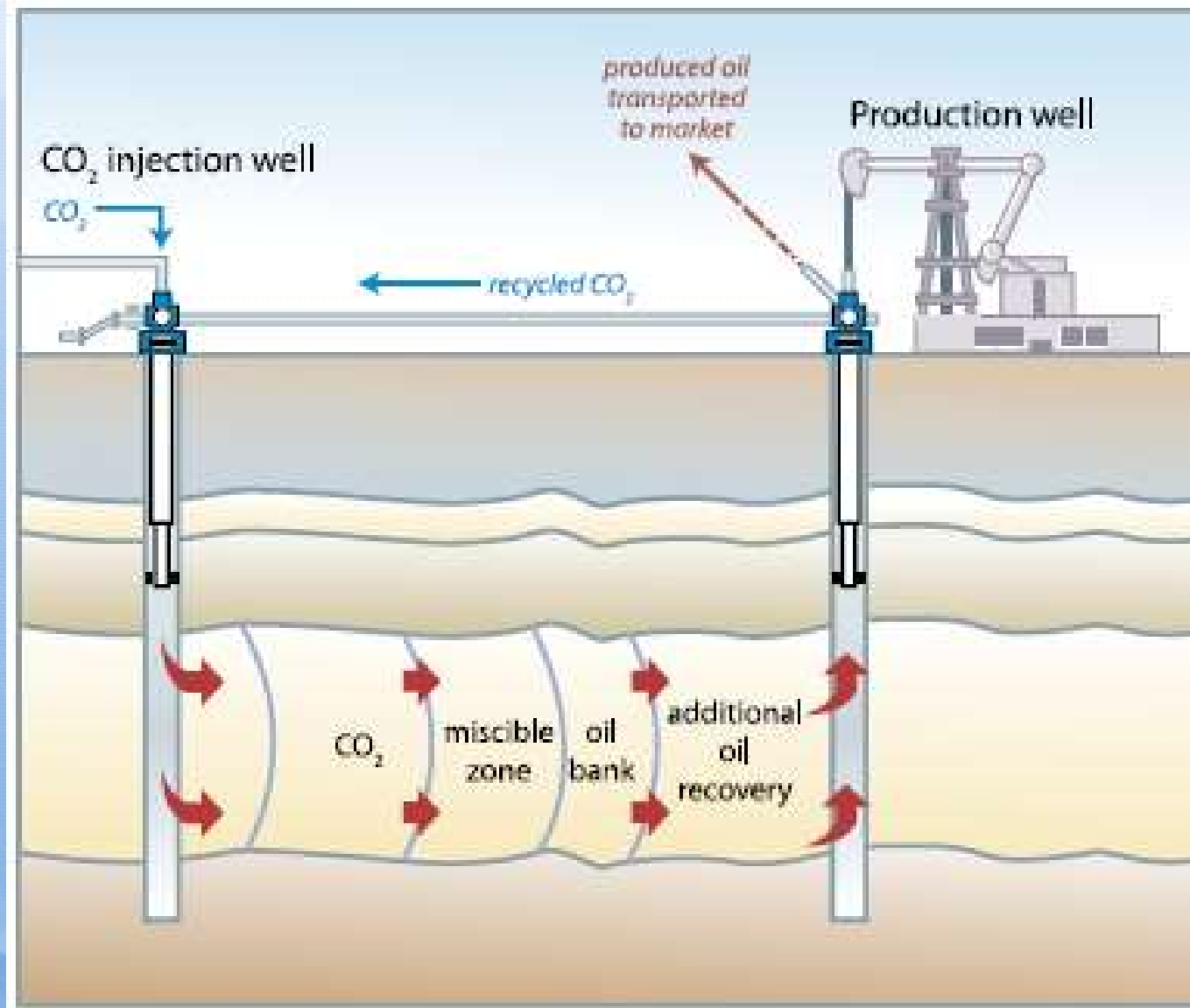


Sources: U.S. Energy Information Administration, International Tanker Owners Pollution Federation

