




International Institute for  
Applied Systems Analysis  
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science for global insight

A large, multi-story classical building with a central clock tower and many windows, likely the IIASA building in Vienna.

# Beyond COP21: A nexus (SDG) perspective on global decarbonization

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*ALPS International Symposium: COP21 results and Long-term  
Reductions of Greenhouse Gas Emissions beyond COP21  
RITE, Tokyo – 10 February 2016*

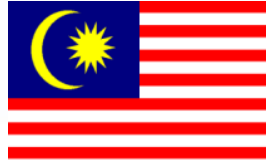


IIASA, International Institute for Applied Systems Analysis

# A GLOBAL RESEARCH INSTITUTE

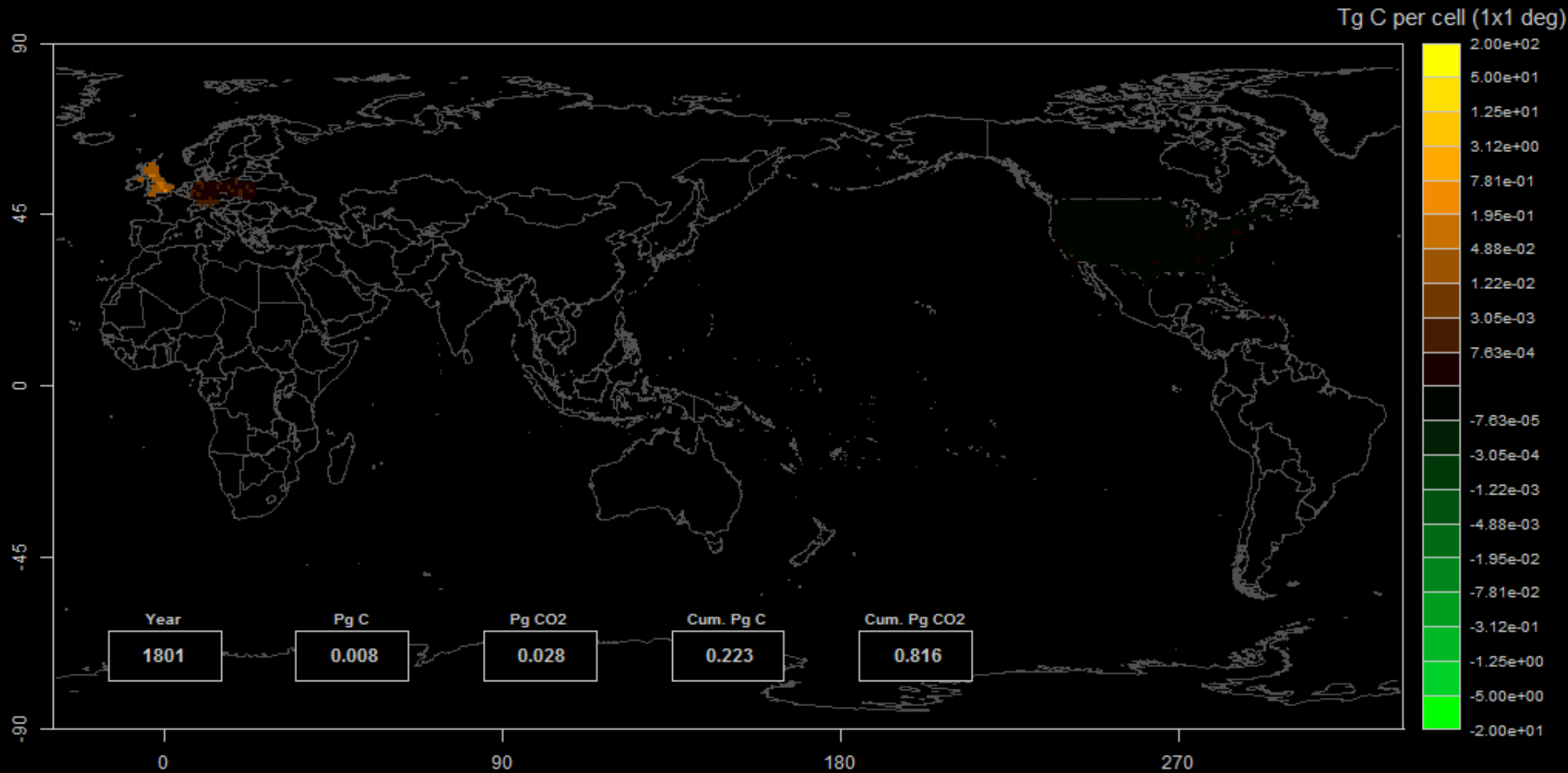
- **Established as a scientific bridge between East and West**
- **After Cold War ended focused on multiple dimensions of global change**
- **Now embarked on the new research strategy for the next decade**

# 23 IIASA NATIONAL MEMBER ORGANIZATIONS

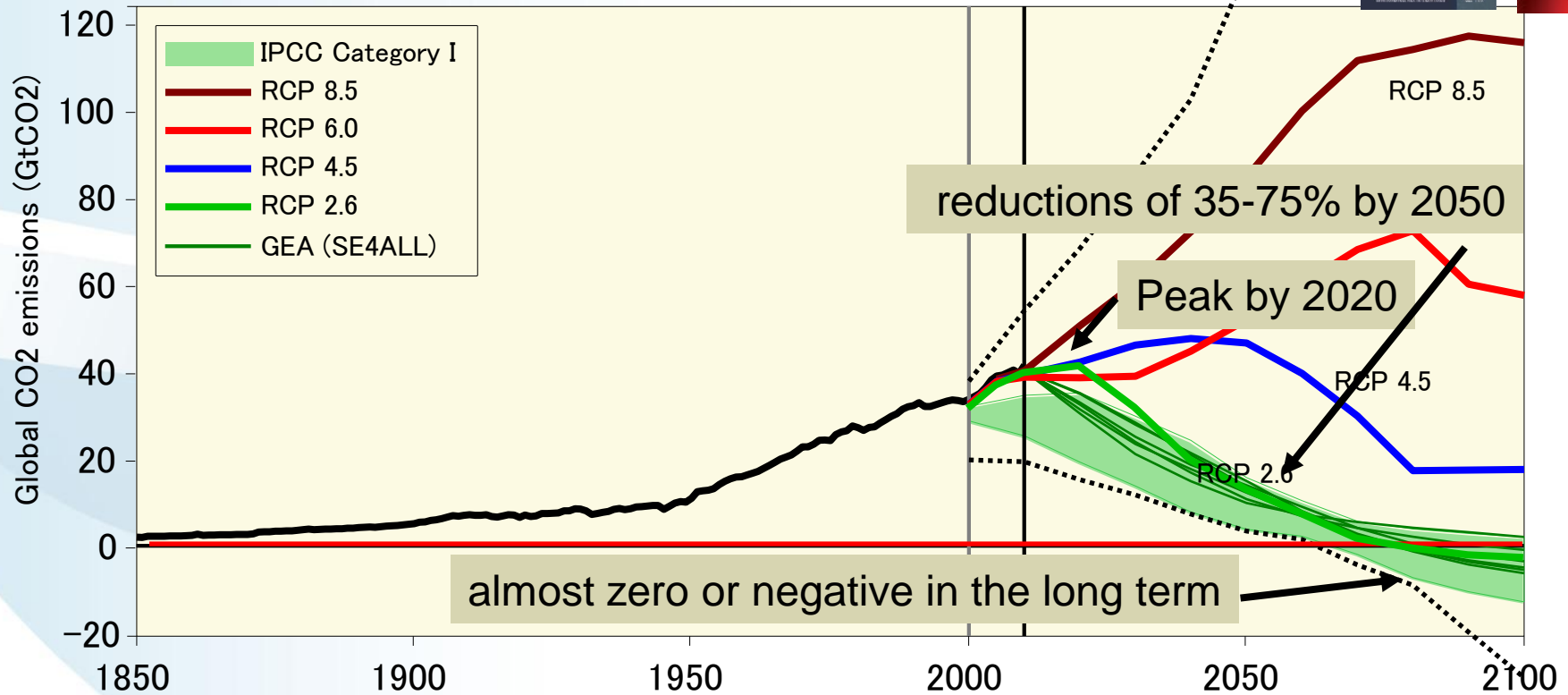
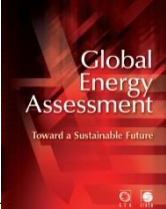


