Transforming Energy Systems Toward Sustainable Climate

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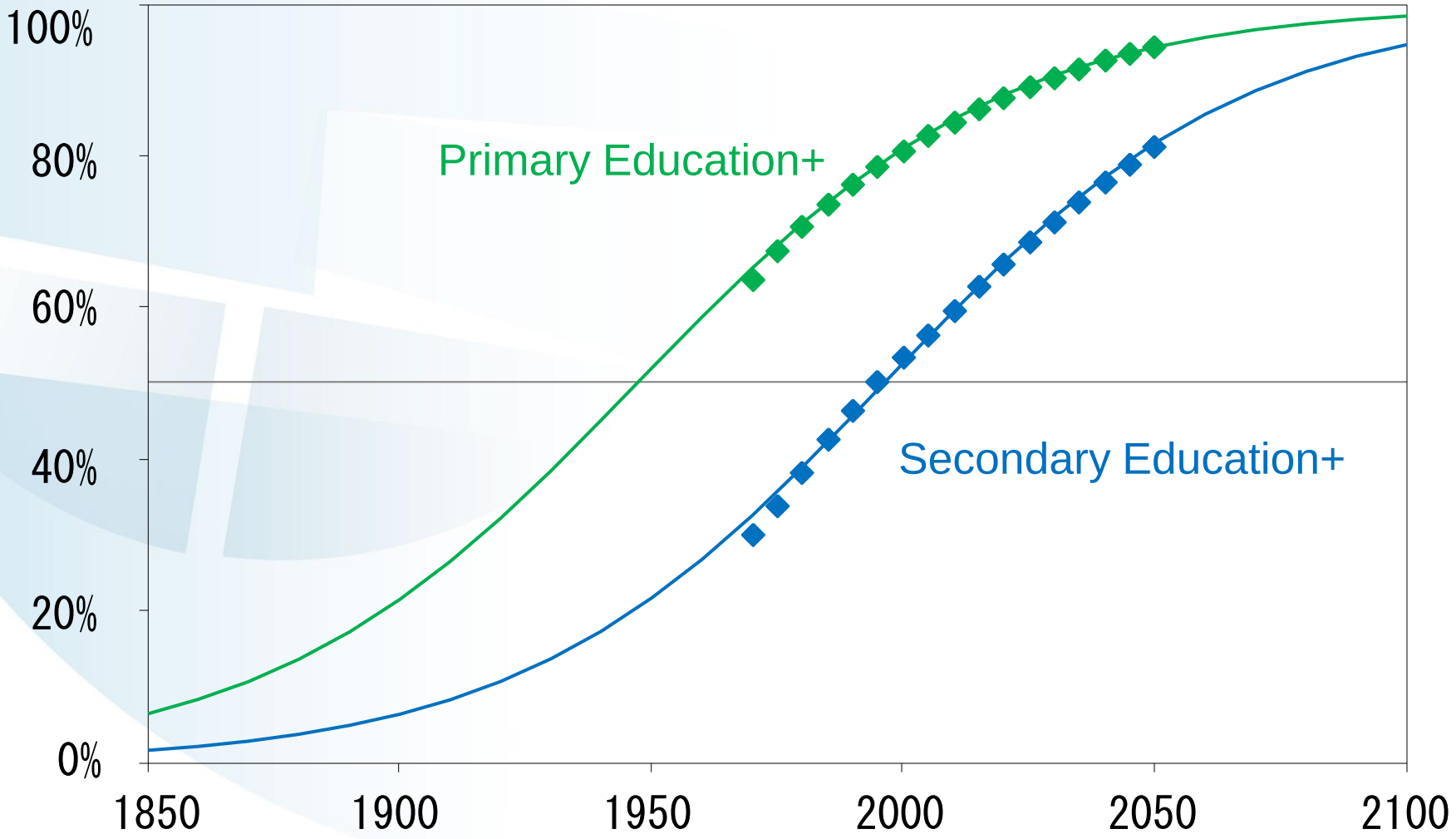
Major Challenges of Anthropocene

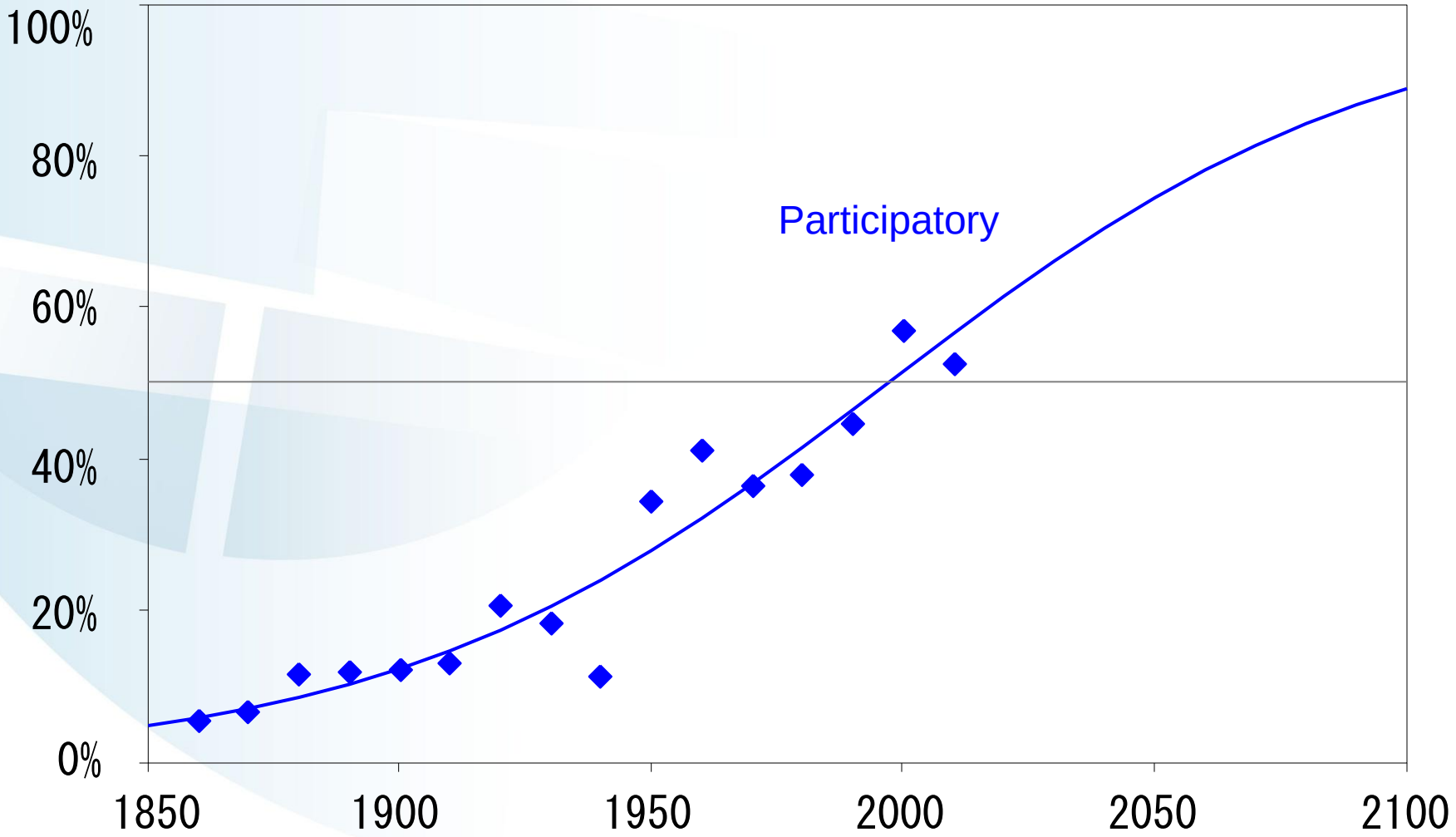
- The industrial revolution led to unprecedented levels of affluence and production, but also inequity;
- The unintended consequences demonstrate significant impacts on our social and natural environments transcending planetary boundaries.
- Overcoming formidable global challenges requires scientific foundations for understanding, formulating effective response strategies and the multi-lateral cooperation for action plans forward.

Global Educational Attainment



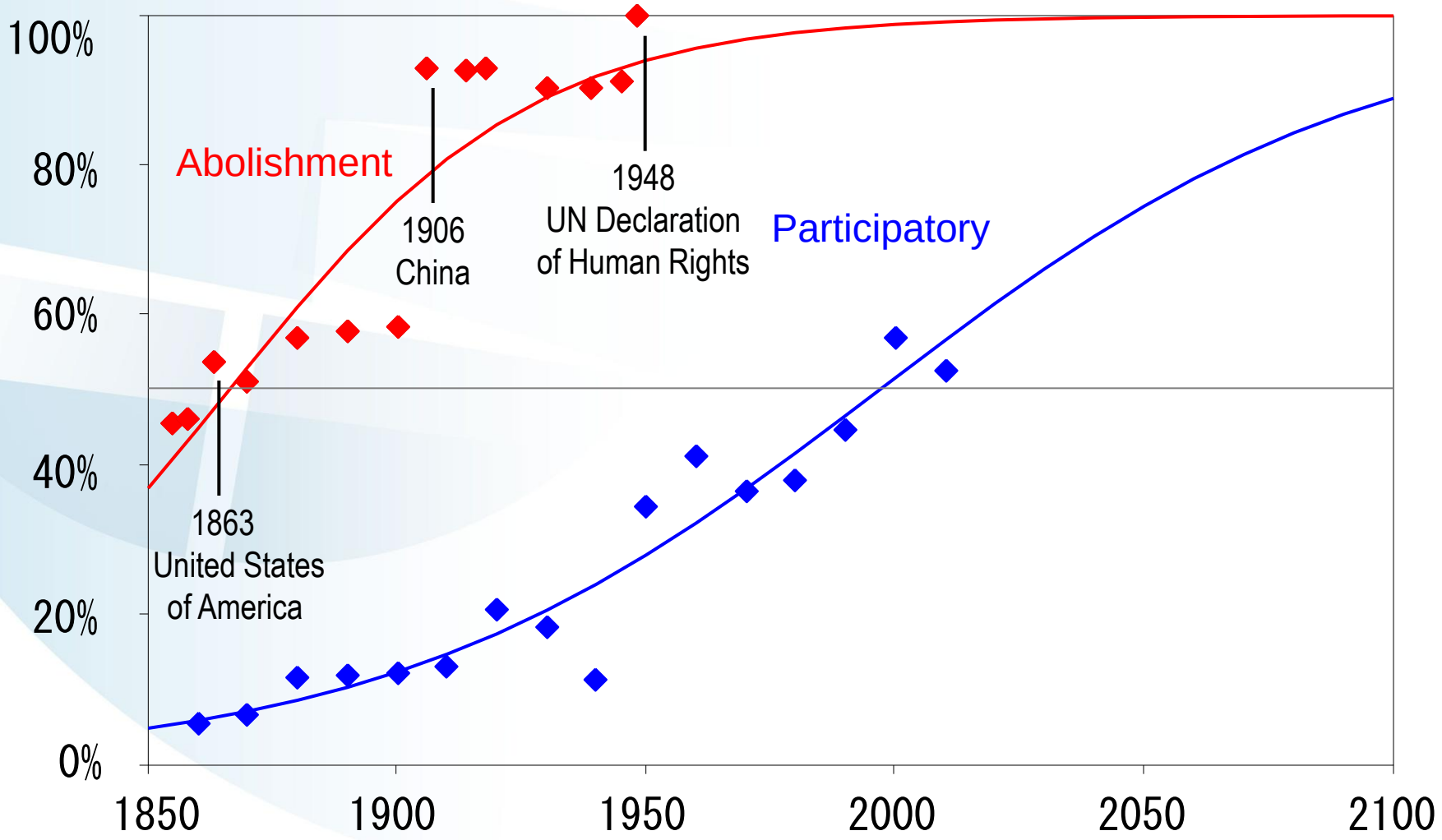
Source: Lutz et al. (2007)

