



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

science for global insight

Benefits of Systems Science

Professor Dr. Pavel Kabat
Director General & CEO, IIASA

Professor of Earth System Science,
Wageningen, Netherlands



IIASA, International Institute for Applied Systems Analysis

THE EARLY 1970s





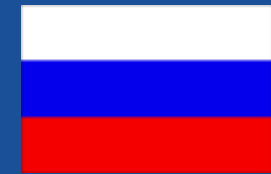
A GLOBAL RESEARCH INSTITUTE

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

21 NATIONAL MEMBER ORGANIZATIONS



➤ International, independent, interdisciplinary



➤ Research on major global problems: excellent science & science diplomacy



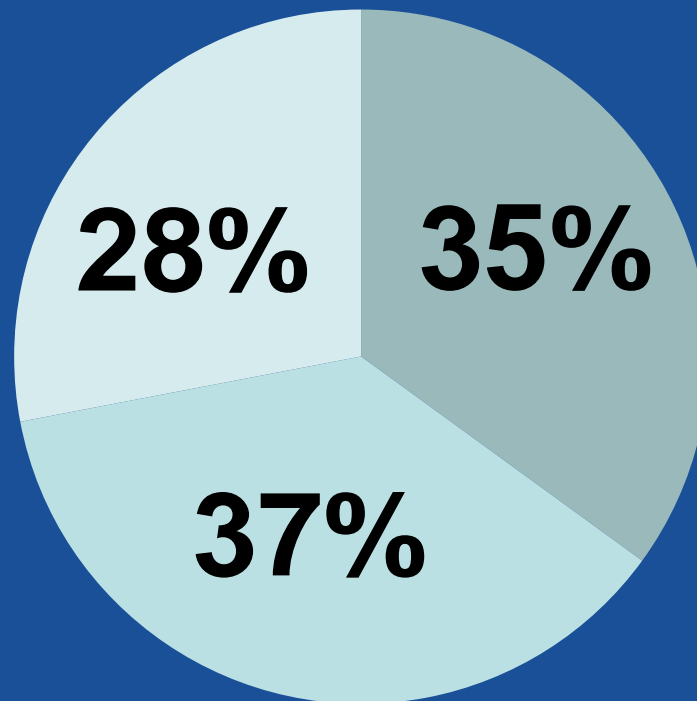
➤ Solution oriented, integrated systems analysis



IIASA: TRULY INTERNATIONAL

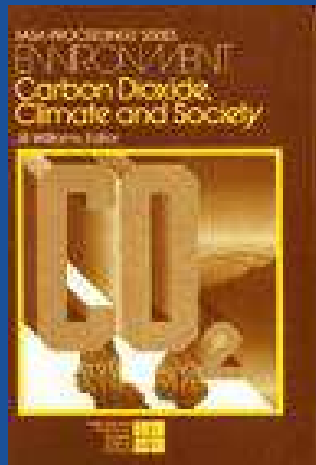
- **~ 300 researchers in house** include researcher scholars, research assistants, postdoctoral research scholars, and young scientists **from more than 50 countries**
- **~25%** of IIASA **alumni (3,475 people worldwide)** remain actively involved in IIASA research
- Active and formalized **collaboration with over 300 institutions worldwide**
- **900 visitors** (science & science diplomacy) coming to IIASA and **180 international meetings** hosted **in 2012**
- **~2050 researchers from some 65 countries** involved in IIASA's research network **in 2012**

INTERDISCIPLINARY



- Natural Scientists & Engineers
- Social Scientists
- Mathematicians and others

EXAMPLES OF EARLY RESEARCH



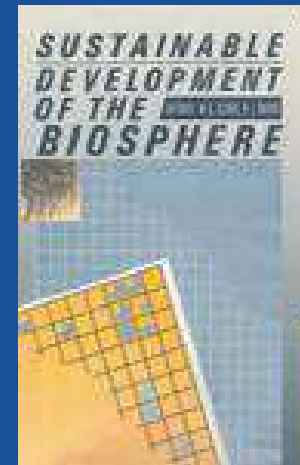
1978



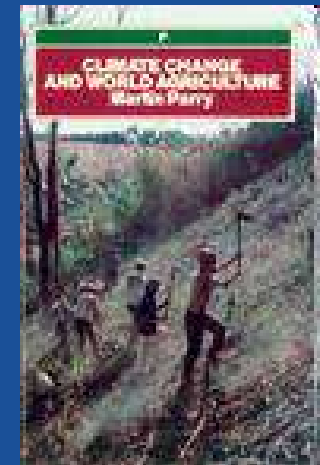
1981



1983



1986



1990

MAJOR GLOBAL CHALLENGES: INEXTRICABLY LINKED



IIASA'S SYSTEMS SCIENCE APPROACH

RESEARCHING GLOBAL CHALLENGES

- Integrated
- Interdisciplinary
- International
- Independent
- Solution-oriented
- Long term
- Trade offs