Staff, W. Foo, 26/3/2015

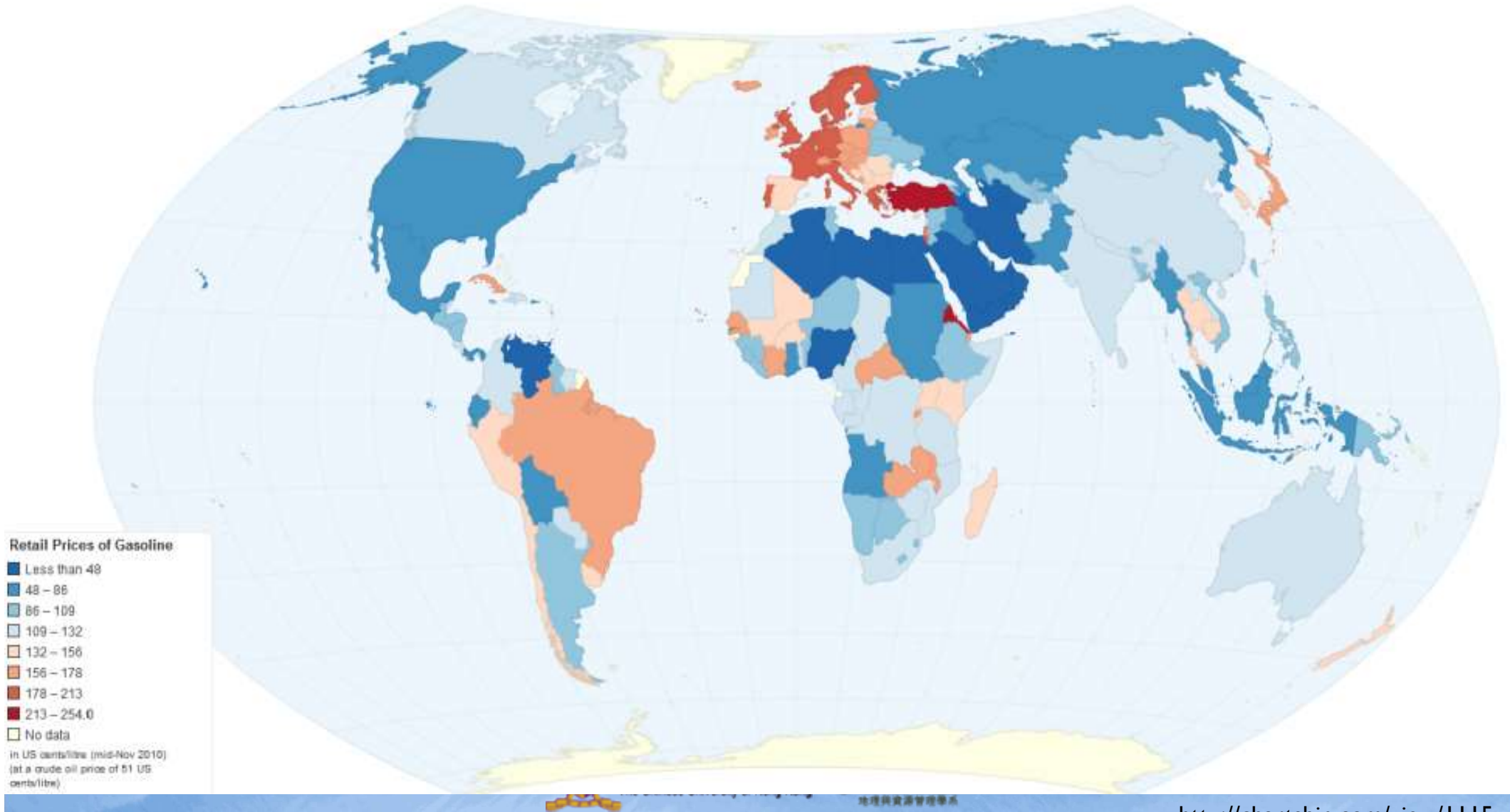
REUTERS

Enhanced Oil Recovery (EOR) for domestic oil production



