Energy scenarios

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Diana Mangalagiu

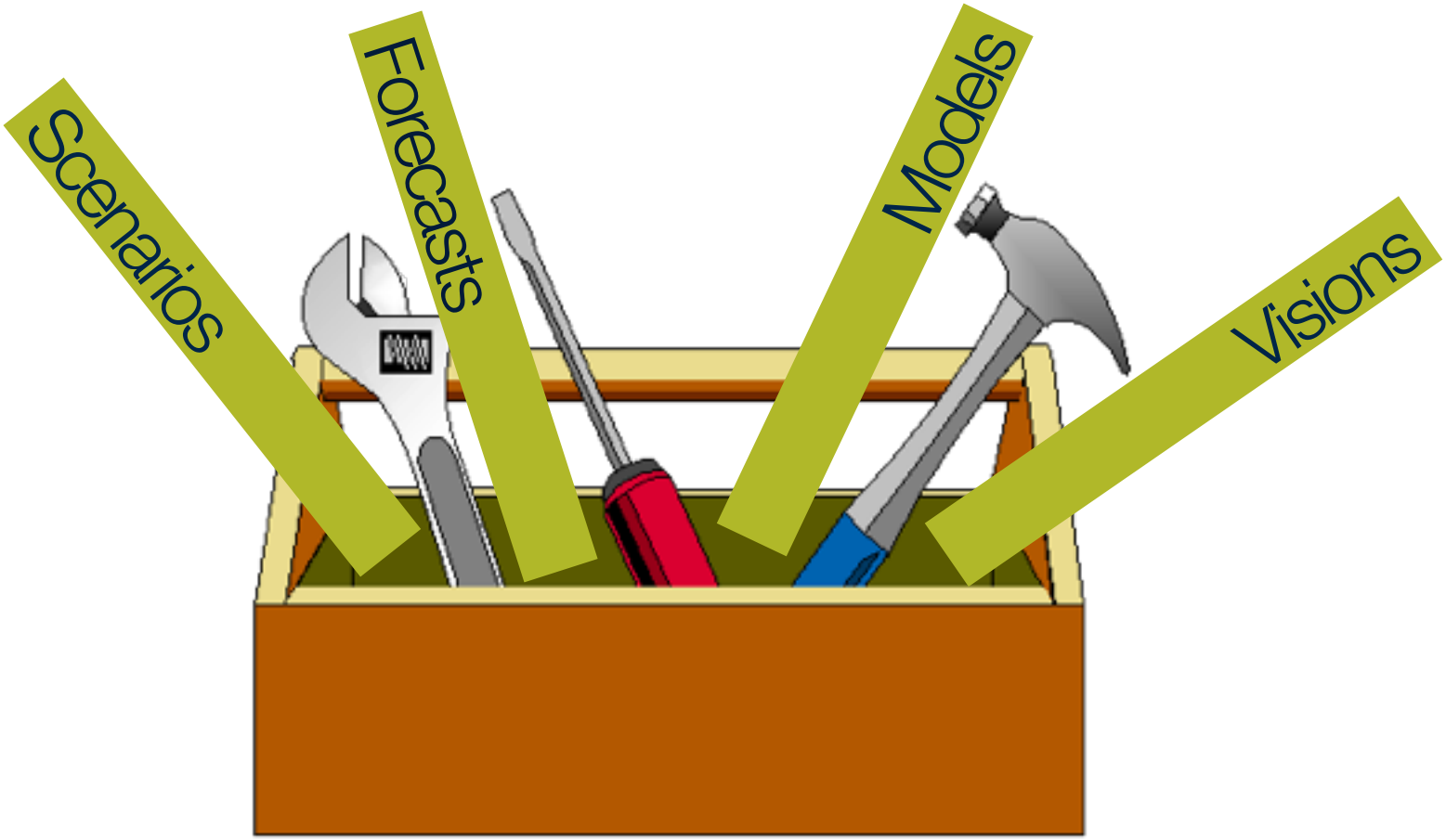
Smith School of Enterprise and Environment, University of Oxford, UK
diana.mangalagiu@smithschool.ox.ac.uk

ssee Smith School of Enterprise and the Environment
UNIVERSITY OF OXFORD

Outline

- What are scenarios?
- Variety of energy foresight and scenarios exercises
- Shell energy scenarios to 2050
- IEA energy scenarios and technology options to 2050

The modern futures toolkit

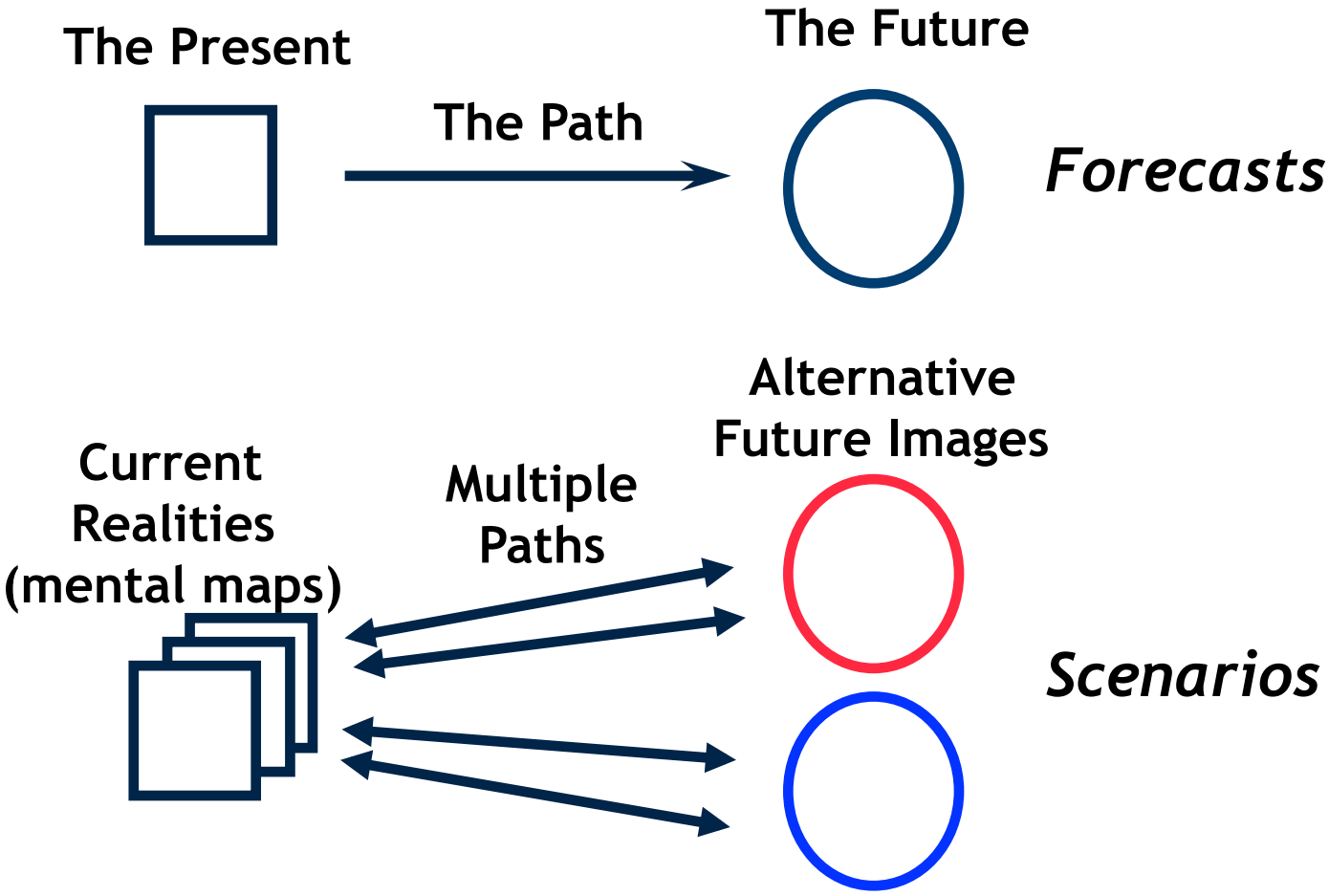


What are scenarios?