- **International, independent, interdisciplinary science**
- **research & big-data on major global problems**
- **Solution & policy oriented, integrated systems analysis**

# Global CO<sub>2</sub> Emissions

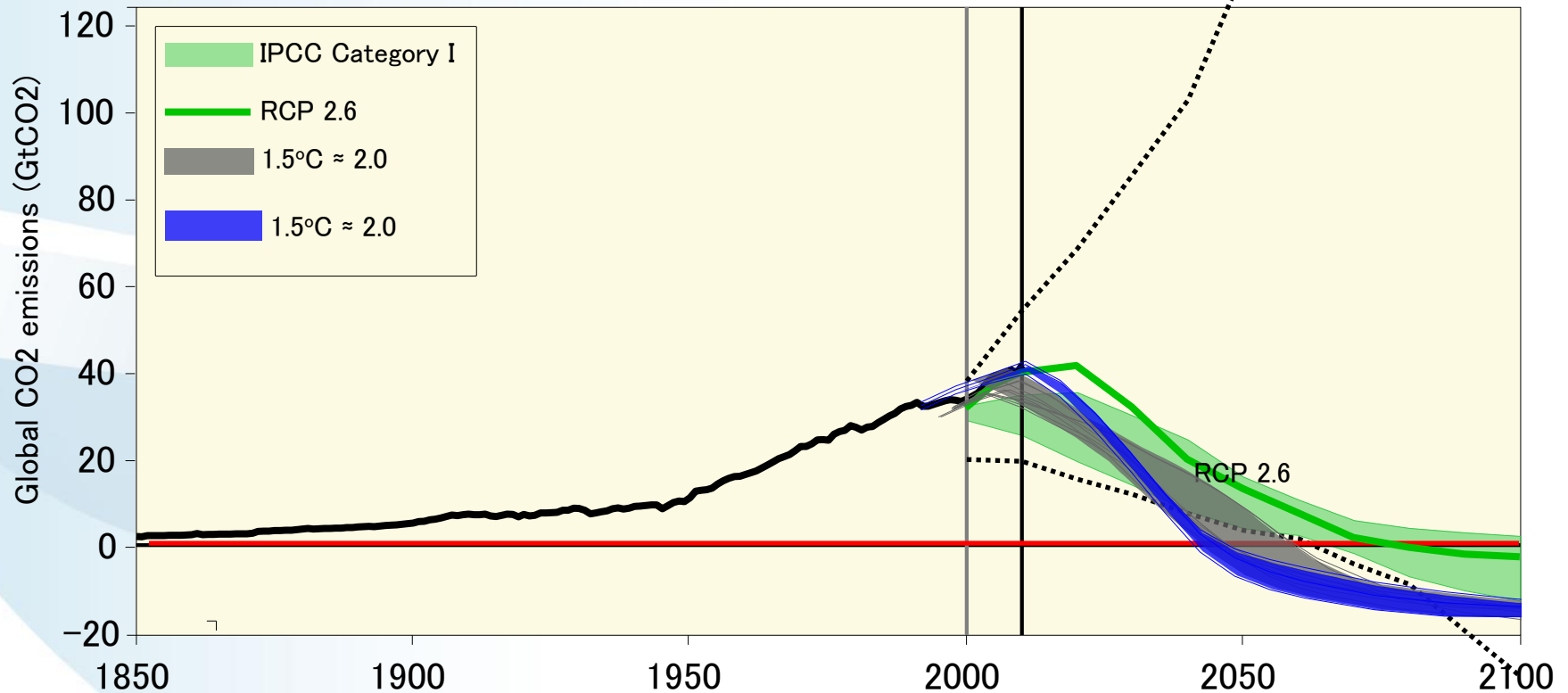


# Global CO2 Emissions

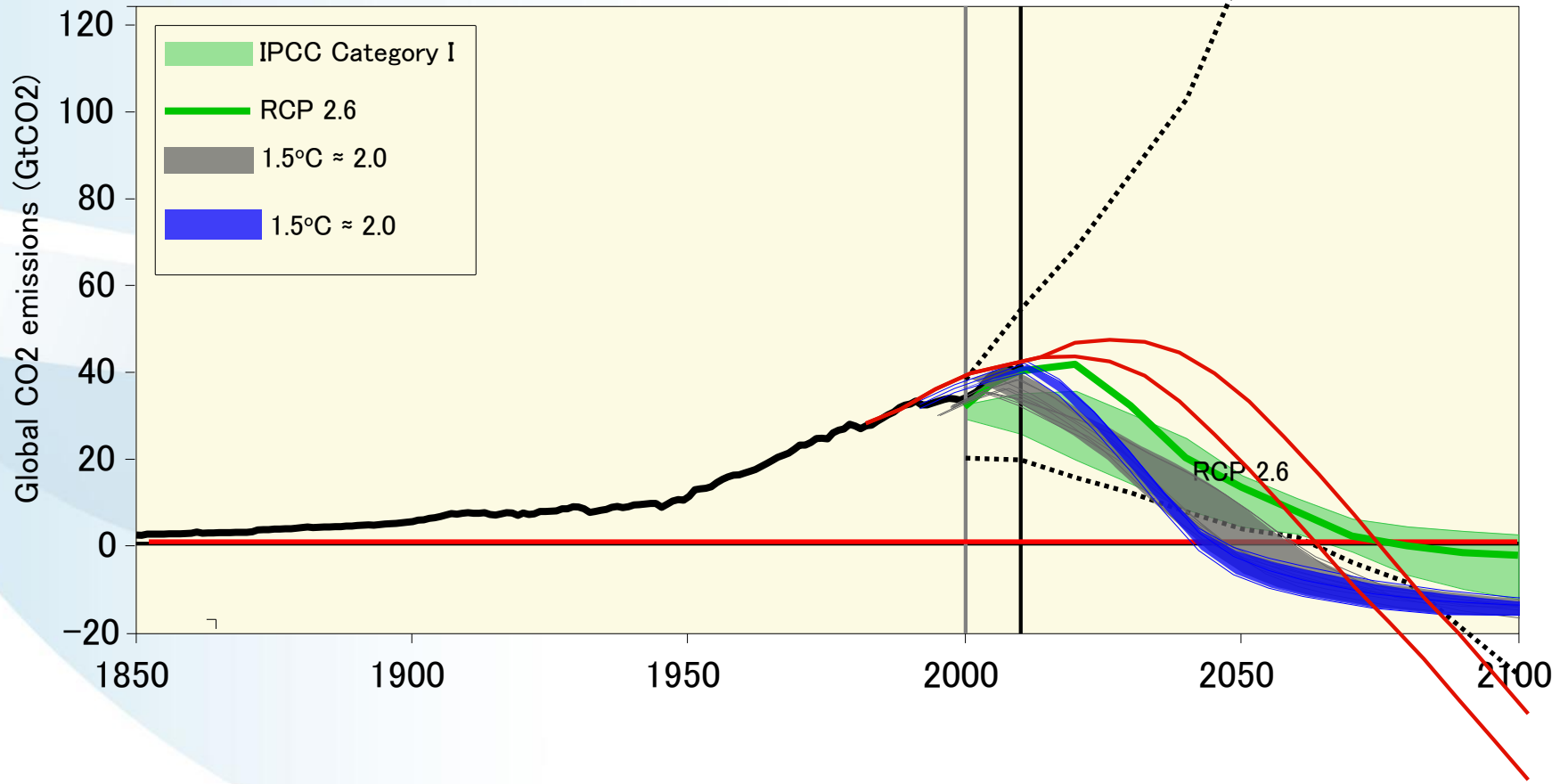


# Global CO2 Emissions

nature  
climate change

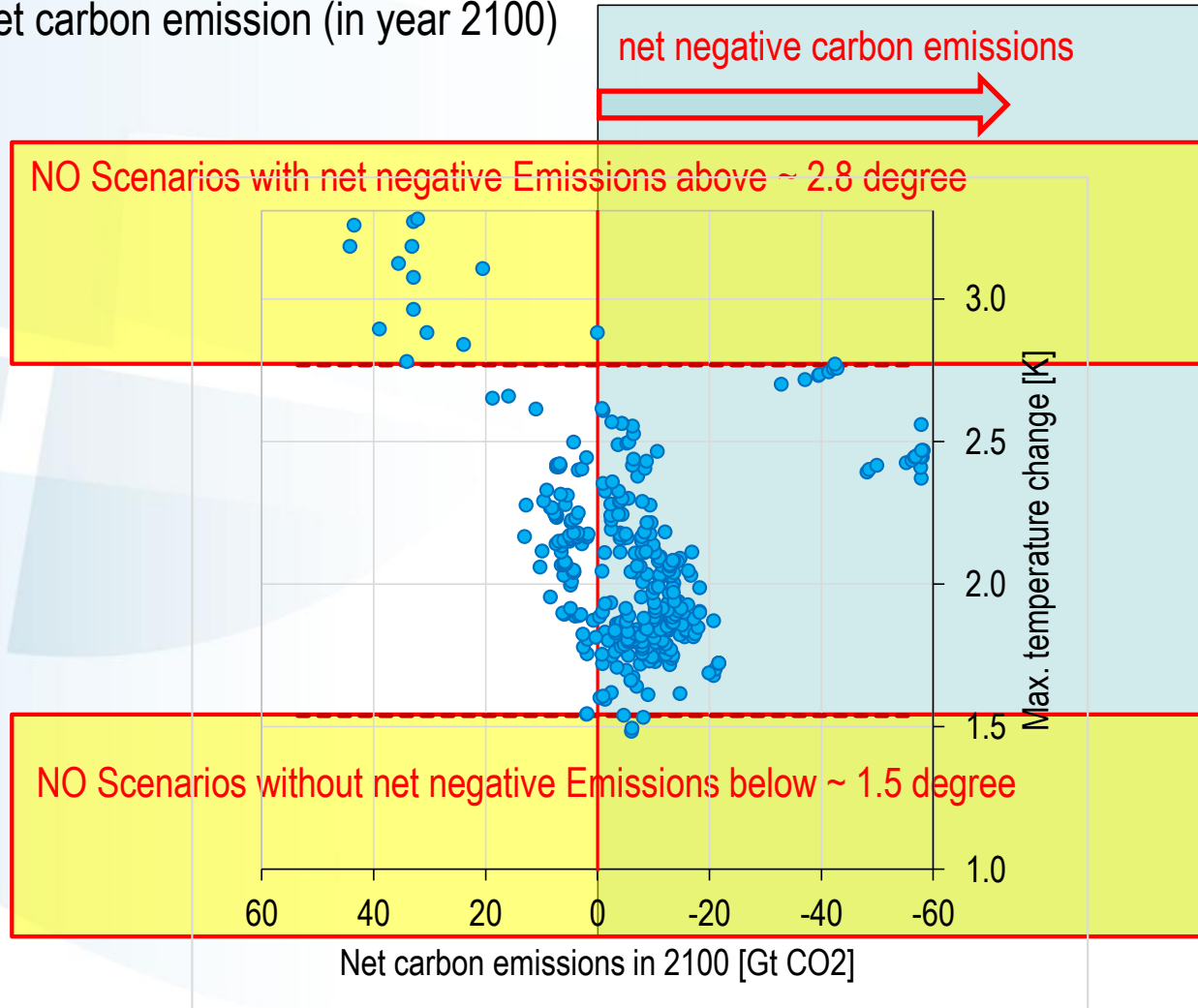


# Global CO2 Emissions



# Net-negative CO<sub>2</sub> Emissions

Max. temperature change in 21th century  
Net carbon emission (in year 2100)





# The Key Energy Challenges



**Energy Access**



**Climate Change**

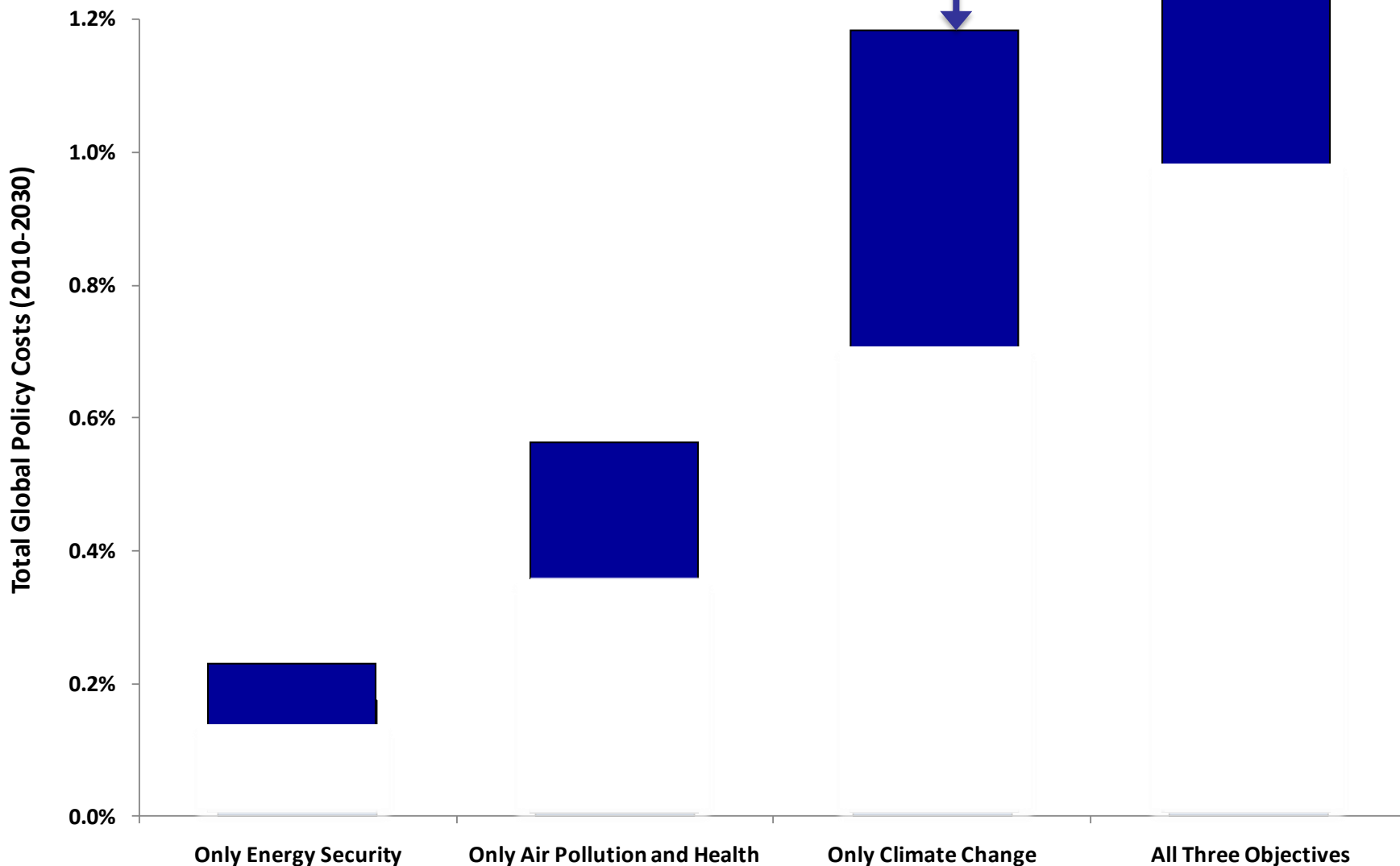


**Energy Security**



**Air Pollution  
Health Impacts**

# Multiple Benefits of Integrated Policies



# Sustainable Development Goals (SDGs)

Goal #	Description	Goal #	Description
Goal 1	End poverty in all its forms everywhere	Goal 10	Reduce inequality within and among countries
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 3	Ensure healthy lives and promote well-being for all at all ages	Goal 12	Ensure sustainable consumption and production patterns
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Goal 13	Take urgent action to combat climate change and its impacts
Goal 5	Achieve gender equality and empower all women and girls	Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 6	Ensure availability and sustainable management of water and sanitation for all	Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all	Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation		

# Sustainable Development Goals (SDGs)

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Goal 9	Build resilient <b>infrastructure</b> , promote inclusive and sustainable <b>industrialization</b> and foster <b>innovation</b>		



# SUSTAINABLE DEVELOPMENT

## GOALS

### IIASA Research

“Science must be at the heart of this process so as to help achieve synergies and avoid conflicts among the 17 SDGs.”



