

Clean Technology

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Global Energy Framework



CTSI

Clean Technology and
Sustainable Industries Organization

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Global energy framework

- Population growth
- Demand growth
- The challenge of liquids supply
- The challenge of supply diversification
- The challenge of carbon management
- The challenge of scale and complexity

Population growth

	2005	2030 estimates	
• China	1.31	• India	1.53
• India	1.09	• China	1.46
• USA	0.29	• USA	0.36
• Indonesia	0.23	• Indonesia	0.28
• Brazil	0.22	• Pakistan	0.23

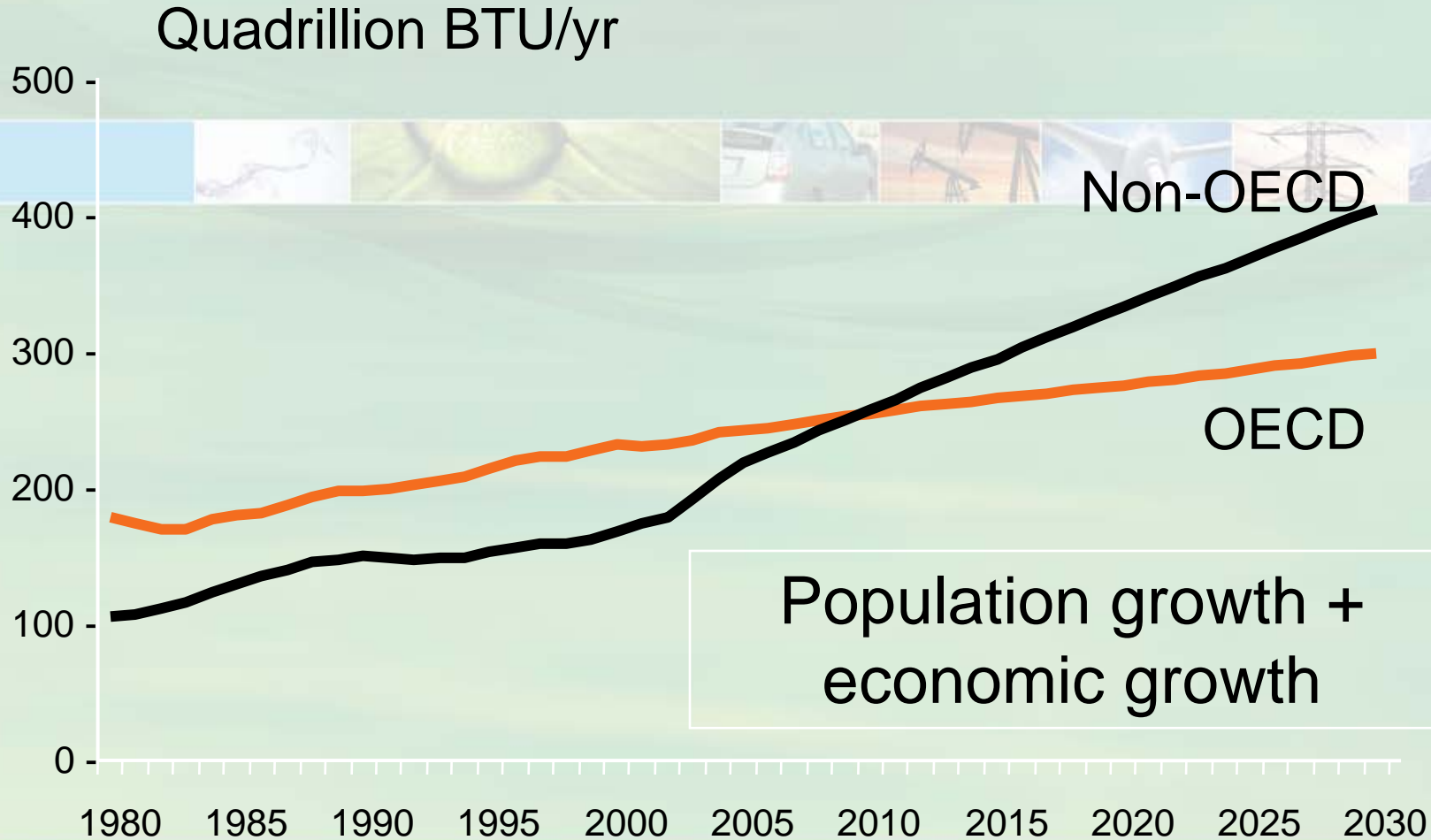
National population in billions

Demand growth

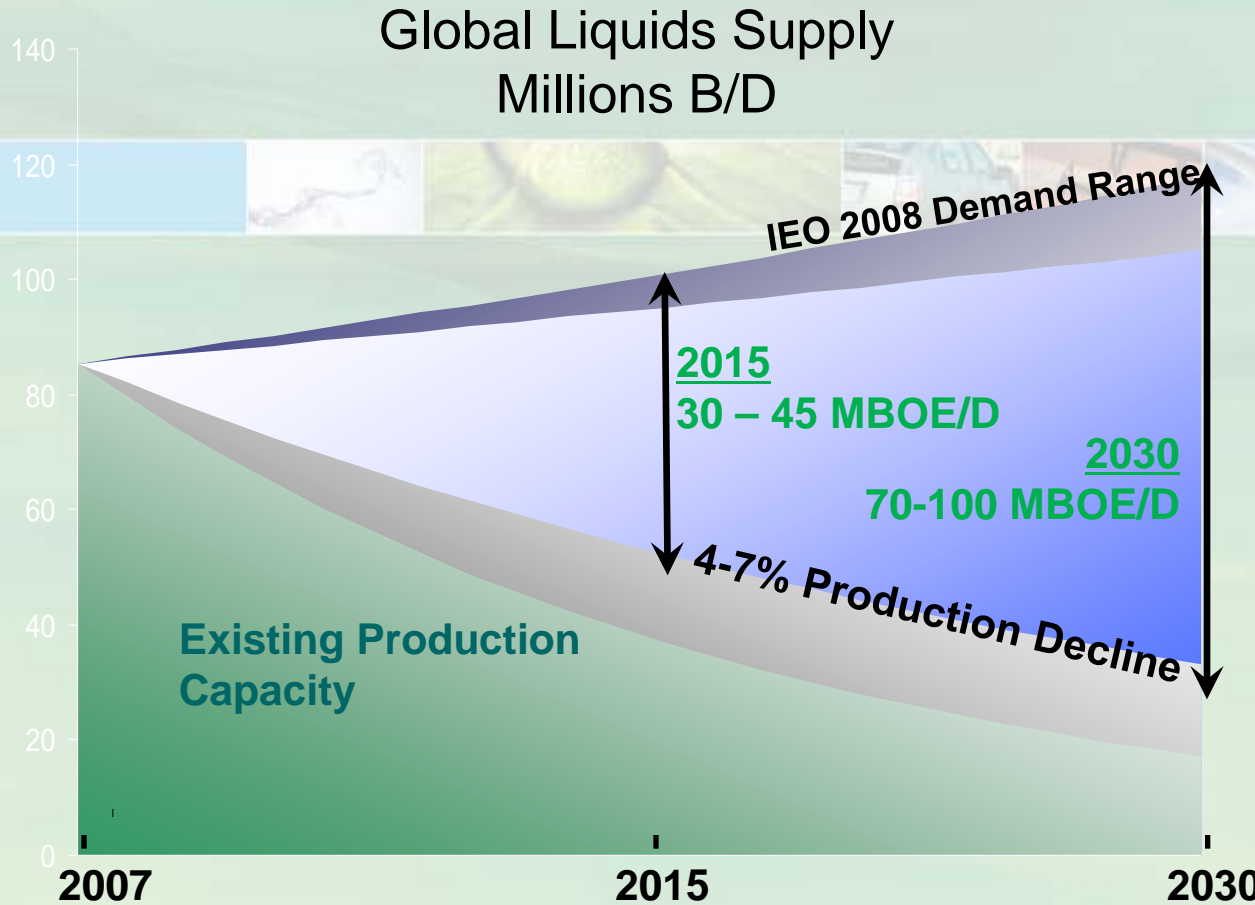
- Global mega-cities:
 - metro-populations > 20 million
 - 80% of the projected population growth
- Auto-mobility: “Two Billion Cars”*