X	✓
Predictions	Consequential
Projections	Challenging
Preferences	Coherent

…stories describing alternative futures and how they might come about

One future or many? Reframing not forecasting



Three key steps in scenario planning

1. What are the rules of the game: what is certain to happen
2. What are the key uncertainties: unknowns, shocks
3. Model possible outcomes >>>>> SCENARIO PLANS

Numerous 'schools' of scenarios

USA: Probabilistic Trends School

- RAND Corporation, Institute for the Future
- Military, public policy and social forecasting, then corporate planning
- Kahn ("thinking the unthinkable")
- Delphi technique, systems analysis, probabilistic scenarios
- Harness computational power to resolve intractable problems

French: La Prospective

- Berger, Masse, de Jouvenel, Godet
- Blueprints for a nation: scientific utopia
- Normative scenarios

Shell: 'Intuitive Logics' School

- 'Scenario planning': quality of strategic conversation
- Plausible scenarios, predetermined causal logics

Two main postures

Probabilistic (USA)

- **Accuracy** affects decision outcomes
- **Scarcity** of data
- Deciding/**truth**/getting it right
- Environments as **independent**

Plausibility (Shell)

- **Knowledge** and **ignorance** co-evolve
- **Abundance** of data: **scarcity** of 'actionable knowledge'
- **Plausibility** guides: keep an 'open mind', ambivalence is optimal
- Interactive design: the interplay of action and interpretation
- Environments as **causal** and 'client' specific

Scenarios as foreground

Analytical product

Relationship of context as foreground

Sense-making process

Plausibility or probability?

Discontinuities are often not obvious…

"Well informed people know it is impossible to transmit voice over waves and that were it possible to do so, the thing would be of no practical value."

Editorial in The Boston Post c.1865

"I think there is a market for about 5 computers."

Thomas J. Watson, Chairman of IBM, 1943

"$10 per barrel [oil] might actually be too optimistic. We may be heading for $5."

Economist magazine, 1999

Why we use scenario planning in energy strategy?

WHY

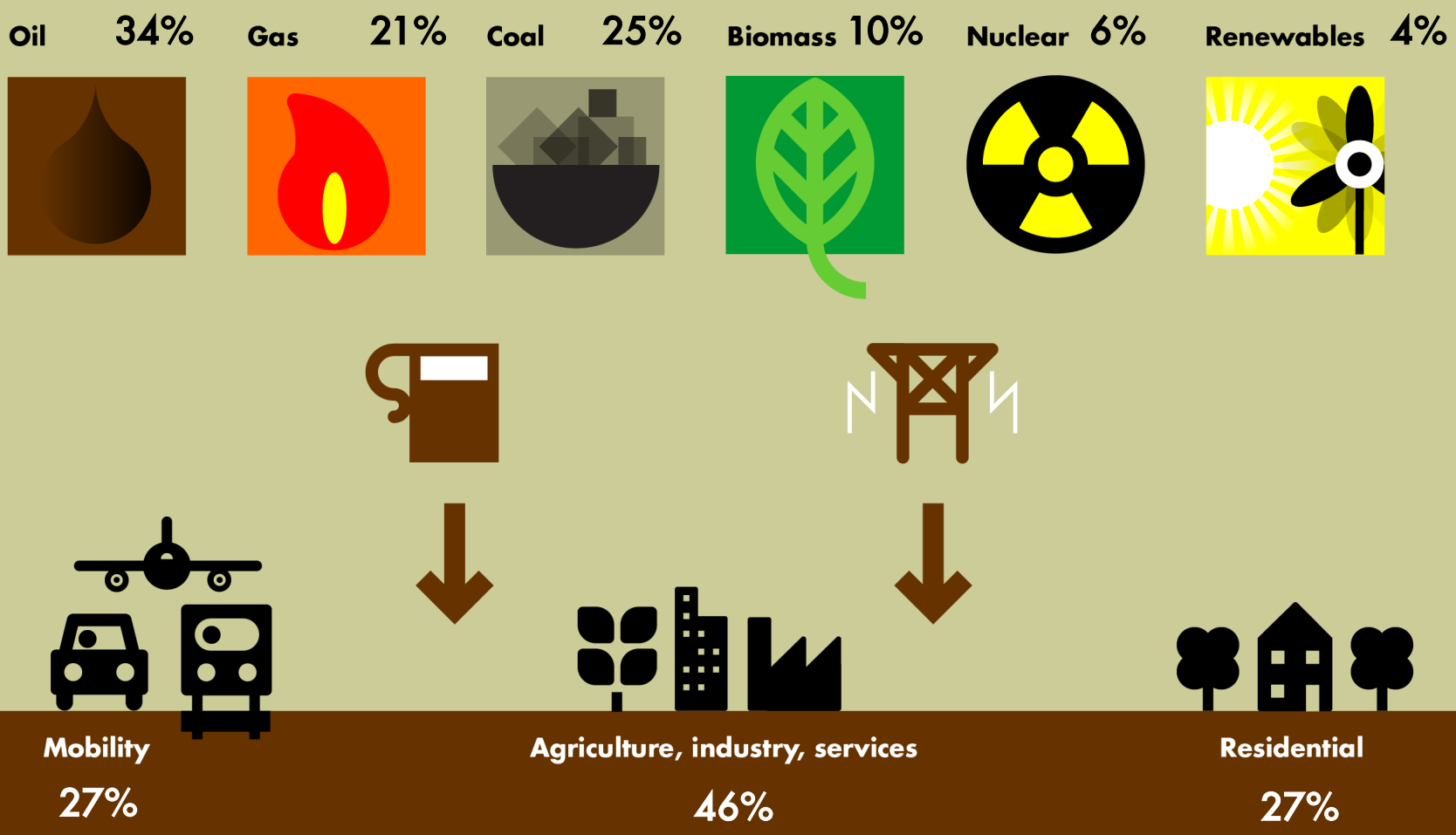
Ask "what if questions – not give answers

Challenge assumptions and mental models

Develop strategies and test plans not as projections of predictions

- 1970's - oil price spikes, stagflation
- 1980's - longevity of Soviet Union, possible oil price collapse
- 1990's - emergence of environmental issues, globalisation, technology, fertile ground for terror backlash
- 2000's – State prominence to the fore, three hard truths, mobile connectivity & ICT , recession and recovery dynamics