### IIASA Partnerships



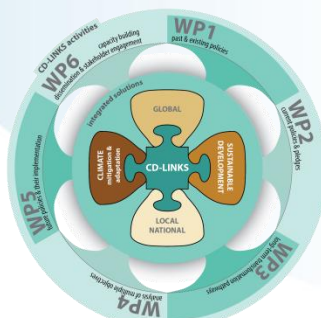
The World In 2050 Initiative

**Stockholm Resilience Centre**  
Sustainability Science for Biosphere Stewardship



THE EARTH INSTITUTE  
COLUMBIA UNIVERSITY

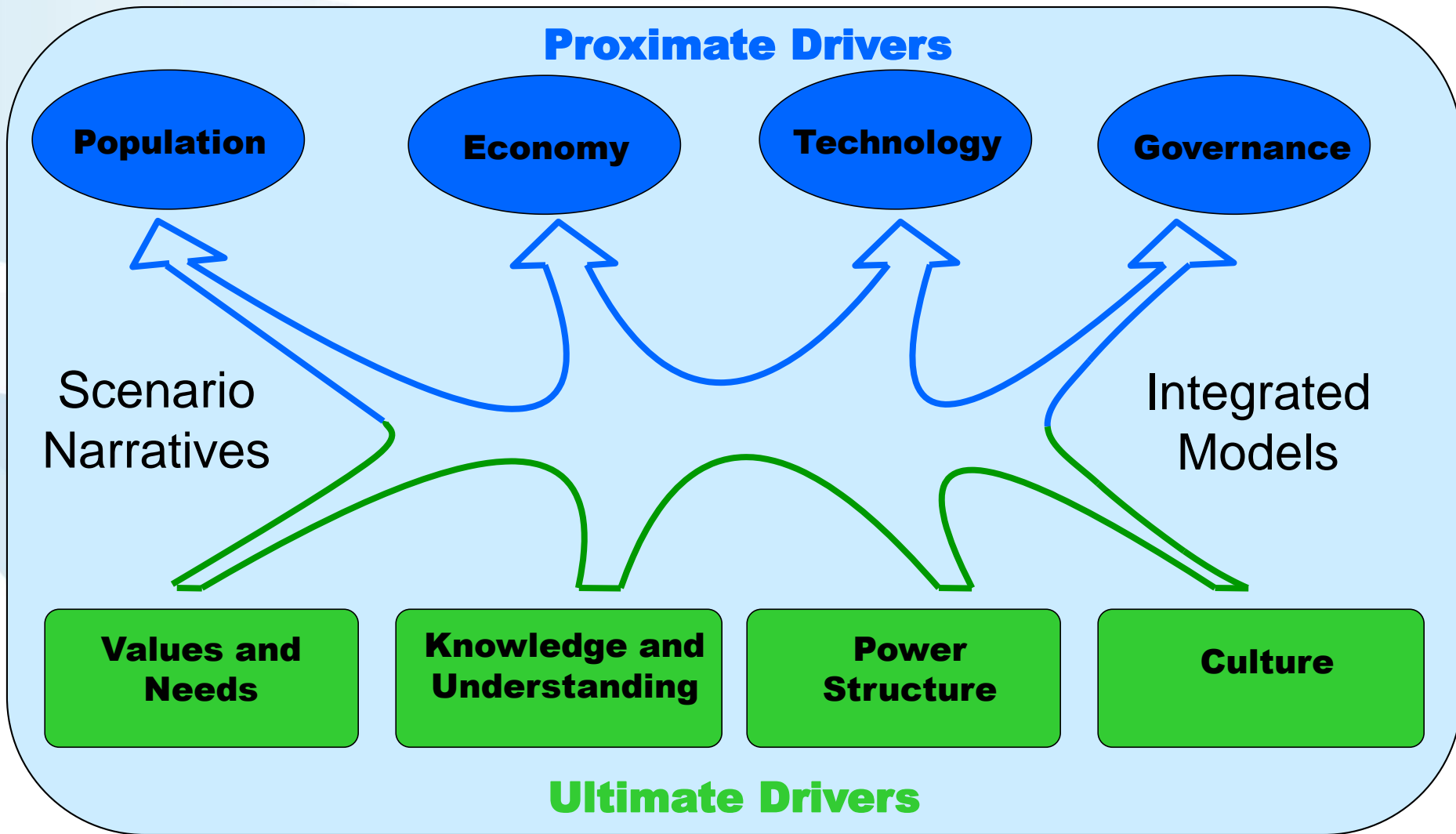
Nexus Solutions Partnership



# The World in 2050

- ➔ Global development within a safe and just operating space and planetary boundaries
- ➔ “Safe Space” of interaction among SDGs: integrated models to sustainability narratives
- ➔ Transformational pathways based on existing literature e.g. SSPs, GEA, SDSN’s DDPP
- ➔ Co-benefits of transformation toward the “safe space” and how to achieve sustainable futures

# Possible Unified Analytical Approach





# The World in 2050 “Consortium”

- AIMS
- Future Earth
- Centre for Integrated Studies on Climate Change and the Environment
- Earth League, whole Earth system modelling initiative
- **Earth Institute, Columbia University**
- Global Ocean Ecosystem Dynamics (GLOBEC)
- Indian Institute International Futures
- Indian Institute of Technology (IIT)
- International Energy Agency (IEA)
- International Food Policy Research Institute (IFPRI)
- International Monetary Fund (IMF)
- **International Institute for Applied System Analysis (IIASA)**
- Joint Global Change Research Institute at Pacific Northwest National Laboratory (PNNL JGCRI)
- National Center for Atmospheric Research (NCAR)
- National Institute for Environmental Studies (NIES)
- UN Population Division
- UNEP- World Conservation Monitoring Centre (UNEP-WC)
- World Bank
- Organisation for Economic Co-operation and Development (OECD)
- Potsdam Institute for Climate Impact Change (PIK)
- PBL - Netherlands Environmental Assessment Agency
- **Sustainable Development Solutions Network (SDSN)**
- Stanford University
- **Stockholm Resilience Centre**
- The City University of New York (CUNY)
- Tsinghua University



INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE  
sustainable solutions for ending hunger and poverty  
Supported by the CGIAR