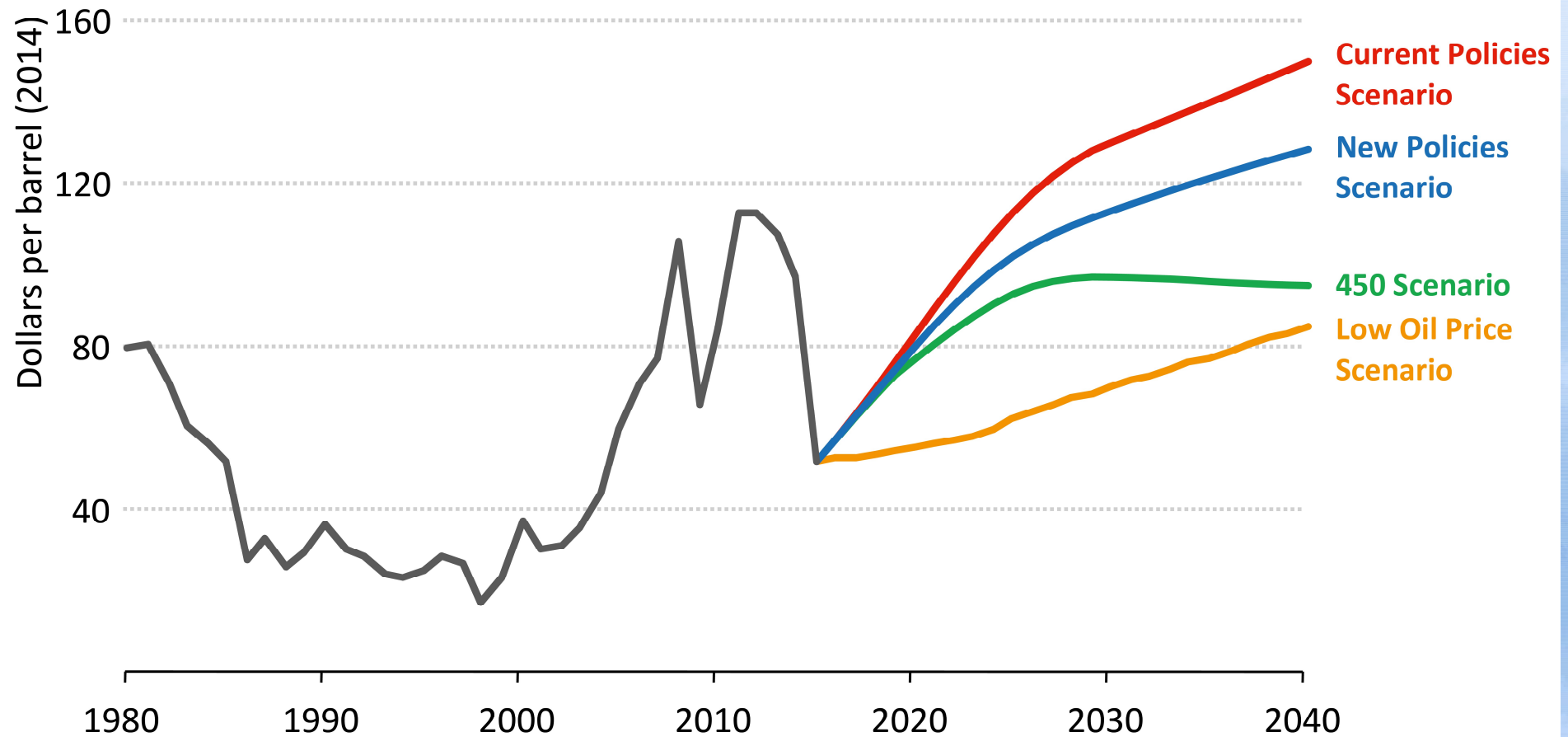
Incentives to discourage oil consumption

Worldwide Retail Prices of Gasoline (US cents per litre)