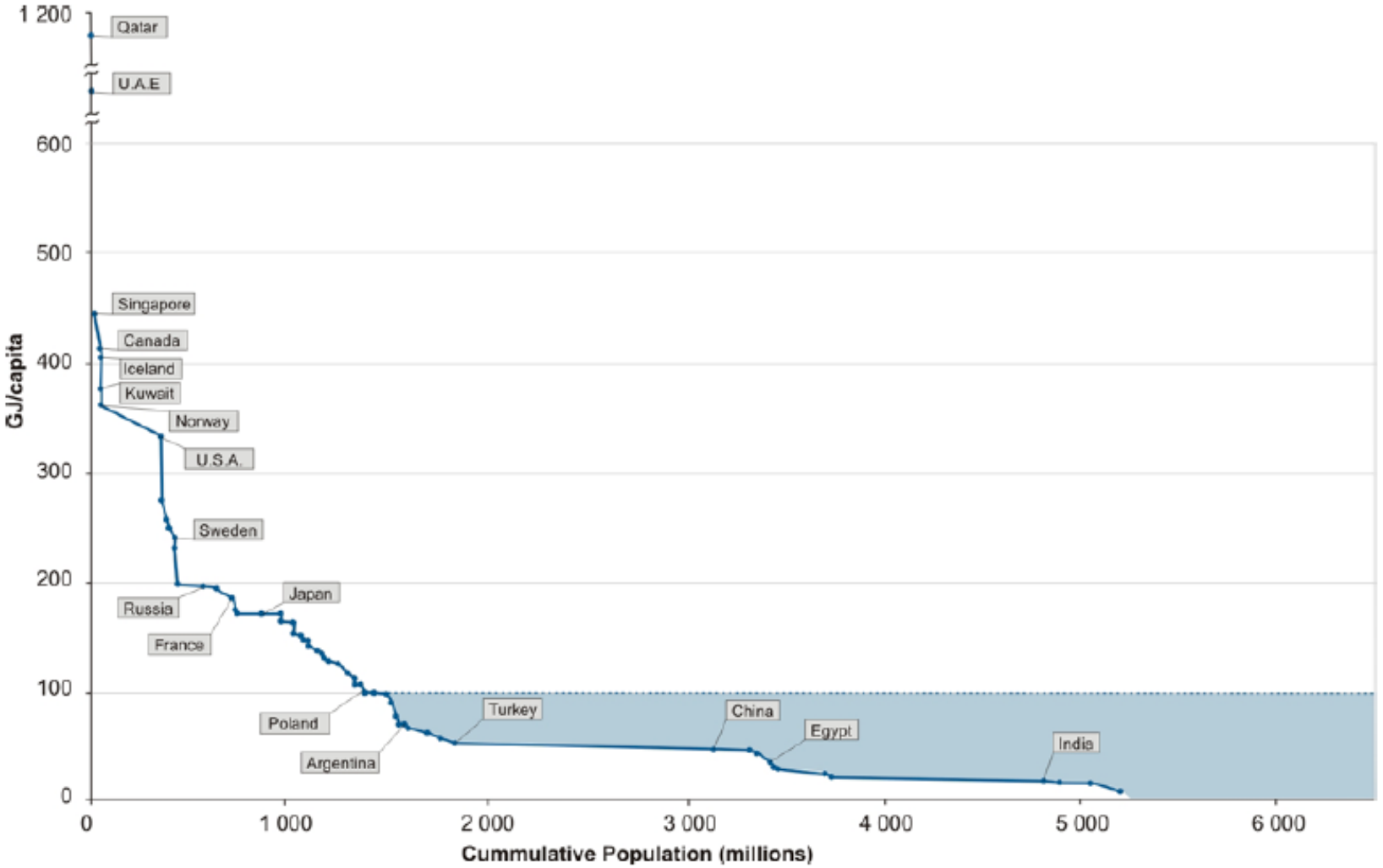
The energy system today sets the context for the future



Source: Shell International BV; UN Population Division

World population 6.6 bln; 50% in urban environment

Energy per capita as a function of cumulative population



Area between dashed line and data points is 500 EJ/year and represents everyone below Poland today achieving this same energy usage of 100 EJ per capita (source: WEC)

Energy foresight exercises

Scenarios

- International Energy Agency (IEA)
- World Energy Council (WEC)
- Energy Associations (Oil, Nuclear, Wind, Solar …)
- Energy companies (Shell)

Visions

- World Business Council for Sustainable Development (WBCSD)

Roadmaps

- European Climate Foundation: Baseline, 40, 60 and 80% renewables by 2050 in Europe

Forecasts

- Everybody

Shell energy scenarios to 2050

Intensified economic cycles and an end to 'The Great Moderation'

Heightened political instability

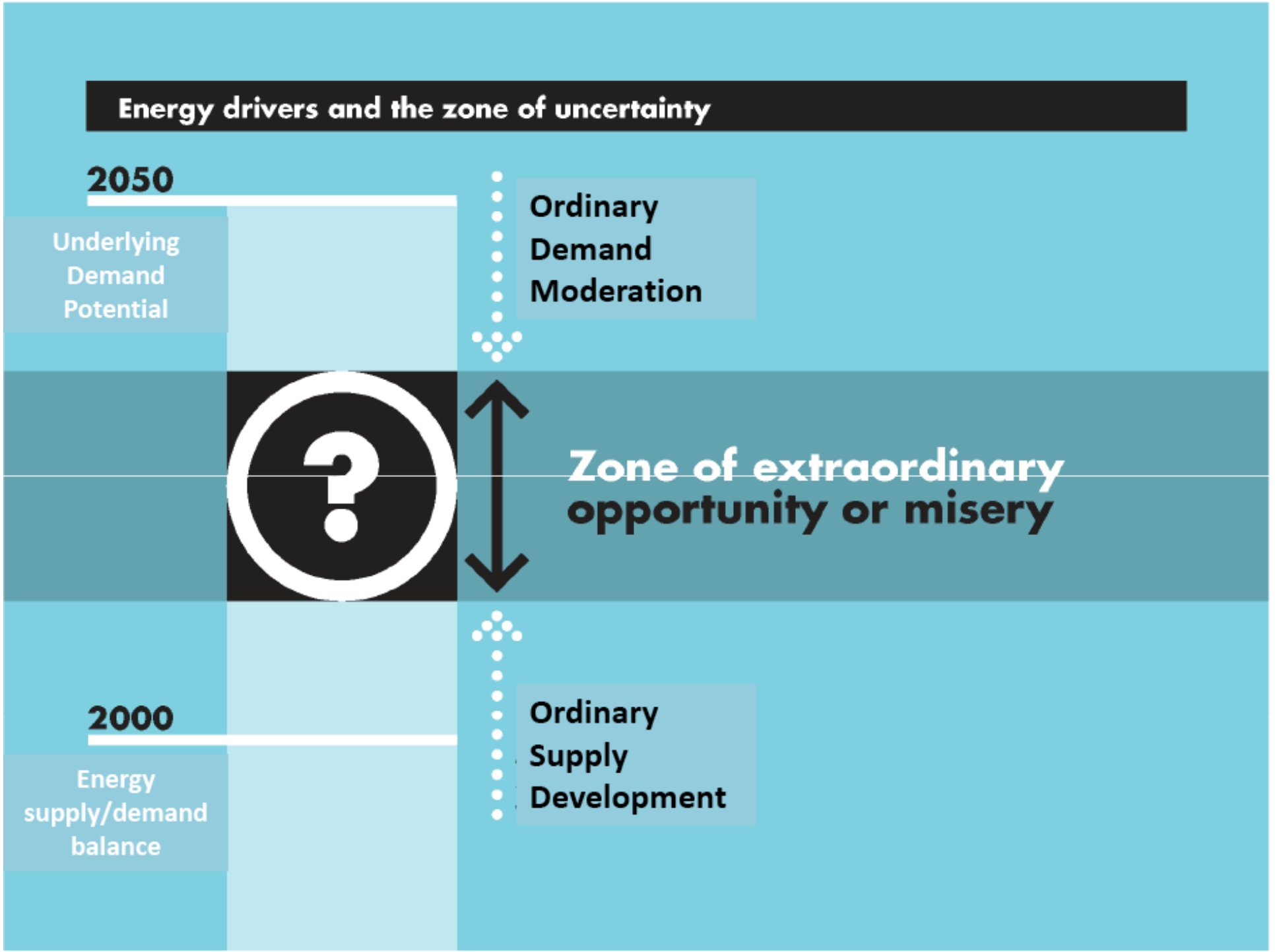
We have entered an

'era of volatile transitions'