NCAR



NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES



**Stockholm Resilience Centre**  
Sustainability Science for Biosphere Stewardship



STANFORD UNIVERSITY



PBL Netherlands Environmental Assessment Agency



Nakicenovic



# SUSTAINABLE DEVELOPMENT GOALS

**1** NO POVERTY

**2** ZERO HUNGER

**3** GOOD HEALTH AND WELL-BEING

**4** QUALITY EDUCATION

**5** GENDER EQUALITY

**6** CLEAN WATER AND SANITATION

**7** AFFORDABLE AND CLEAN ENERGY

**8** DECENT WORK AND ECONOMIC GROWTH

**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE

**10** REDUCED INEQUALITIES

**11** SUSTAINABLE CITIES AND COMMUNITIES

**12** RESPONSIBLE CONSUMPTION AND PRODUCTION

**13** CLIMATE ACTION

**14** LIFE BELOW WATER

**15** LIFE ON LAND

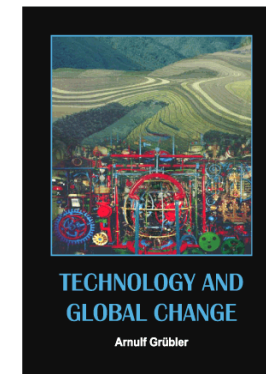
**16** PEACE, JUSTICE AND STRONG INSTITUTIONS

**17** PARTNERSHIPS FOR THE GOALS

**SUSTAINABLE DEVELOPMENT GOALS**

# Transformation Drivers

## Learning from the Past



- **Normative goals, visions**

Abolition of slavery, participatory governance, EU

- **Crises, “gales of creative destruction”**

The Great Depression, financial crises, disasters

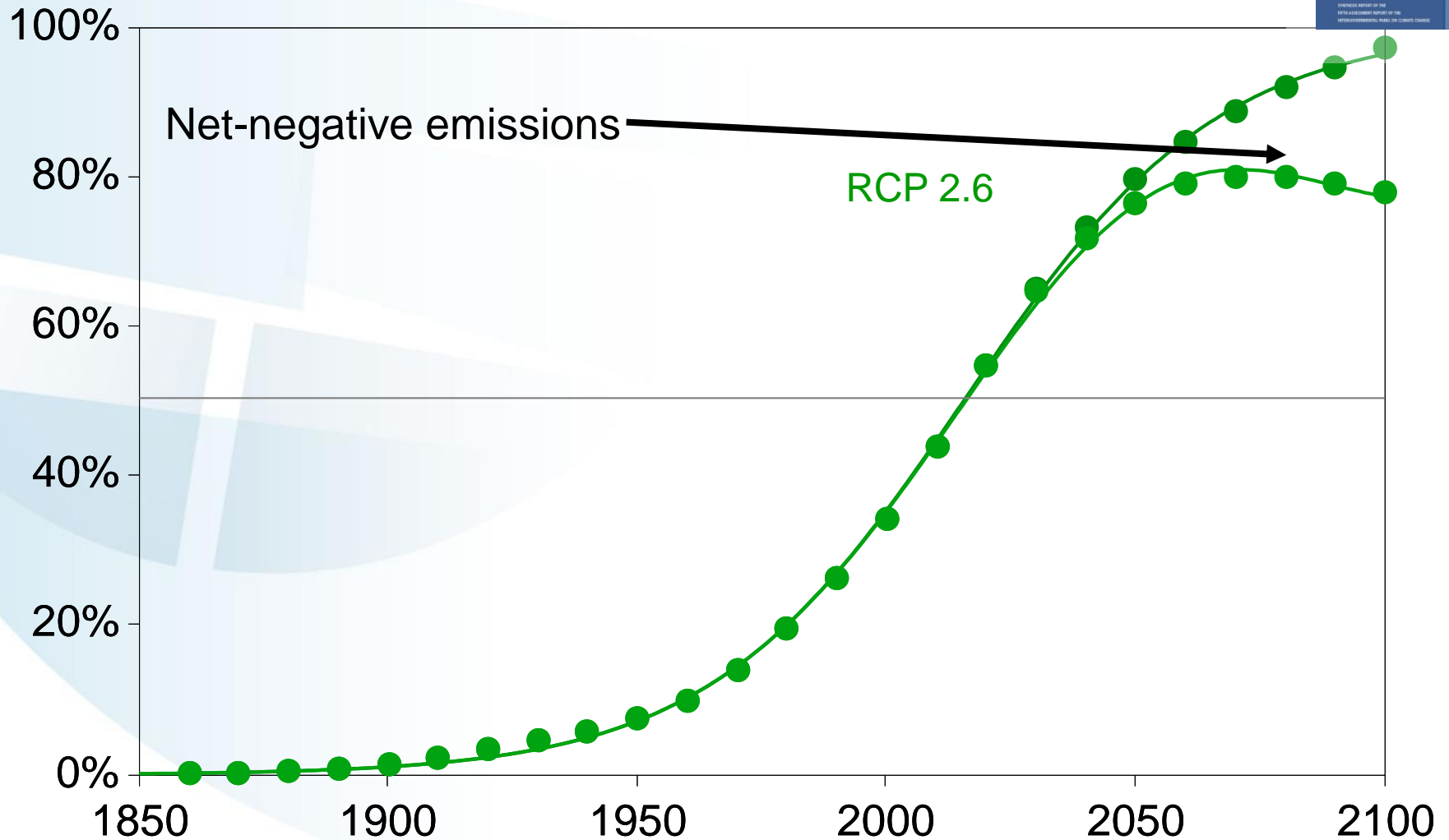
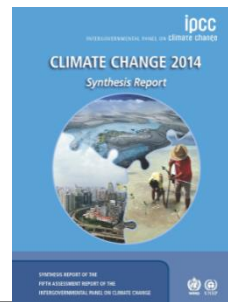
- **Technology, rapid innovation diffusion**

Substitution of carriages by cars, IT-revolution

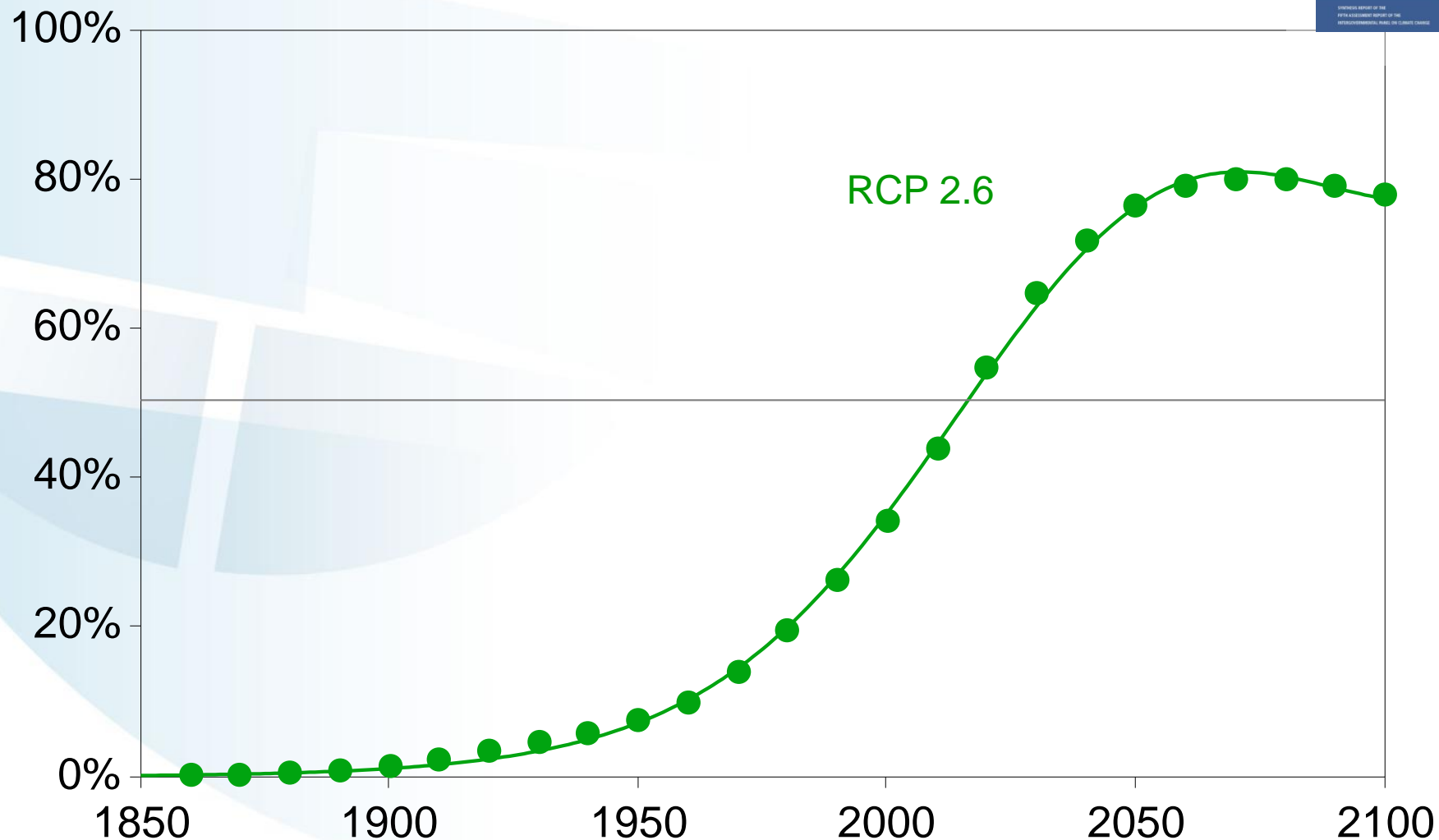
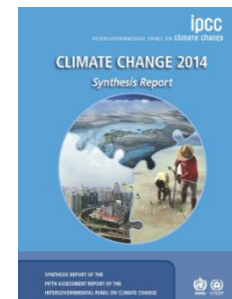
- **Knowledge, research-driven society**