Diffusion of Democracy



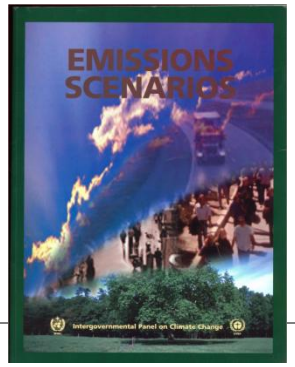
Source: Modelski & Perry, 2002; 2010

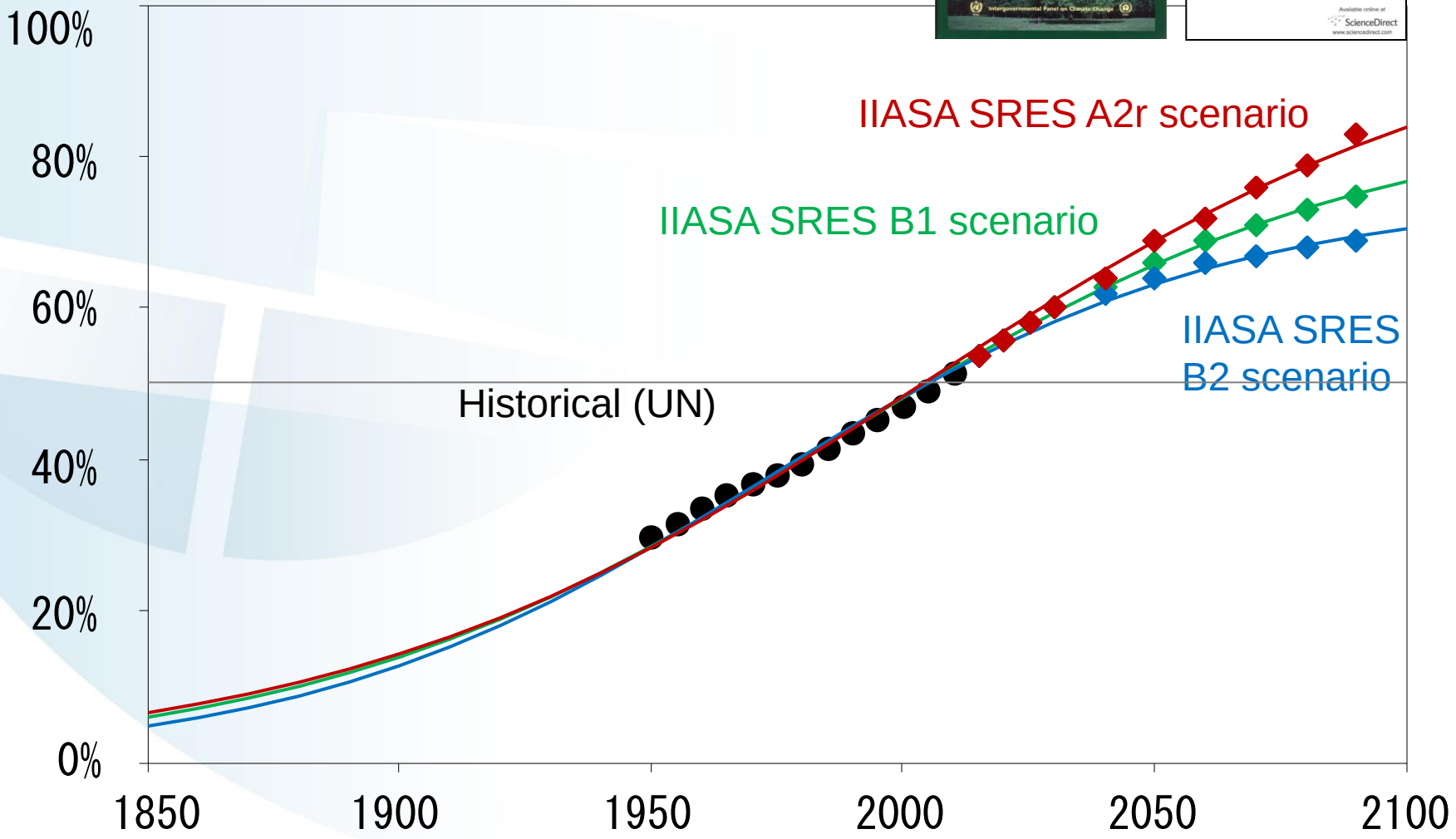
Diffusion of Democracy
Slavery Abolishment