Significant demographic transition – urbanisation

New political relationship building – a *mini-lateral* world

Defined and challenging planetary boundaries


Energy drivers and the zone of uncertainty
2050
Underlying Demand Potential
Ordinary Demand Moderation
Zone of extraordinary opportunity or misery
2000
Energy supply/demand balance
Ordinary Supply Development

Three hard truths will shape the future of the energy system

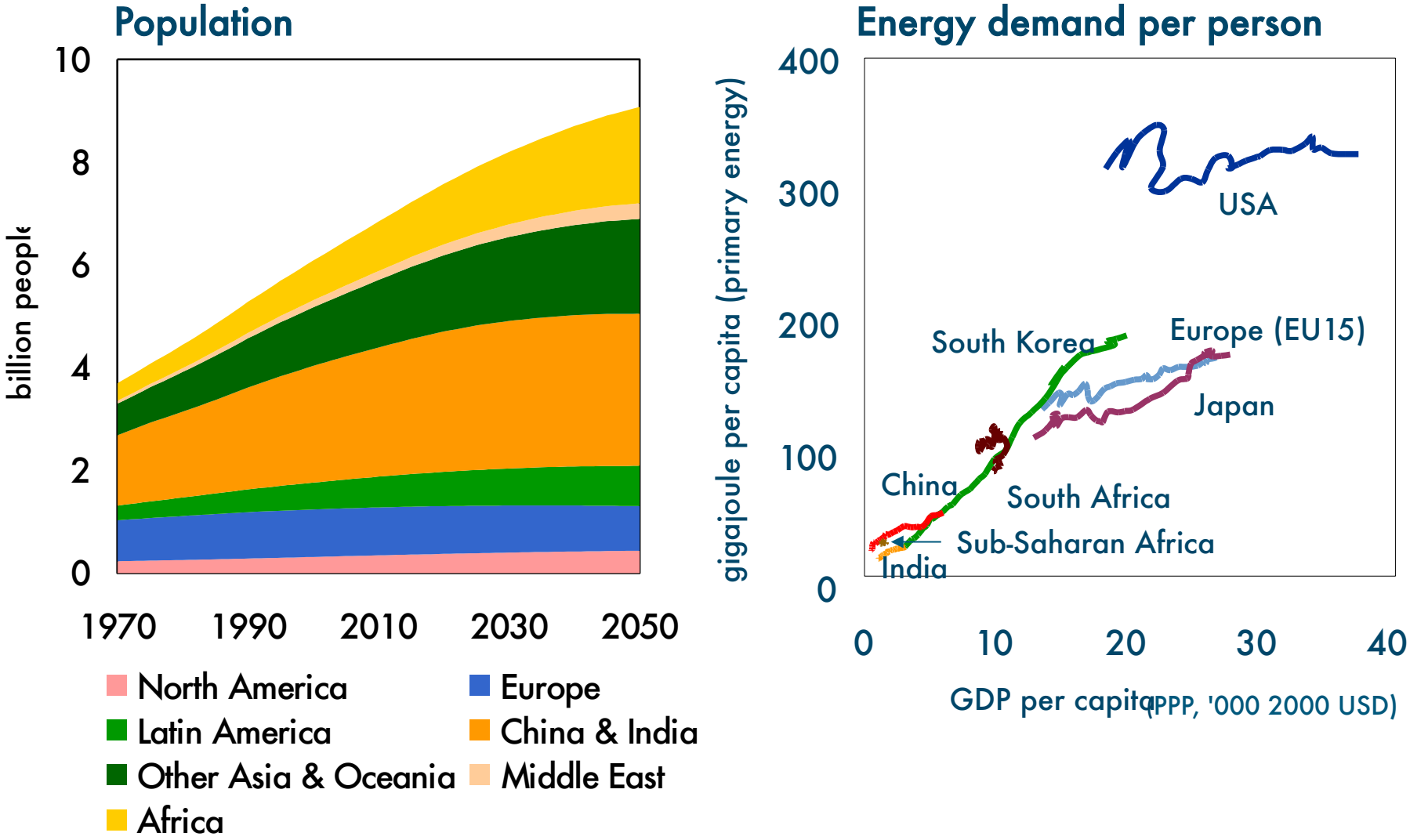
Step change in energy use through global rise in population and prosperity

Supply from conventional energy resources outstripped – leading to stresses

Environmental stresses – CO_2 and emerging tensions for water, food, land, etc

HT1 – Surge in Energy Demand

Growth in population and prosperity



Source: Shell International BV, Oxford Economics and Energy Balances of OECD and Non-OECD Countries © OECD/IEA 2006

