



International Institute for
Applied Systems Analysis
www.iiasa.ac.at

science for global insight

Sustainable Development Challenges and



TWI2050
The World in 2050
www.twi2050.org

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Future Outlook on The World in 2050 Initiative, UNU – 9 October 2018

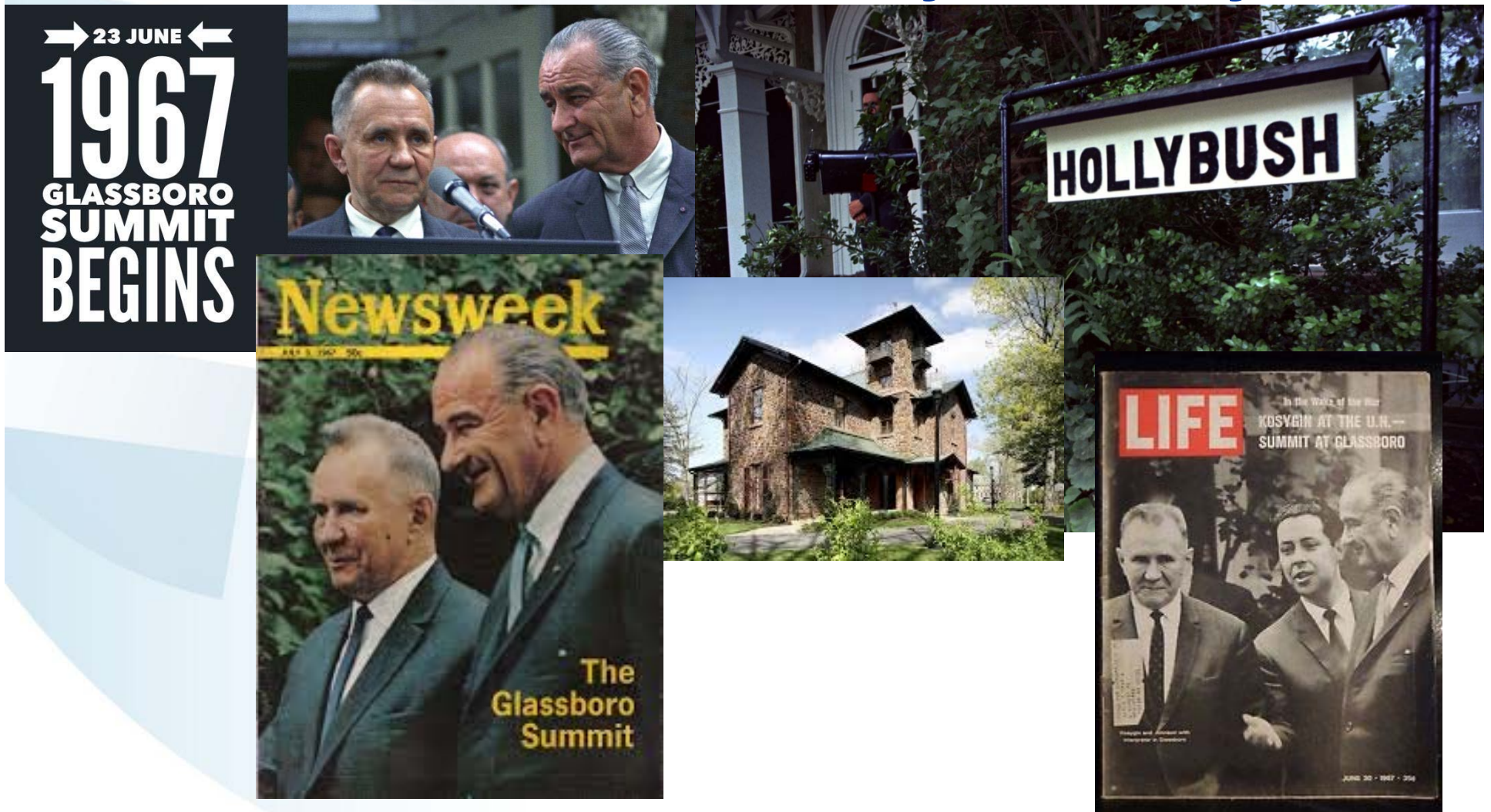


IIASA, International Institute for Applied Systems Analysis

Half Century of IIASA : Creation, Cold War, Global Change, Grand Transformations

- ⇒ Creation: 1963 & 1967 to 1972
- ⇒ Cold War: 1973 to 1989 (Fall of Berlin Wall)
- ⇒ Global Change: 1990 to ~2000
- ⇒ Integration and Transformations: to 2018

Creation: 1963 & 1967 to 1972 Form Glassboro to Royal Society



Source: <http://bjlibrary.org/collections/photo-archive/photolab-detail.html?id=1149>



Creation: 1963 & 1967 to 1972

Signing of the IIASA Charter in Royal Society



Howard Raiffa YSSP Talk in 1992

The IIASA charter was signed in London in October 1972, but the history goes back six years earlier. In 1966 American president **Lyndon Johnson** gave a rather remarkable speech — in the middle of the Cold War — in which he said it was time that the scientists of the United States and the Soviet Union worked together on problems other than military and space matters, on problems that plagued all advanced societies, like energy, our oceans, the environment, health. And he called for a liaison between the scientists of East and West.

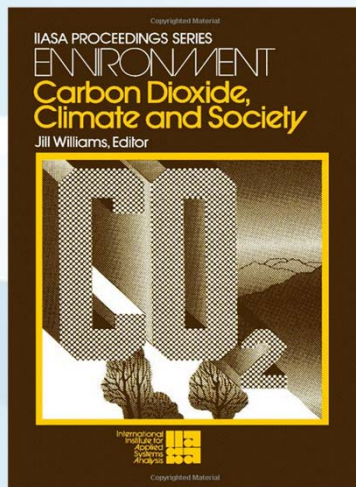
YOUNG SCIENTISTS SUMMER PROGRAM



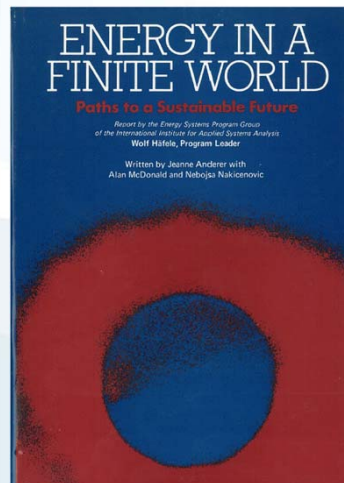
The Emergence of Climate Science & Policy

UN Conference on Human Environment 1972
(1ST Earth Summit)
1ST Climate Conference Villach 1985

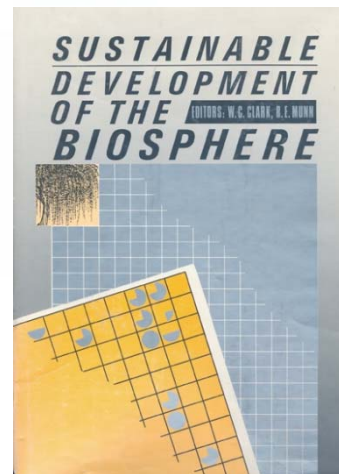
Early IIASA Climate Change Related Reports



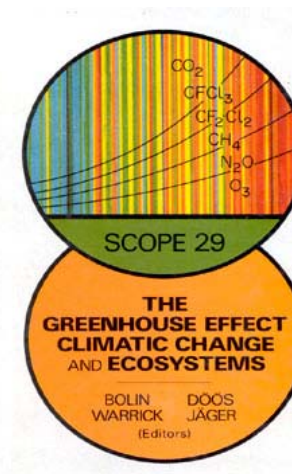
1978



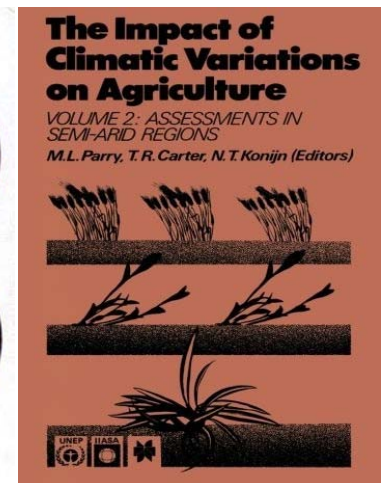
1981



1986



1986

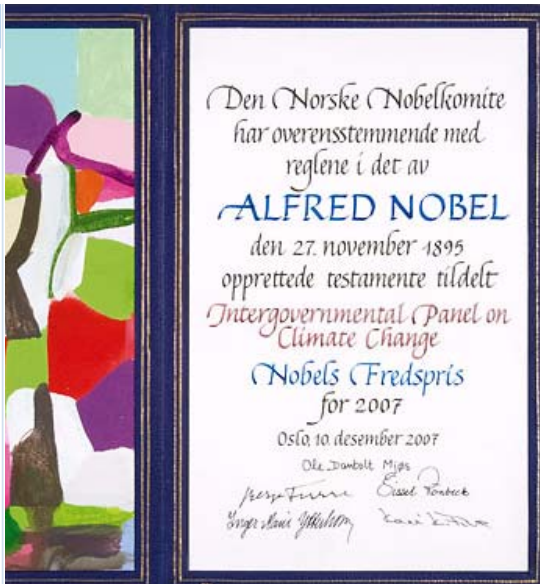


1988

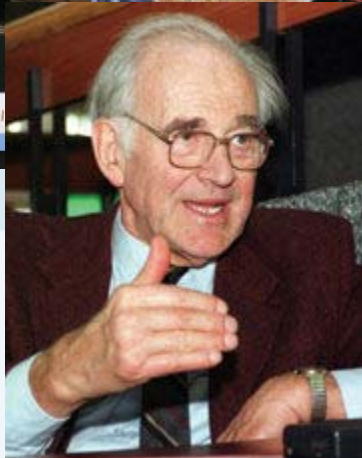
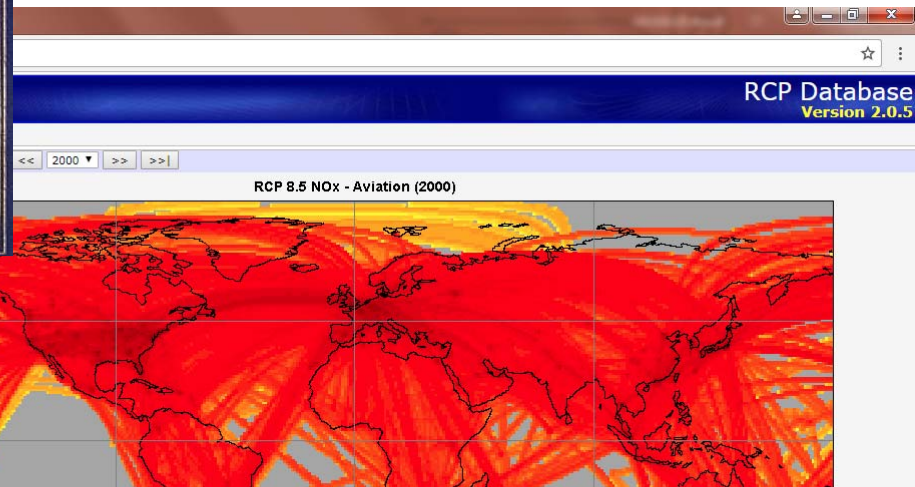
Other early IIASA climate research highlights 1976:
Cesare Marchetti introduces concept of Geoengineering,
Bill Nordhaus develops first climate policy model (DICE precursor),
Jill Jaeger performs first GCM model runs for energy scenario climate impacts



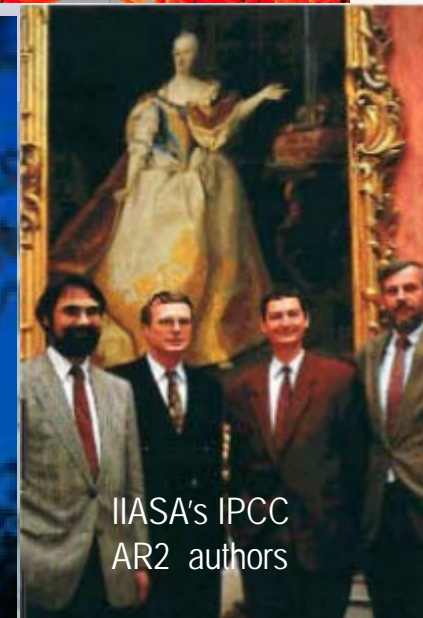
30th Anniversary



IIASA & IPCC



Bert Bolin IPCC Chair
Chair IIASA SAC



IIASA's IPCC
AR2 authors

Nobel Laureate and IIASA alumnus
Tom Schelling reviews the history of climate science







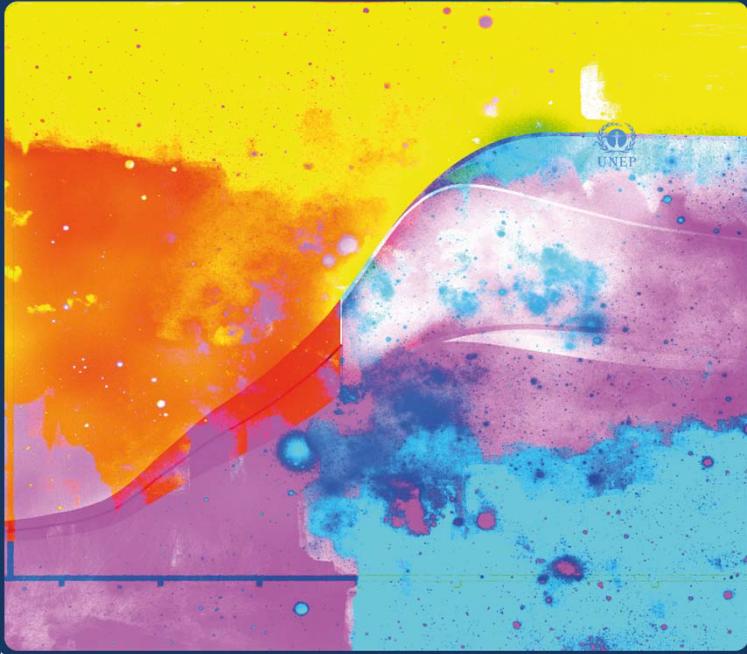
Nordhaus_2.jpg

ipcc
INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

Global Warming of 1.5°C

An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.



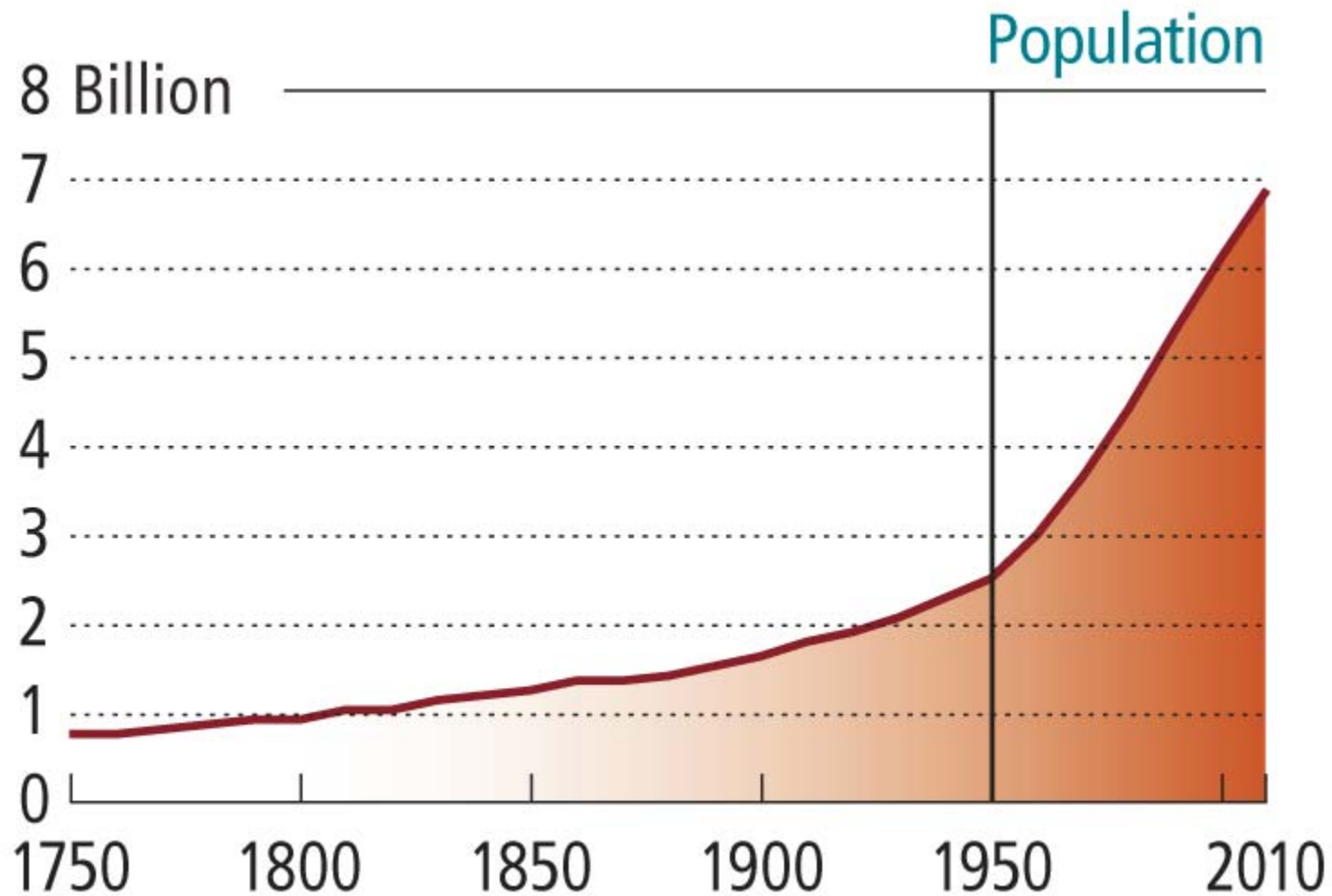
Research with 31 Organizations, incl.