Source: Naki & Rogner, 2012; Modelski & Perry, 2002; 2010

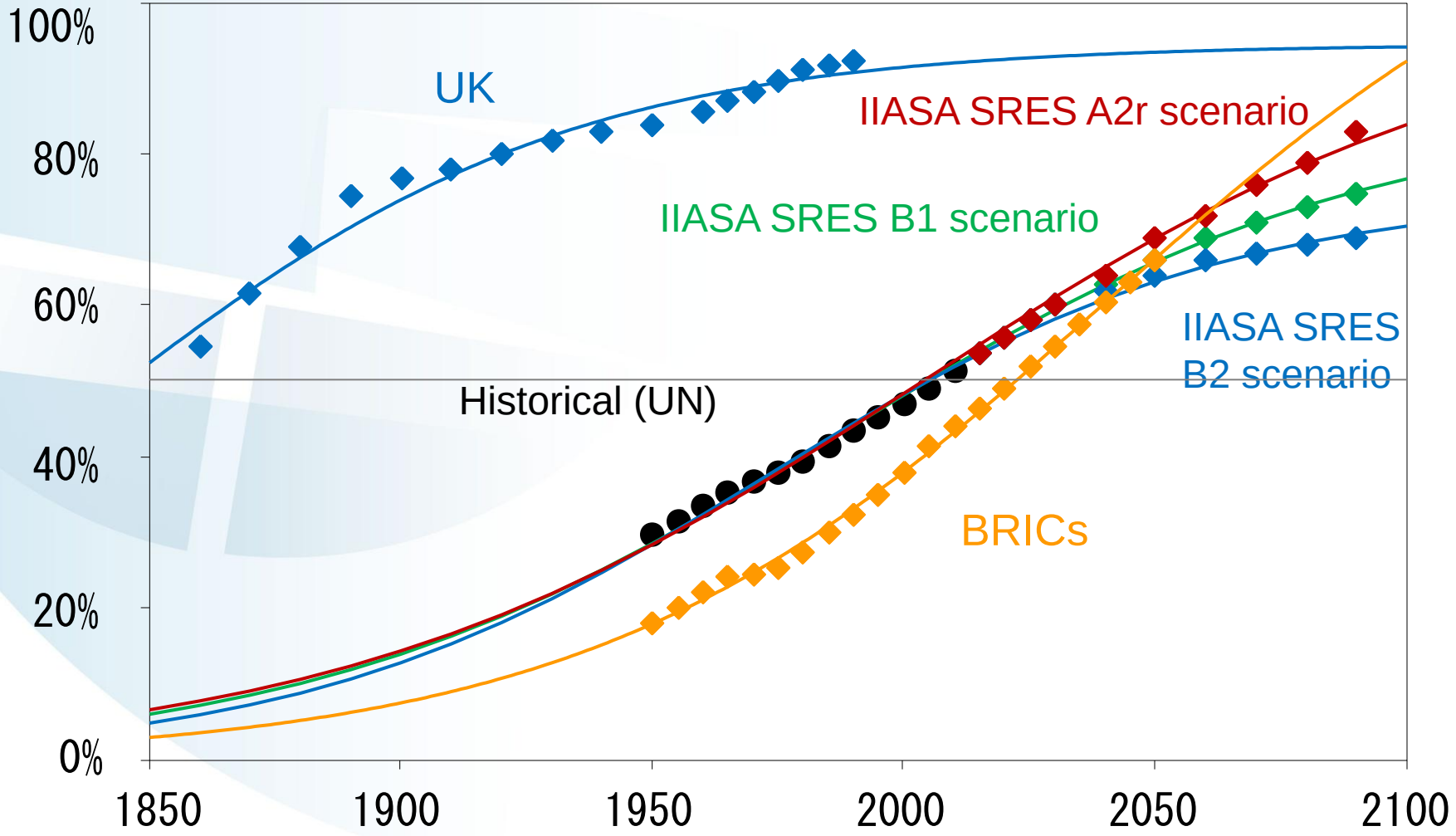
Urbanization World





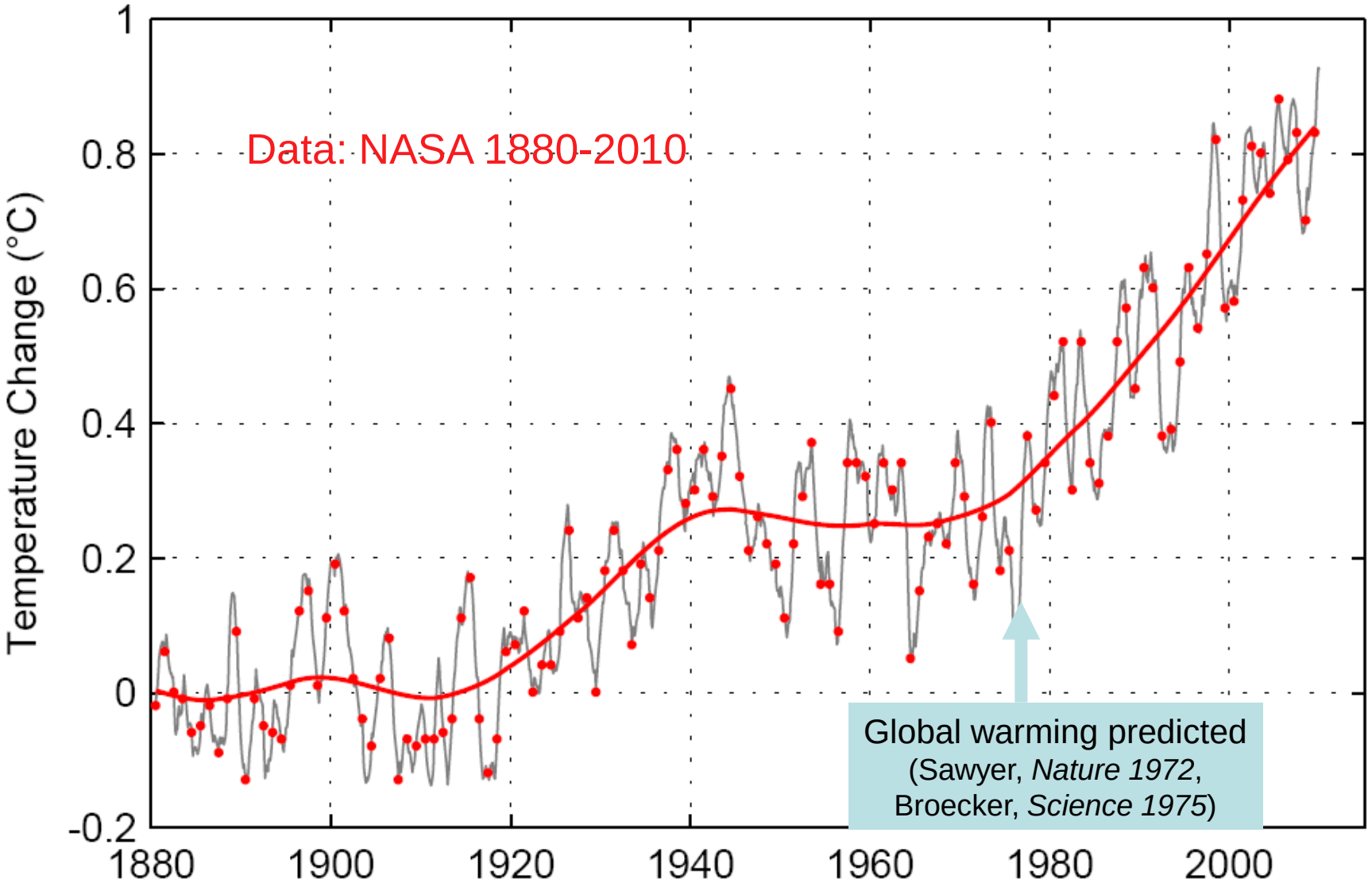
Source: Grubler, 2007

Urbanization
World, UK, BRICs

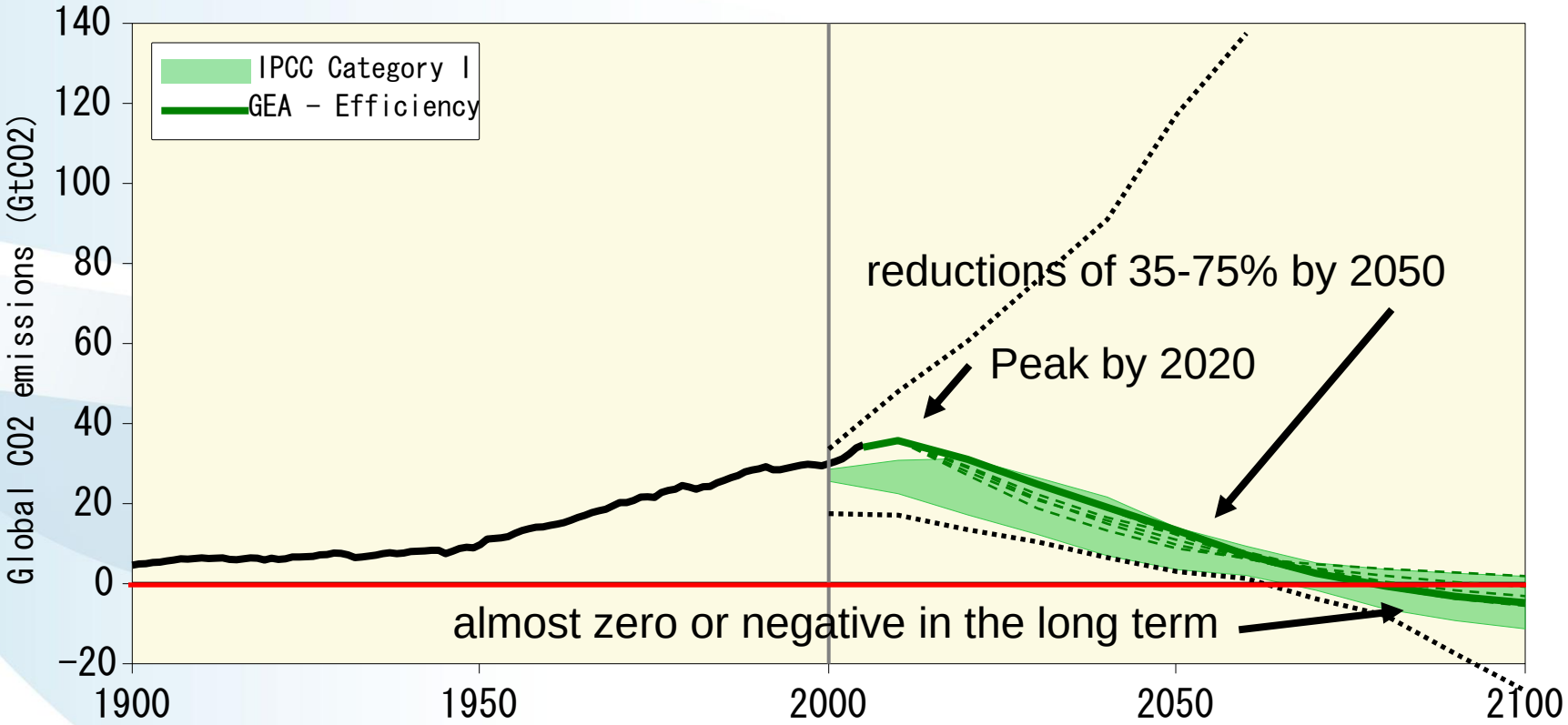


Source: Grubler, 2007

Earth is Warming



Global Carbon Emissions

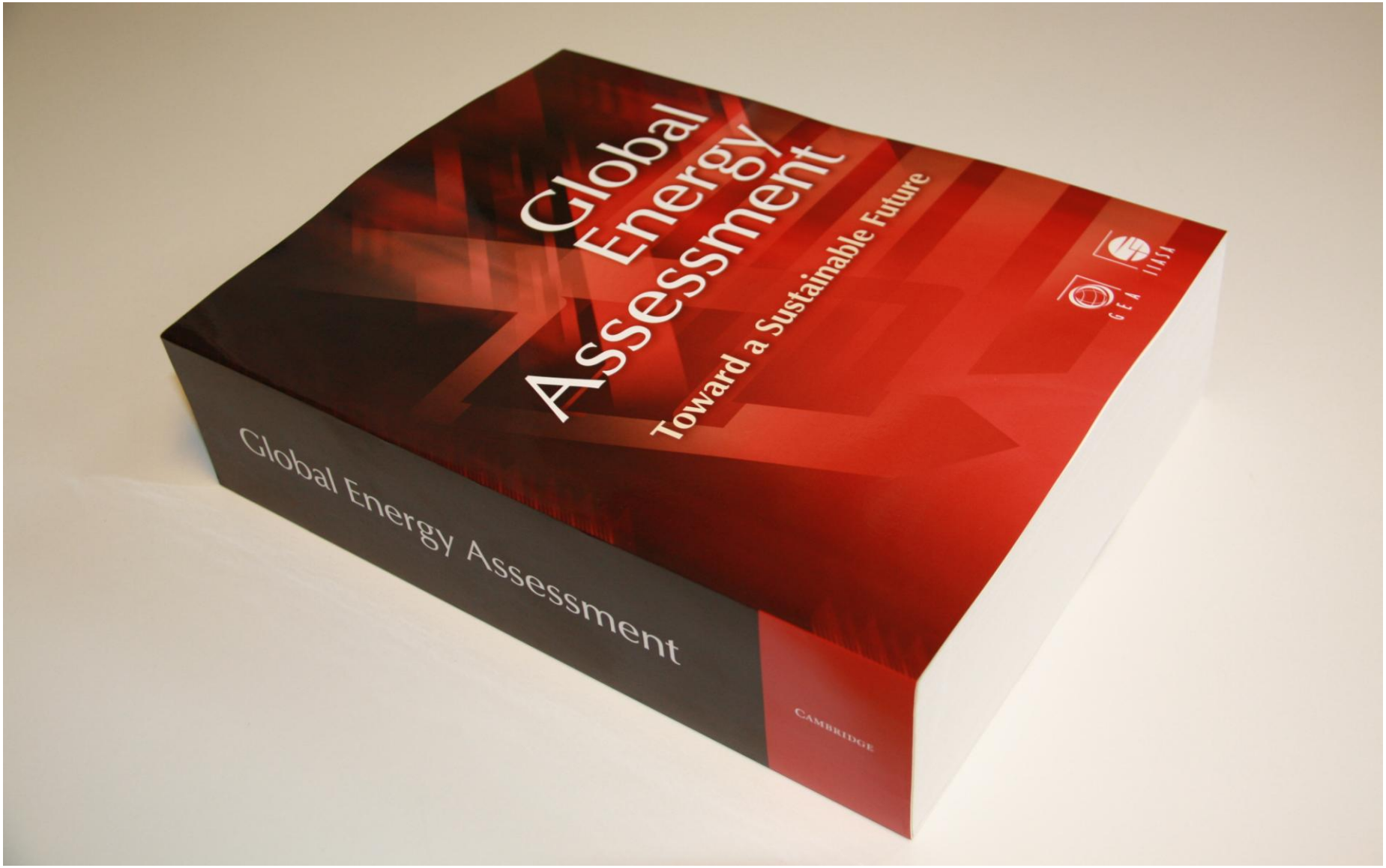


Source: Riahi et al, 2012

Global Energy Challenges

- From 7 bn people, 3 bn cook with solid fuels and 1.5 bn lack access to electricity
- Efficiency and decarbonization bring multiple benefits for health, security, climate change
- Financing requirements are huge, but achievable with right and sustained policies