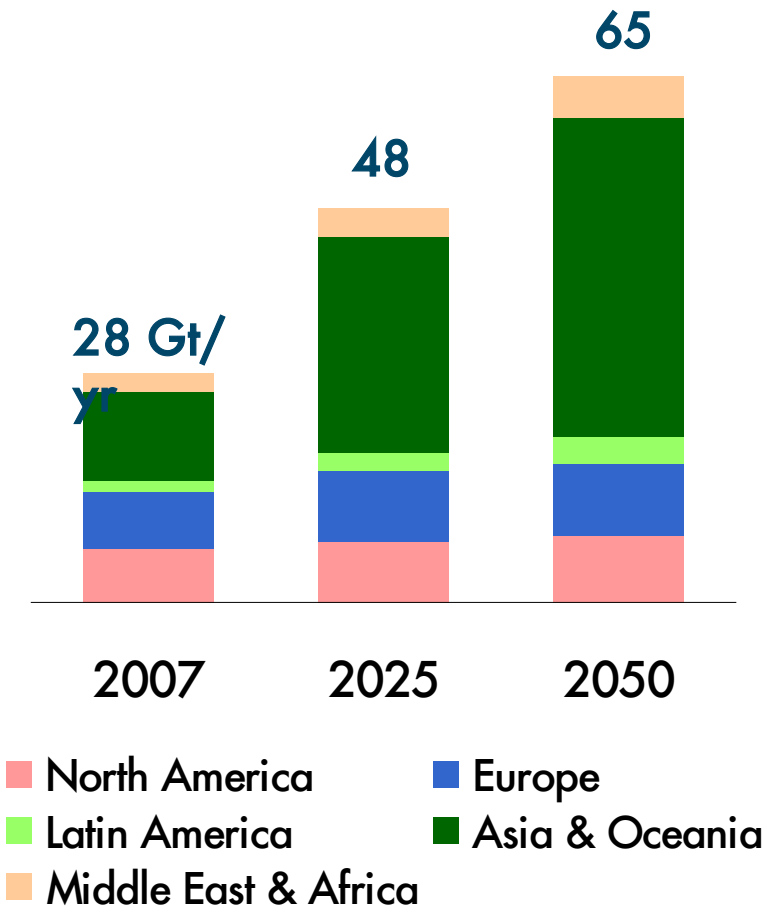
HT2 - Supply will struggle to keep pace

No silver bullets

HT3 - Environmental stresses are increasing

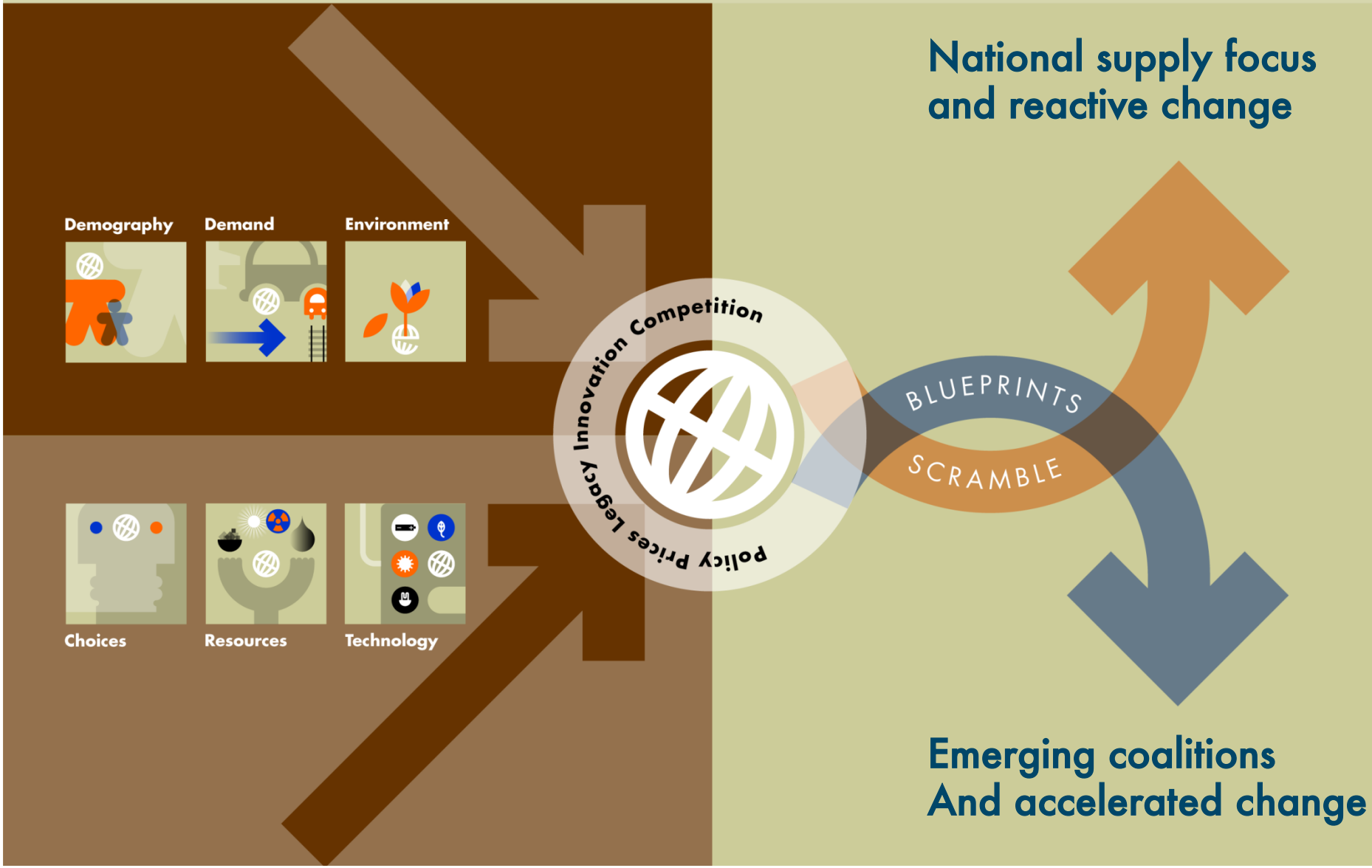
Not just Climate – water, land-use etc.

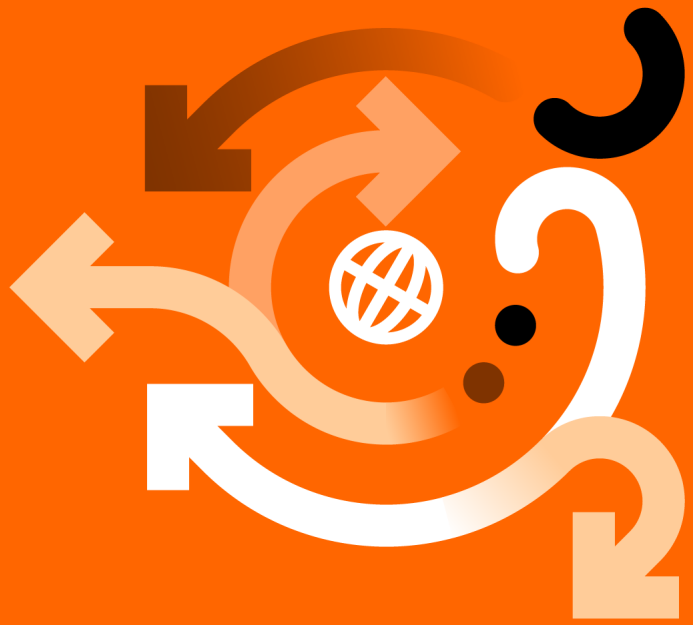
In "Business as usual" world, direct CO_2 from energy could rise dramatically



Source: Shell International BV

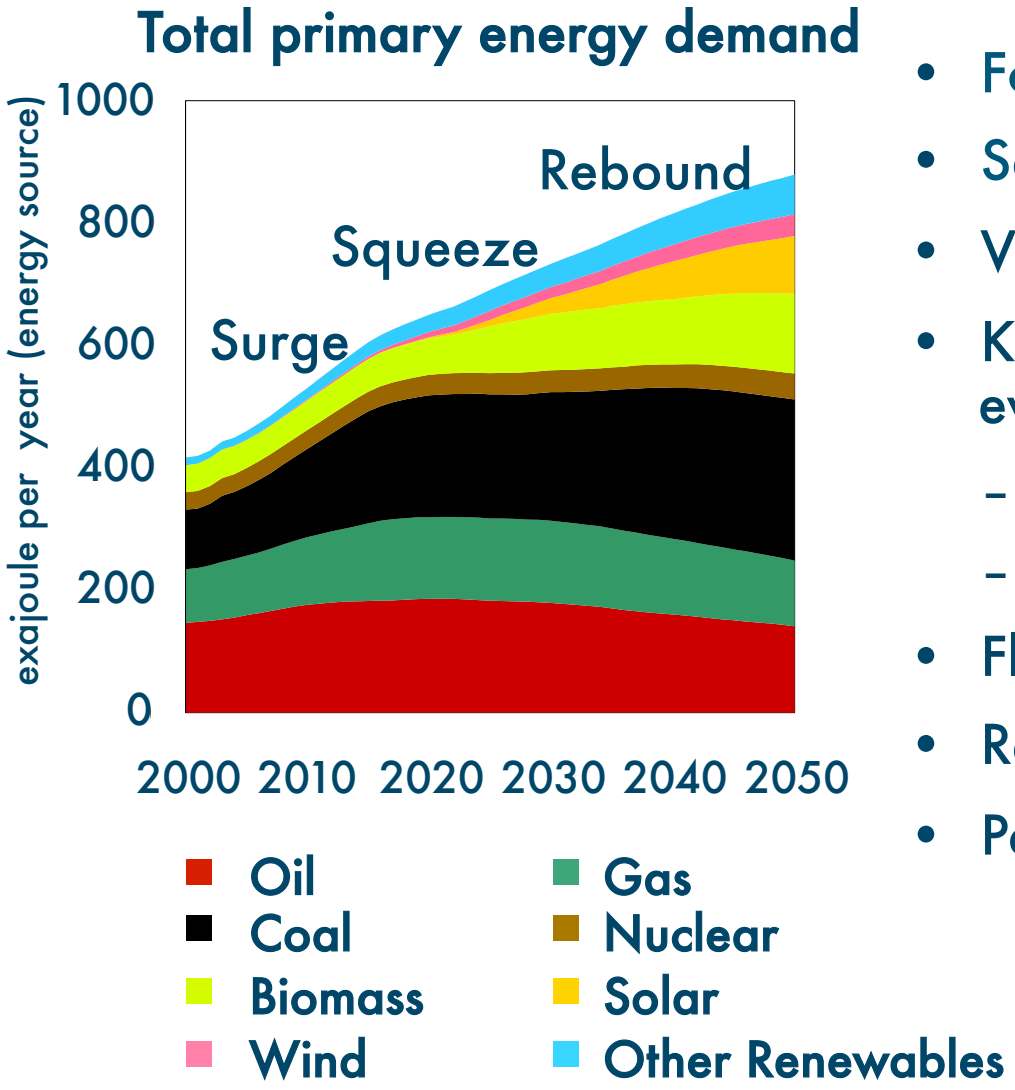
Shell energy scenarios





SCRAMBLE

Scramble – supply focus and late responses



- Focus on existing infrastructure
- Sequential responses to hard truths
- Volatile energy prices
- Knee-jerk reactions to climate events
  - No effective carbon pricing
  - Adaptation
- Flight to coal, then biofuels
- Renewables forced in by mandates
- Patchwork of national standards