- ➔ Asia Center for Air Pollution Research
- ➔ Central Research Institute of Electric Power Industry (CRIEPI)
- ➔ Institute for Applied Energy (IAE)
- ➔ Institute for Global Environmental Strategies (IGES)
- ➔ Kyoto University
- ➔ Ministry of the Environment
- ➔ Ministry of Economy, Trade and Industry (METI)
- ➔ National Institute for Environmental Studies (NIES)
- ➔ Research Institute of Innovative Technology for the Earth (RITE)
- ➔ Toyota Central Research and Development Corporation (TCRD)
- ➔ Tokyo Electric Power Company (TEPCO)

Four Great Achievements since the Beginning of Industrial Revolution

- ➔ Life expectancy has doubled in a century
- ➔ One billion are obese while less go hungry
- ➔ More die by suicide than war and violence
- ➔ Everyone in the world has a mobile phone

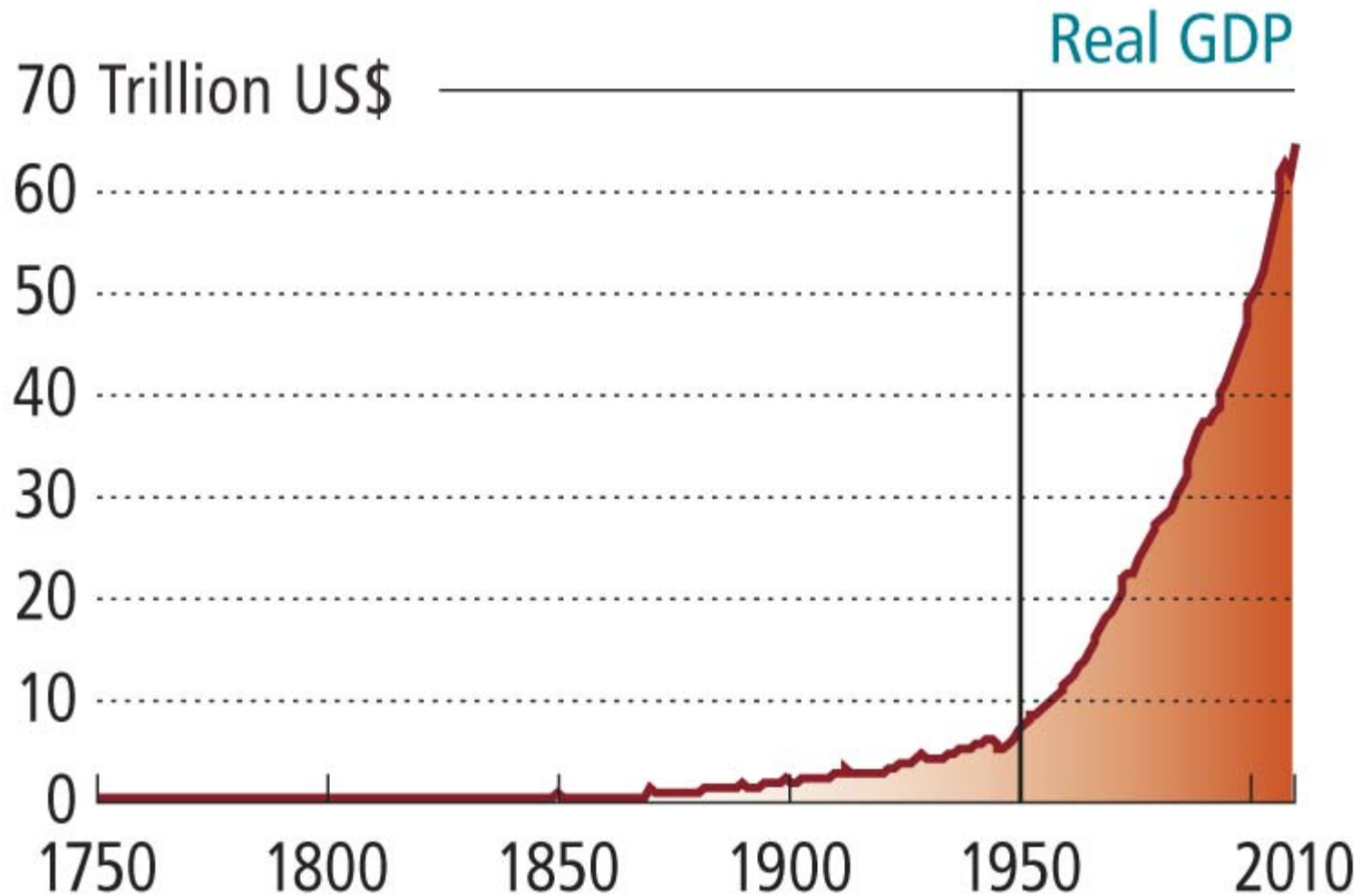
The Great Acceleration



Source: Steffen et al. 2015

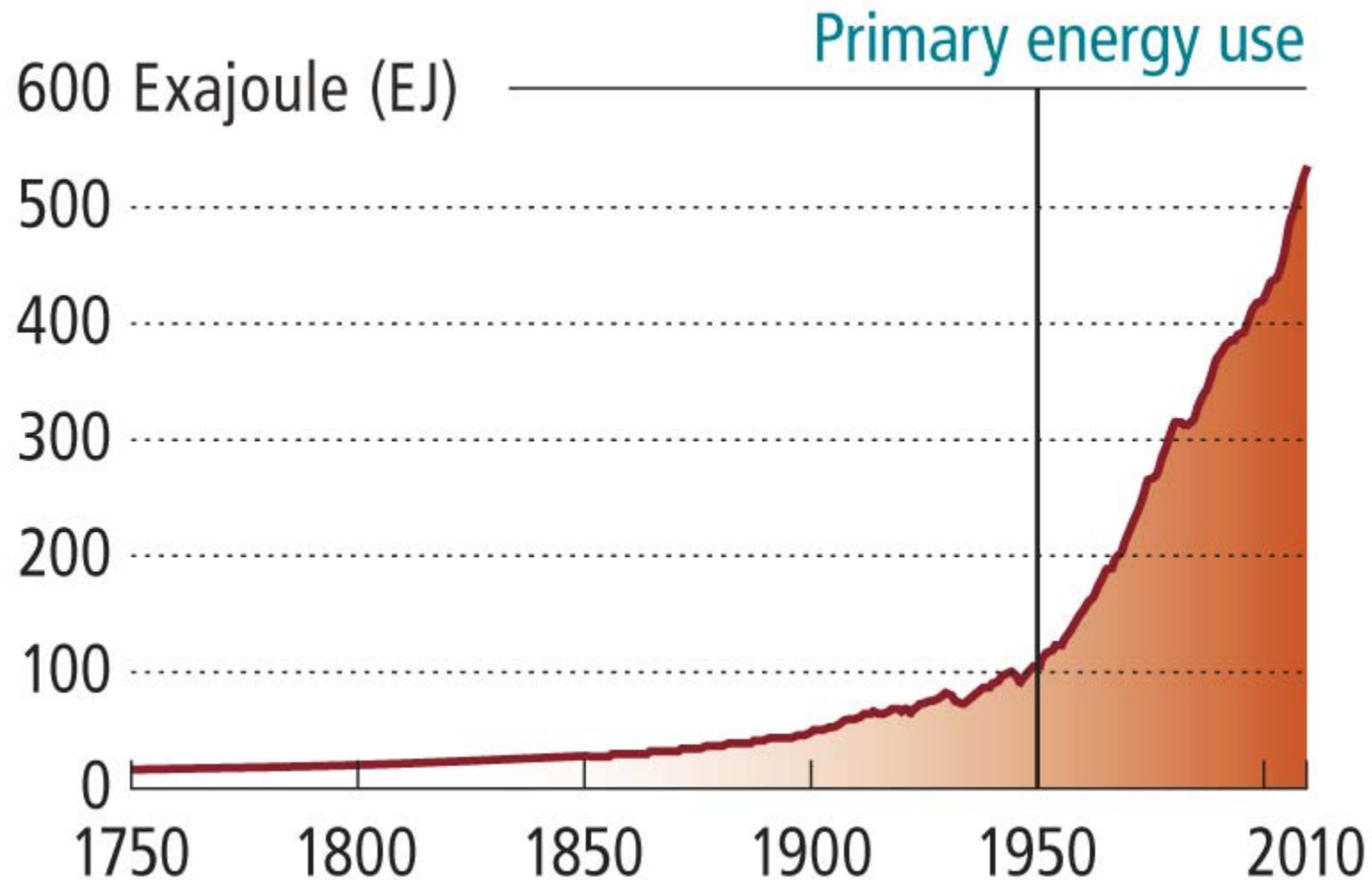


The Great Acceleration



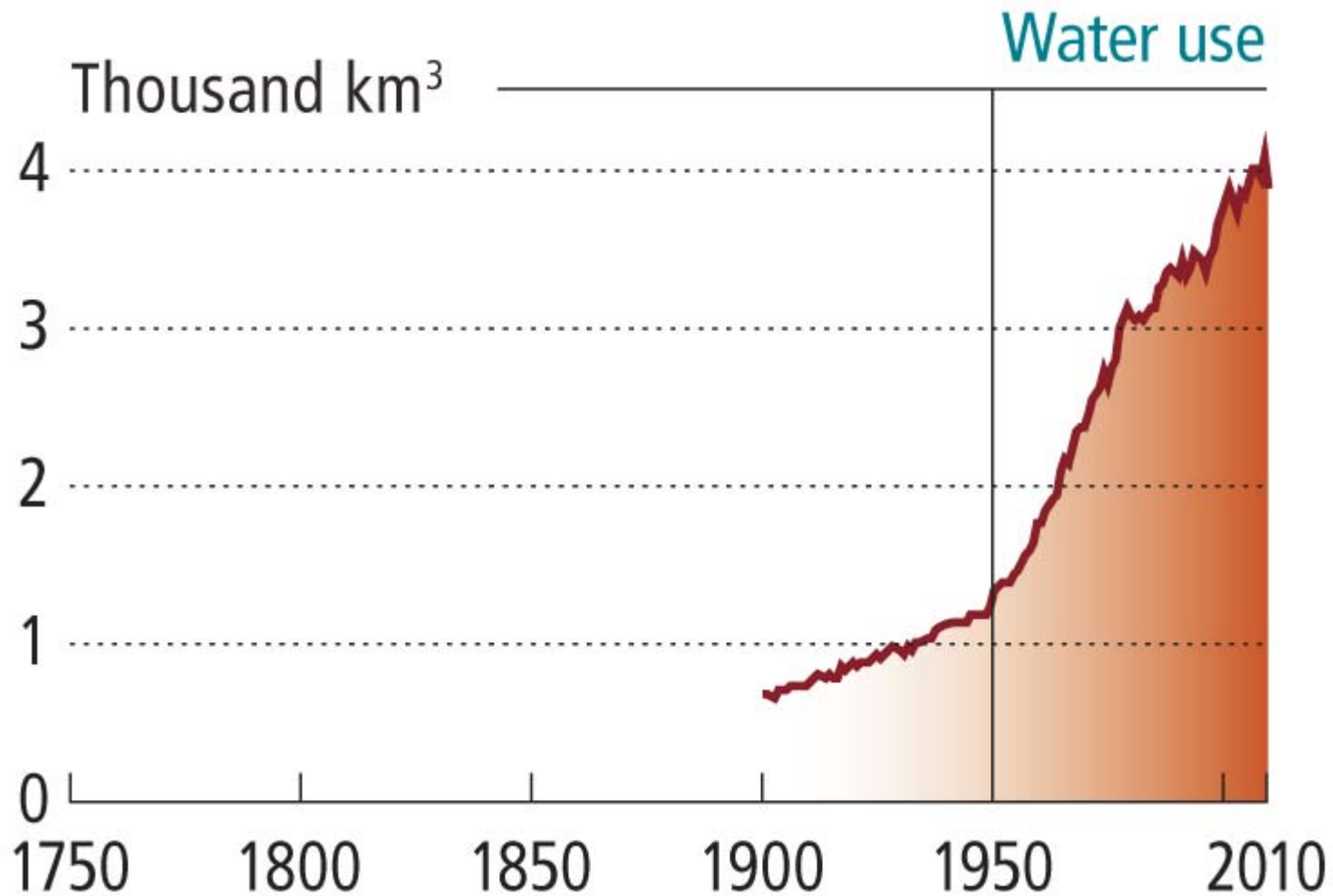
Source: Steffen et al. 2015

The Great Acceleration



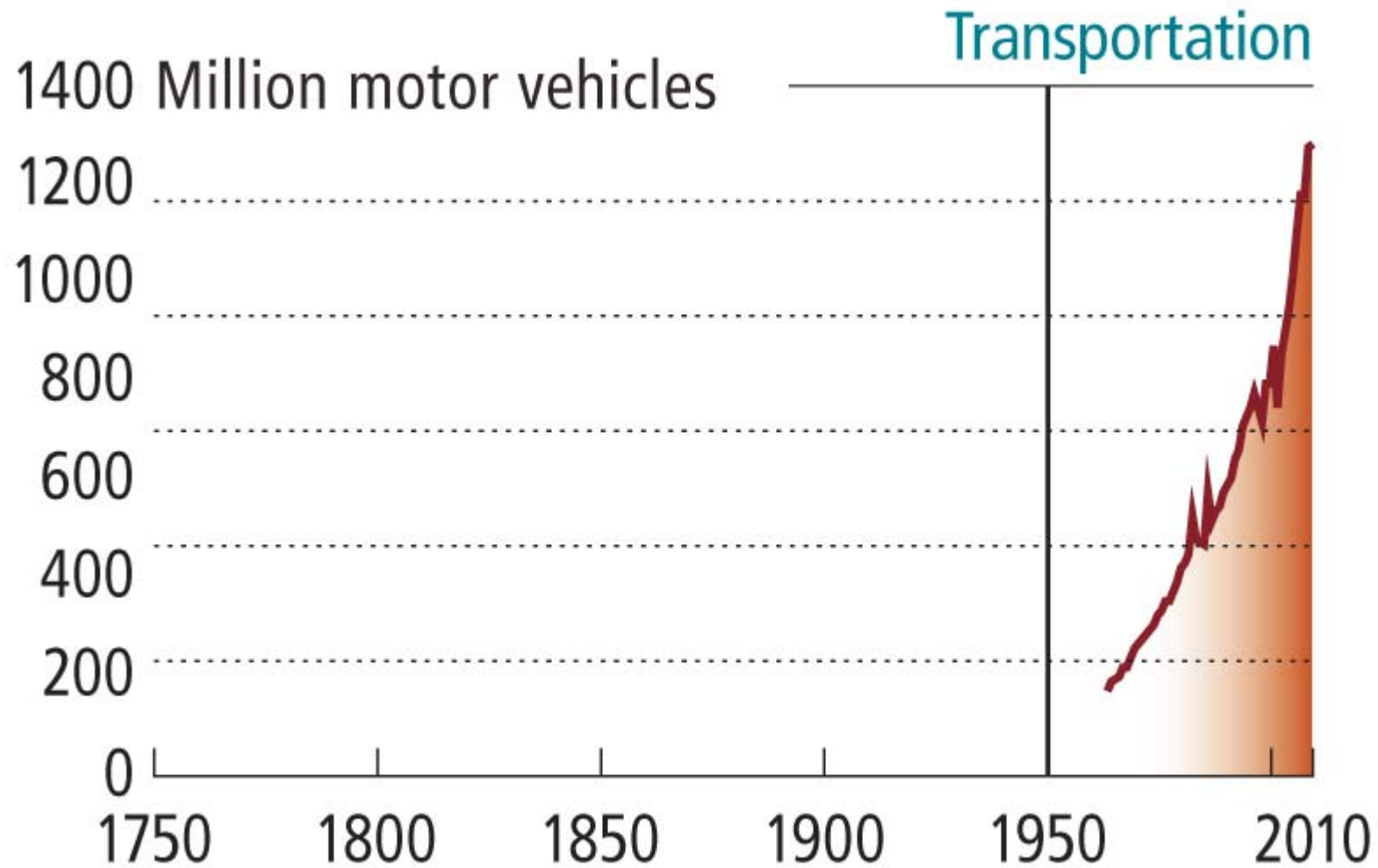
Source: Steffen et al. 2015

The Great Acceleration



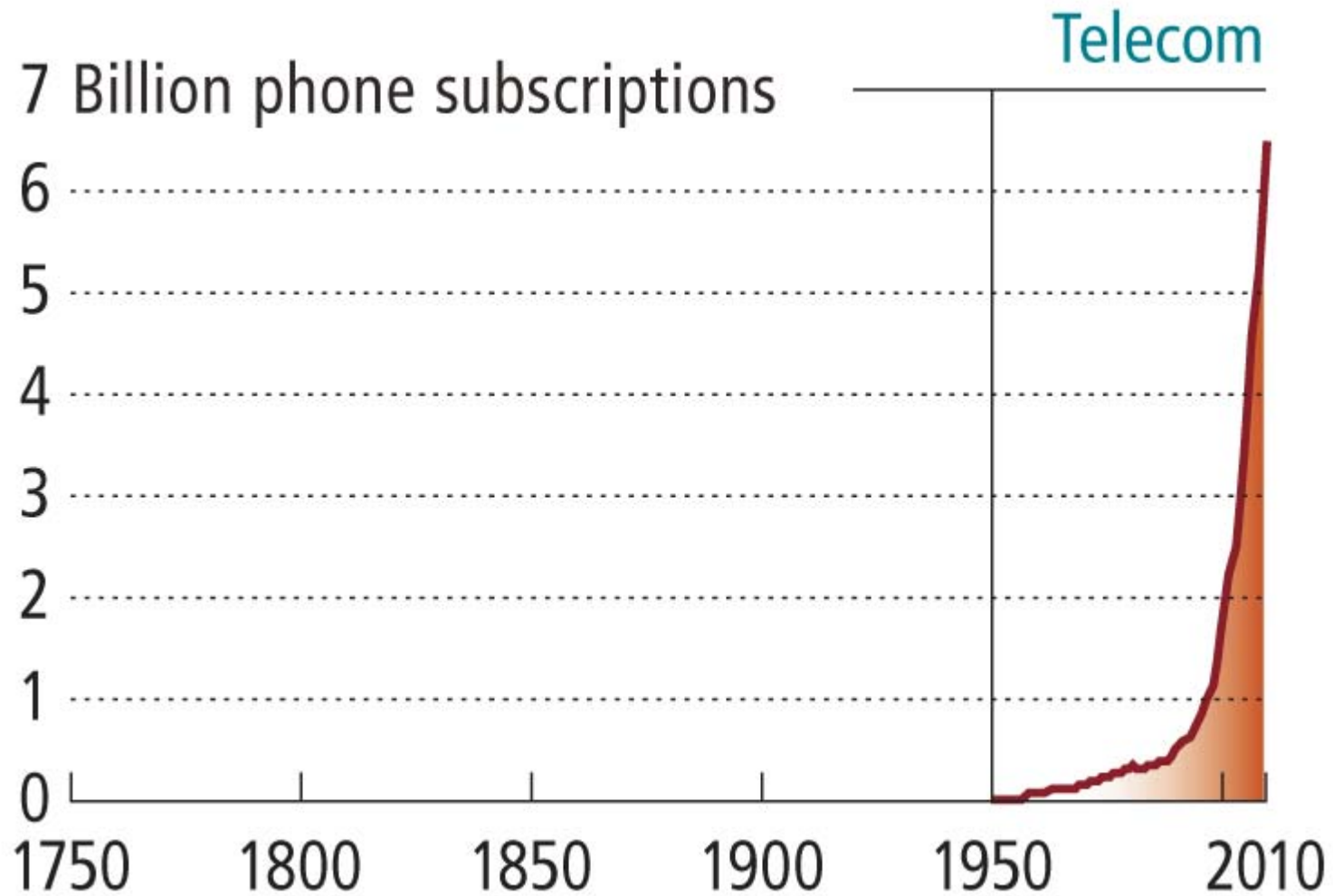
Source: Steffen et al. 2015

The Great Acceleration



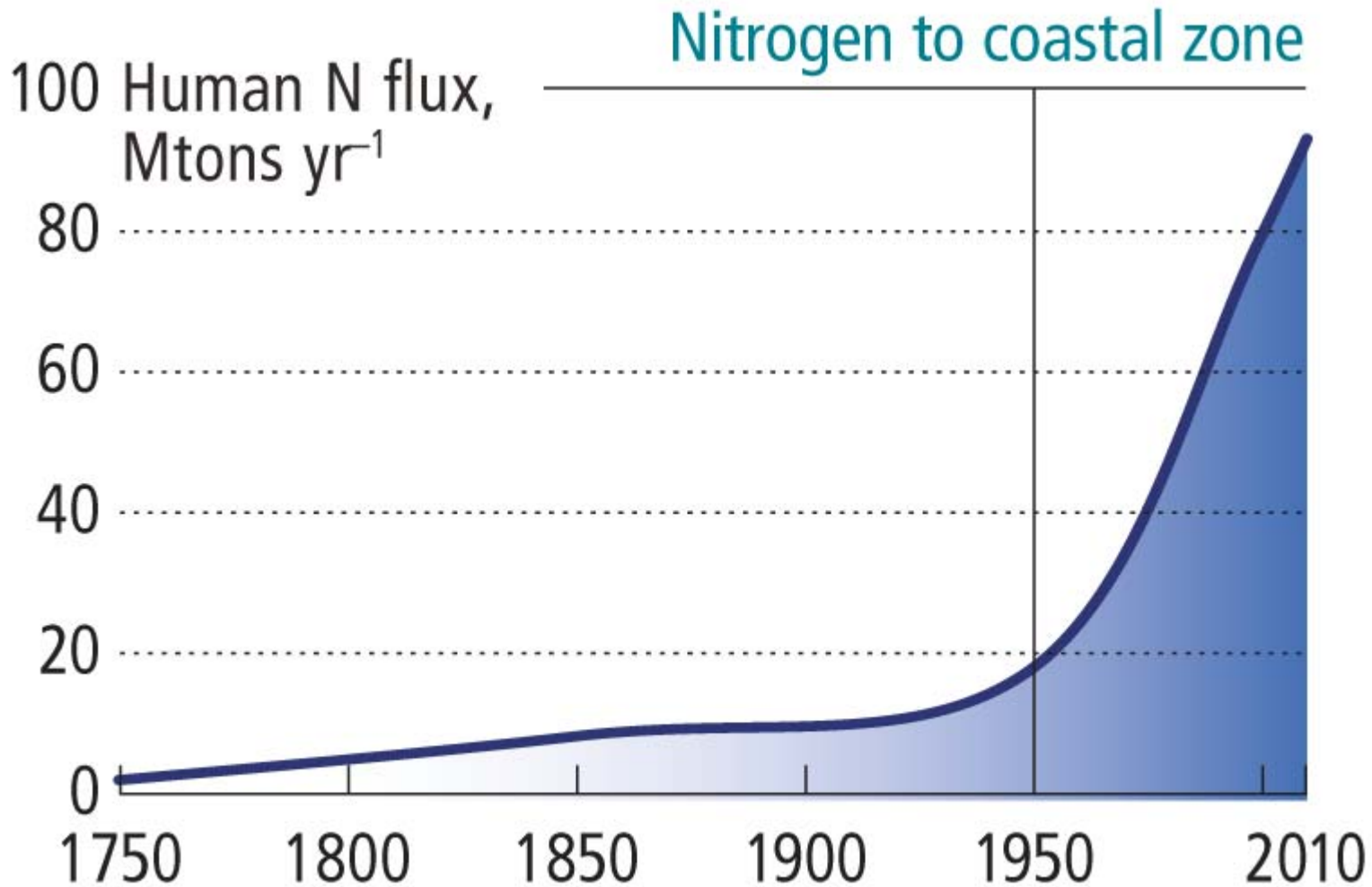