www.GlobalEnergyAssessment.org



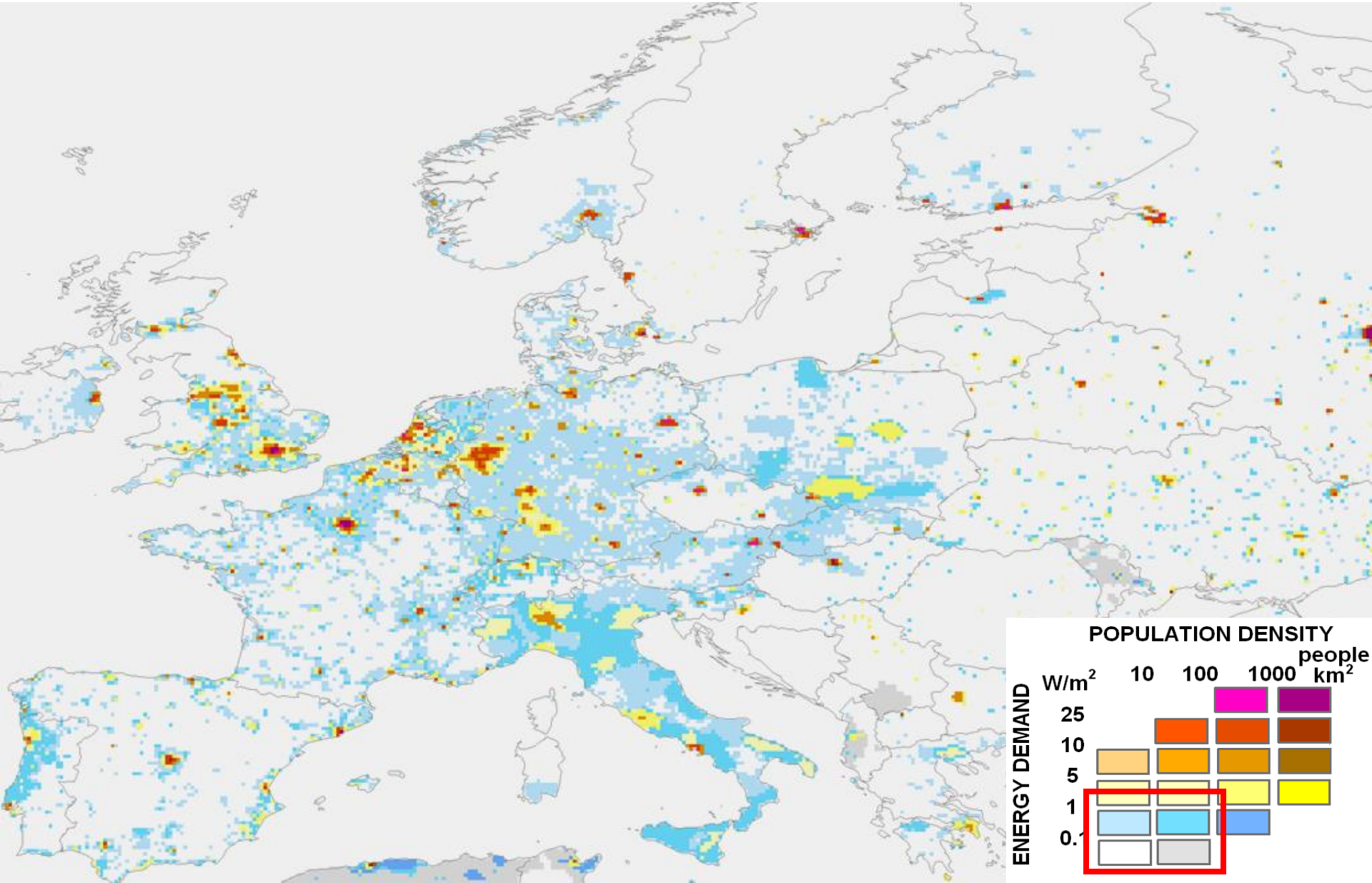
2012 INTERNATIONAL YEAR OF
SUSTAINABLE ENERGY
FOR ALL

2030 Energy Goals

- Universal Access to Modern Energy
- Double Energy Efficiency Improvement
- Double Renewable Share in Final Energy