EVENTS OUTPACE ACTIONS

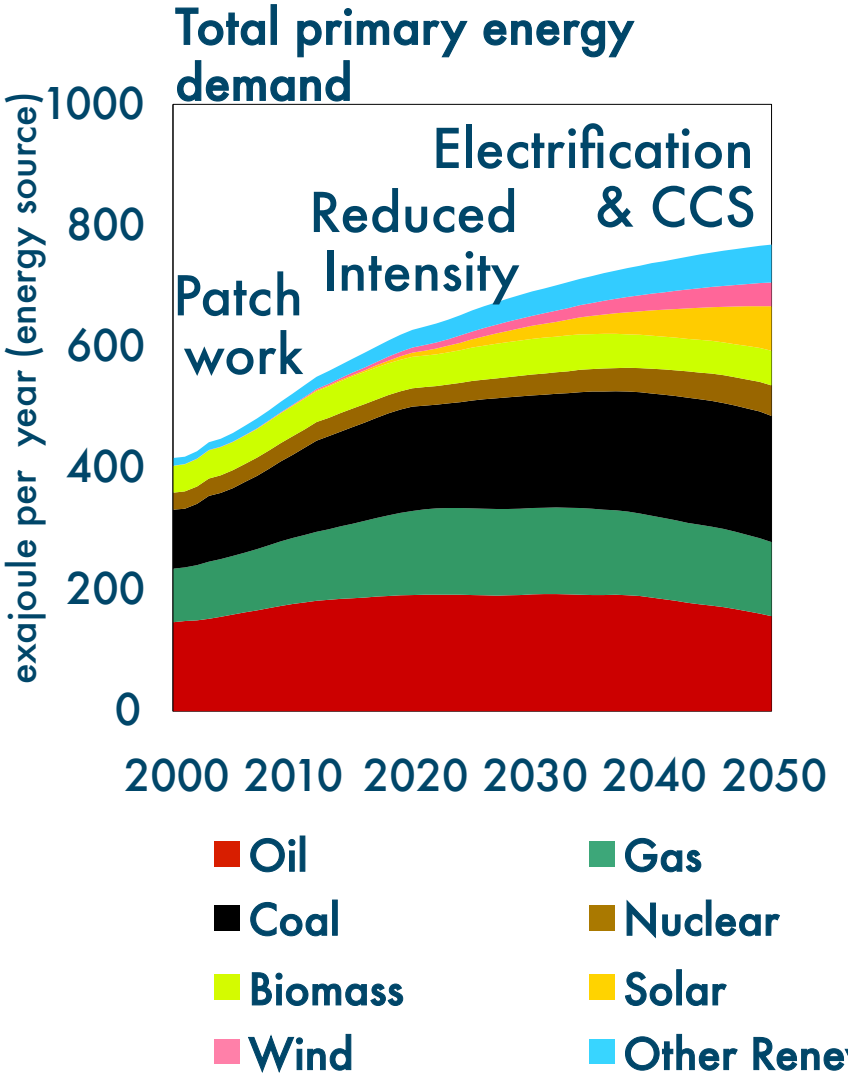
Sources: Shell International BV and
Energy Balances of OECD and Non-OECD Countries©OECD/IEA 2006

Scramble - People at the heart of the storylines … individually and collectively

- People choose the easiest option for them
- Fear is not enough to change behaviors
- Climate change is too difficult
- Delegating action to the state
- Adapt rather than change

BLUEPRINTS

Blueprints – multi-focus and early actions



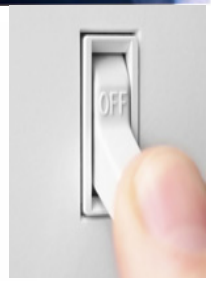
- Broader anticipation of challenges
- Critical mass of parallel responses to hard truths
- Effective carbon pricing established early
- Aggressive efficiency standards
- Growth shifts to electrification
- New infrastructure develops
- CCS emerges after 2020

ACTIONS OUTPACE EVENTS

Sources: Shell International BV and Energy Balances of OECD and Non-OECD Countries©OECD/IEA 2006

Blueprints - People at the heart of the storylines … individually and collectively

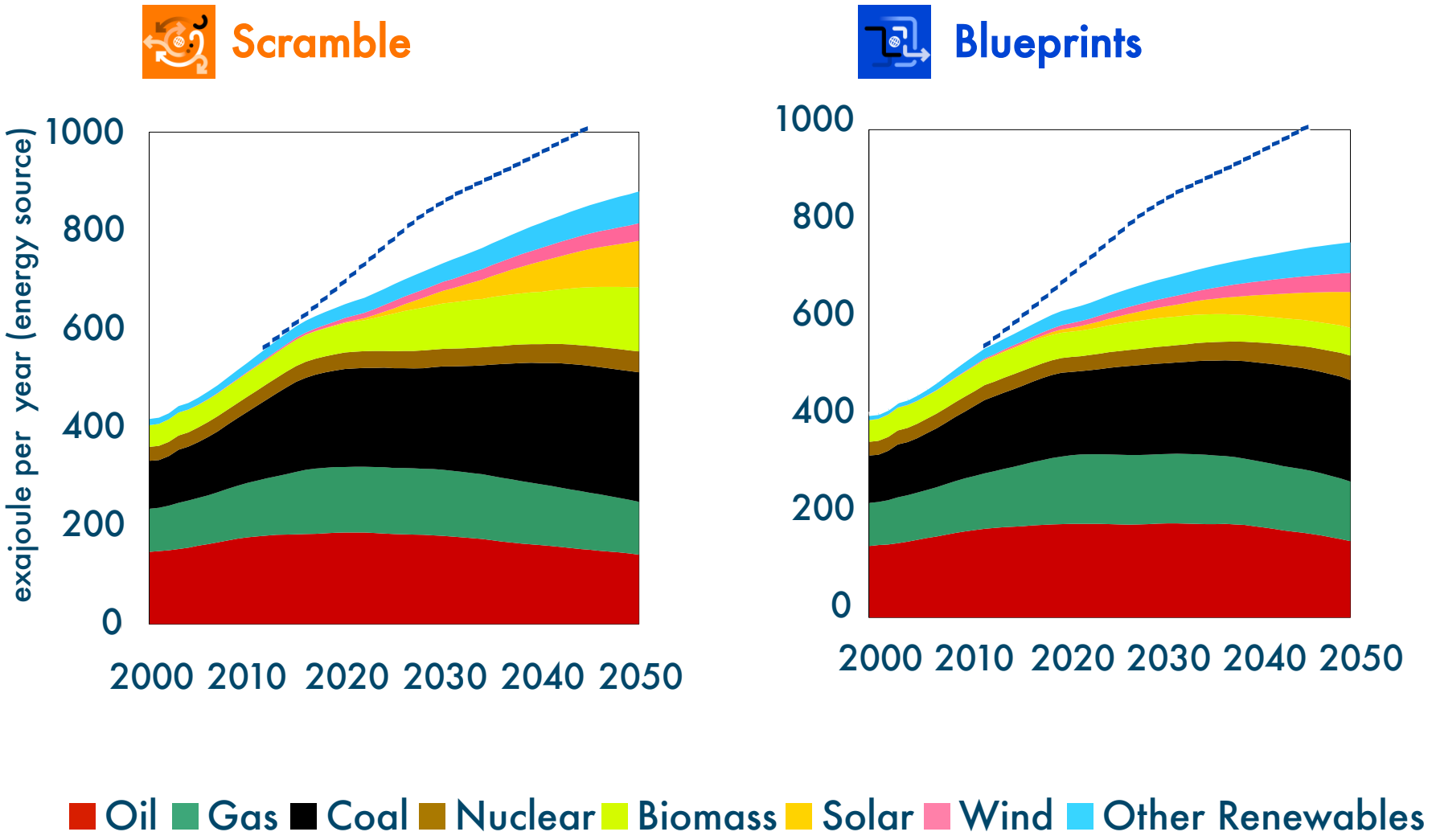
- Shared interest not altruism
- Adoption through "mainstreaming"
- Trial, error, collaboration and copying success
- Success is emergent, not centrally driven initially