Source: Steffen et al. 2015

The Great Acceleration



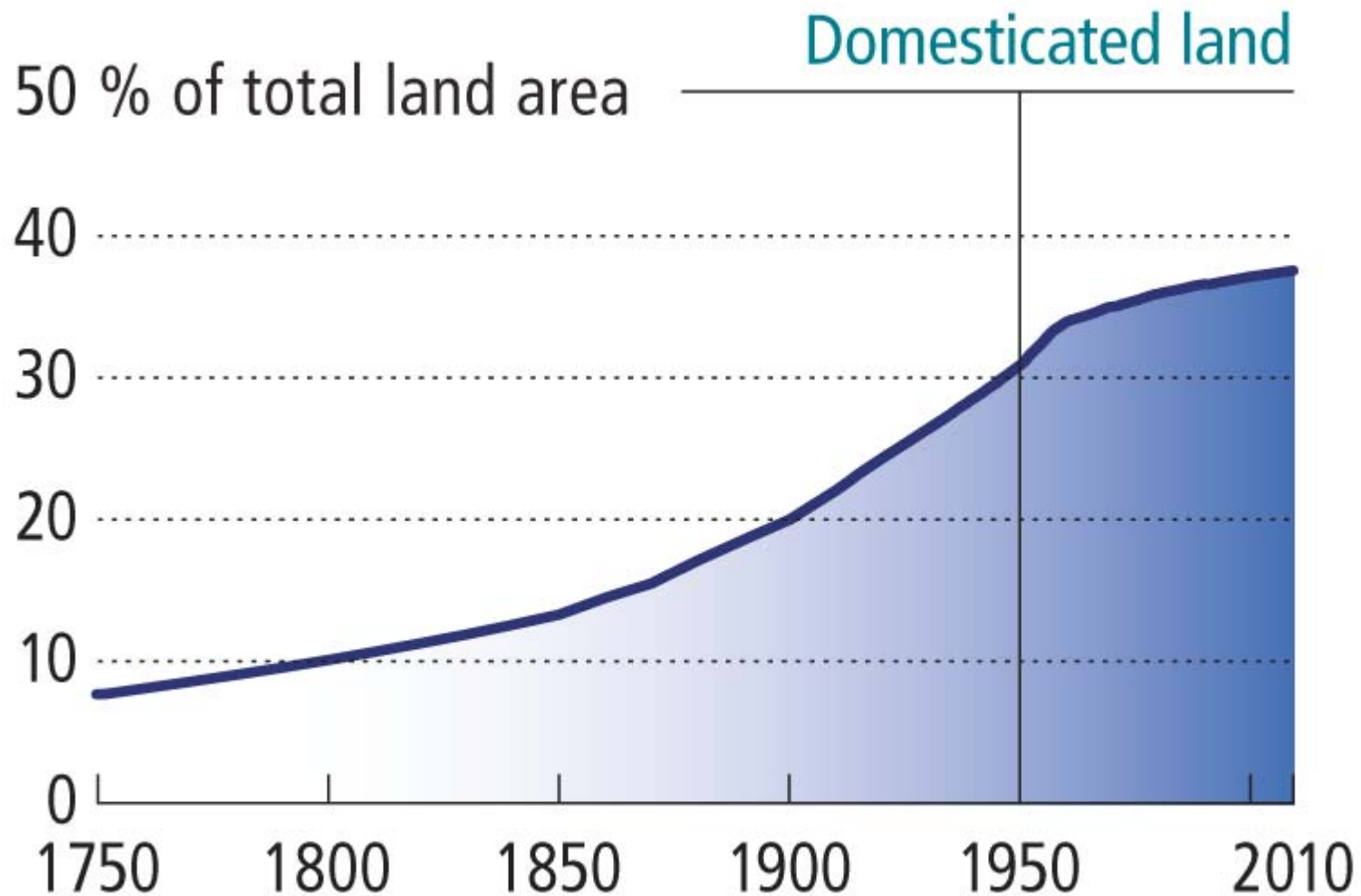
Source: Steffen et al. 2015

The Great Acceleration



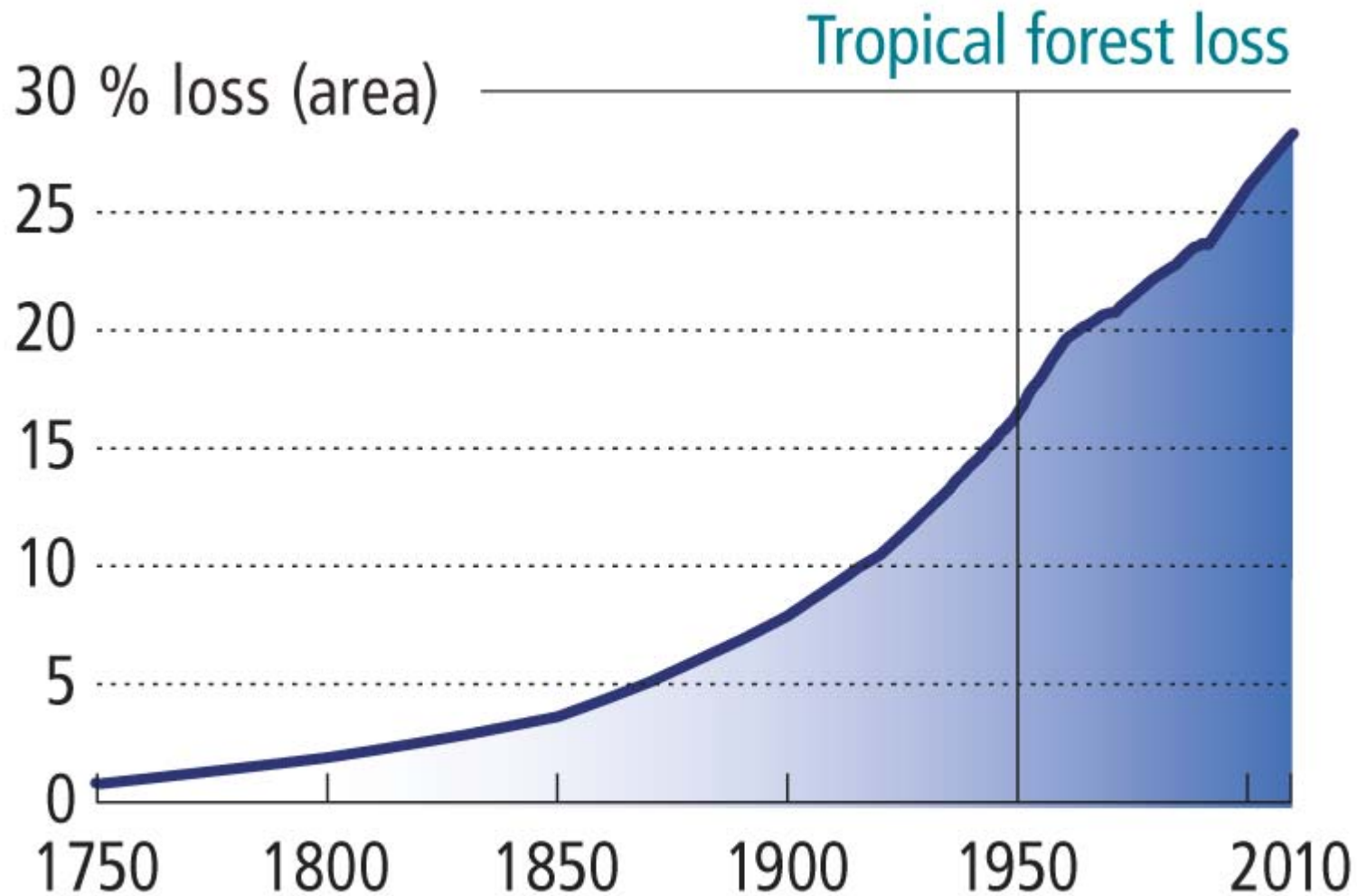
Source: Steffen et al. 2015

The Great Acceleration



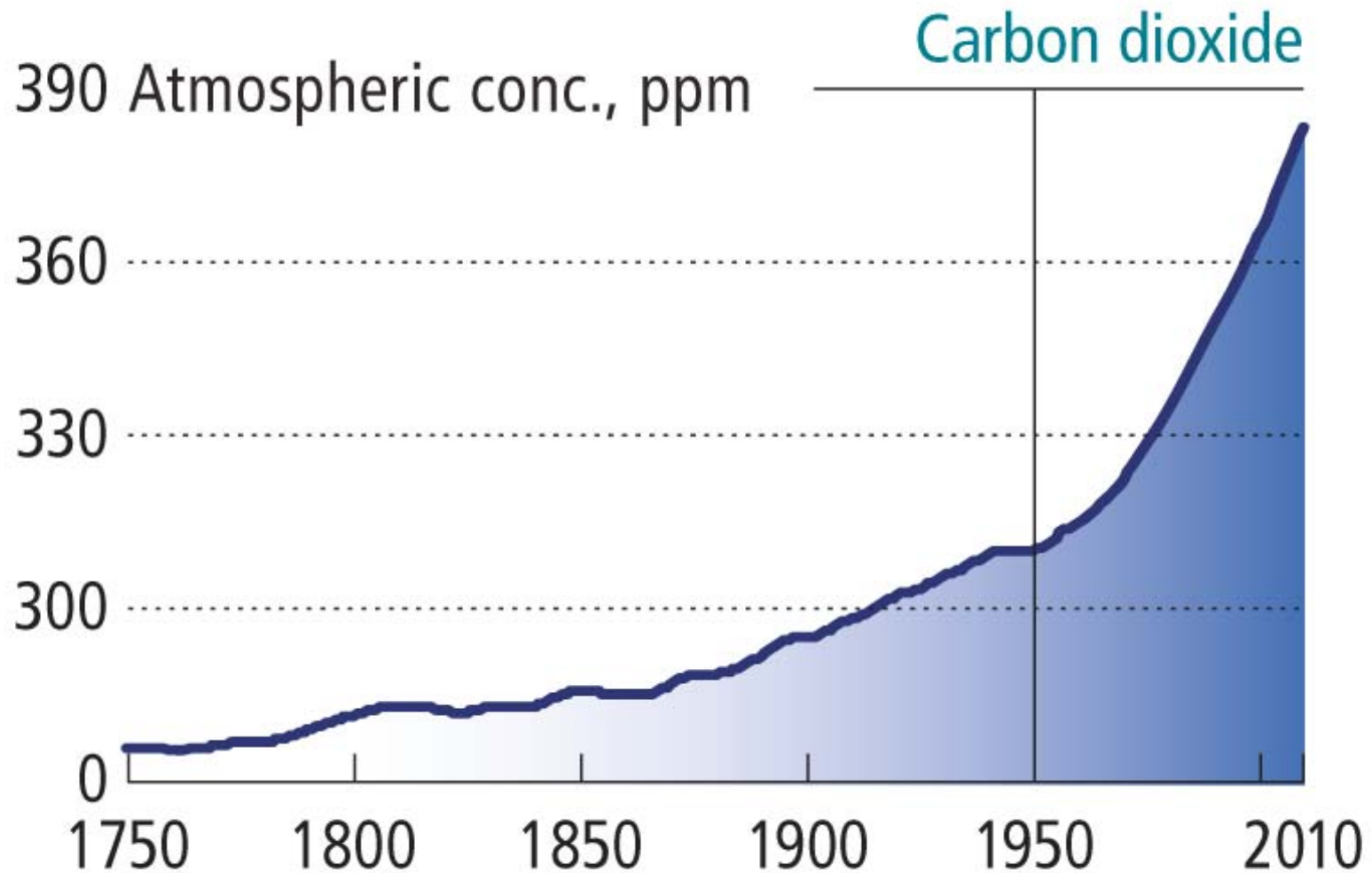
Source: Steffen et al. 2015

The Great Acceleration



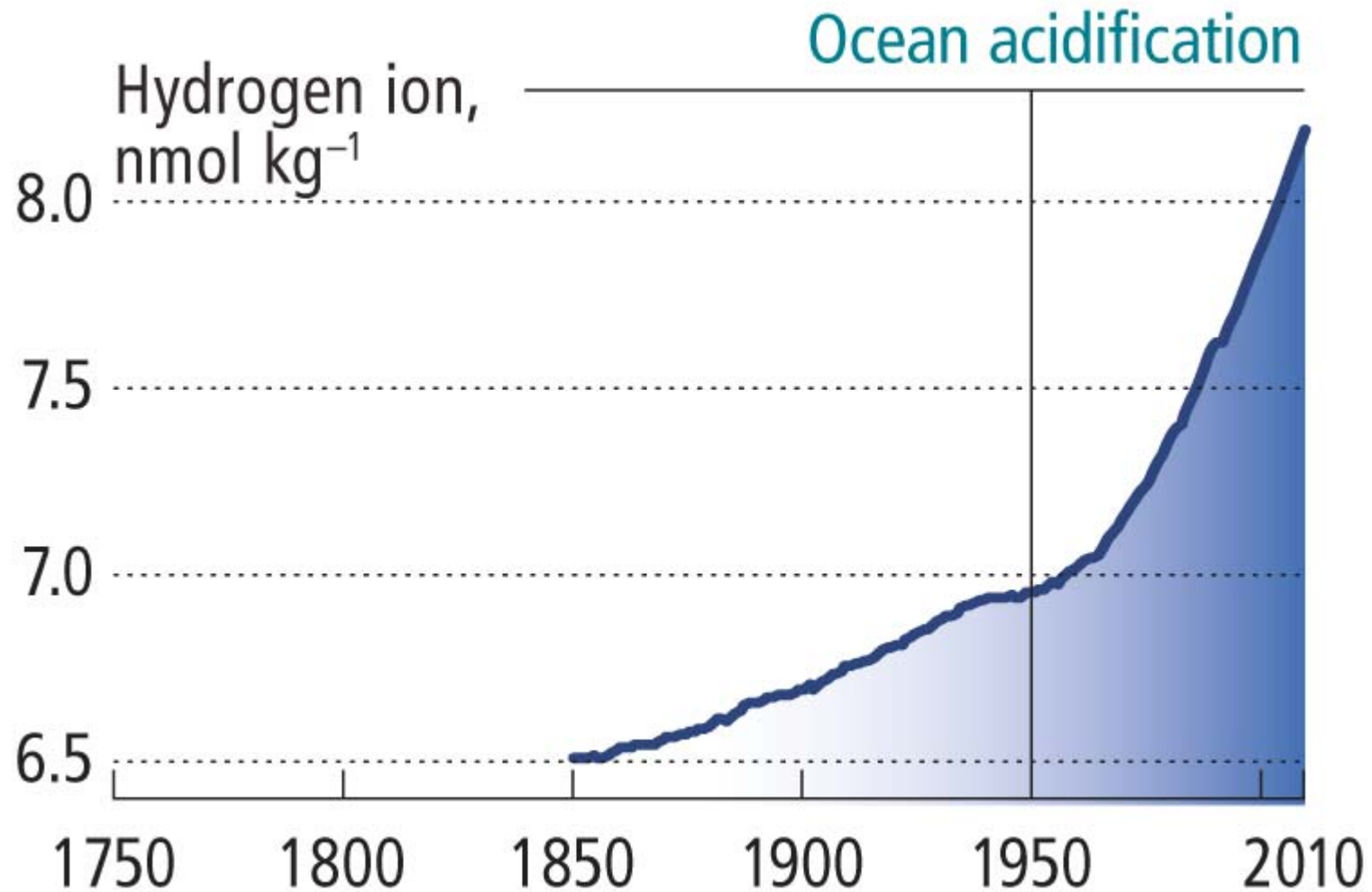
Source: Steffen et al. 2015

The Great Acceleration



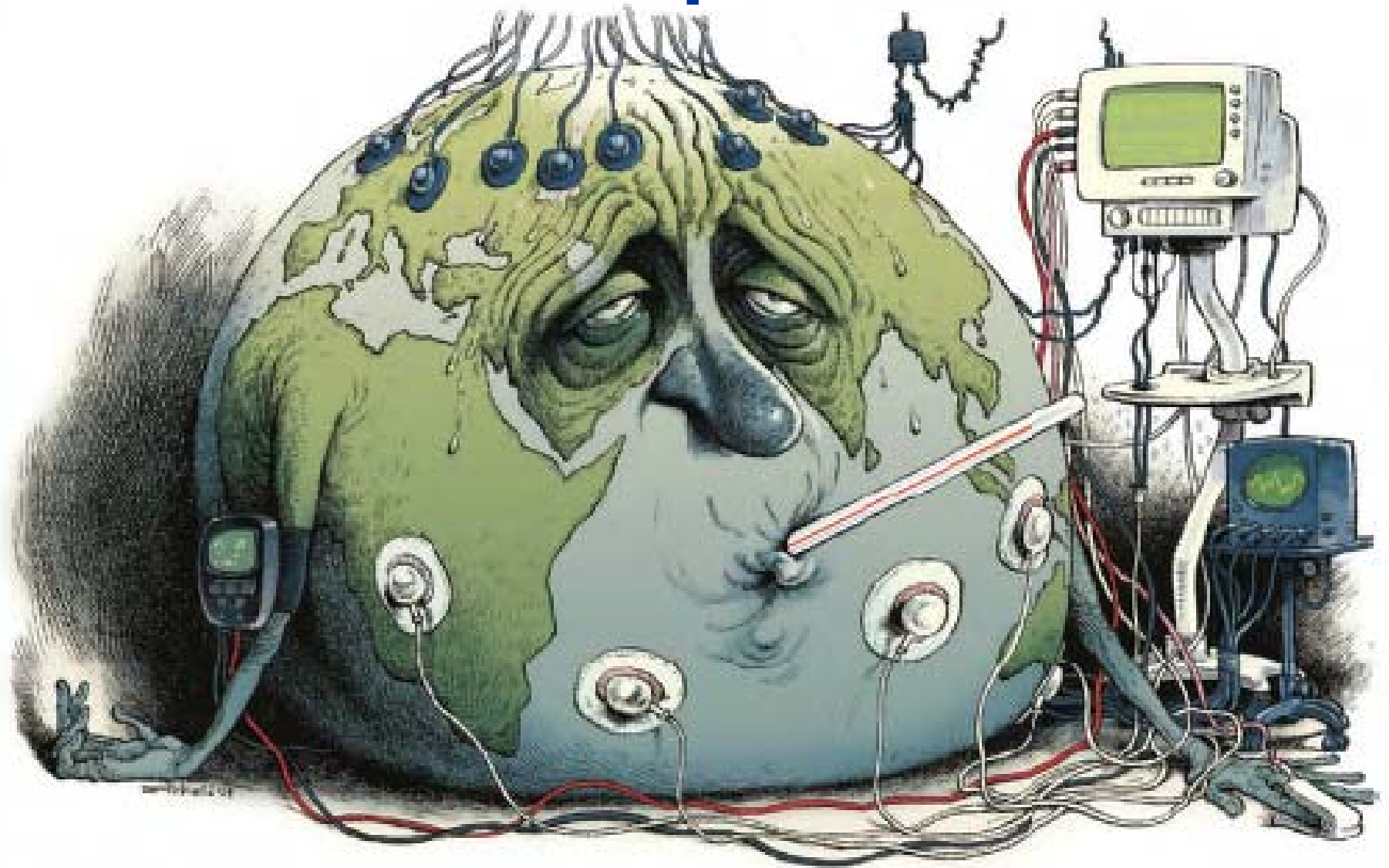
Source: Steffen et al. 2015

The Great Acceleration

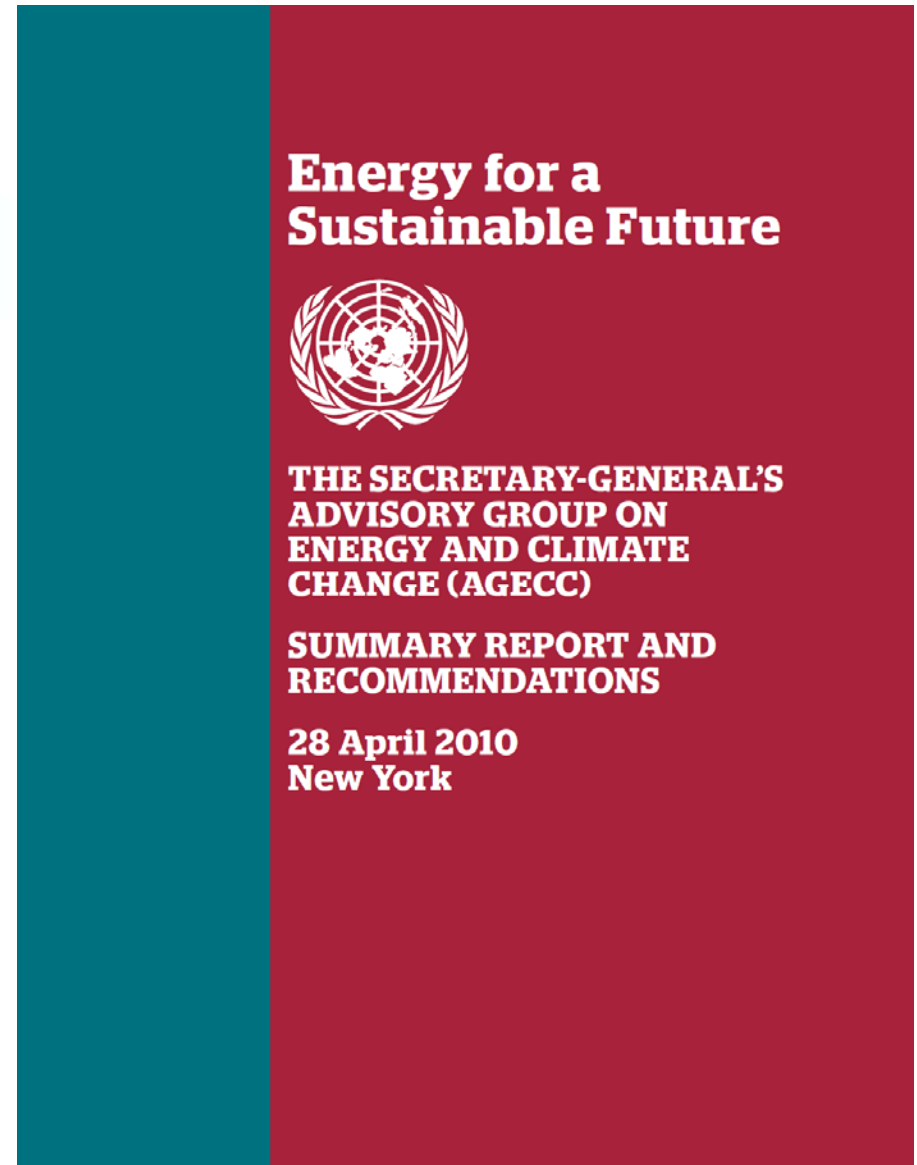
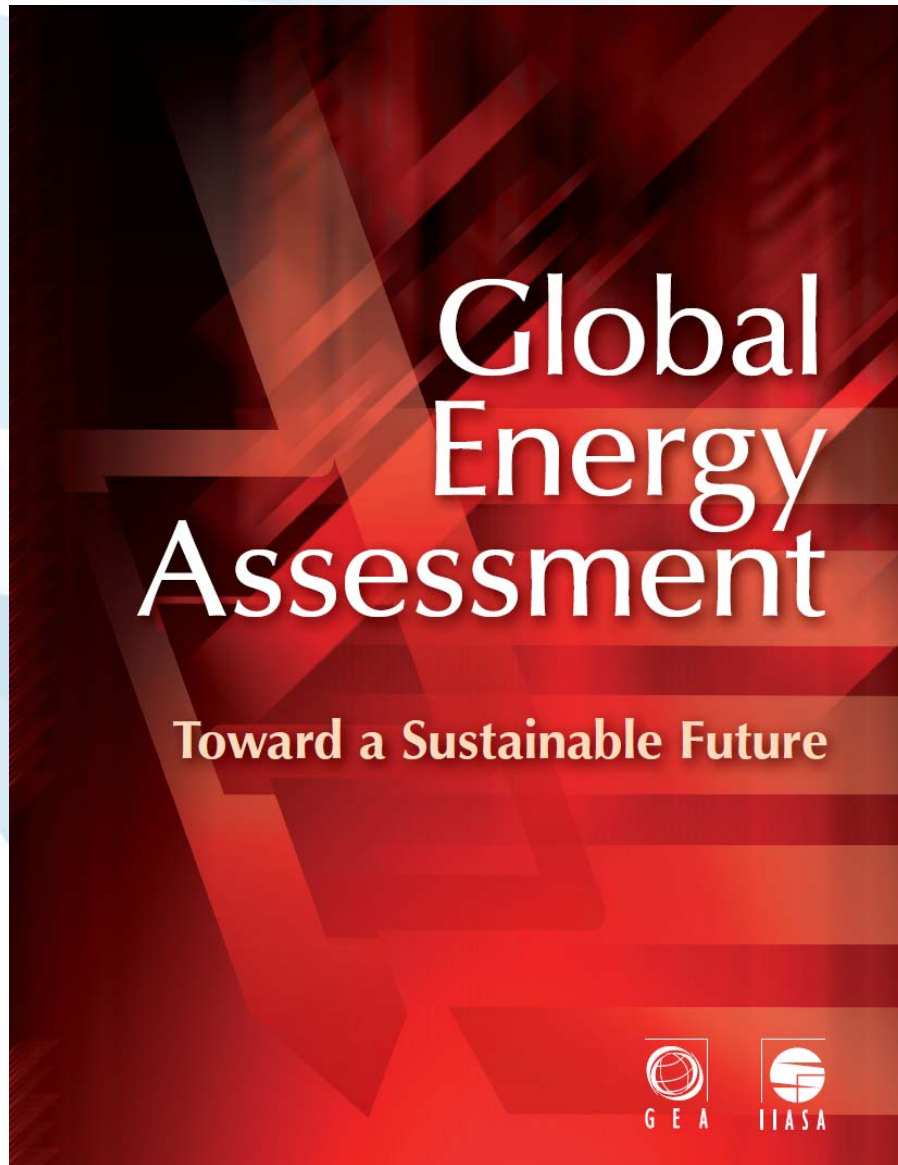