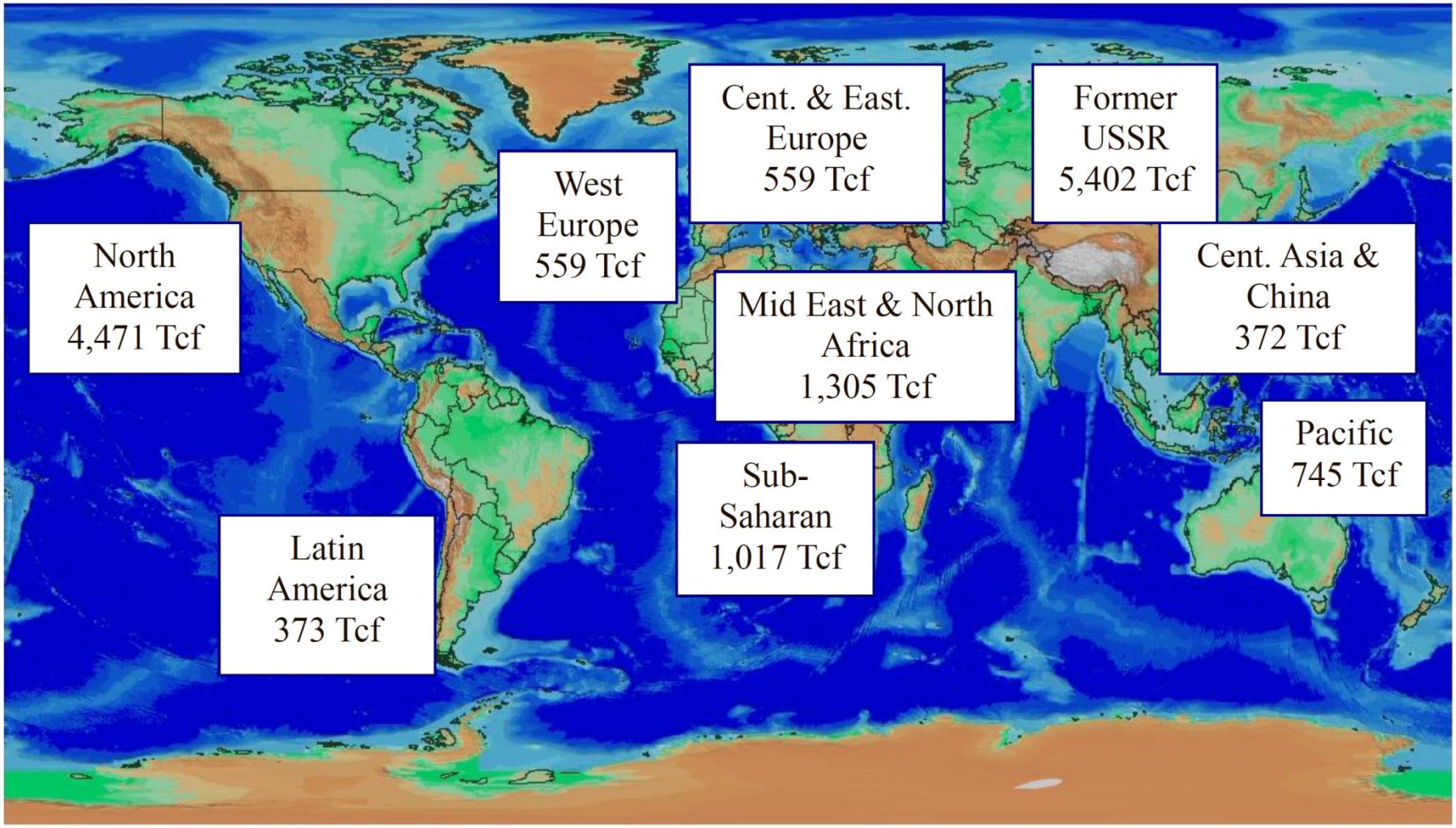
Aspirational & Ambitious but Achievable

Europe Population vs. Energy Demand Density



Energy and Water from Deserts

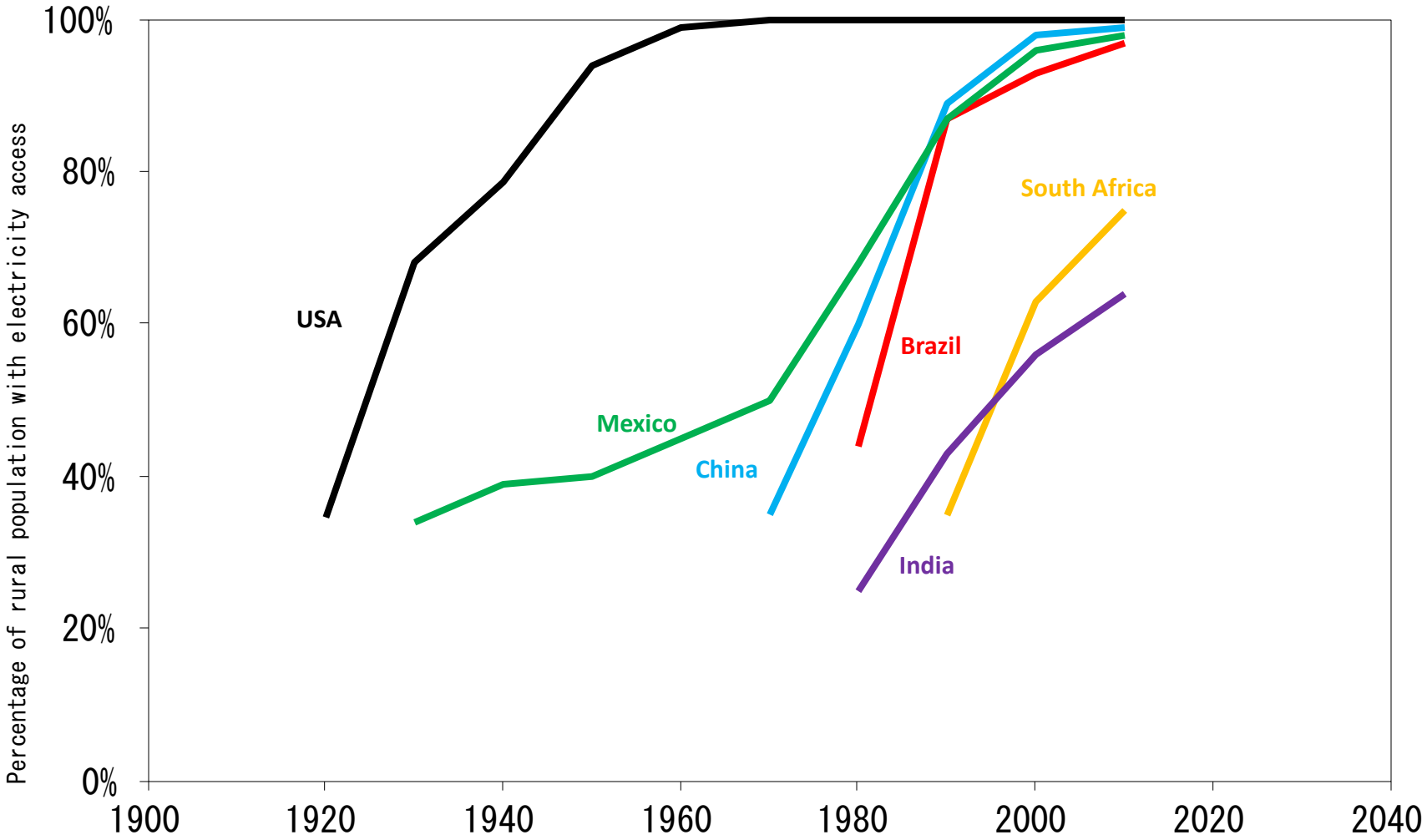
Estimated shale gas resource



14,803 TCF ≈ 15,600 EJ

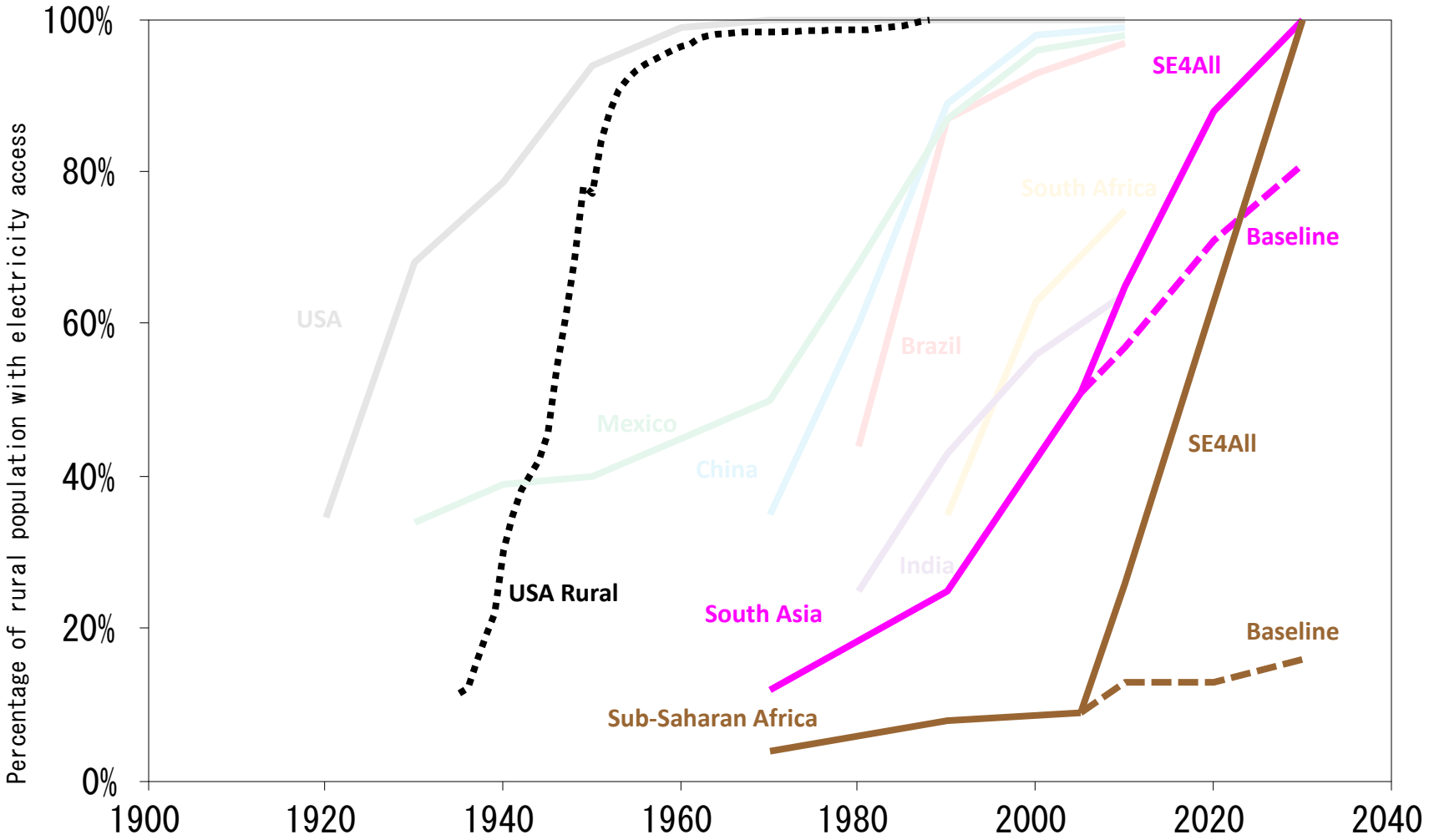
IGU 2003, VNIIGAS 2007, USGS 2008, BGR 2009