Scenario Comparisons

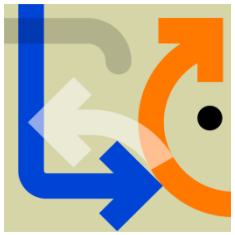
Scramble	vs.	Blueprints
Mandates		Market driven incentives
Flight to coal		Coal only if clean
Guarded national interests		Innovative, collaborative and shared innovation
Supply optimisation		Demand load management
Energy vs. Food		Sustainability principle
Renewables sequential and late		Incentives for early innovation and adoption

Comparing the scenarios: energy mix



Source: Shell International BV and Energy Balances of OECD and Non-OECD Countries©OECD/IEA 2006

Summary



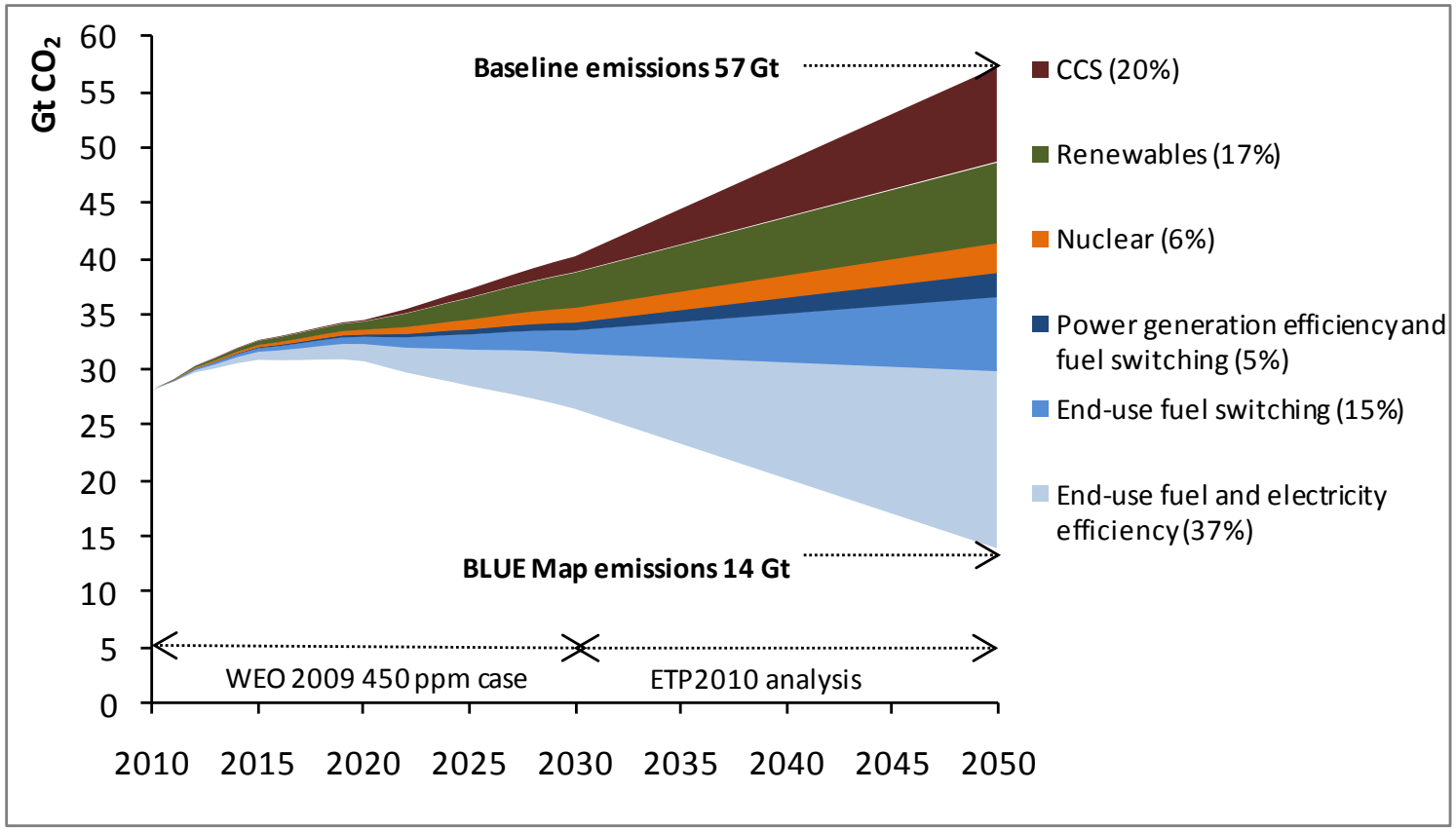
- The three hard truths are *very* hard
- Transition is both inevitable and necessary
- Technology plays a major role,
  but no silver bullets
- Political and regulatory choices are pivotal
- The next 5 years are critical

Tackling all three hard truths TOGETHER is essential for a sustainable future

International Energy Agency: World Energy Outlook and Energy Technology Scenarios

- Two scenarios:
  - Baseline
  - BLUE MAP
- Regional detail
  - China, India, OECD Europe, United States
- Sectoral detail
  - Including smart grids
- Cross-cutting themes
  - Roadmaps and technology policy
  - Financing
  - Technology diffusion and transfer
  - Co-benefits of low carbon technologies

Key Technology Options to halve global CO_2 emissions



- Energy efficiency and renewables account for more than half of the total reduction
- Power generation is the sector with the largest reductions