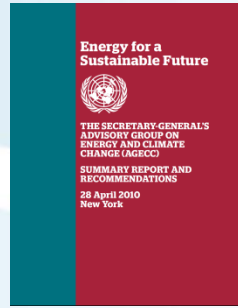
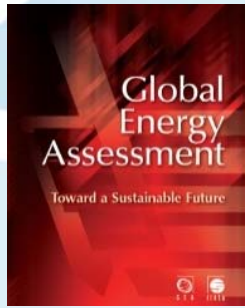
Source: Steffen et al. 2015

Collective Responsibility in the Anthropocene



www.GlobalEnergyAssessment.org





SUSTAINABLE ENERGY
FOR ALL



2030 GEA Goals and Targets

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

Aspirational & Ambitious but Achievable



Climate change and people

- Close links to United Nations Sustainable Development Goals (SDGs)
- Mix of measures to adapt to climate change and reduce emissions can have benefits for SDGs
- National and sub-national authorities, civil society, the private sector, indigenous peoples and local communities can support ambitious action
- International cooperation is a critical part of limiting warming to 1.5°C



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

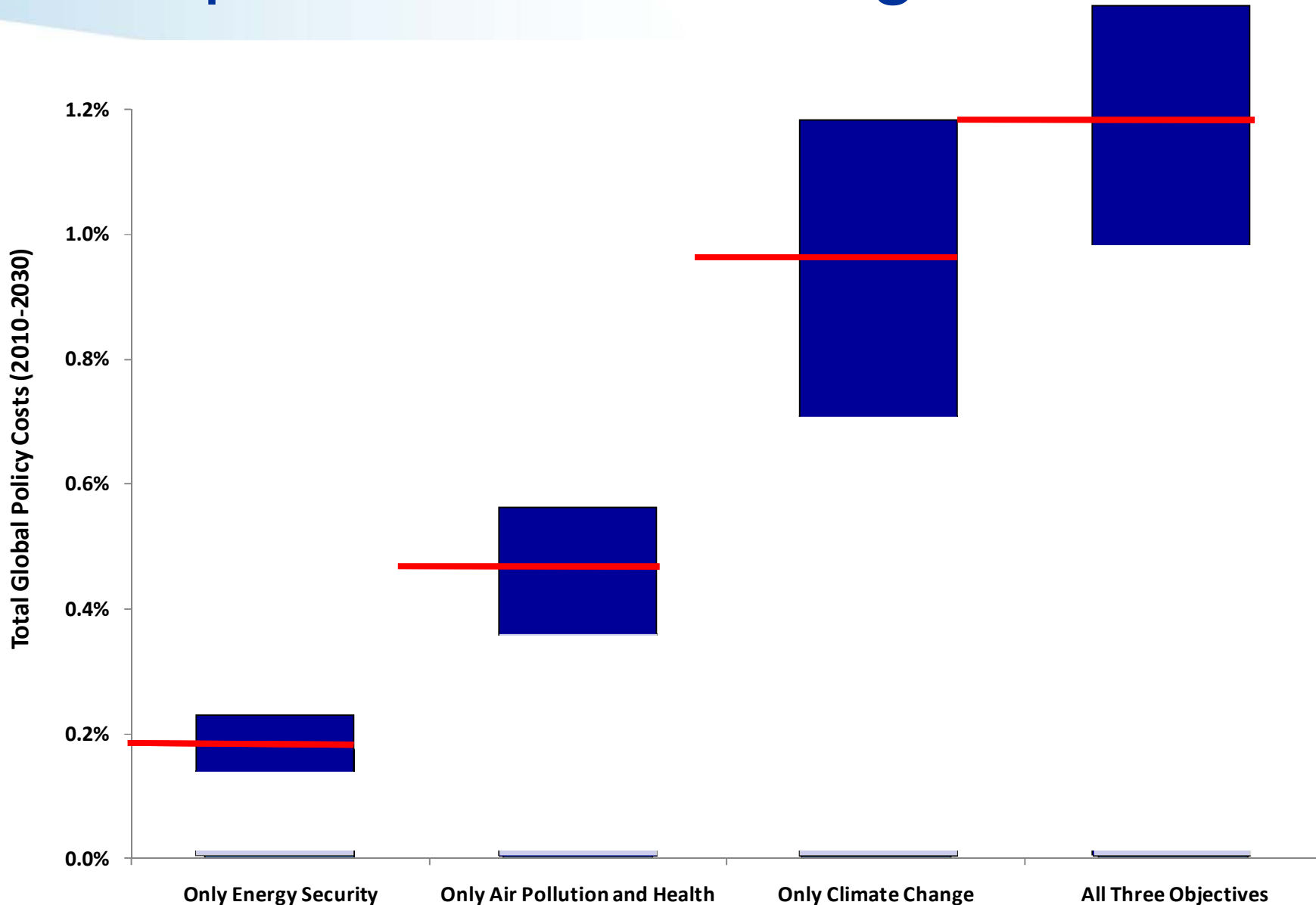
15 LIFE ON LAND

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS

SUSTAINABLE DEVELOPMENT GOALS

Multiple Benefits of Integrated Policies





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."

nature



CD-LINKS



Nexus Solutions Partnership



IIASA Partnerships



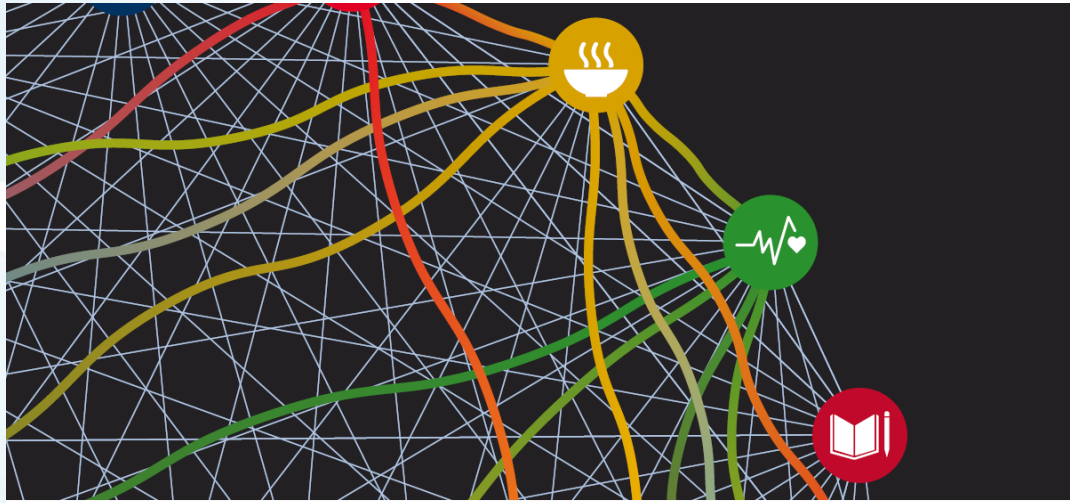
The World In 2050

Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship



THE EARTH INSTITUTE
COLUMBIA UNIVERSITY

Global Commons



A GUIDE TO
SDG INTERACTIONS:
FROM SCIENCE
TO IMPLEMENTATION



INTERNATIONAL
COUNCIL
FOR SCIENCE



Interactions between SDG 7 & other SDGs

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





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science for global insight

Transformations to Achieve the Sustainable Development Goals

A report prepared by
The World in 2050 initiative



*Side Event on The World in 2050 initiative, S-1522/23 at UN
Secretariat Building (15th floor), UN Headquarters, during
High-Level Political Forum, United Nations, NYC – 12 July 2018*



IIASA, International Institute for Applied Systems Analysis

TWI2050 Report (www.TWI2050.org)

Key Messages

Synthesis

1. Framing and Introduction
2. The Challenges Ahead
3. Sustainable Development Pathways
4. Governing the Transformation

- >60 authors from ~20 organizations
- >150 contributors and participants



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TWI2050 Writing Meeting
5-7 March 2018, IIASA

TWI2050 Report (www.TWI2050.org)

- AAU/BOKU: Helmut Haberl, Verena Rauchenwald
- ASU: Sander van der Leeuw
- CMCC: Lorenza Campagnolo
- COPPE: Roberto Schaeffer
- DIE: Anita Breuer, Ines Dombrowsky, Hannah Janetschek, Julia Leininger, Dirk Messner, Constantin Ruhe
- EC-JRC: Apollonia Miola, Daniela Buscaglia
- Future Earth: Avit Bhowmik
- JGCRI: Jae Edmonds
- **IGES; Miho Kamei**
- IPCC/Imperial College London: Joana Portugal Pereira, Kris Murray
- Kiel University: Jörn Schmidt, Athanasios Vafeidis
- LSHTM: Pauline Scheelbeek
- MCC: Felix Creutzig
- PBL: Heleen van Soest, Detlef van Vuuren
- PIK: Elmar Kriegler, Alex Popp, Hermann Lotze-Campen
- Polimi: Oreane Edelenbosch
- SDSN: Guido Schmidt-Traub, Juan Manuel Puyana, Jeff Sachs, Gary Verburg, John Biberman, Juan Puyana
- SDG Centre Africa: George Sempeho
- SRC: Ana Paula Aguir, Lars Berg, Tiine Häyhä, Johan Rockström, Owen Gaffney, David Collste, Uno Svedin, Sarah Cornell
- University of Washington: Kristie L. Ebi, Samuel Sellers
- IIASA: Benigna Boza-Kiss, Sebastian Busch, Geoff Clarke, **Shinichiro Fujimori**, Anne Goujon, Arnulf Grubler, **Tomoko Hasegawa**, Peter Kolp, David McCollum, Raya Muttarak, Nebojsa Nakicenovic, Michael Obersteiner, Shonali Pachauri, Simon Parkinson, Keywan Riahi, **Yoshi Wada**, Caroline Zimm



The World in 2050 Network

- Centre for Integrated Studies on Climate Change and the Environment (CIRED)
- Climate Center Service Germany (GERICS)
- Earth Institute, Columbia University
- European Commission, Joint Research Centre (JRC)
- Energy Planning Program, COPPE, Federal University of Rio de Janeiro
- Environmental Change Institute (ECI) at the University of Oxford
- Fondazione Eni Enrico Mattei (FEEM)
- Future Ocean
- German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE)
- International Institute for Applied System Analysis (IIASA)
- Millennium Institute
- MIT Joint Program on the Science and Policy of Global Change
- National Institute for Environmental Studies (NIES)
- National Renewable Energy Laboratory (NREL)
- Organisation for Economic Co-operation and Development (OECD)
- Potsdam Institute for Climate Impact Change (PIK)
- Stockholm Resilience Centre
- Sustainable Development Solutions Network (SDSN)

THE EARTH INSTITUTE
COLUMBIA UNIVERSITY



NATIONAL INSTITUTE FOR
ENVIRONMENTAL STUDIES



Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship



The World in 2050 Network

- Alpen-Adria University (AAU)
- Analysis, Integration and Modelling of the Earth System (AIMES)
- Austrian Research Promotion Agency
- Australian National University (ANU)
- Arizona State University (ASU)
- University of Natural Resources and Life Sciences (BOKU)
- Brazilian Federal Agency for the Support and Evaluation of Graduate Education (CAPES)
- Centro Nacional de Monitoramento e Alertas de Desastres Naturals (CEMADEN)
- Centre for Global Sustainability Studies (CGSS)
- Commonwealth Scientific and Industrial Research Organization (CSIRO)
- Conservation International
- Earth League, whole Earth system modelling initiative
- Empresa Brasileira de Pesquisa Agropecuária (Embrapa)
- Forestry and Forest Products Research Institute (FFPRI)
- Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)
- Fundação Oswaldo Cruz
- Future Earth
- Global Environment Facility (GEF)
- Imperial College
- Indian Institute of Technology (IIT)
- Institute for Advanced Sustainability Studies (IASS)
- Institute for Global Environmental Strategies (IGES)
- International Energy Agency (IEA)



International Energy Agency
Secure • Sustainable • Together



The World in 2050 Network

- International Food Policy Research Institute (IFPRI)
- International Monetary Fund (IMF)
- Intergovernmental Panel on Climate Change (IPCC)
- Korea University (KU)
- London School of Hygiene & Tropical Medicine
- Mercator Research Institute on Global Commons and Climate Change (MCC)
- National Center for Atmospheric Research (NCAR)
- National Science Foundation (NSF)
- Pacific Northwest National Laboratory (PNNL)
- PBL - Netherlands Environmental Assessment Agency
- Research Institute of Innovative Technology for the Earth (RITE)
- Rheinisch-Westfälische Technische Hochschule Aachen (RWTH)
- Stakeholder Forum
- Swedish Research Council for Sustainable Development (FORMA)
- Tsinghua University
- United Nations Department of Economic and Social Affairs (UNDESA)
- United Nations Environment Programme (UNEP)
- Université Catholique de Louvain
- University of Sussex
- US National Academy of Sciences (NAS)
- World Bank
- World Wildlife Fund (WWF)



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



Pacific Northwest
NATIONAL LABORATORY



Research Institute of Innovative
Technology for the Earth



United Nations
Department of Economic and Social Affairs



PBL Netherlands Environmental
Assessment Agency



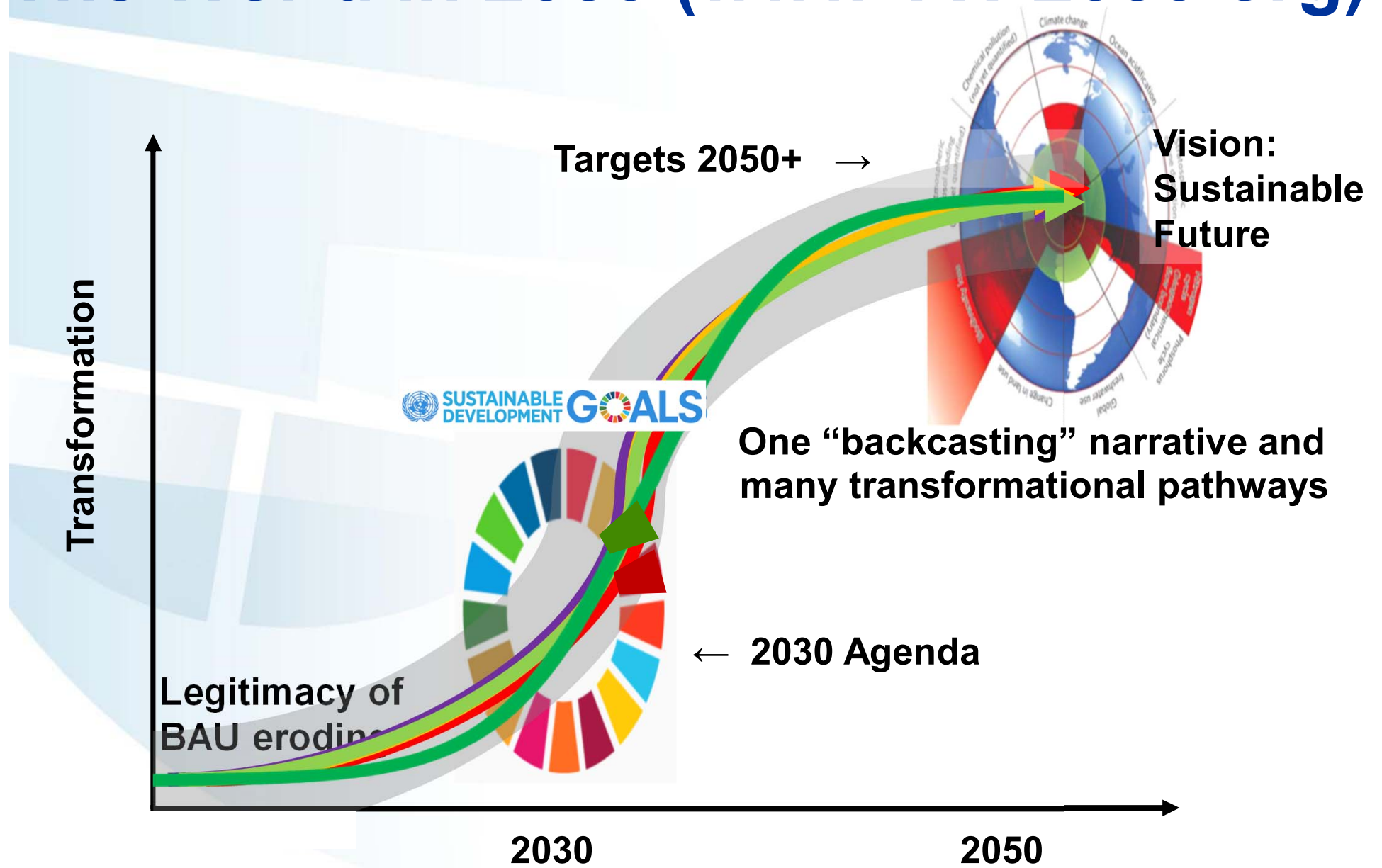
STAKEHOLDER
FORUM



Some Key Messages

- ➔ Attaining the SDGs in a resilient and lasting way, requires vigorous action now, **and a people and planet focus beyond 2030!**
- ➔ As everything is integrated in the connected world, the grand **transformation requires a holistic perspective!**
- ➔ Transformational change is needed but to succeed we must **take along winners and losers!**
- ➔ The world is at crossroads as we are currently experiencing signs of a **counter-transformation!**
- ➔ A central element of the sustainability transformation is **effective and inclusive governance!**
- ➔ Think globally, act locally! Think long-term, act now!