Electrification



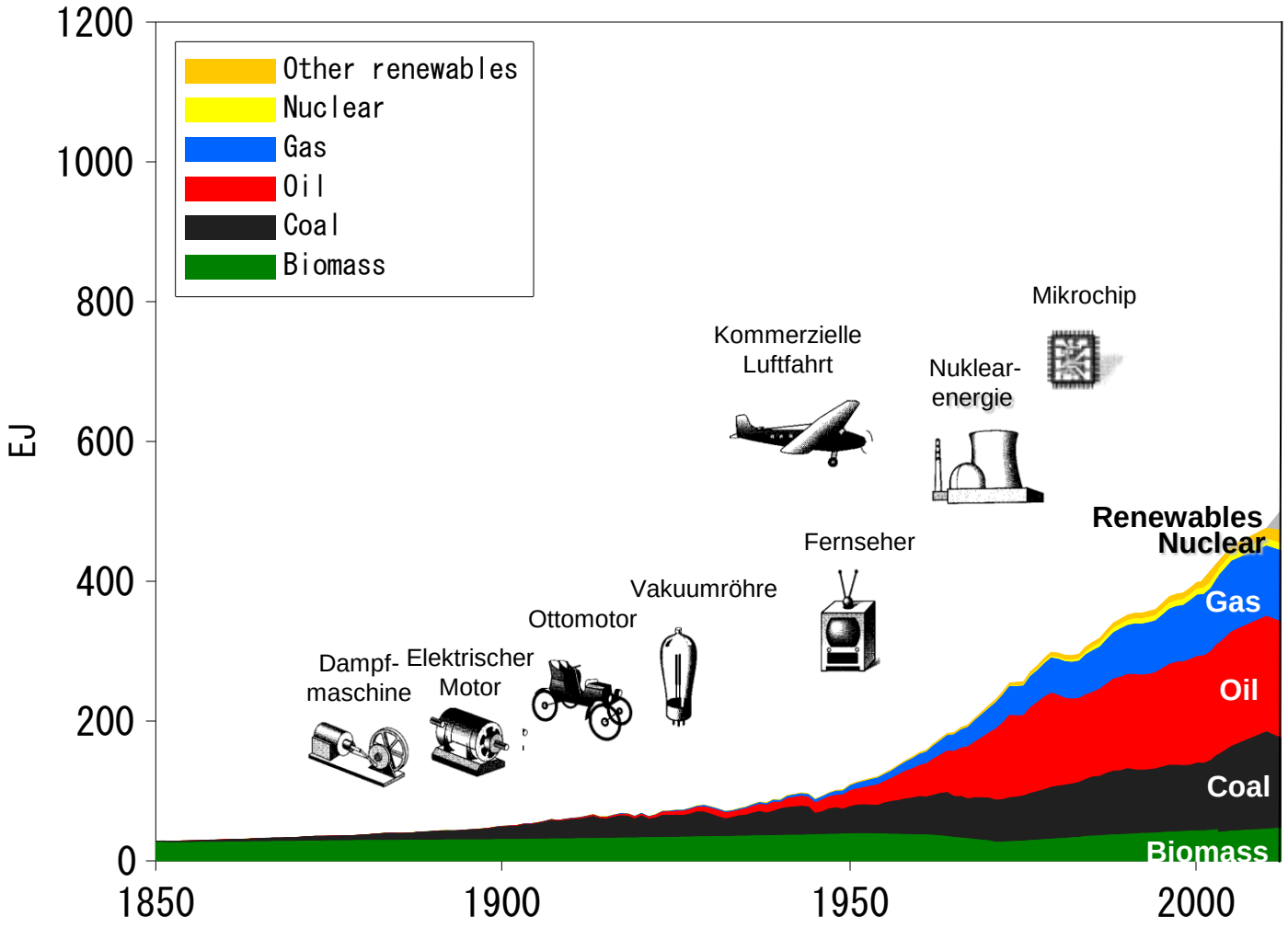
Source: Pachauri et al, 2012

Electrification



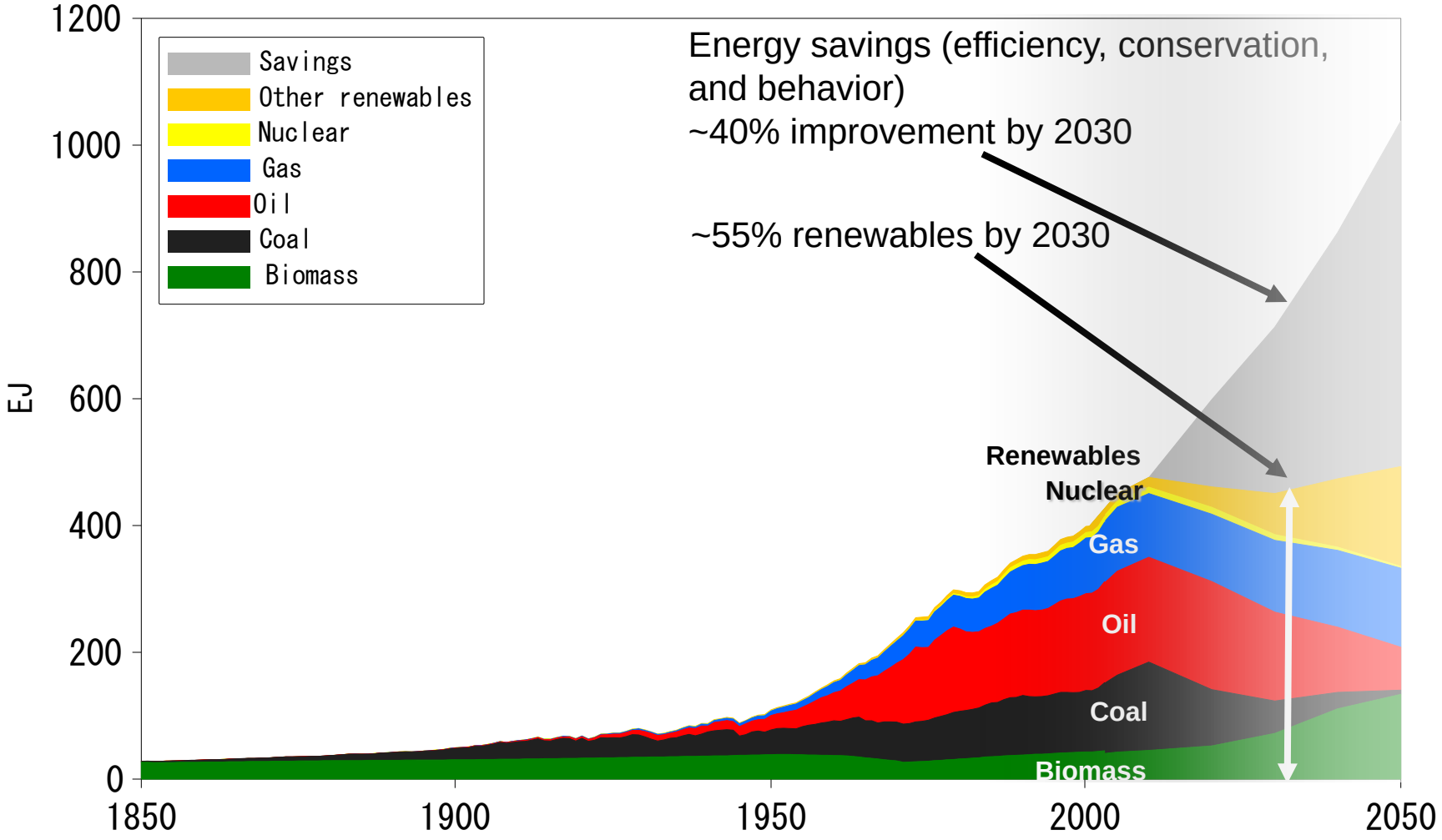
Source: Pachauri et al, 2012

Global Primary Energy



Global Primary Energy

no CCS, no Nuclear



Source: Riahi et al, 2012

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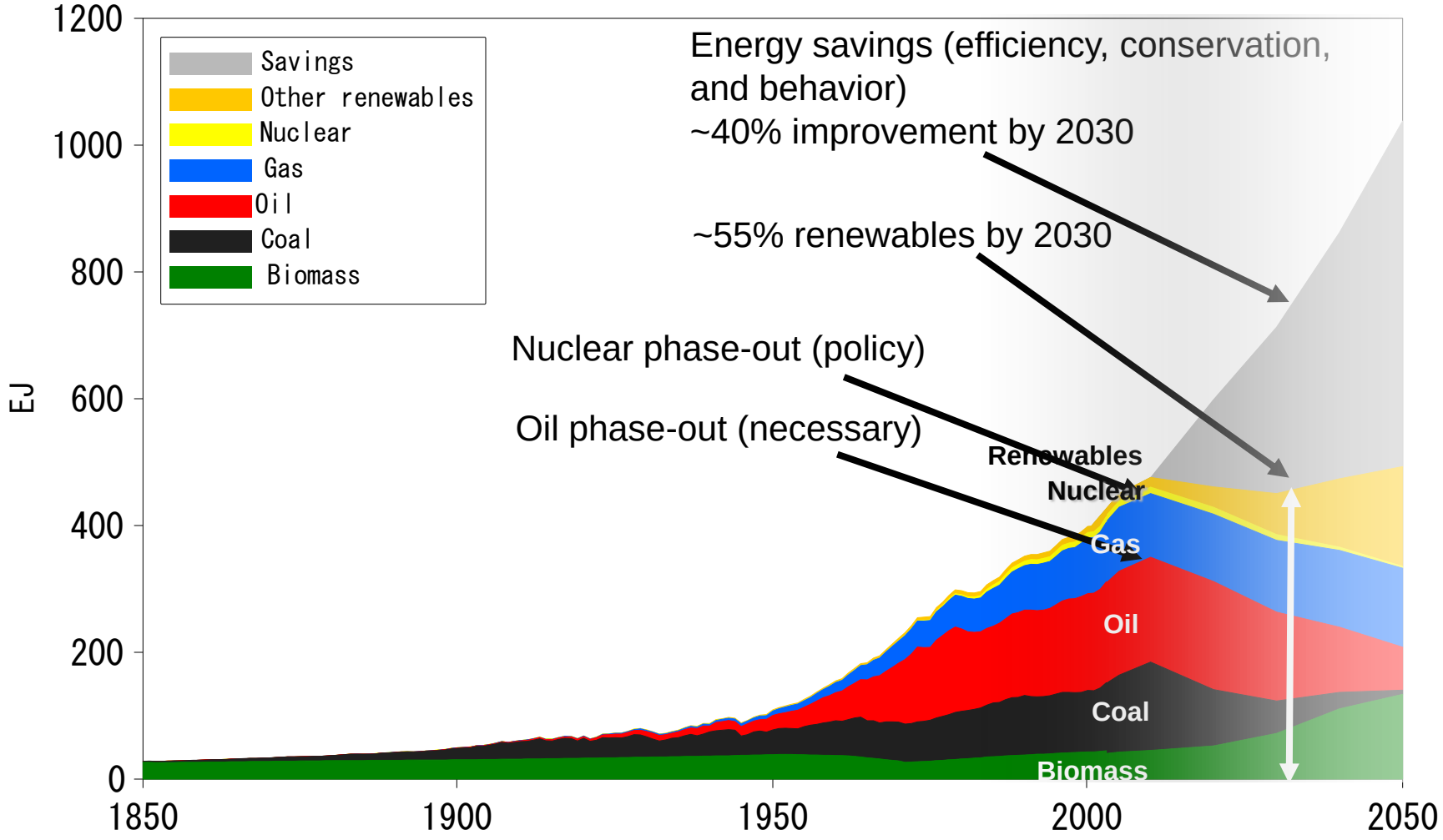