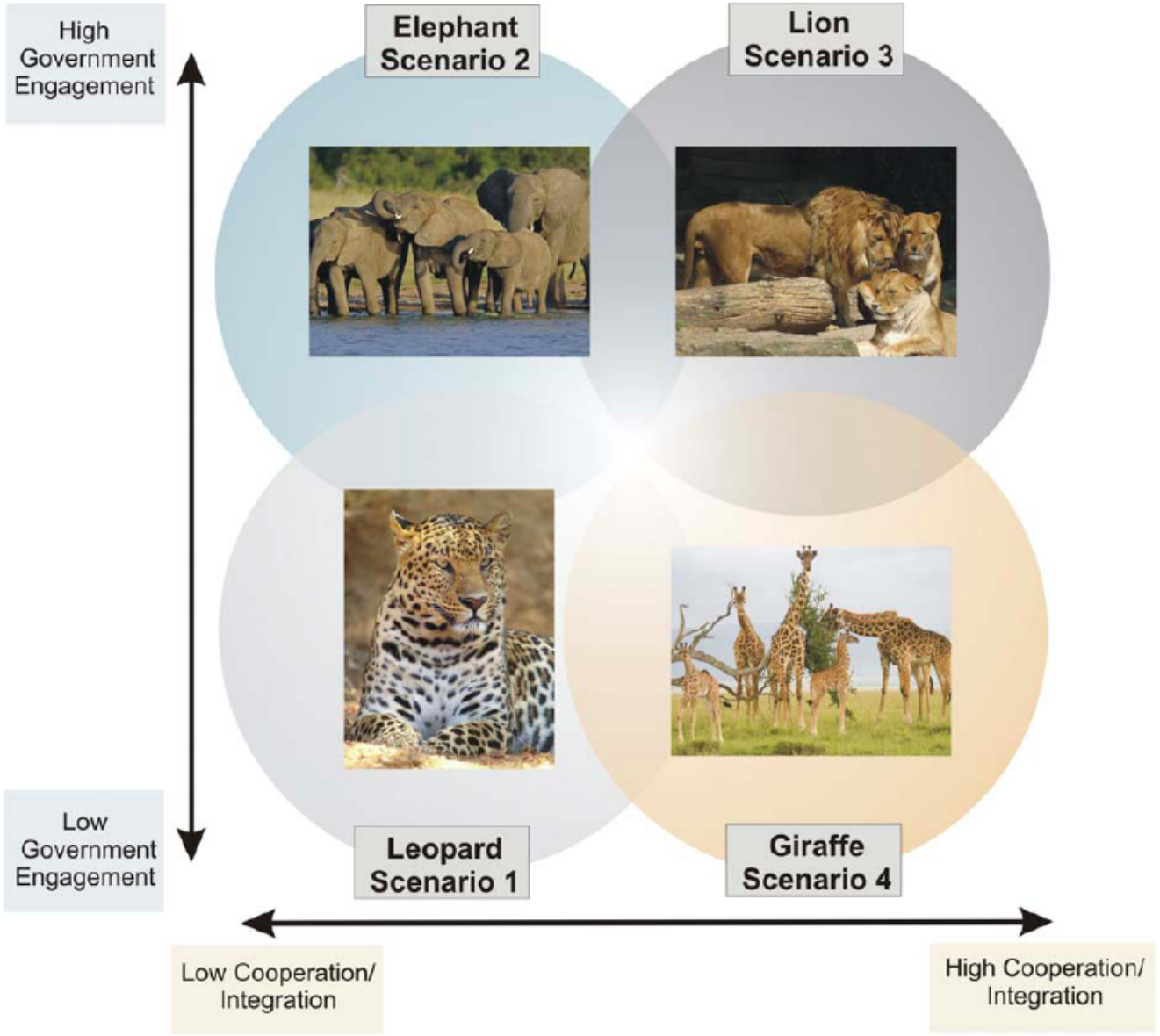
Key Messages from ETP2010 Scenarios (1)

- The **Baseline** scenario is unsustainable
  - Global CO_2 emissions double by 2050, oil and gas prices are high, and energy security concerns increase as imports rise.
- The widespread deployment of a range of low carbon technologies can lead to a more secure and sustainable energy future
  - Under **BLUE MAP** emissions are reduced by 50% in 2050
  - Oil demand in 2050 is 27% lower than in 2007 and gas demand is 12% lower. Oil prices are significantly lower than Baseline
- The electricity sector will need to be substantially decarbonised through the use of renewable energy, nuclear power and fossil-fuels with CCS

Key Messages from ETP2010 Scenarios (2)

- Rate of energy efficiency improvement will need to double across all end-use sectors
- New low-carbon technologies will be required in transport and industry
- Fuel switching to low or zero carbon fuels will be a significant source of carbon reductions.
  - In **BLUE MAP**, biomass use doubles and low-carbon electricity is increasingly used in buildings, transport and industry. Hydrogen also plays a role later on
- Urgent action is needed
  - Emissions must peak around 2020 and thereafter show a steady decline
- Non-OECD countries will need to make absolute cuts in CO_2 emissions to reach the 50% reduction target

Energy policy scenarios developed by the World Energy Council



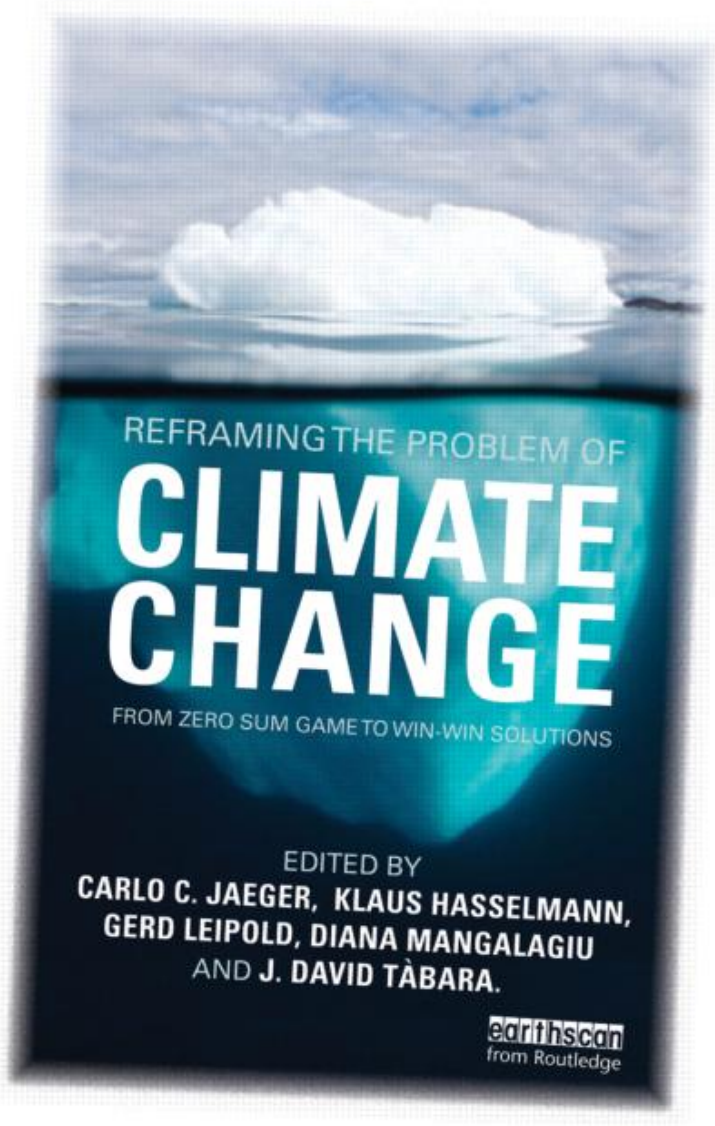
Key indicators for the four policy scenarios

- Growth in gross domestic product
- Demographic growth
- Energy intensity
- Primary energy mix
- Total primary energy required (TPER)
- Greenhouse gas emissions
- Supply–demand tensions (the balance between the two)
- Oil
- Gas
- Coal
- Nuclear power
- Renewable energy

The four scenarios developed for 2020 by the Millennium Project

1. **Business as usual**. Global changes continue without great surprises or much change in energy patterns, other than those resulting from dynamics and trends already in place
2. Environmental backlash. The international environmental movement becomes more organized and violent, attacking fossil energy industries
3. High tech economy. Technological innovations accelerate beyond current expectations, and have large scale impacts in the energy supply mix and consumption patterns
4. Political turmoil. Increasing political instability and conflicts, relating to or resulting from energy needs and capacities

Synthesis, full report and supplementary material at www.newgrowthpath.eu



Reframing the Problem of Climate Change: From Zero Sum Game to Win-win Solutions
Earthscan, 21 November 2011