Precautionary principle - ozone layer, climate change

# Cumulative Carbon Emissions



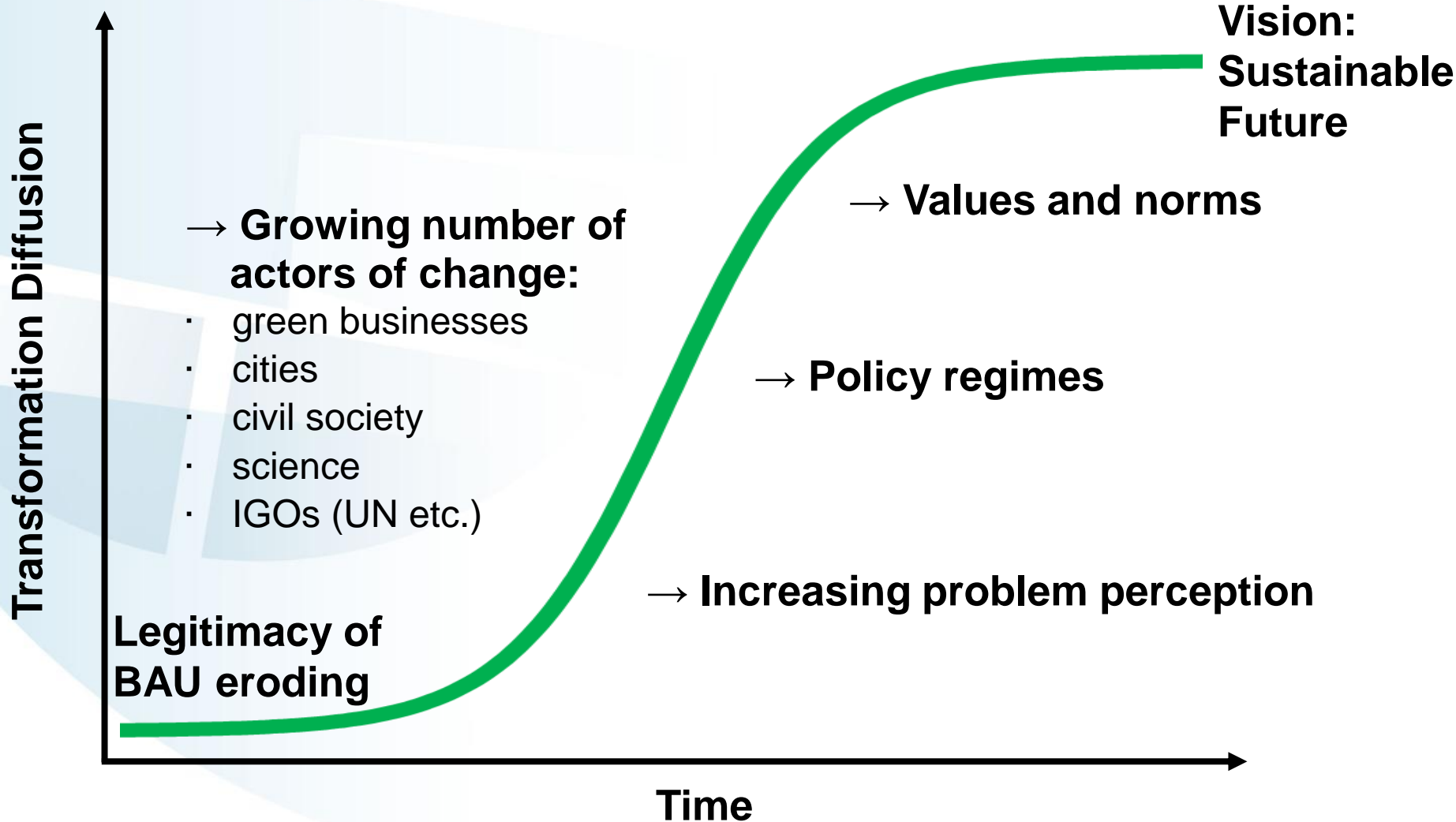
# Cumulative Carbon Emissions



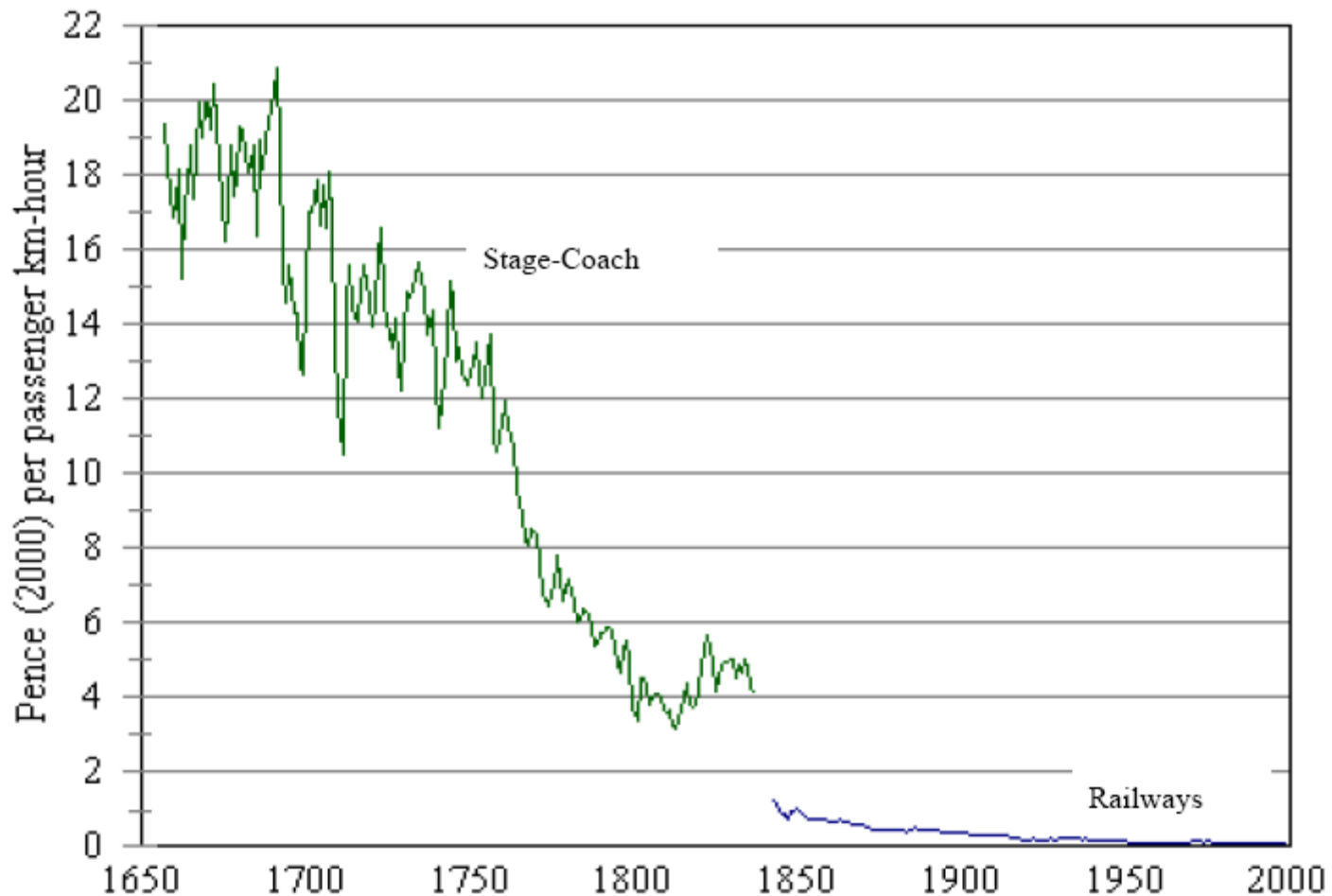
# Sustainability Transformation



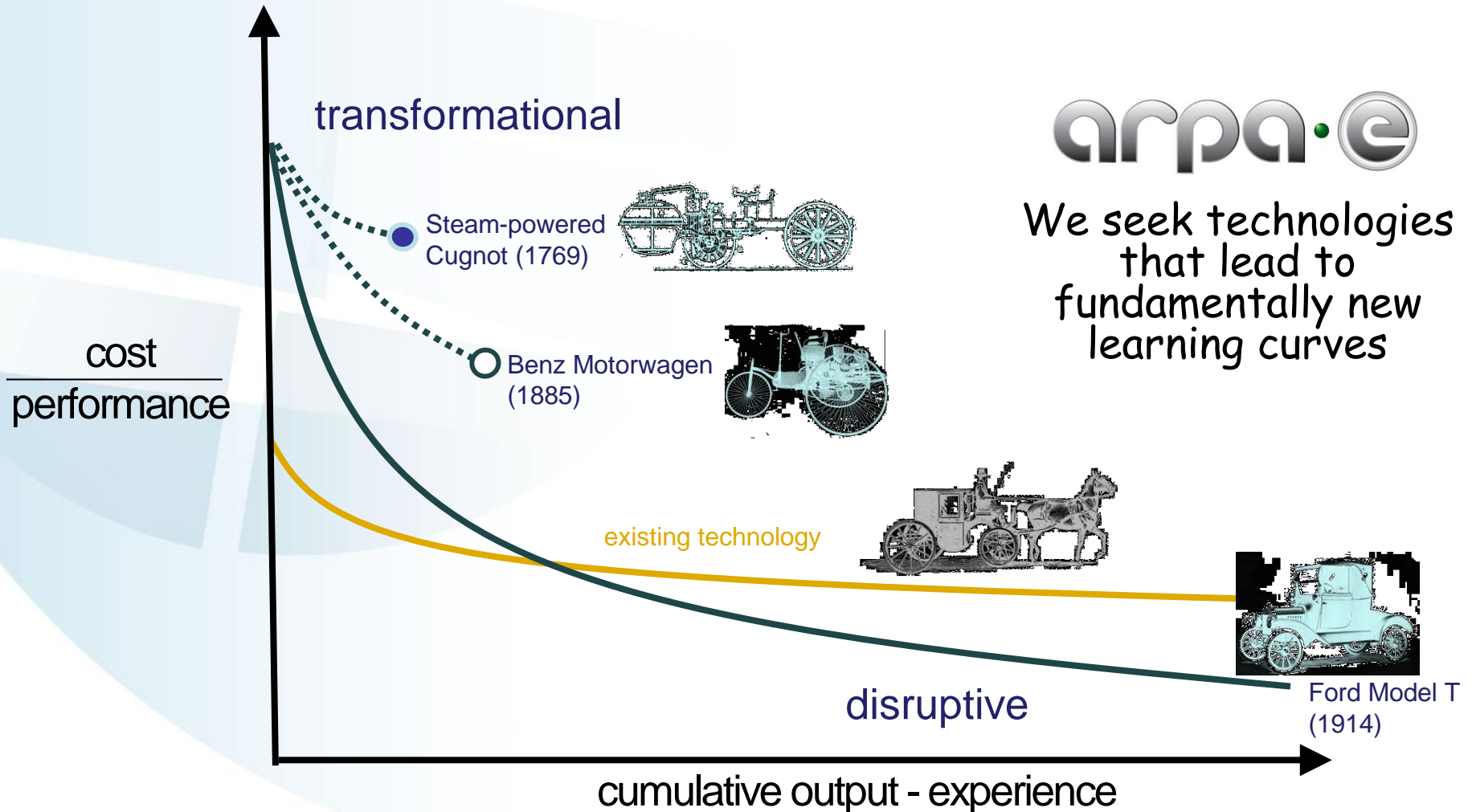
“Doing More with Less” within Planetary Boundaries



# Price of Passenger Transport (per pass-km-hour)



# Incremental & Disruptive Technologies

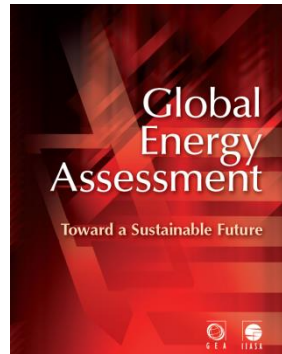
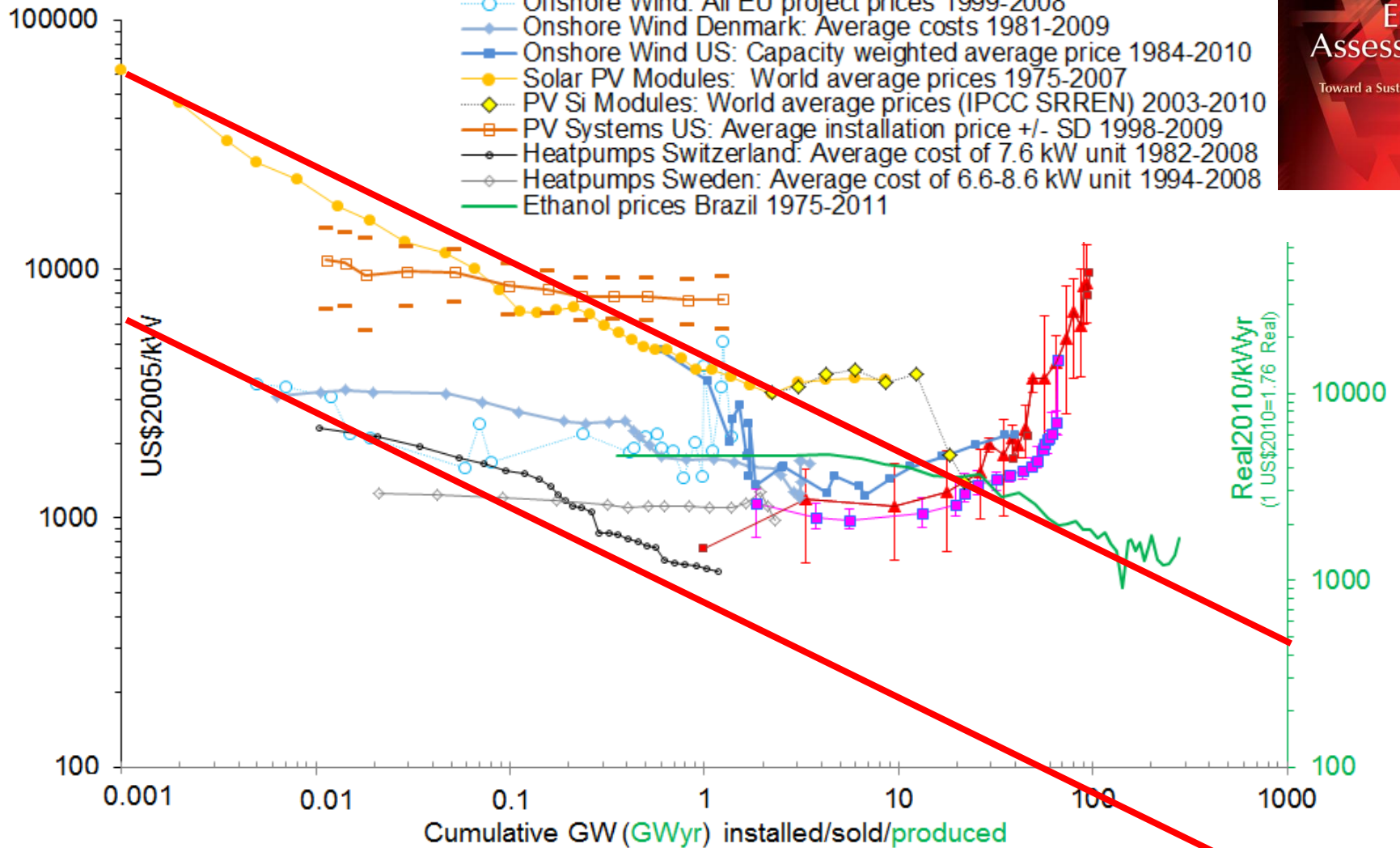


We seek technologies that lead to fundamentally new learning curves



# Supply Technologies Cost Trends

- ▲ Nuclear US: Average and Minimum/Maximum 1971-1996
- Nuclear US: Single Reactor (No Range) 1971-1996
- Nuclear France: Average and Min/Max 1977-1999
- Offshore Wind: All EU project prices 1999-2008
- ◆ Onshore Wind Denmark: Average costs 1981-2009
- Onshore Wind US: Capacity weighted average price 1984-2010
- Solar PV Modules: World average prices 1975-2007
- ◆ PV Si Modules: World average prices (IPCC SRREN) 2003-2010
- PV Systems US: Average installation price +/- SD 1998-2009
- Heatpumps Switzerland: Average cost of 7.6 kW unit 1982-2008
- ◇ Heatpumps Sweden: Average cost of 6.6-8.6 kW unit 1994-2008
- Ethanol prices Brazil 1975-2011