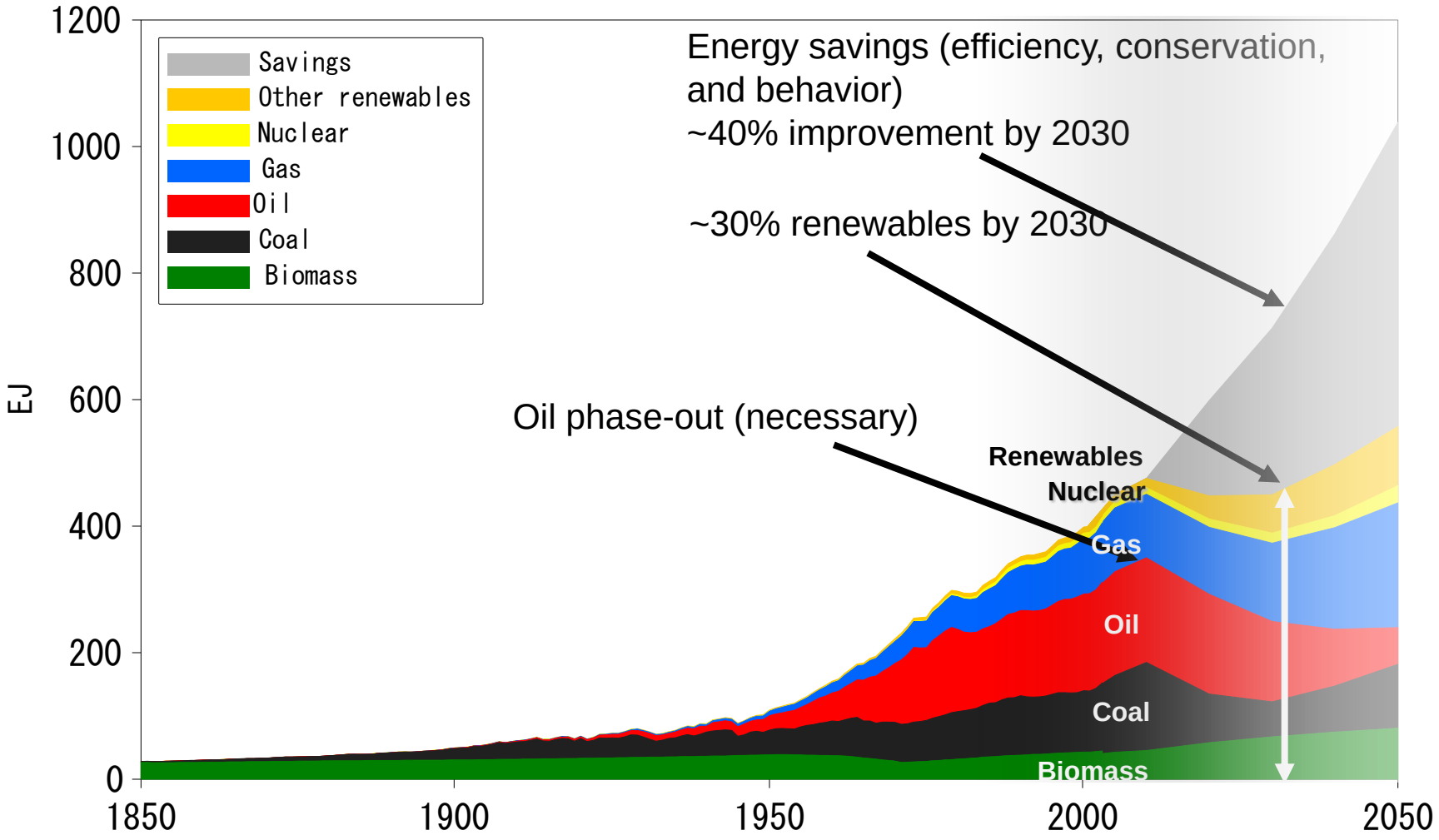


Global Primary Energy

lim. Bioenergy, lim. Intermittent REN



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Global Primary Energy

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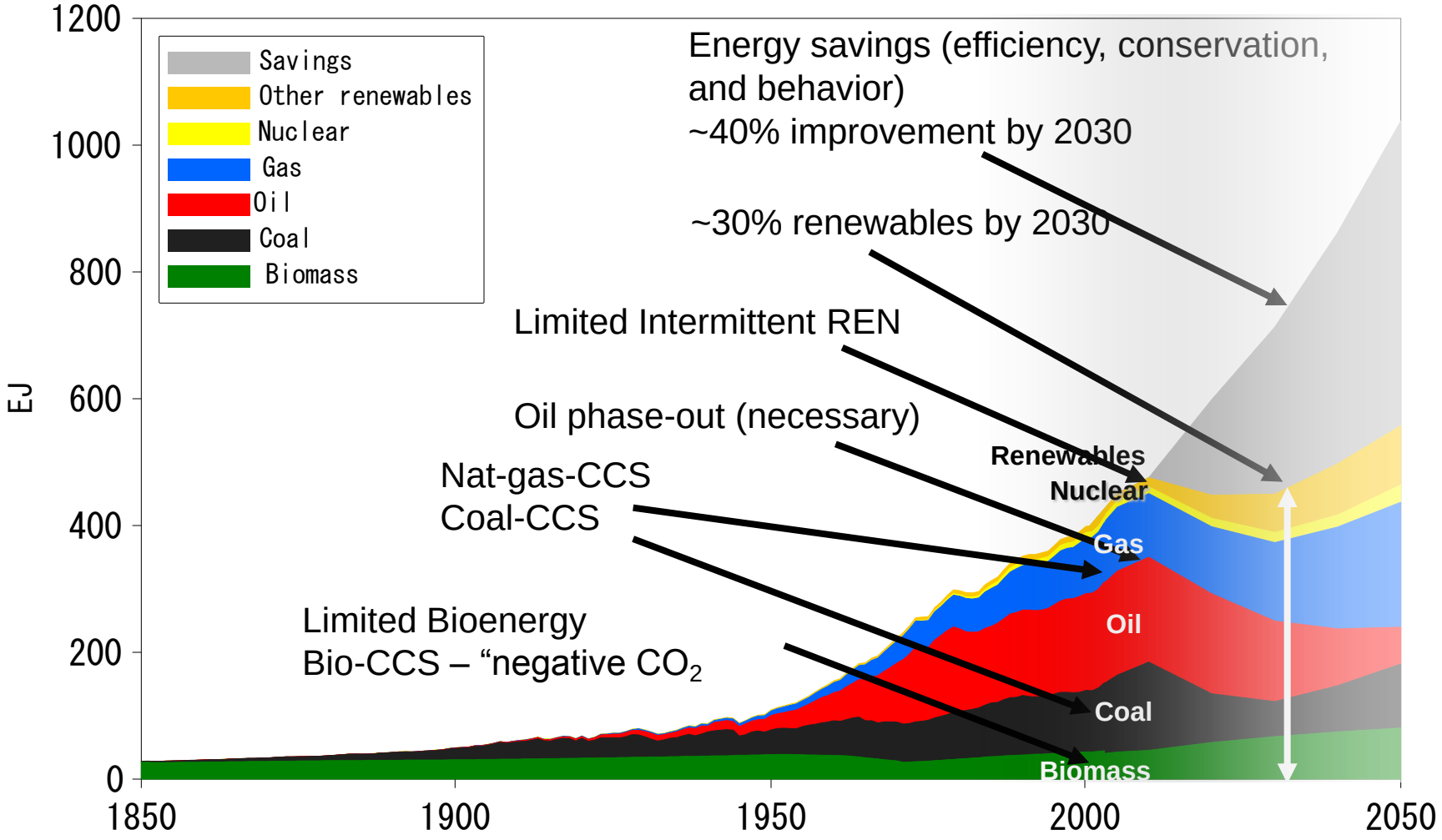
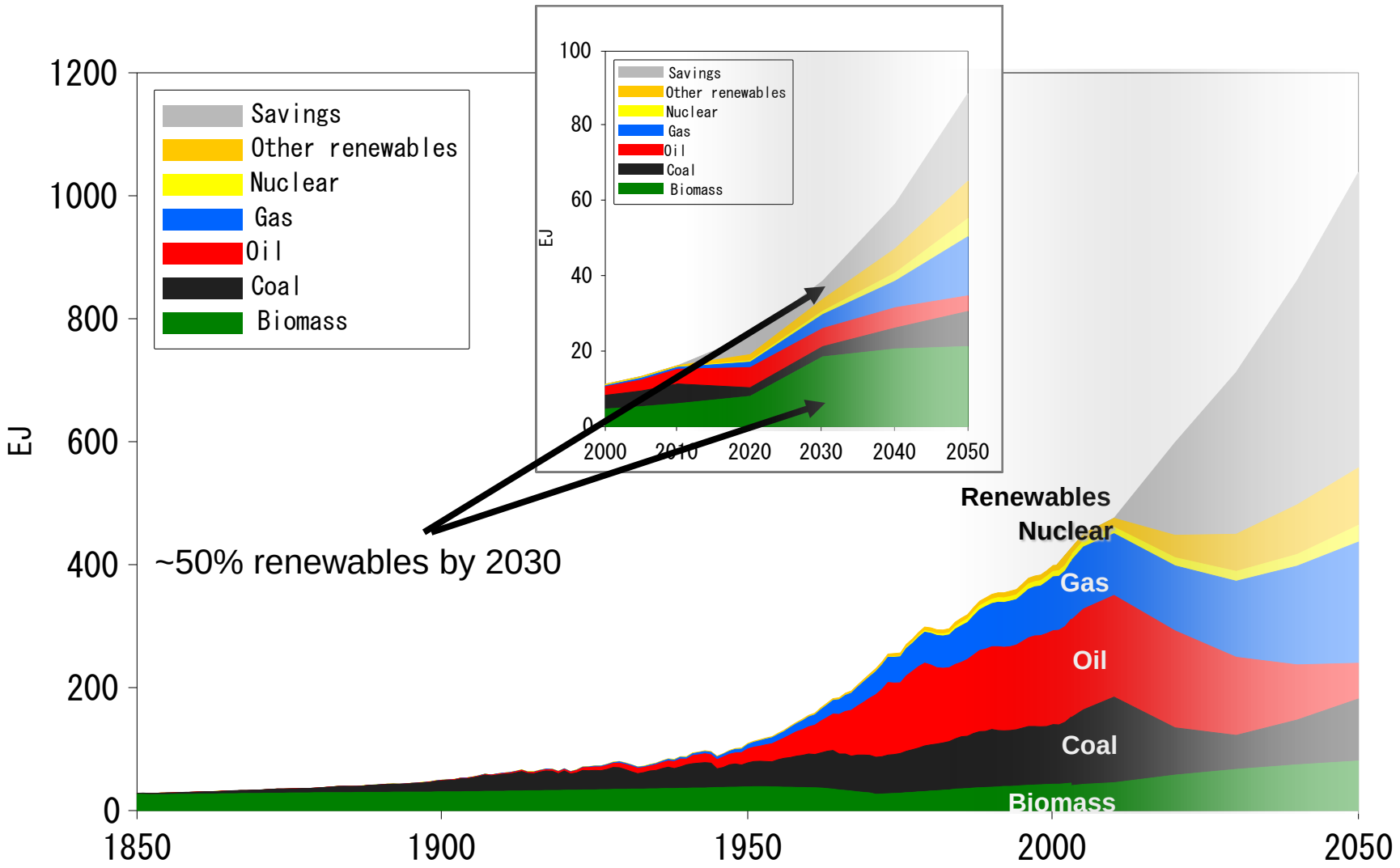