Lower oil prices, fewer conflicts

Figure 1.5 ▷ Average IEA crude oil import price by scenario



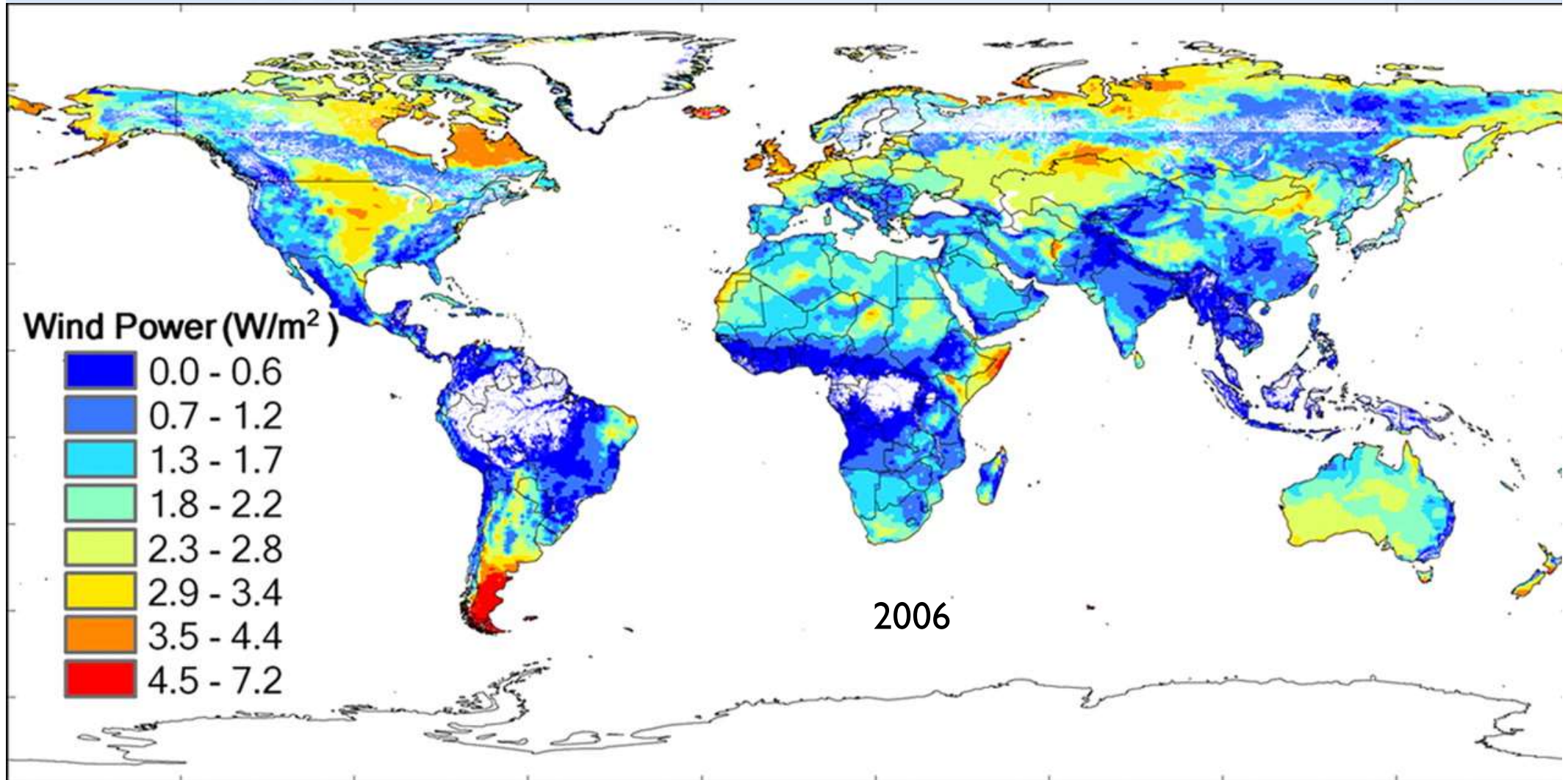
INNOVATION AND TECHNOLOGY



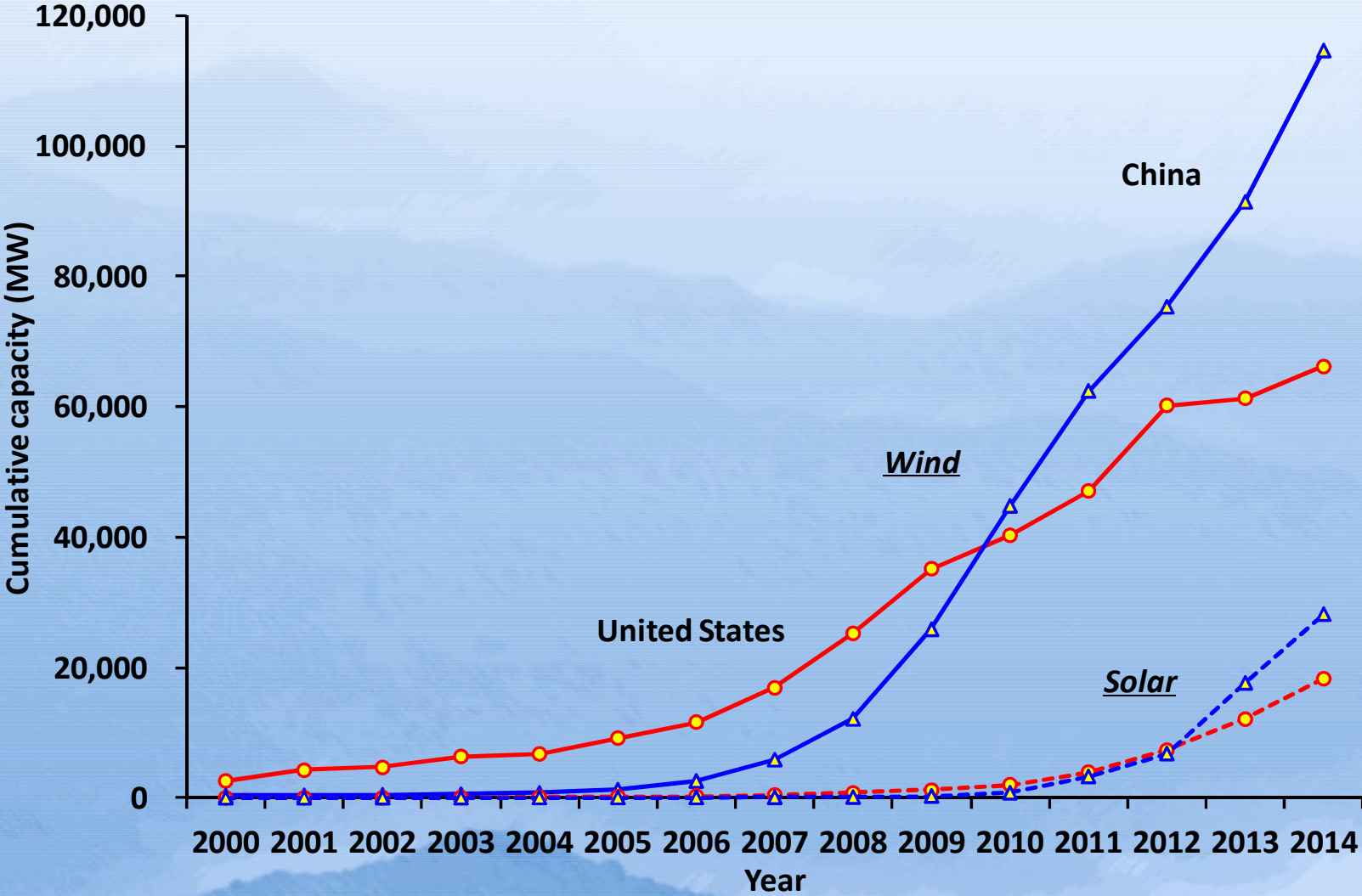