The World in 2050 (www.TWI2050.org)



Six Major Transformations (TWI2050.org)

Digital revolution

Artificial intelligence, big data, biotech, nanotech, autonomous systems



Human capacity & demography

Education, health, ageing, labor markets, gender, inequalities



SDGs:

Prosperity
Social Inclusion
Sustainability



The World in 2050
www.twi2050.org

Consumption & production

Resource use, circular economy, sufficiency, pollution



Smart cities

Decent housing, mobility, sustainable infrastructure, pollution



Food, biosphere & water

Sustainable intensification, biodiversity, forests, oceans, healthy diets, nutrients



Decarbonization & energy

Energy access, efficiency, electrification, decent services



Six Major Transformations (TWI2050.org)

Digital revolution

Artificial intelligence, big data, biotech, nanotech, autonomous systems



Human capacity & demography

Education, health, ageing, labor markets, gender, inequalities



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Sustainable intensification, biodiversity, forests, oceans, healthy diets, nutrients



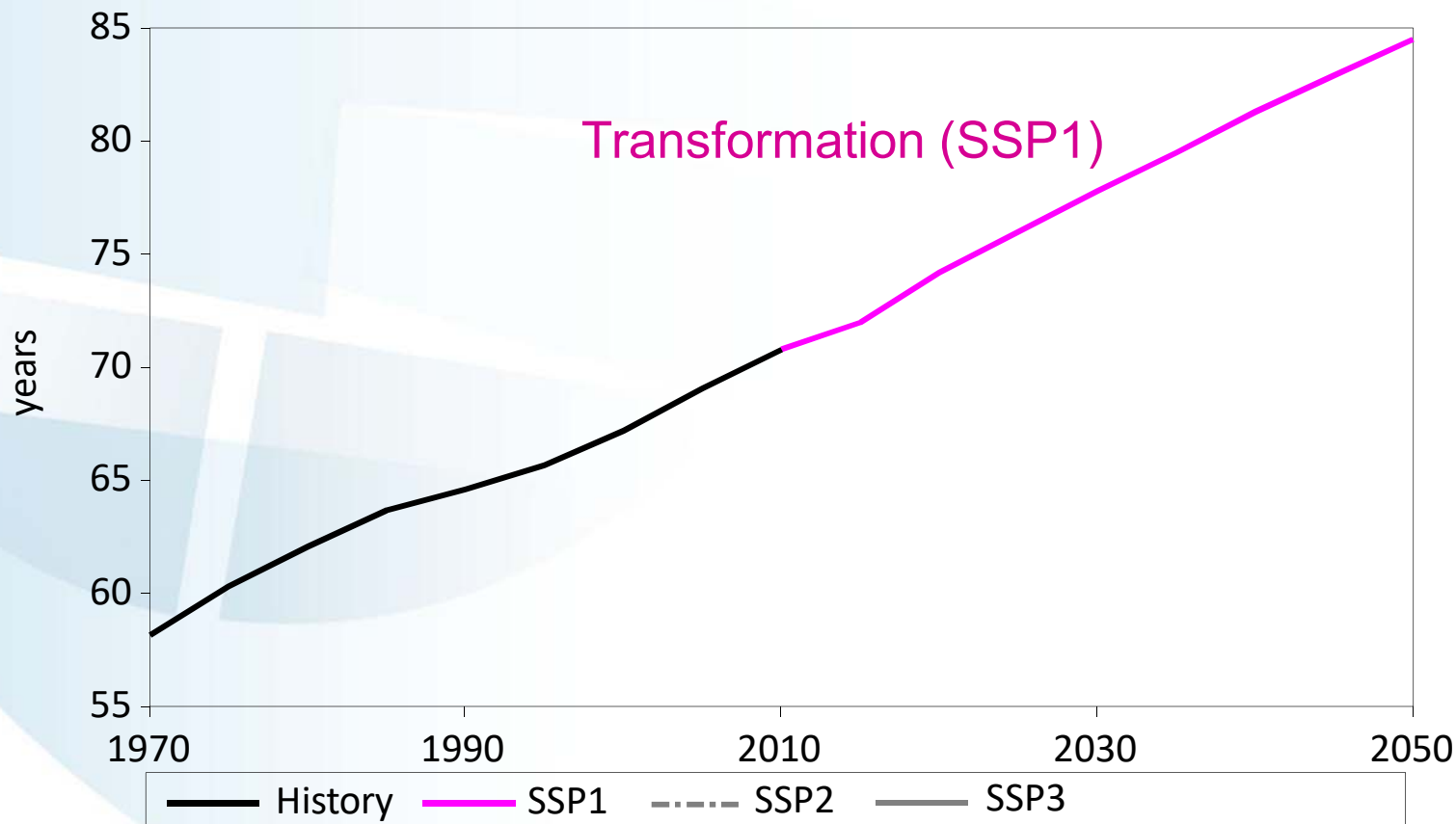
Decarbonization & energy

Energy access, efficiency, electrification, decent services



Human capacity & demography

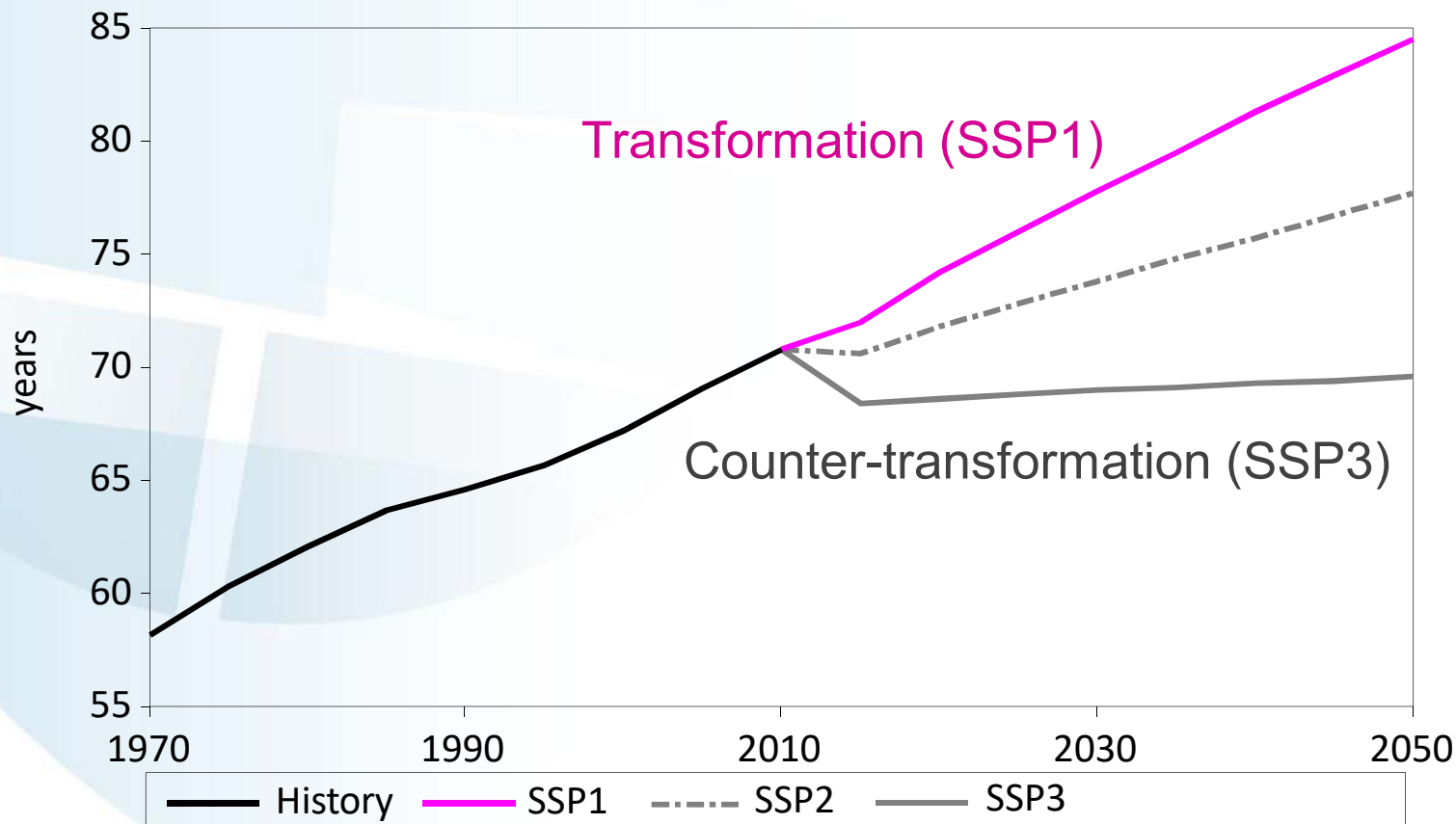
Life Expectancy



Source: UNDESA (2017) and Wittgenstein Centre for Demography and Global Human Capital (2015).