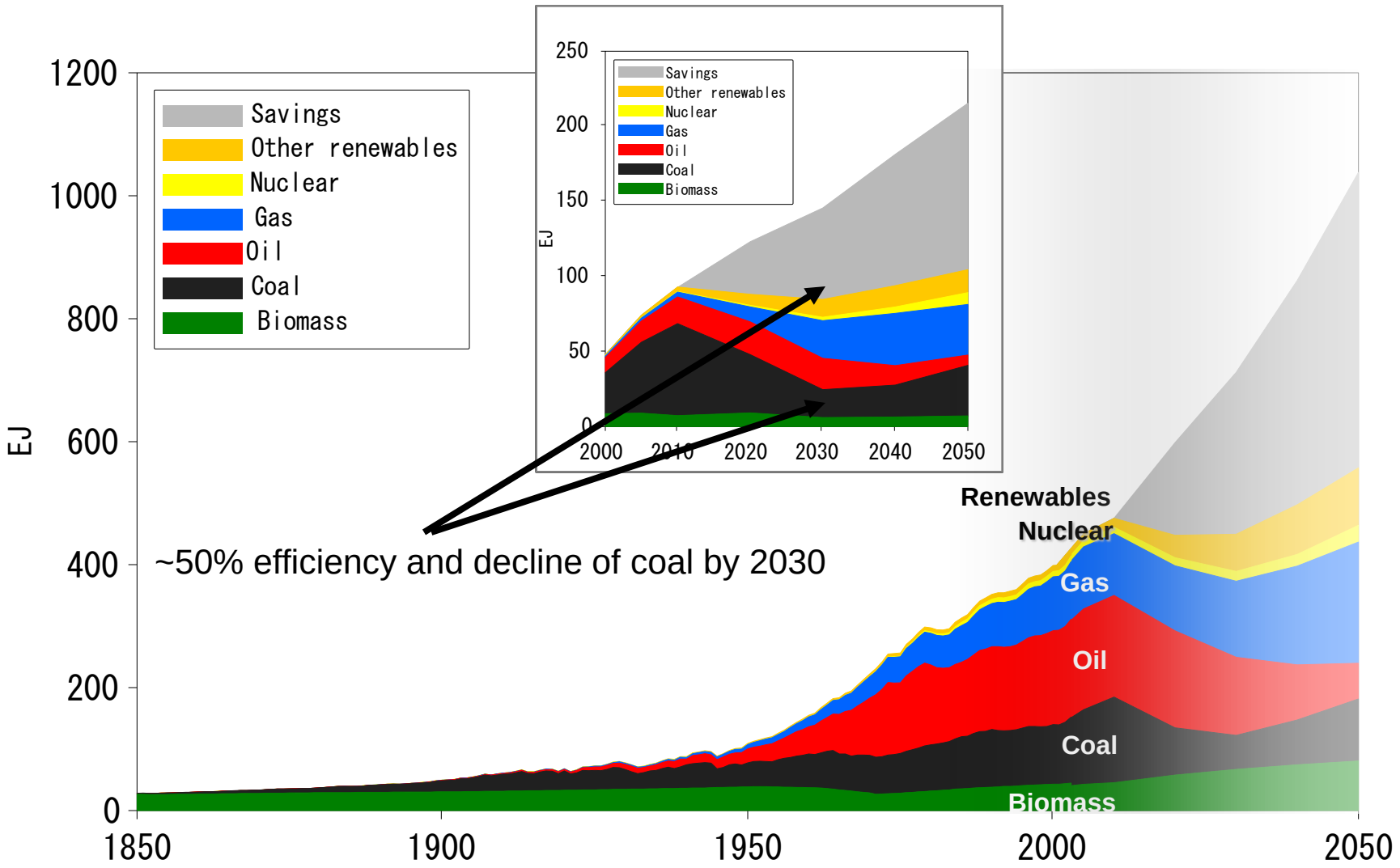
Global Primary Energy

Sub-Saharan Africa

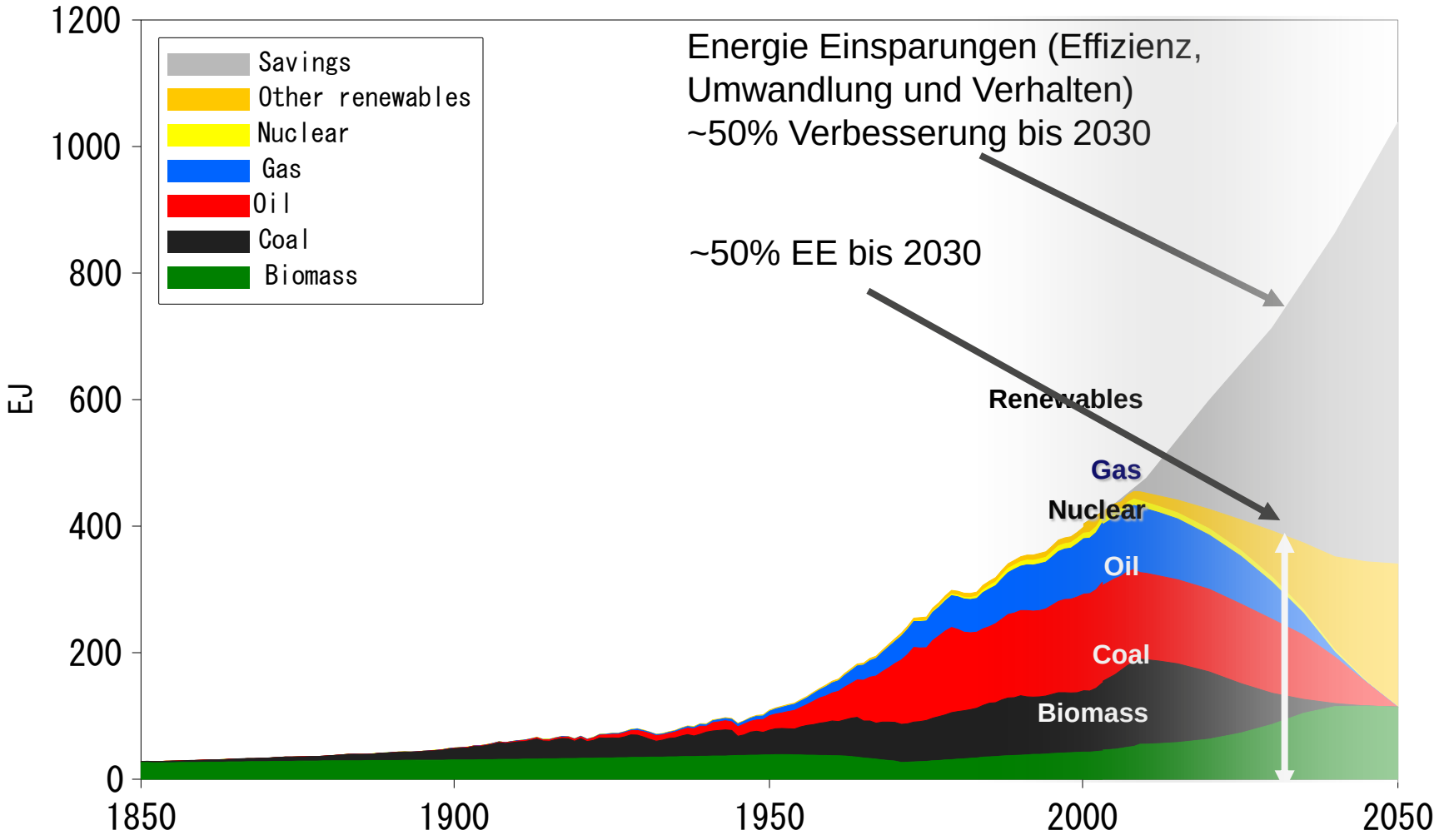


Global Primary Energy

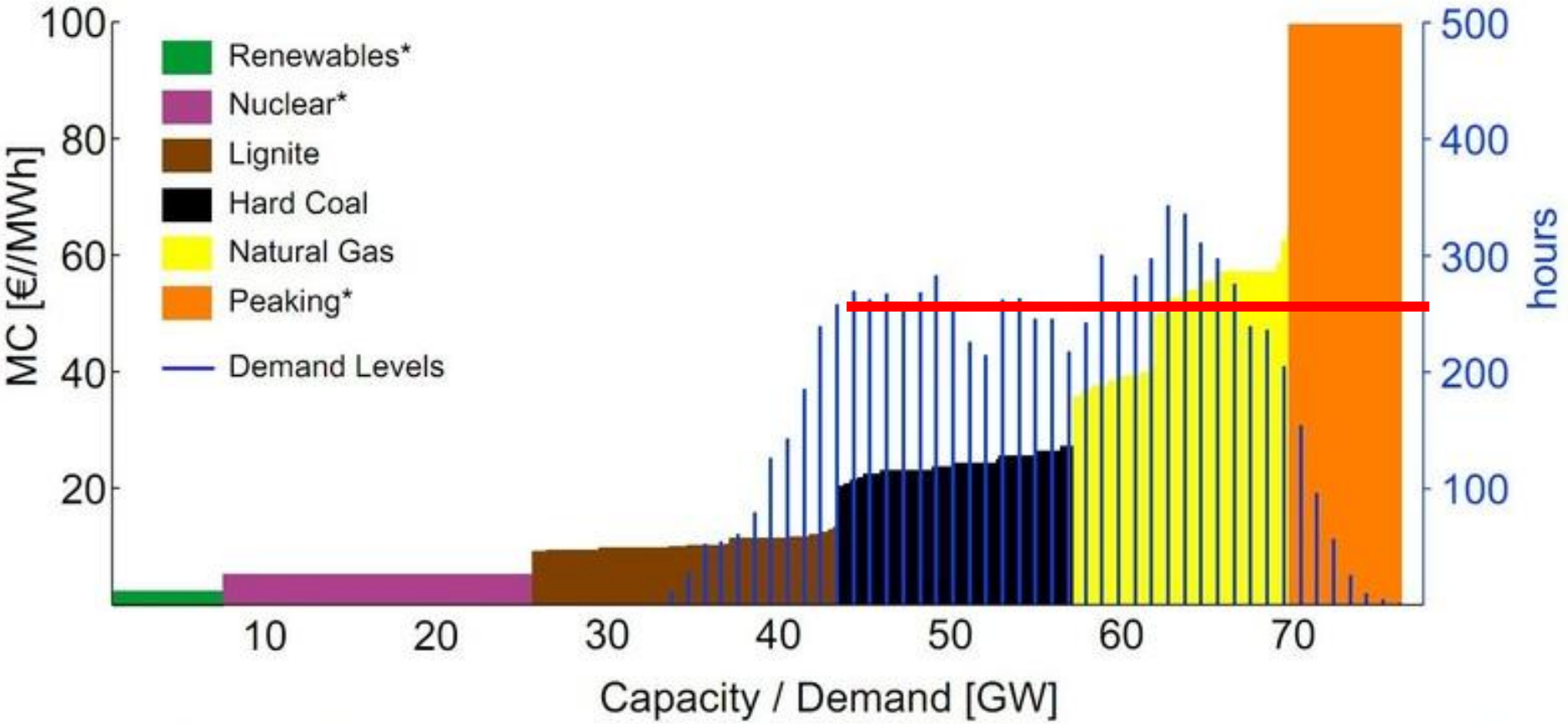
China



Global Primärenergie

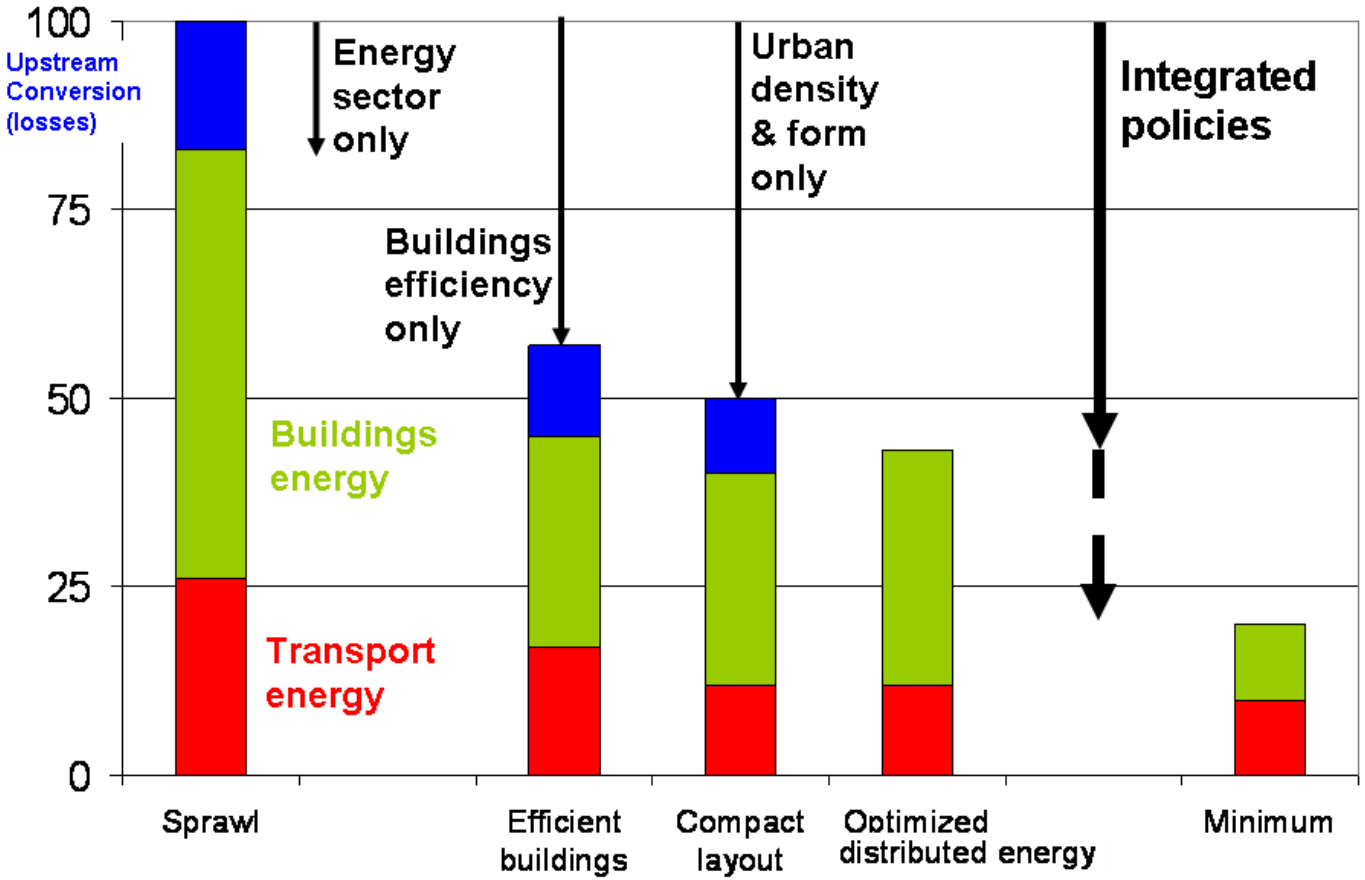


Merit-Order in Germany



costs; *stylized representation; (UBA 2009, ENTSO-E 2010, own calculations)

Policy Integration at the Urban Scale



Simulated energy use, urban settlement of 20,000, using the SimCity Model

Source: Grubler et al, 2012

Drivers of Transformations

learning from the past

Vision – better future, normative perspectives

Abolition of slavery, Democracy, European Union

Crisis – "Gales of Creative Destruction"

The Great Depression, Structural adjustment programmers, financial market reforms after 2008

Technology – Rapid innovation diffusion

Substitution of carriages by cars, IT-revolution

Knowledge – research-driven, precautionary principle

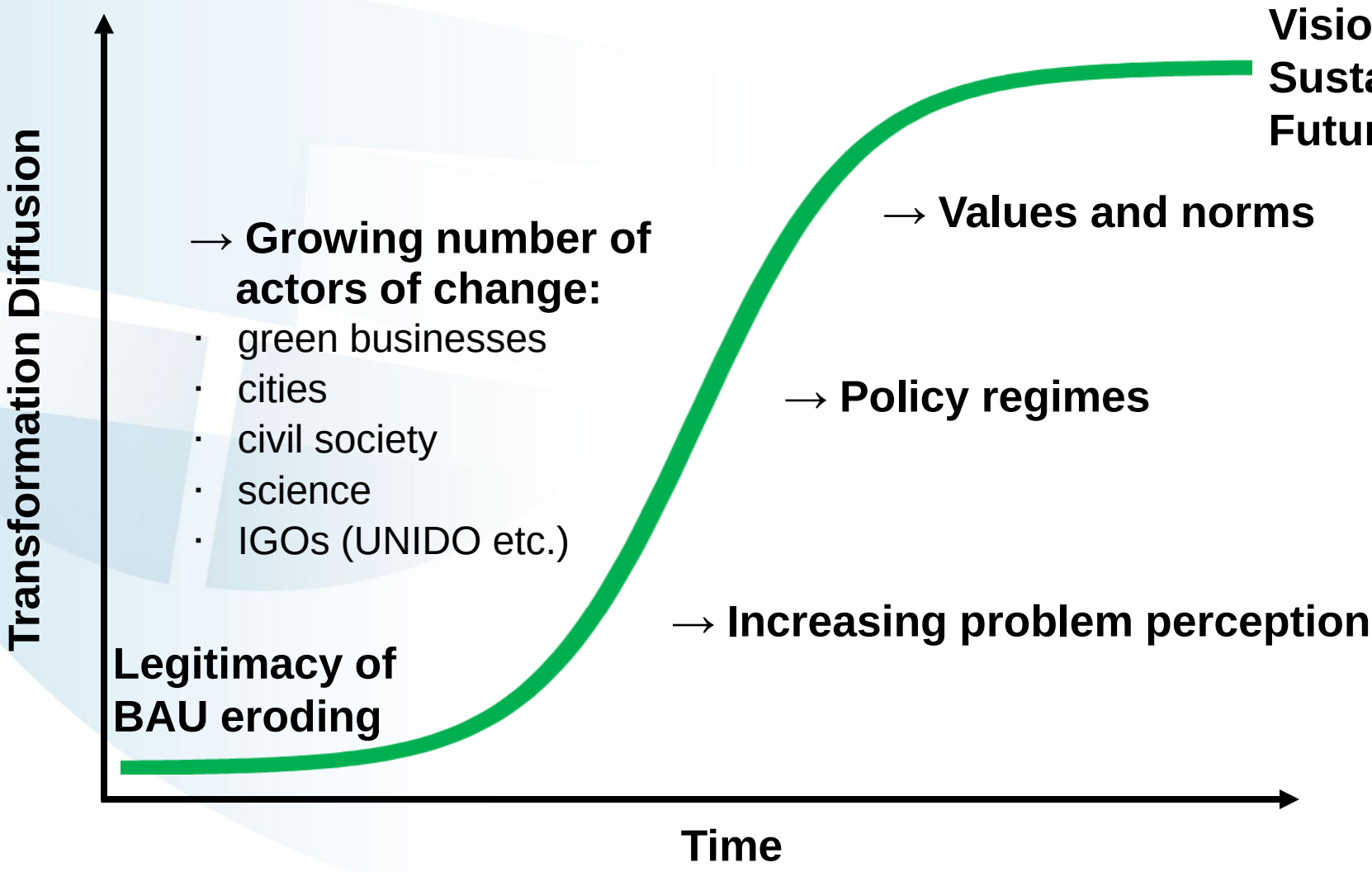
Protection of the ozone layers, climate change mitigation

Jean-Jacques Rousseau

Social contract:
“Man is born free,
and everywhere
he is in chains”

Sustainability Transformation

"Doing More with Less" within Boundaries



Source: WBGU, 2011