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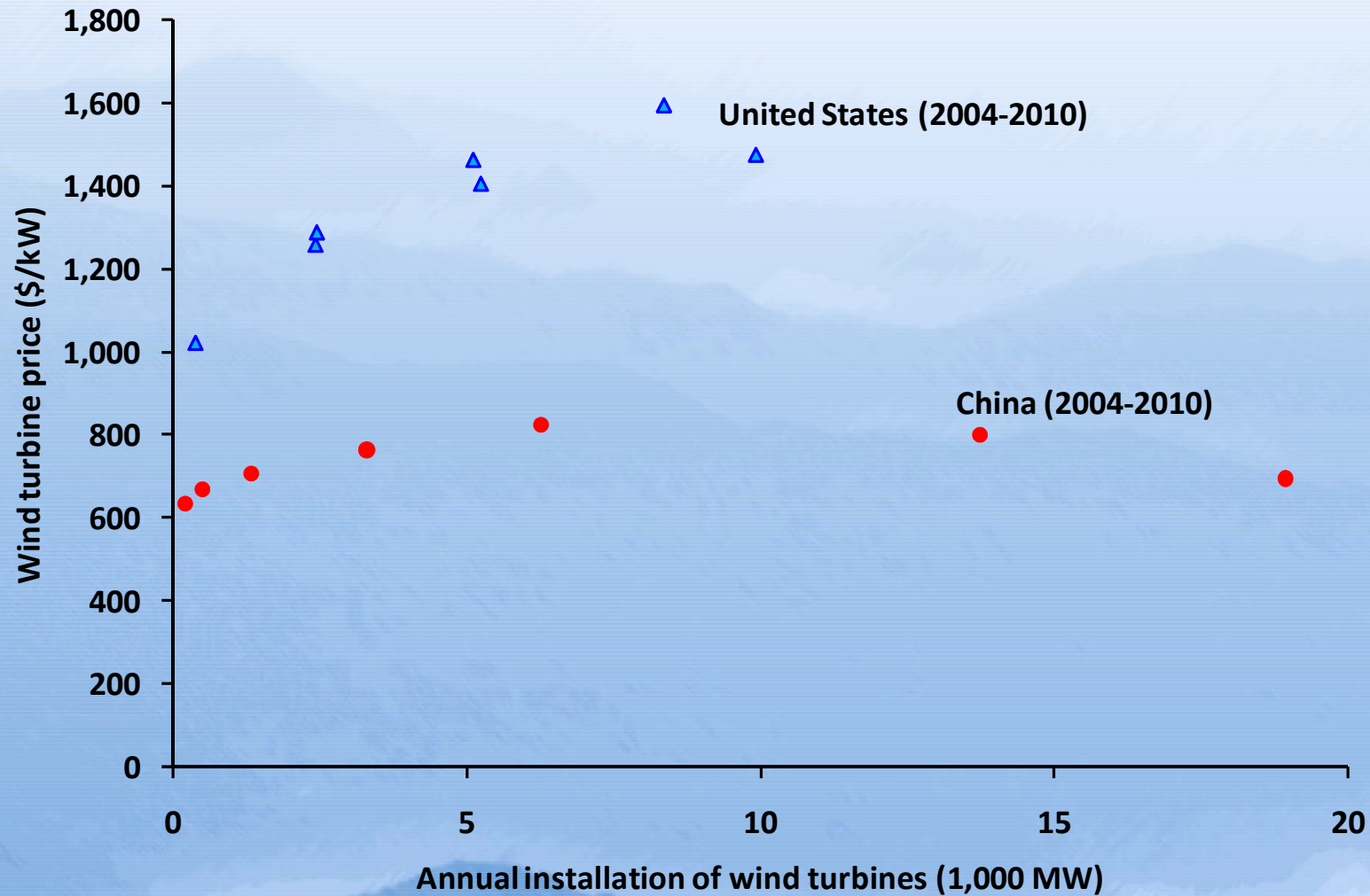
Wind energy resources