# Global Investment in Renewable Energy

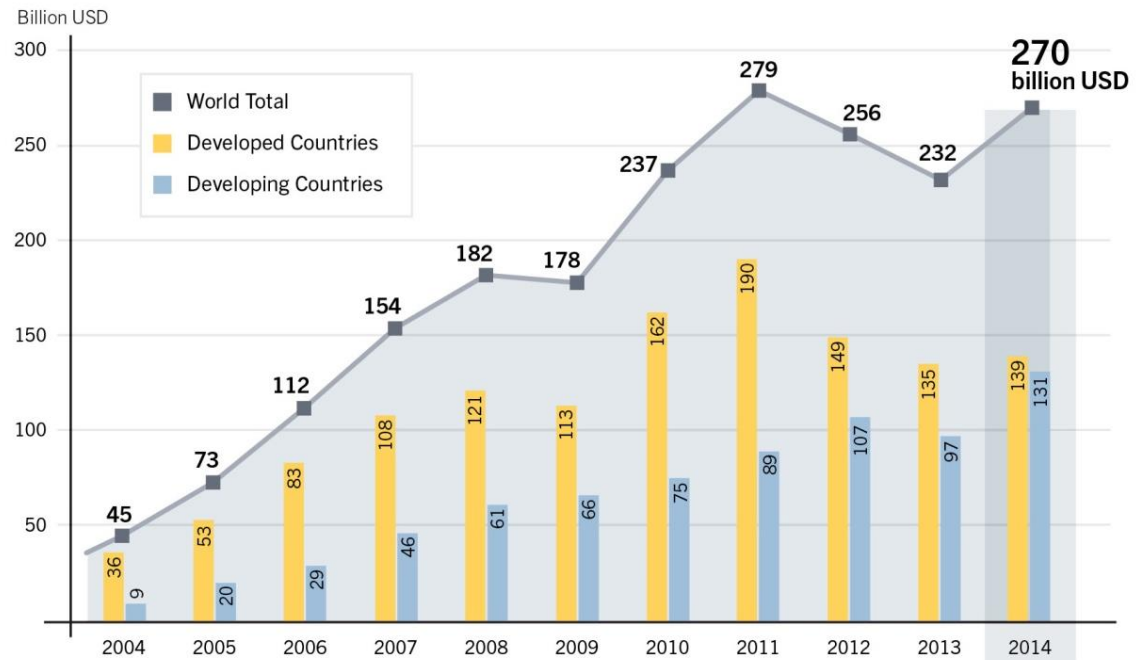
Global new investment estimated **USD 270.2 billion in 2014**

(including hydropower USD 301 billion)

Reasons for the increase:

- Increase in solar power installations in China and Japan
- Investment in solar power up **25%**
- Record investment in offshore wind projects in Europe

Global New Investment in Renewable Power and Fuels, Developed and Developing Countries, 2004–2014



REN21 *Renewables 2015 Global Status Report*



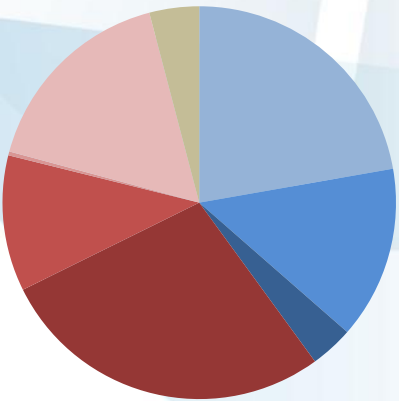
Source: Frankfurt School–UNEP and BNEF



# Investment Portfolios World

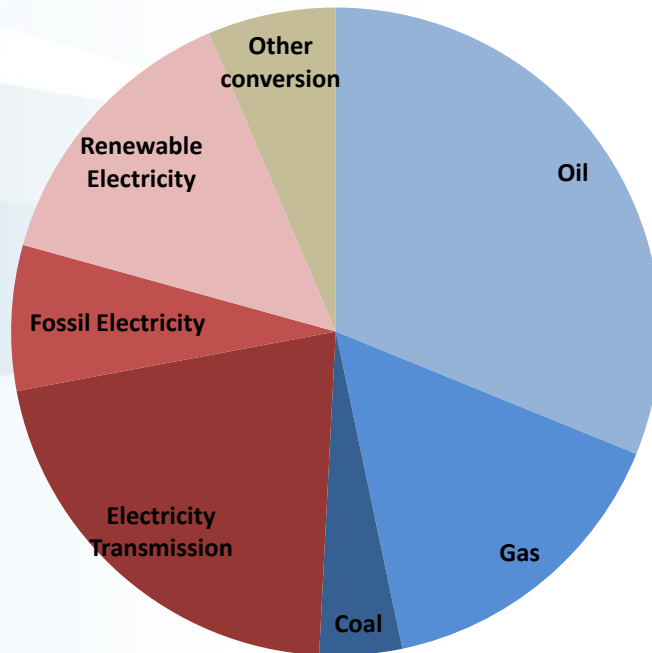
## No Sustainability Policies (2558 bill.)

**Today**  
(941bill.)



**2005-2010**

(2558 bill.)



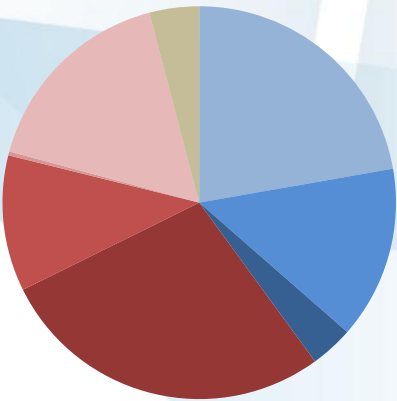
**2050**

# Investment Portfolios World

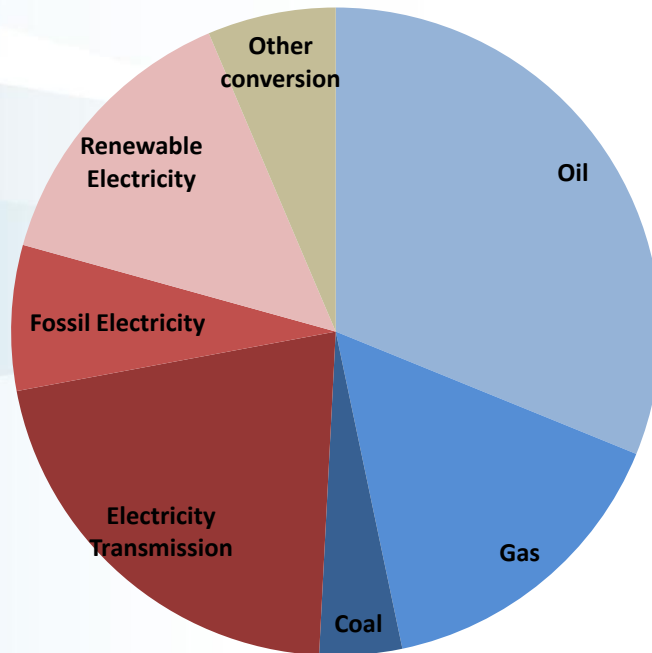
**No Sustainability Policies**  
(2558 bill.)

**GEA-Efficiency**  
(2849 bill.)

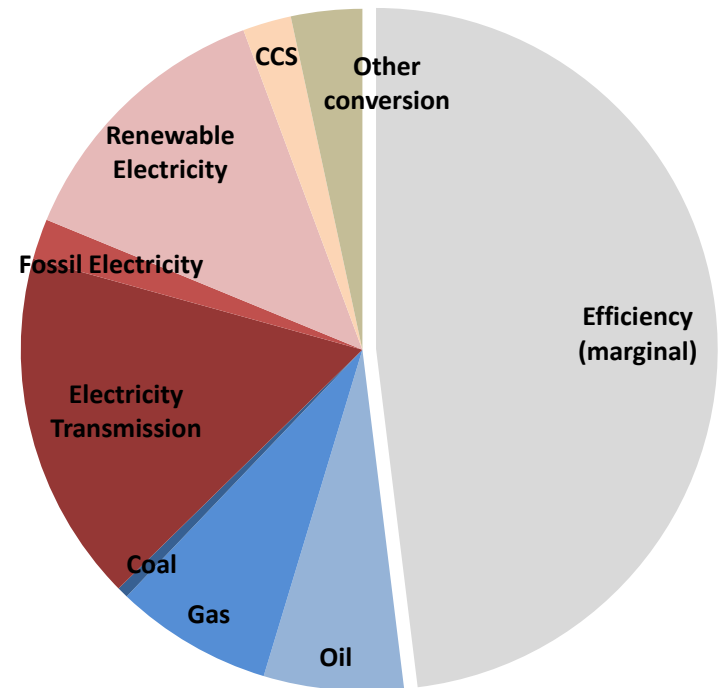
**Today**  
(941 bill.)



**2005-2010**



**2050**



# Science for Transformation

- **Better integration across science communities**
  - “Climate or development first” approach too narrow
- **More integrated & holistic assessment of climate change policy in the context of other priorities:**
  - Multi-objective & multi-policy framing to better understand climate policy tradeoffs & benefits
  - “Nexus” approaches to reach multiple objectives simultaneously: energy, water, food & urbanization
- **Challenges are huge:**
  - Different constraints and priorities across scales
  - Normative goals for policy prioritization – 17 SDGs



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# THANK YOU



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