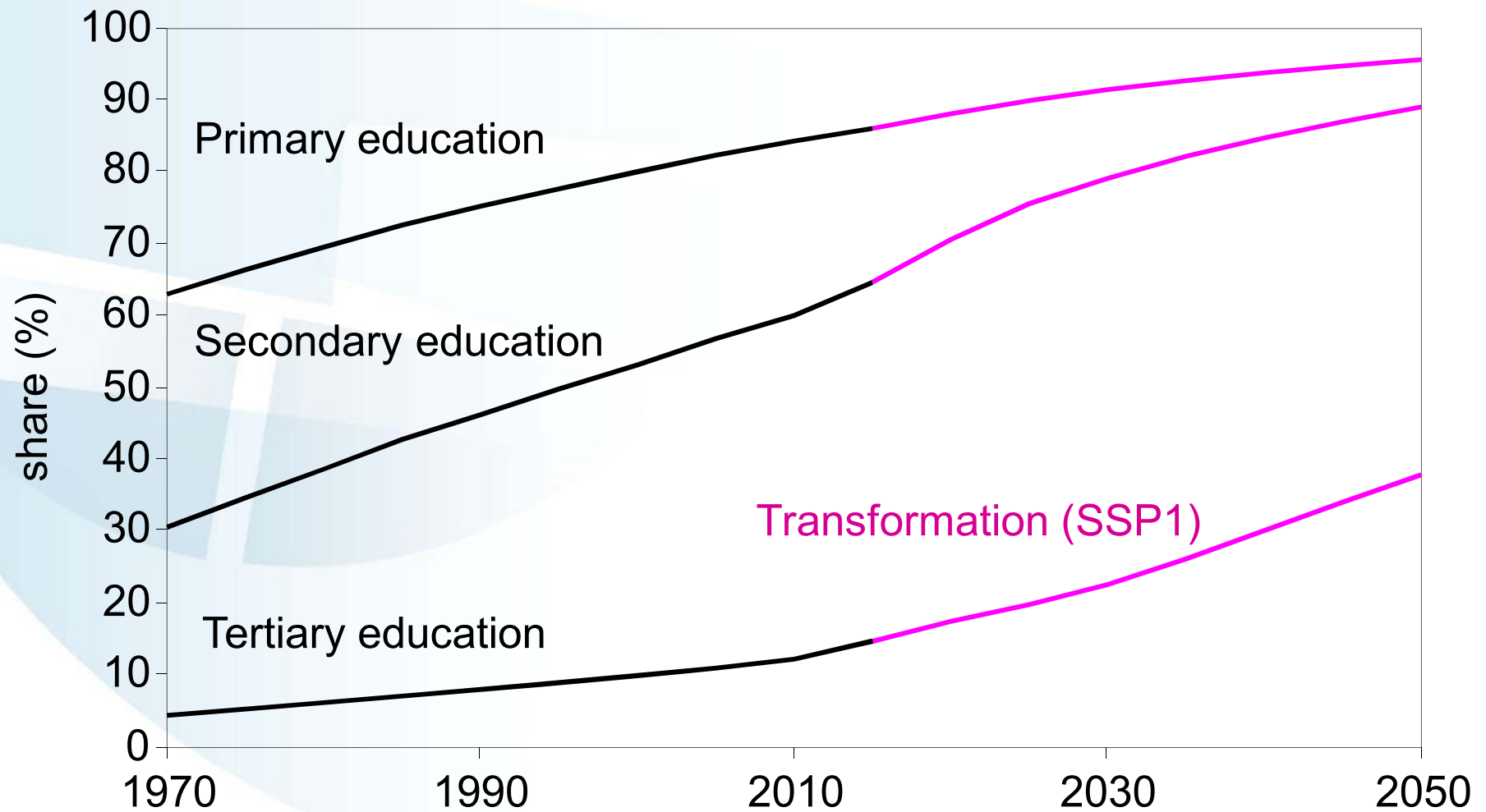
Human capacity & demography

Life Expectancy

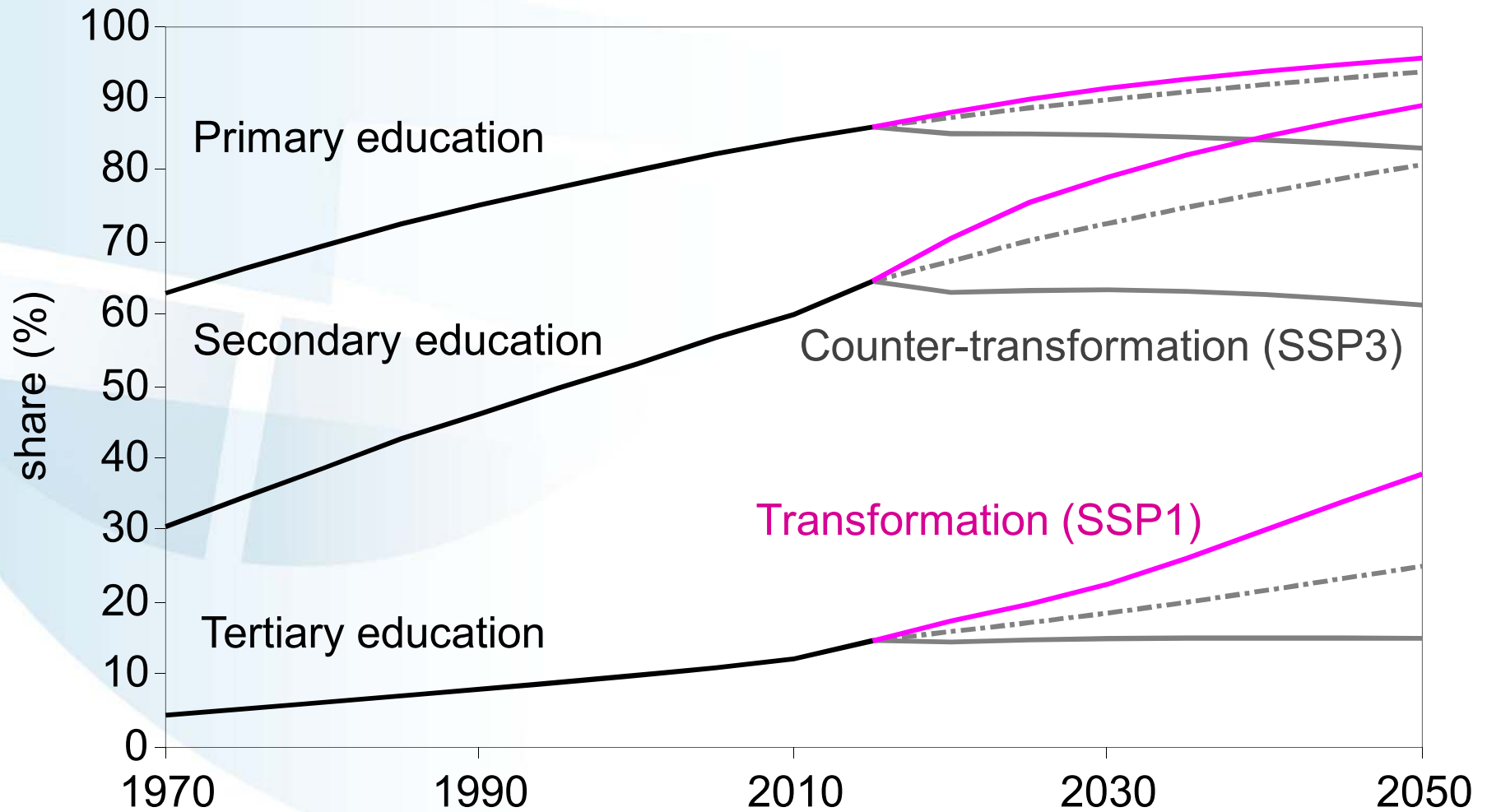


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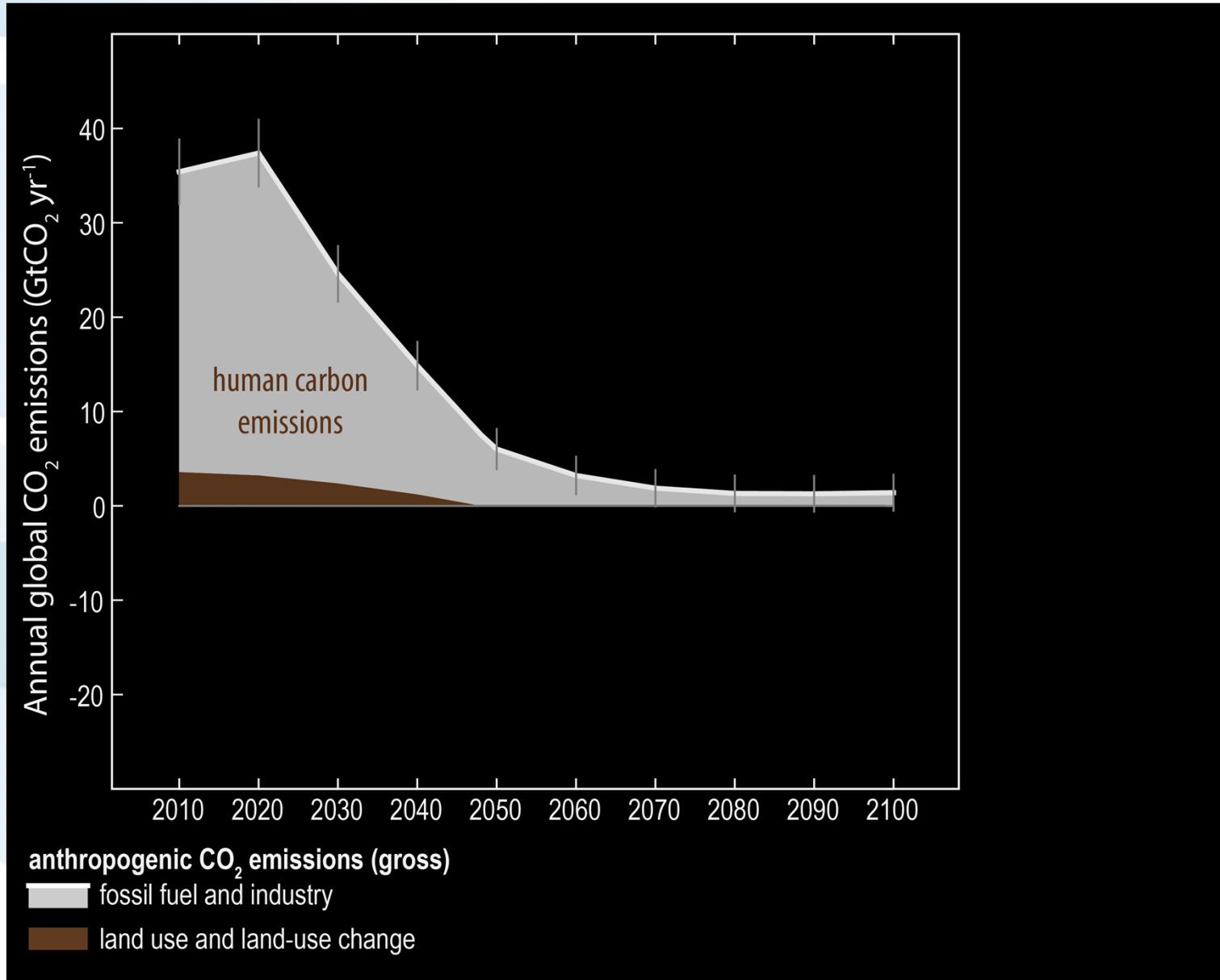
Education and Human Capacity



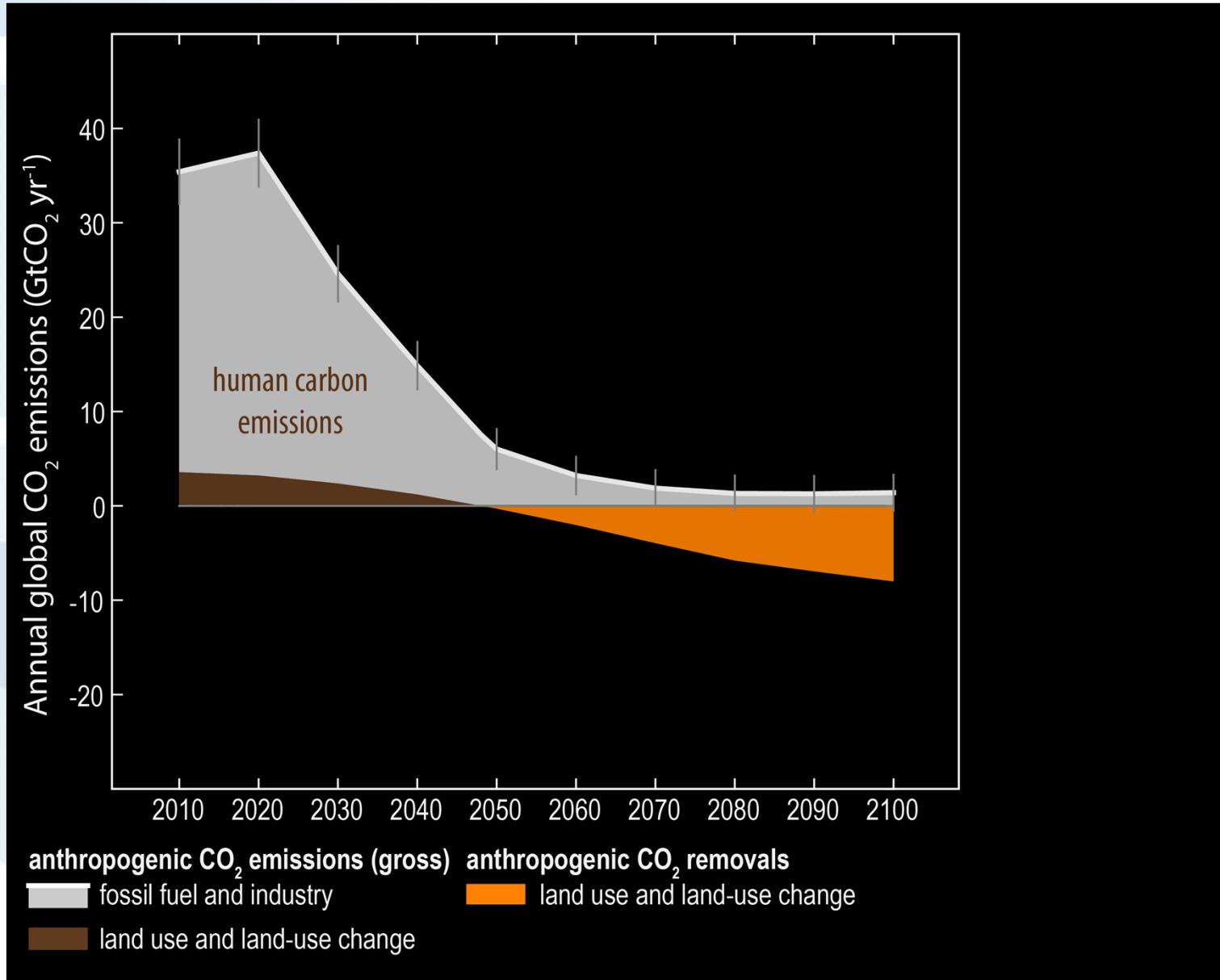
Education and Human Capacity



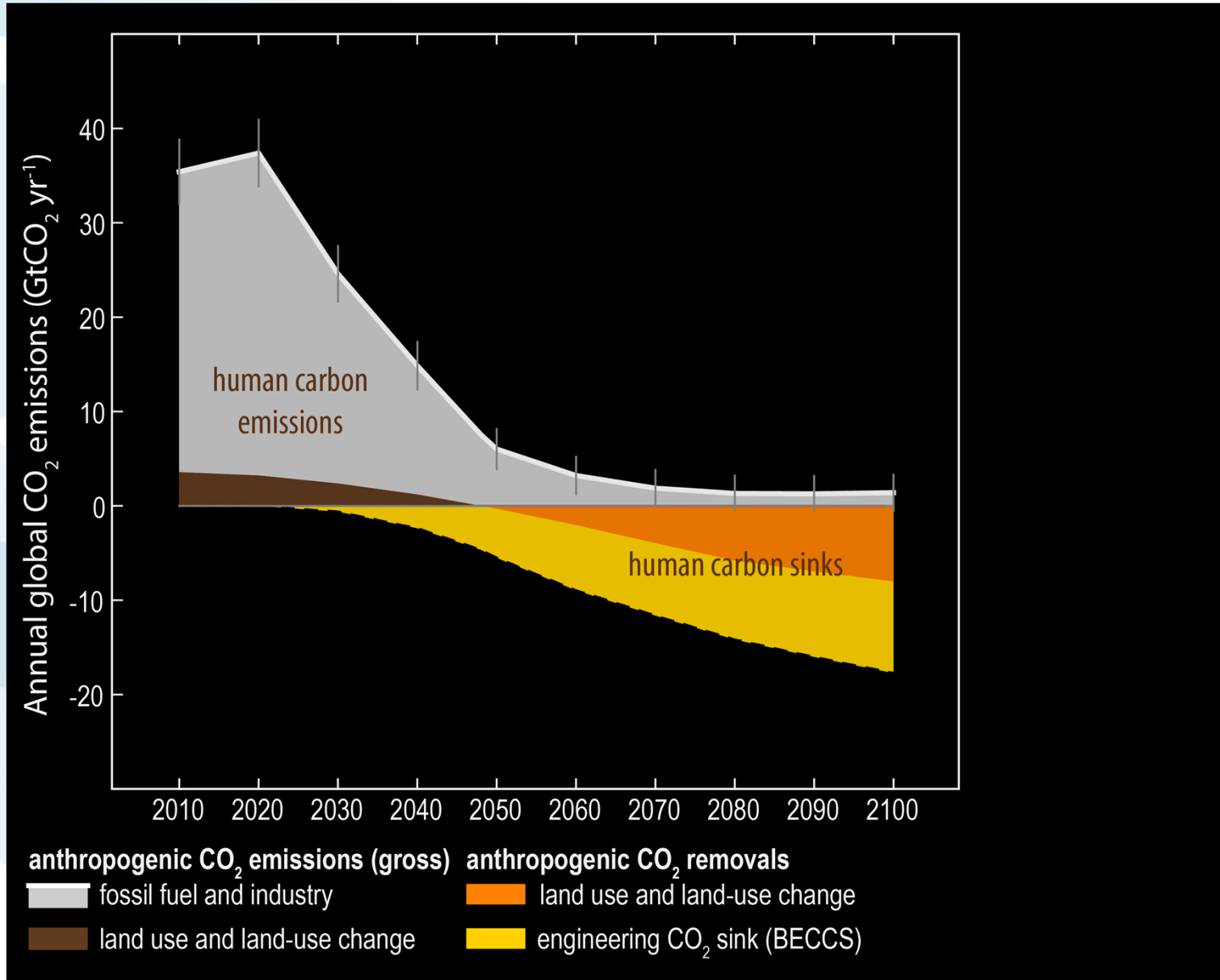
Moore's "Carbon Law"



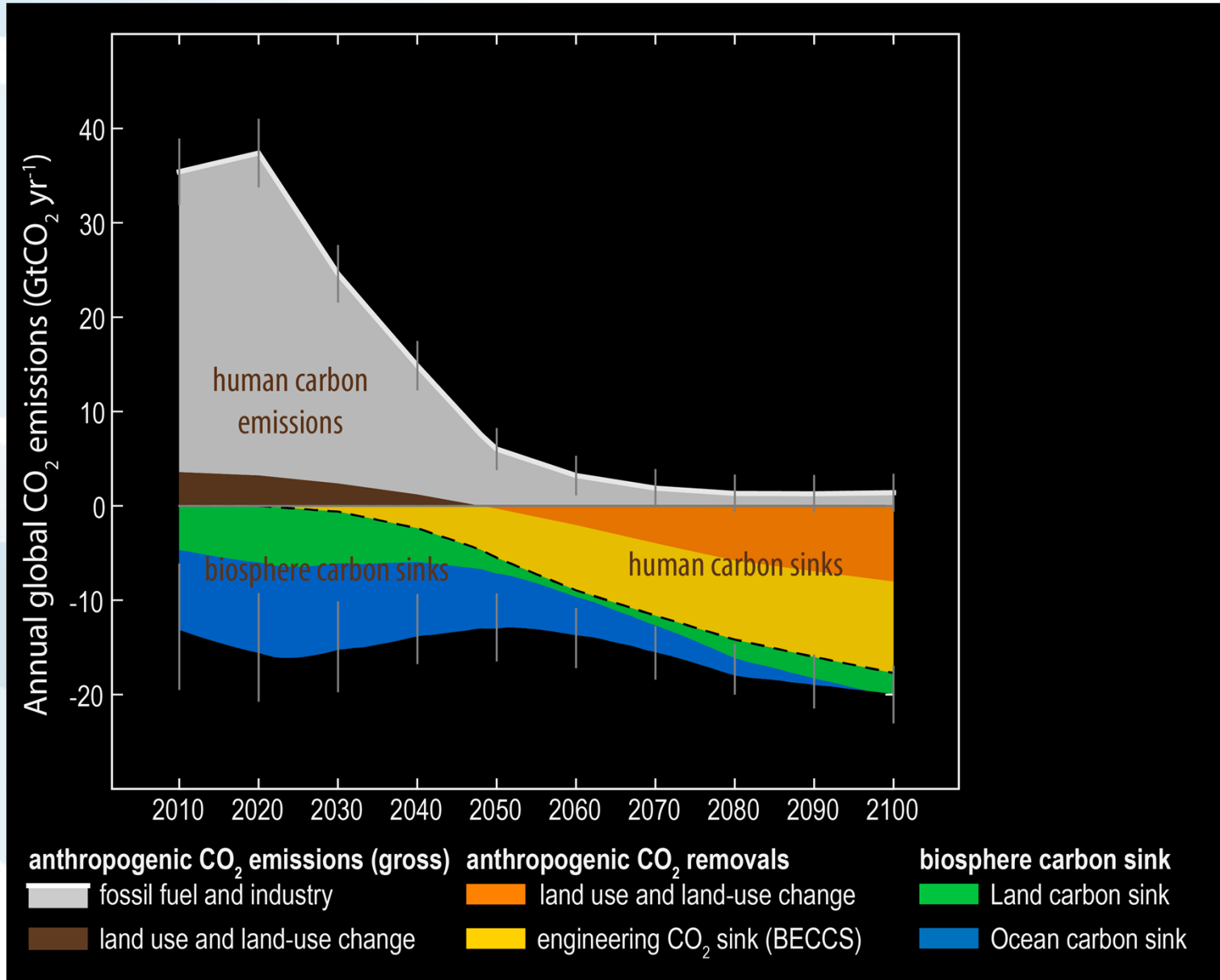
Moore's "Carbon Law"



Moore's "Carbon Law"



Moore's "Carbon Law"





Greenhouse gas emissions pathways

- To limit warming to 1.5°C, CO₂ emissions fall by about 45% by 2030 (from 2010 levels)
 - Compared to 20% for 2°C
- To limit warming to 1.5°C, CO₂ emissions would need to reach 'net zero' around 2050
 - Compared to around 2075 for 2°C
- Reducing non-CO₂ emissions would have direct and immediate health benefits