The development of wind and solar energy

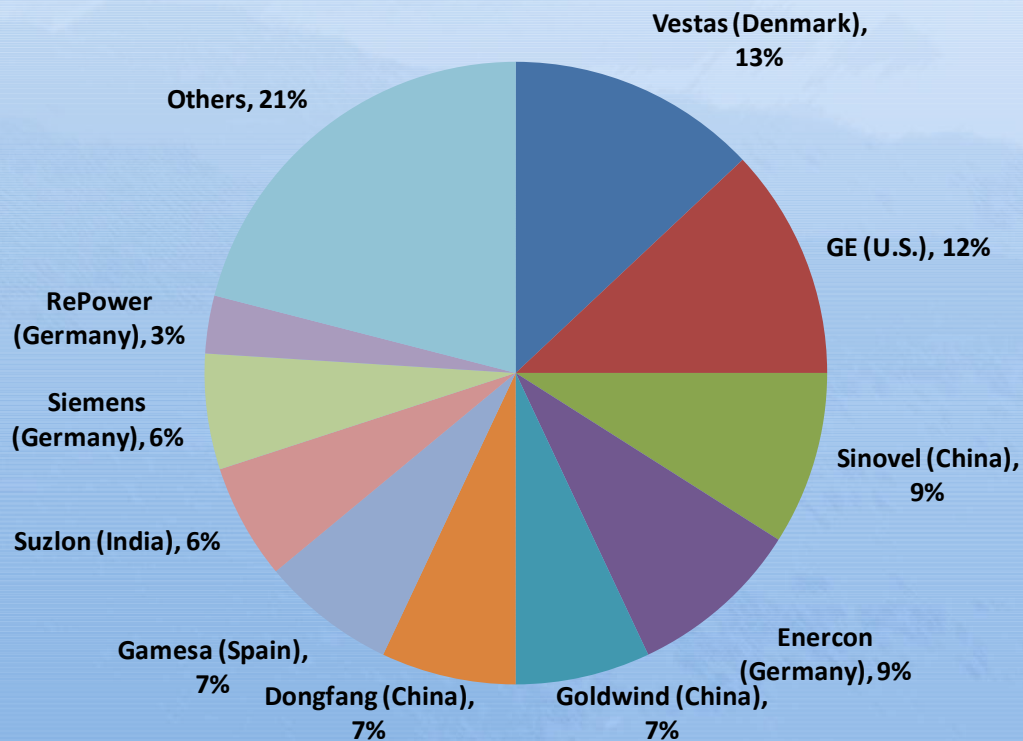


Competition on innovation and technology

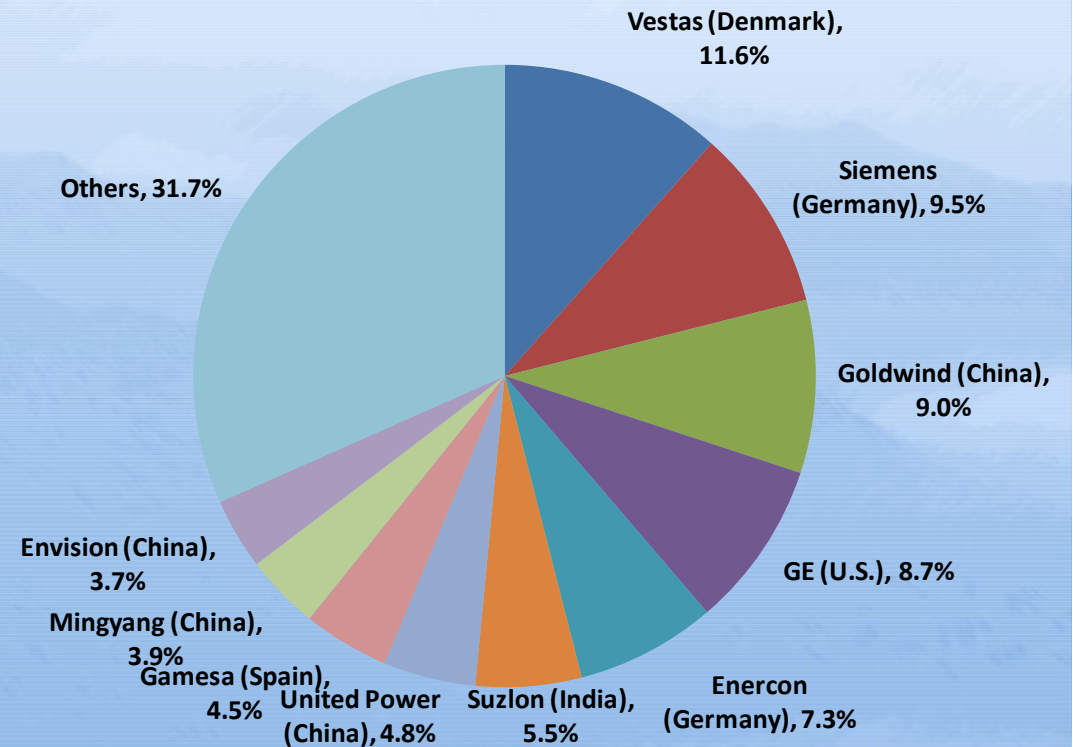


Market shares of wind turbine manufacturers

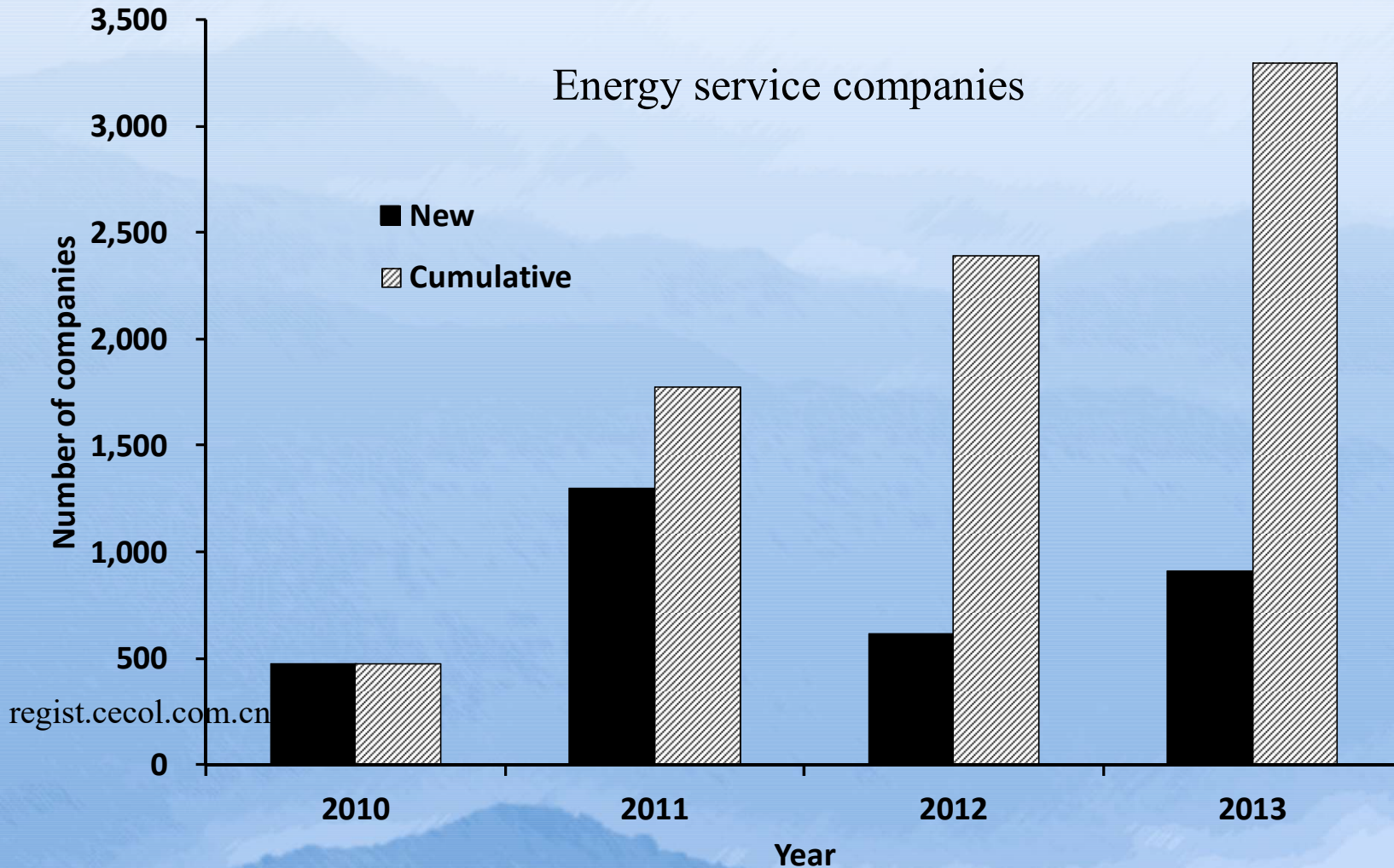
2009



2014

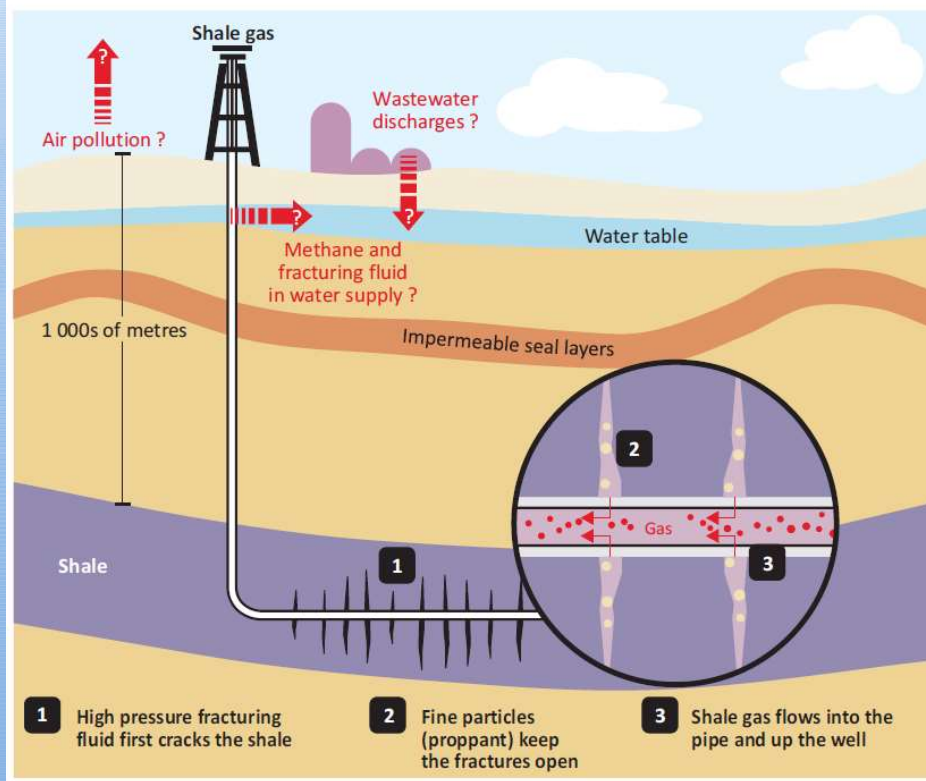


Innovation and technology for energy conservation



Innovation and technology for shale gas development

Figure 1.3 ▷ Shale gas production techniques and possible environmental hazards



Source: IEA, 2012

Shale gas basins in China



Source: Chang, Liu and Christie, 2012

Conclusion

- If we take climate change as a common, great villain
 - Less environmental pollution
 - Fewer conflicts on energy resources
 - More innovation
- A villain *could* make the world a better place