* *“Two Billion Cars: Driving Toward Sustainability”, by Daniel Sperling and Deborah Gordon*

A structural shift in global energy demand

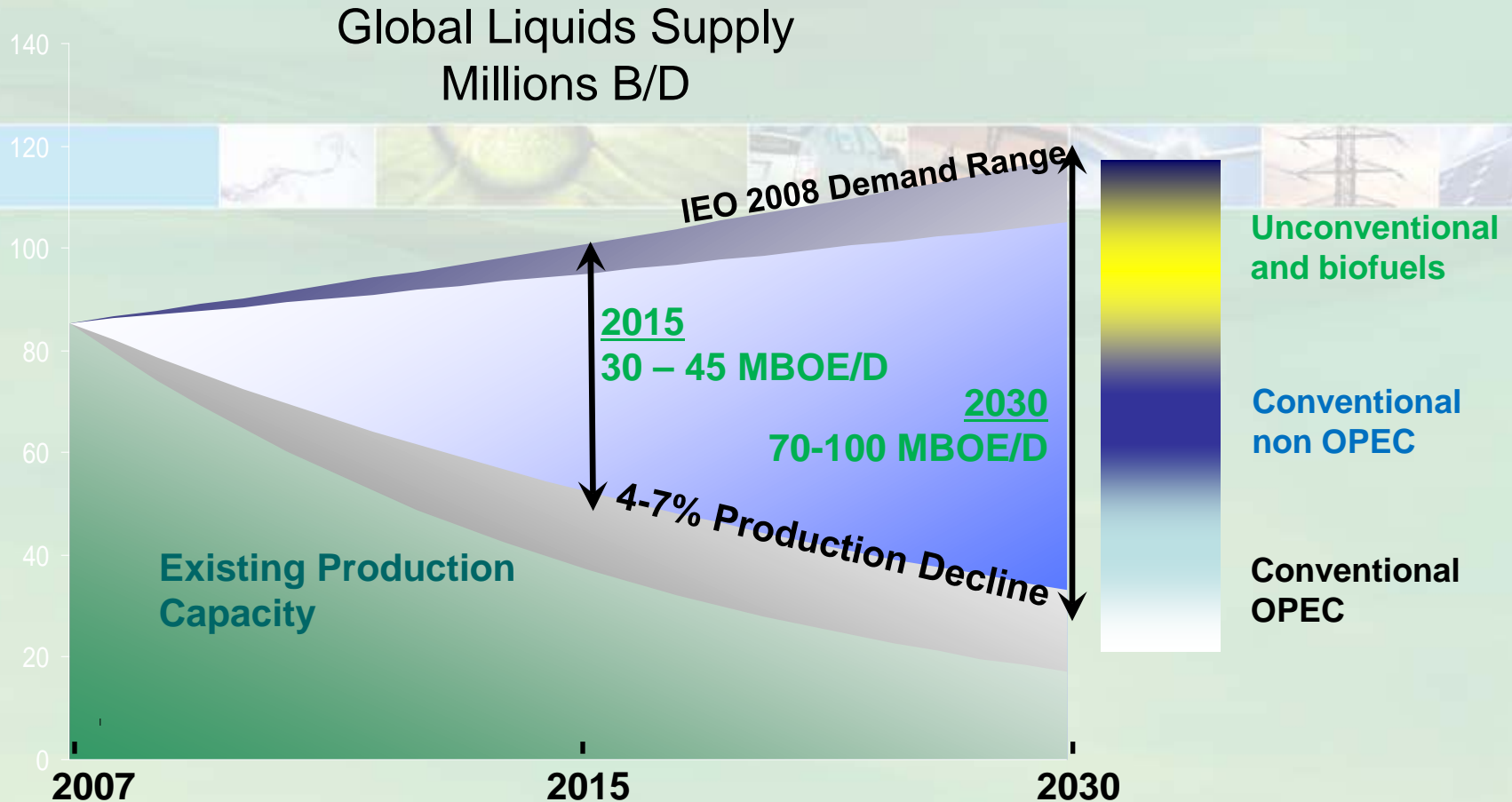


Challenges for liquid supply



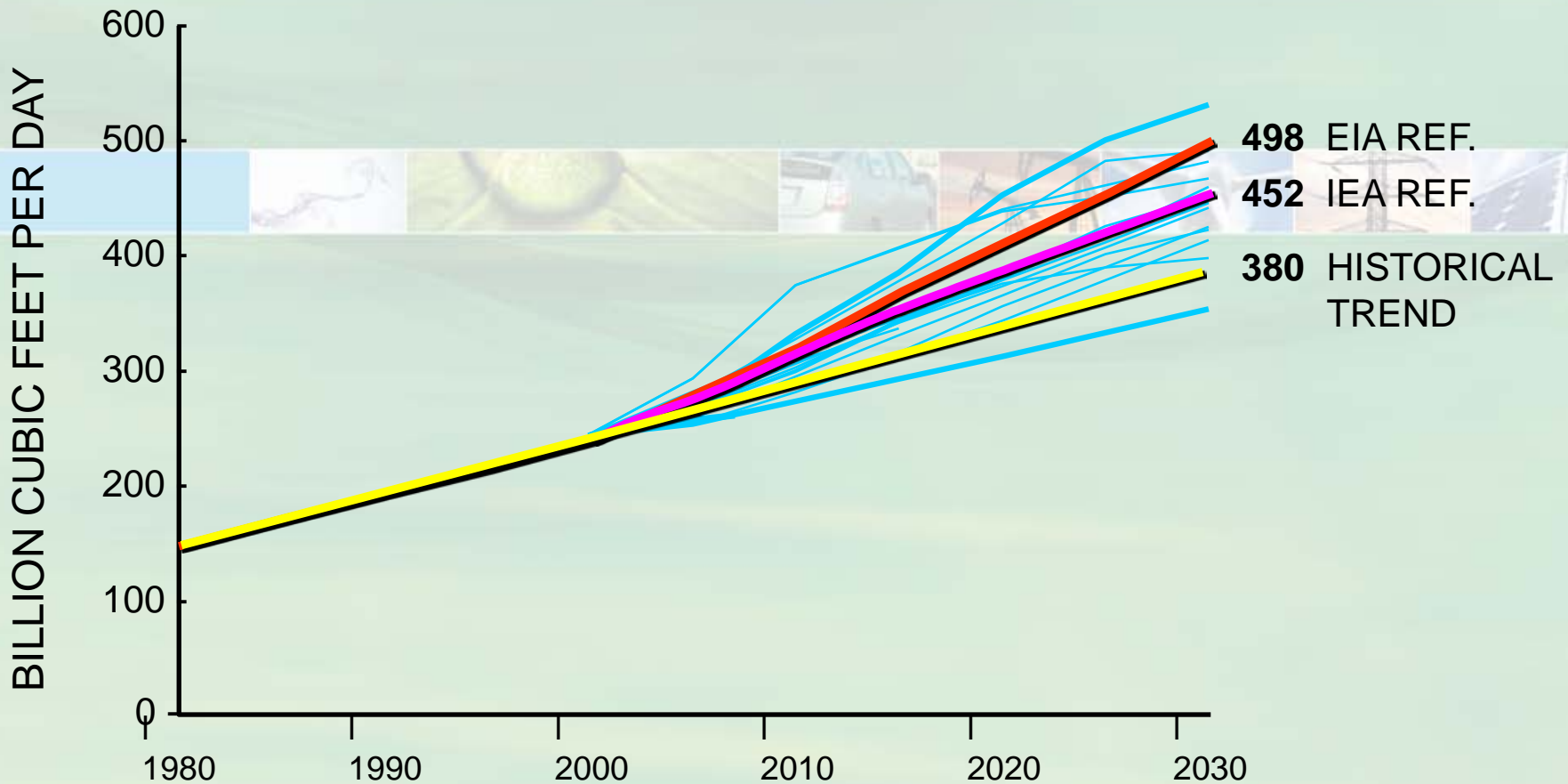
Source: NPC 2007 Report – “The Hard Truths” - One Year Later

Challenges for liquid supply



Source: NPC 2007 Report – “The Hard Truths” - One Year Later

Global gas supply projections



Source: NPC 2007 Report

Diversification of supply:

- Expanding the fossil resource base
 - Unconventional, deepwater, and arctic O&G
 - Converting extra-heavy hydrocarbons
- Developing new infrastructures
 - Expanding the global gas supply
 - Growing renewable power
 - Reviving nuclear power
 - Implementing bio-energy systems
 - Developing carbon management systems

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Challenge: scale and complexity

Diversification: grid evolution

“Smart Grids”

WIND & SOLAR

Distributed
Generation

NATURAL GAS

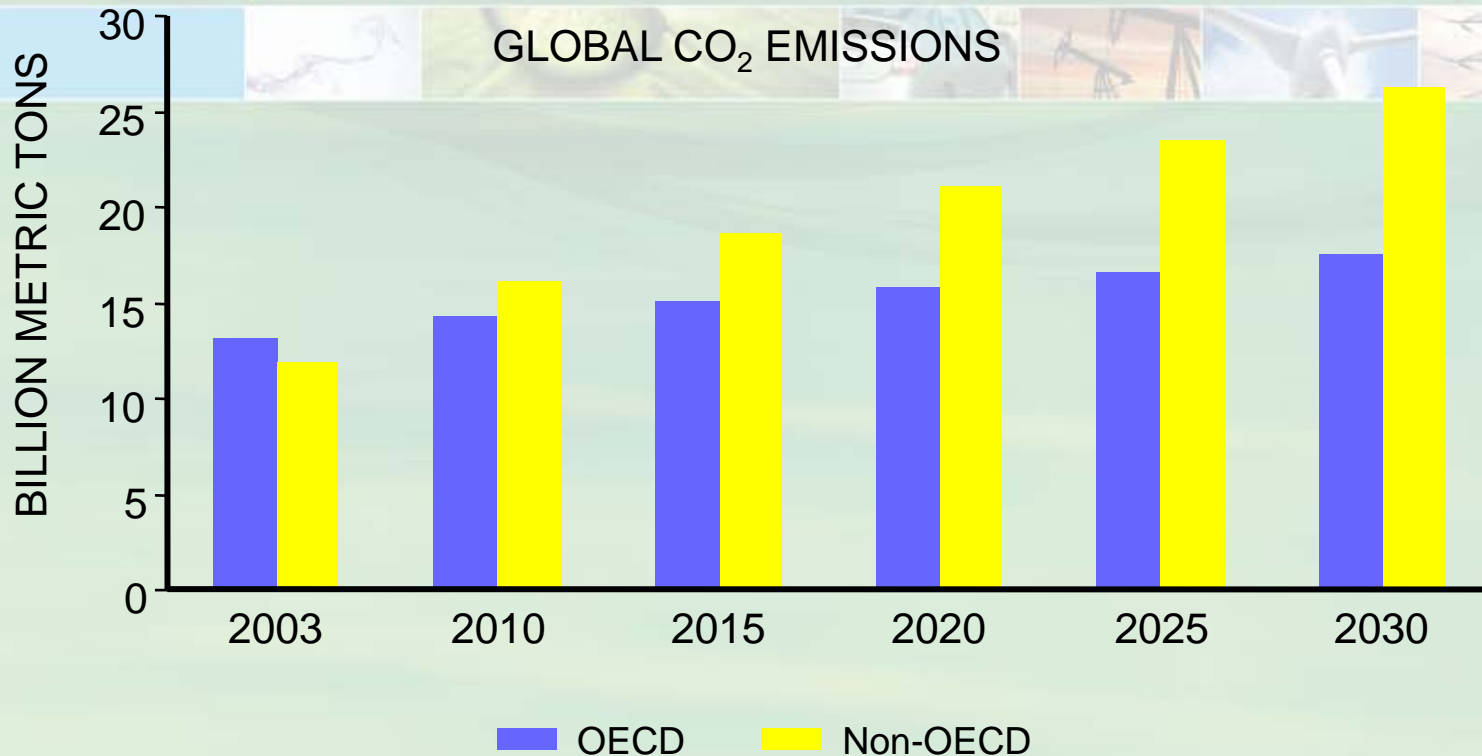
BASELOAD

Carbon Management

Energy productivity

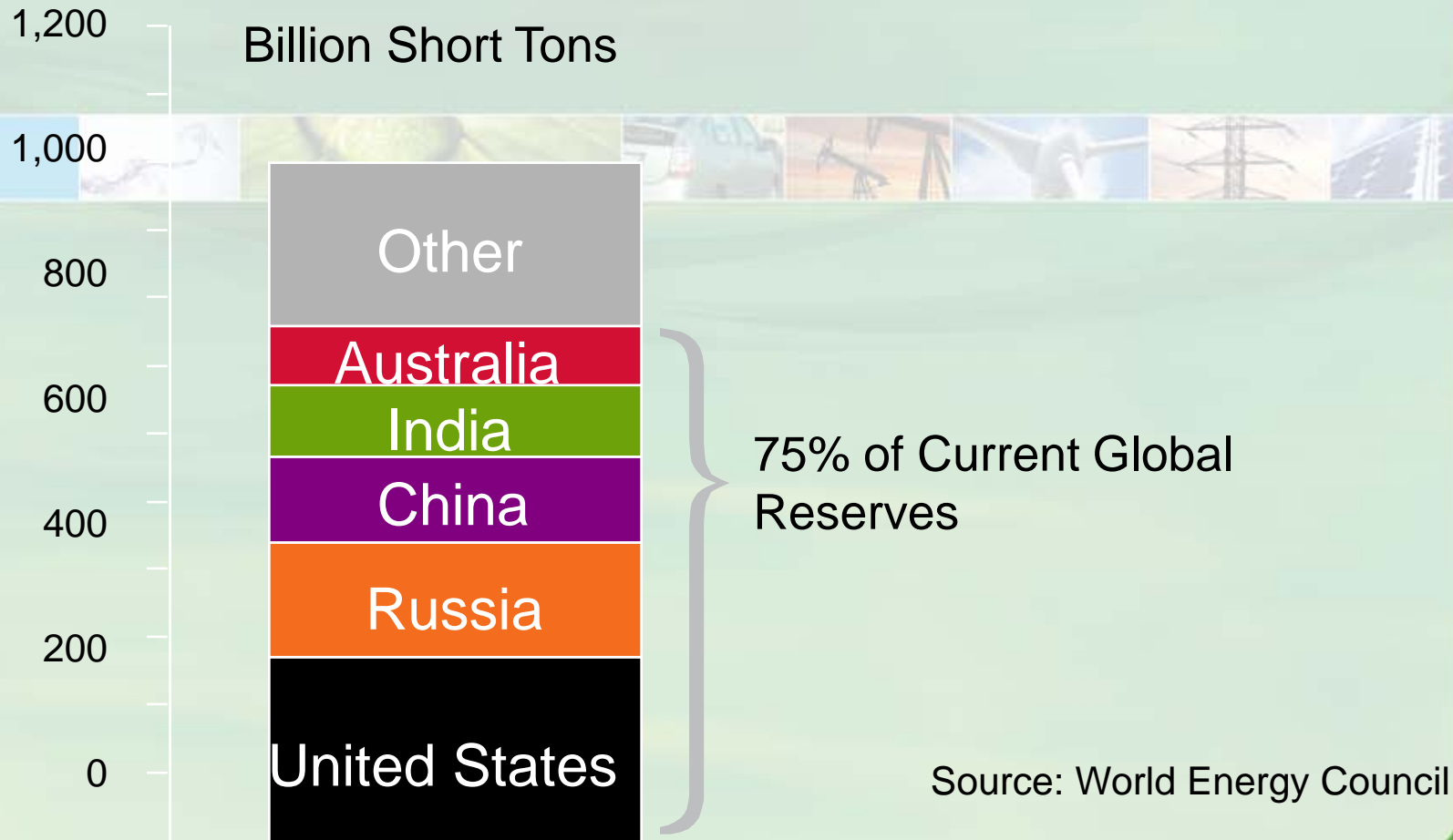
De-carbonization challenge

60% of the growth will be in the developing world



Source: EIA 2006

De-carbonization critically involves coal



Summary thoughts

- Demand growth will return
- Fossil energy use will continue at scale
- Diversification will continue
- Lower carbon intensity will be required
- Technology intensity and complexity will grow