Greenhouse gas emissions pathways

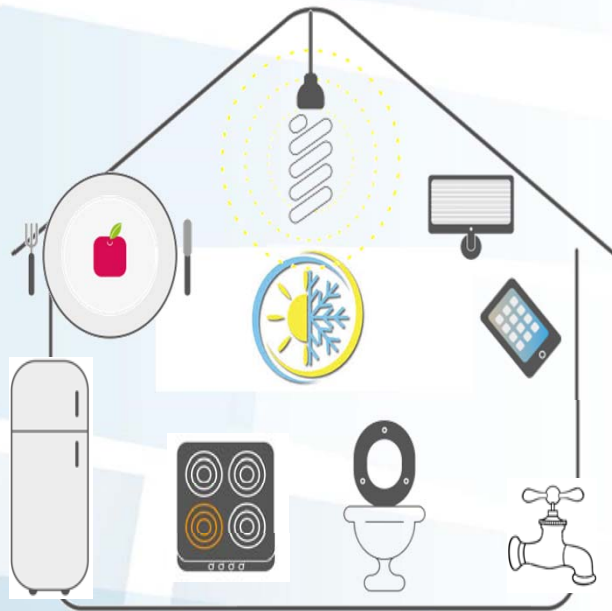
- Limiting warming to 1.5°C would require changes on an unprecedented scale
 - Deep emissions cuts in all sectors
 - A range of technologies
 - Behavioural changes
 - Increase investment in low carbon options



Greenhouse gas emissions pathways

- Progress in renewables would need to be mirrored in other sectors
- We would need to start taking carbon dioxide out of the atmosphere
- Implications for food security, ecosystems and biodiversity

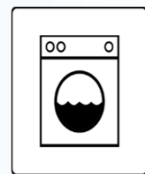
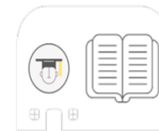
ALPS LED Energy for 'Decent Living'



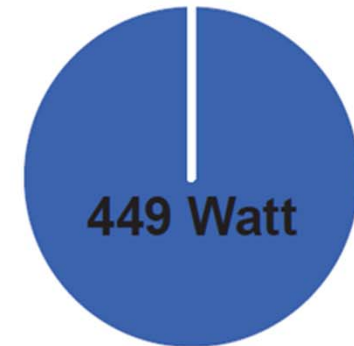
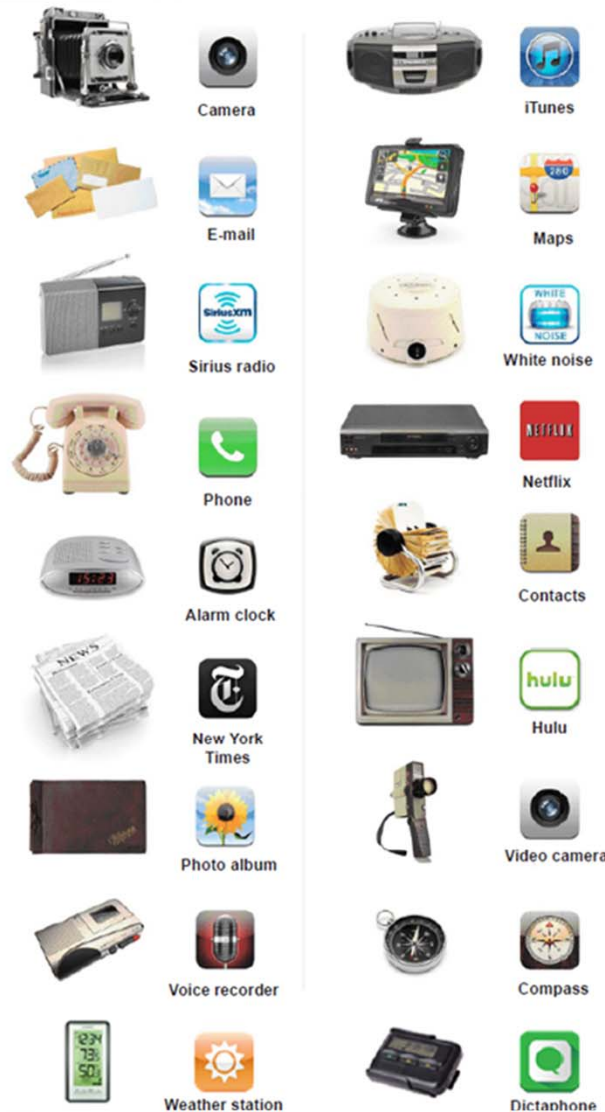
Household

Community

Society



Impact of IC Technology Convergence

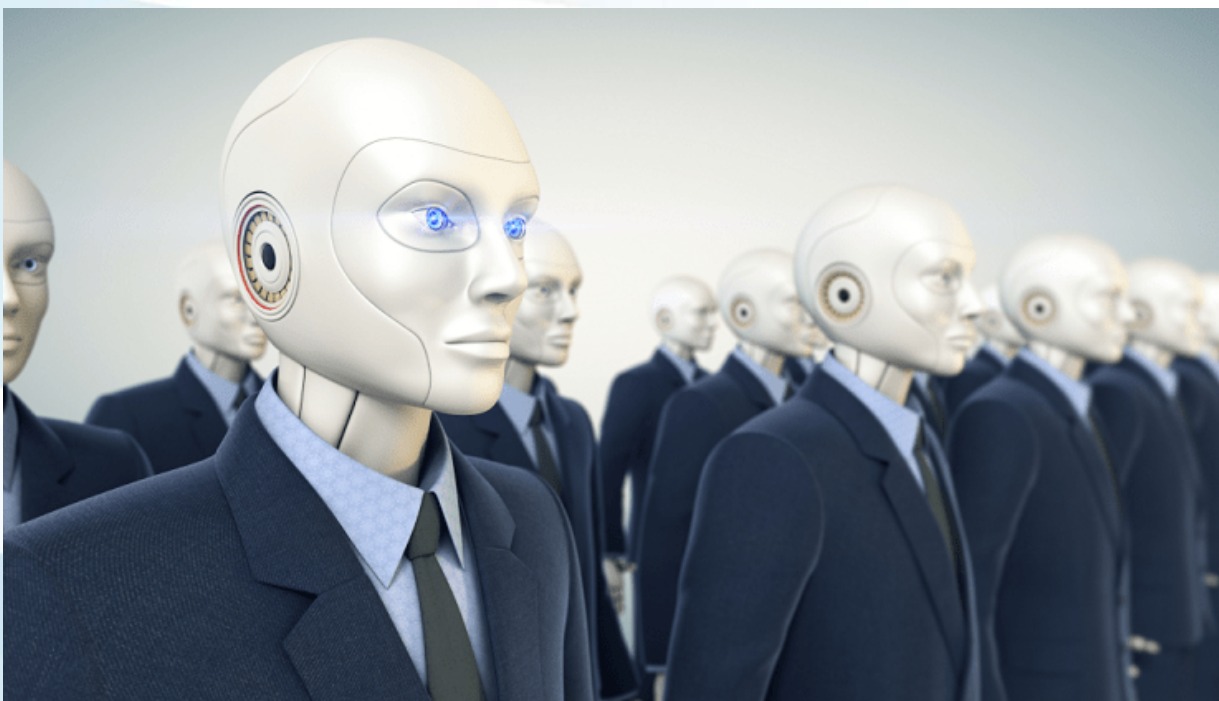


Power consumption

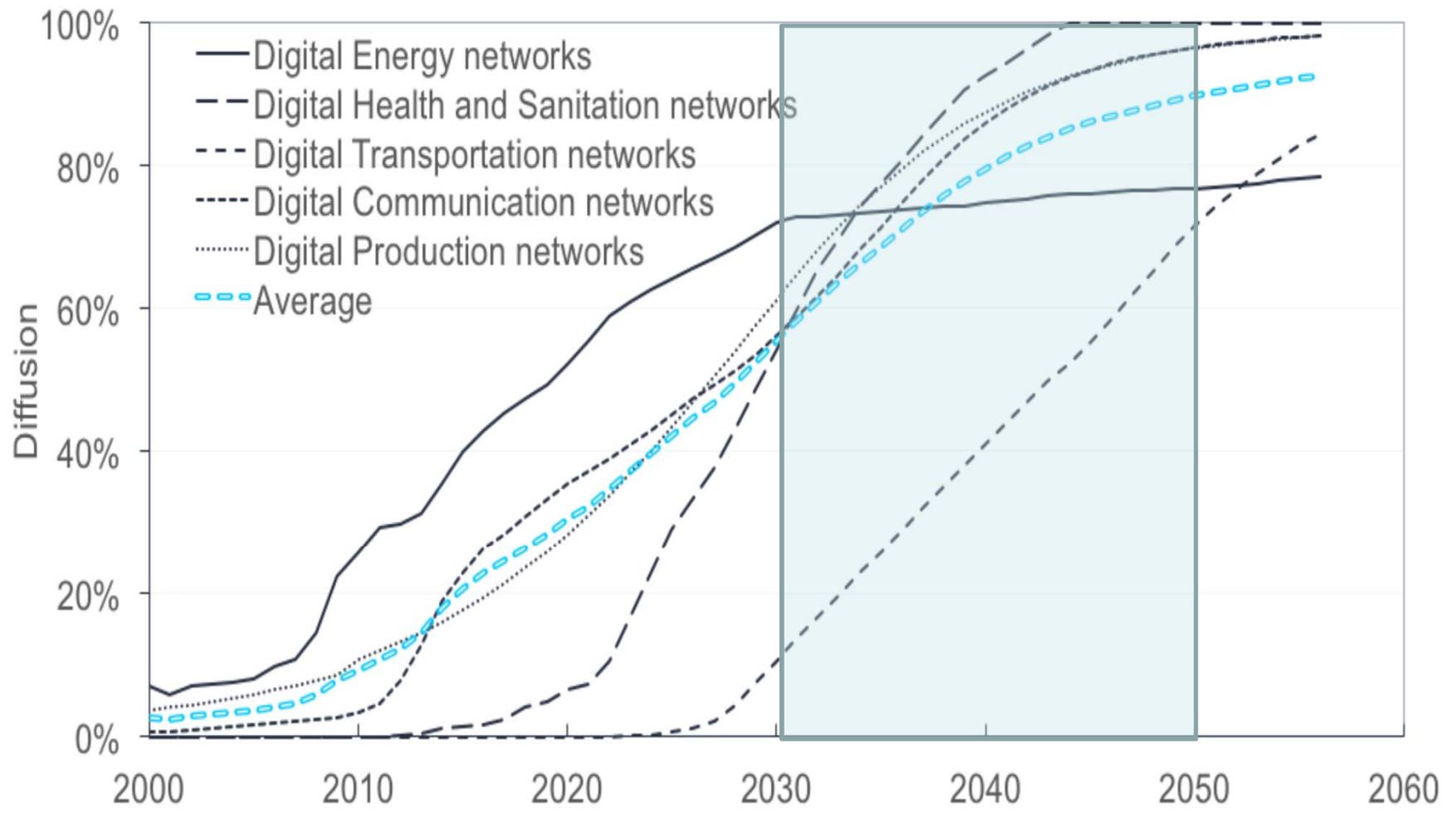


Stand-by

Digital Revolution



Technology Diffusion Compared digital revolution



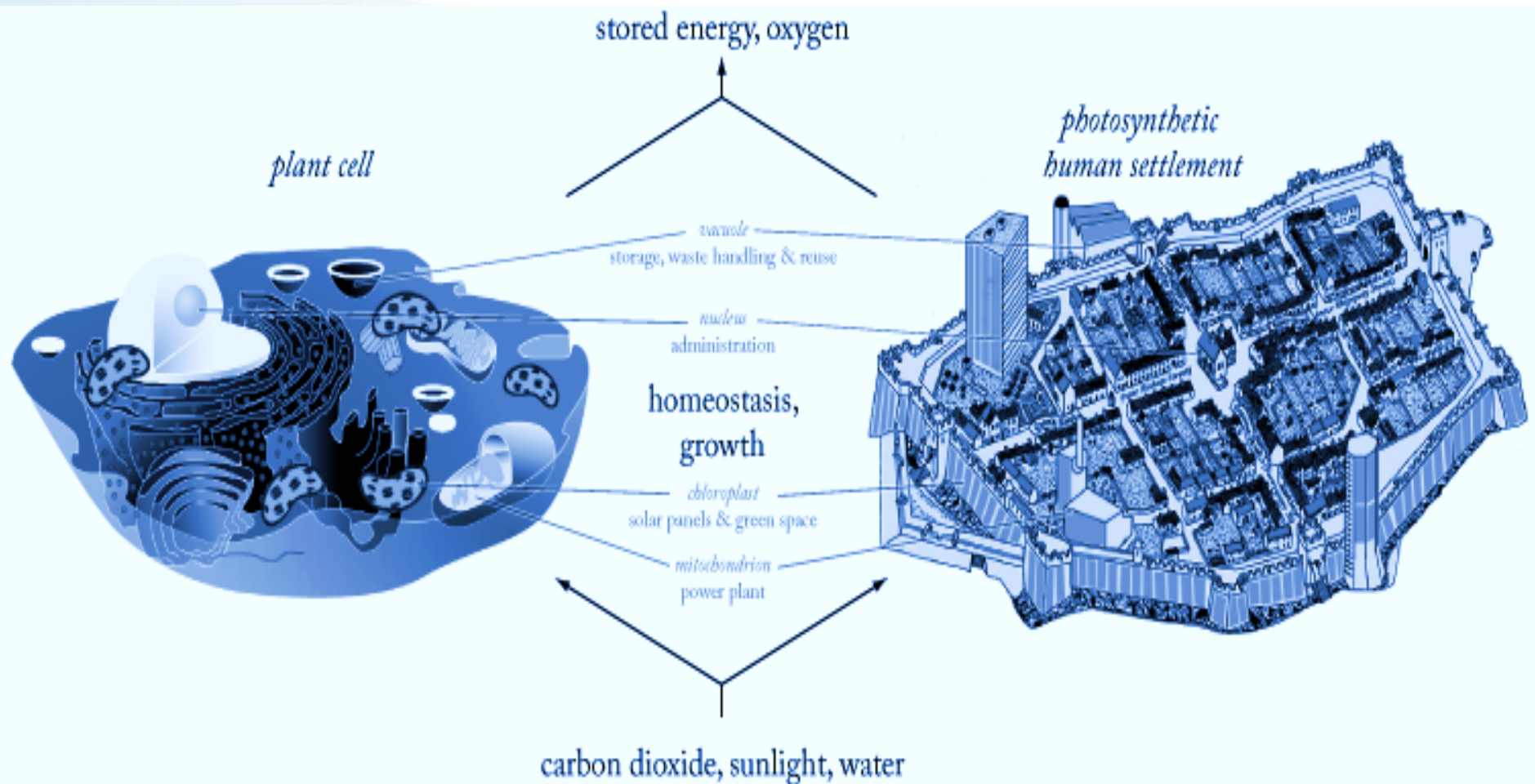
Smart Cities



<https://www.slideshare.net/manjumanjusha/ppt-on-smart-city>

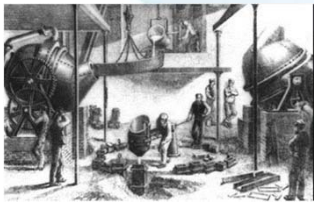


Urban Metabolism or Ecology

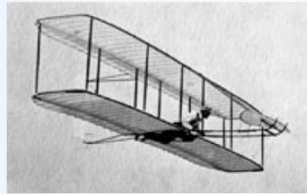


Transformational Change

1850



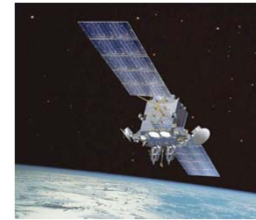
1900



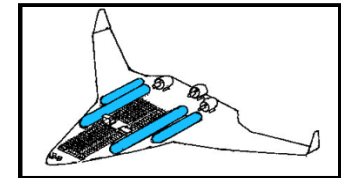
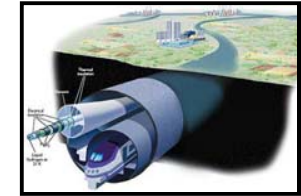
1950



2000



2050



Source: After Granger Morgan, 2013

2018 #60

Disruptive Change

Easter Parade on Fifth Avenue, New York, 13 years apart

1900: where's the car?

1913: where's the horse?



Images: L, National Archive, www.archives.gov/research/american-cities/images/american-cities-101.jpg
R, shorpy.com/node/204.
Inspiration: Tona Seba's keynote lecture at AltCar, Santa Monica CA, 28 Oct 2014,
<http://tonyseba.com/keynote-at-altcar-expo-100-electric-transportation-100-solar-by-2030/>

Sankt. Petersburg Airport Duty Free



The World in 2050 (www.TWI2050.org)

Possible Next Steps

- ➔ Further integration of the pathways
- ➔ Interpretation for developing roadmaps
- ➔ Regional and country perspectives
- ➔ Assessment of investment and financing
- ➔ Stronger linkage to science and technology
- ➔ Human capacity and learning processes
- ➔ Behavior, incentives and policy dimensions



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ありがとう

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