=

**Systems
Analysis**

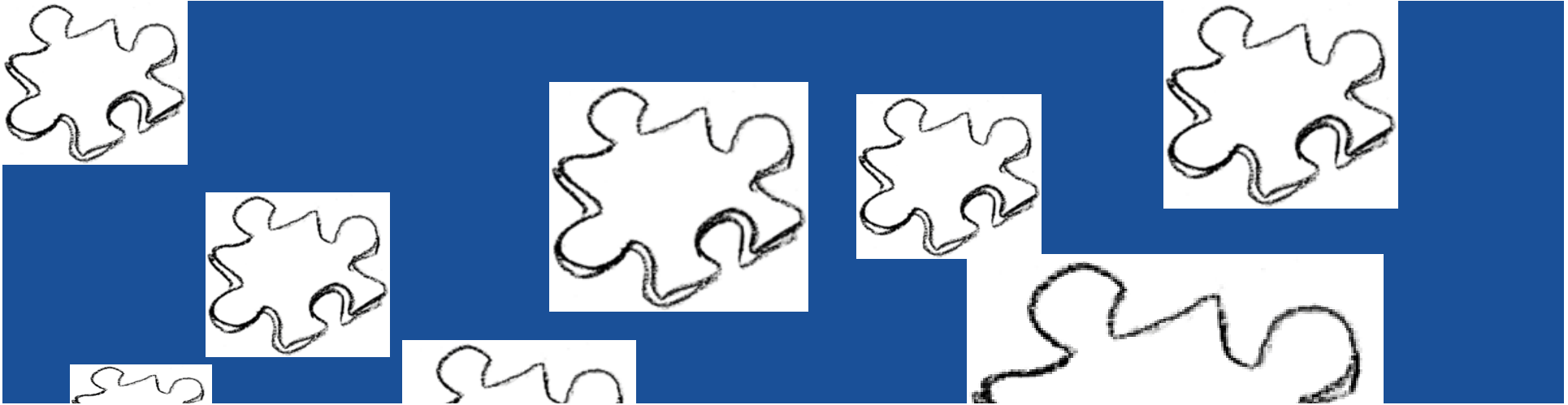
ADVANCED SYSTEMS ANALYSIS

PAST SUCCESSES

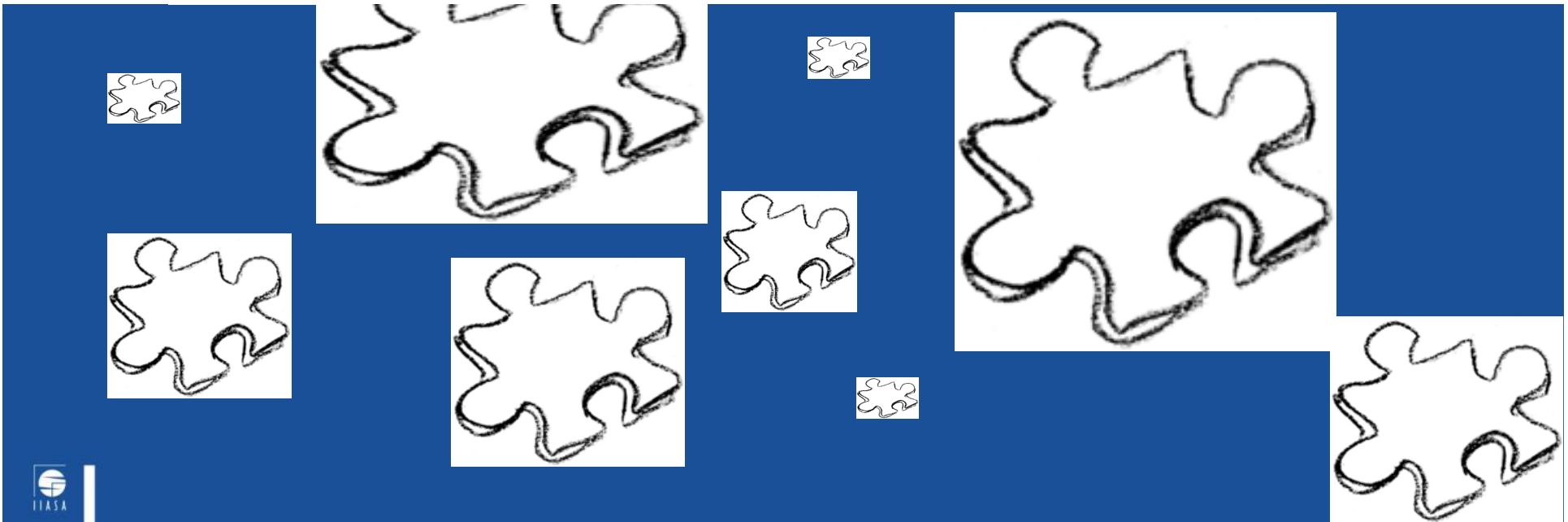
- **Dynamic Systems**
- **Multi-criteria decision analysis**
- **Adaptive dynamics theory**
- **Game theory**
- **Agent-based modeling**
- **Stochastic optimization**

NEW RESEARCH

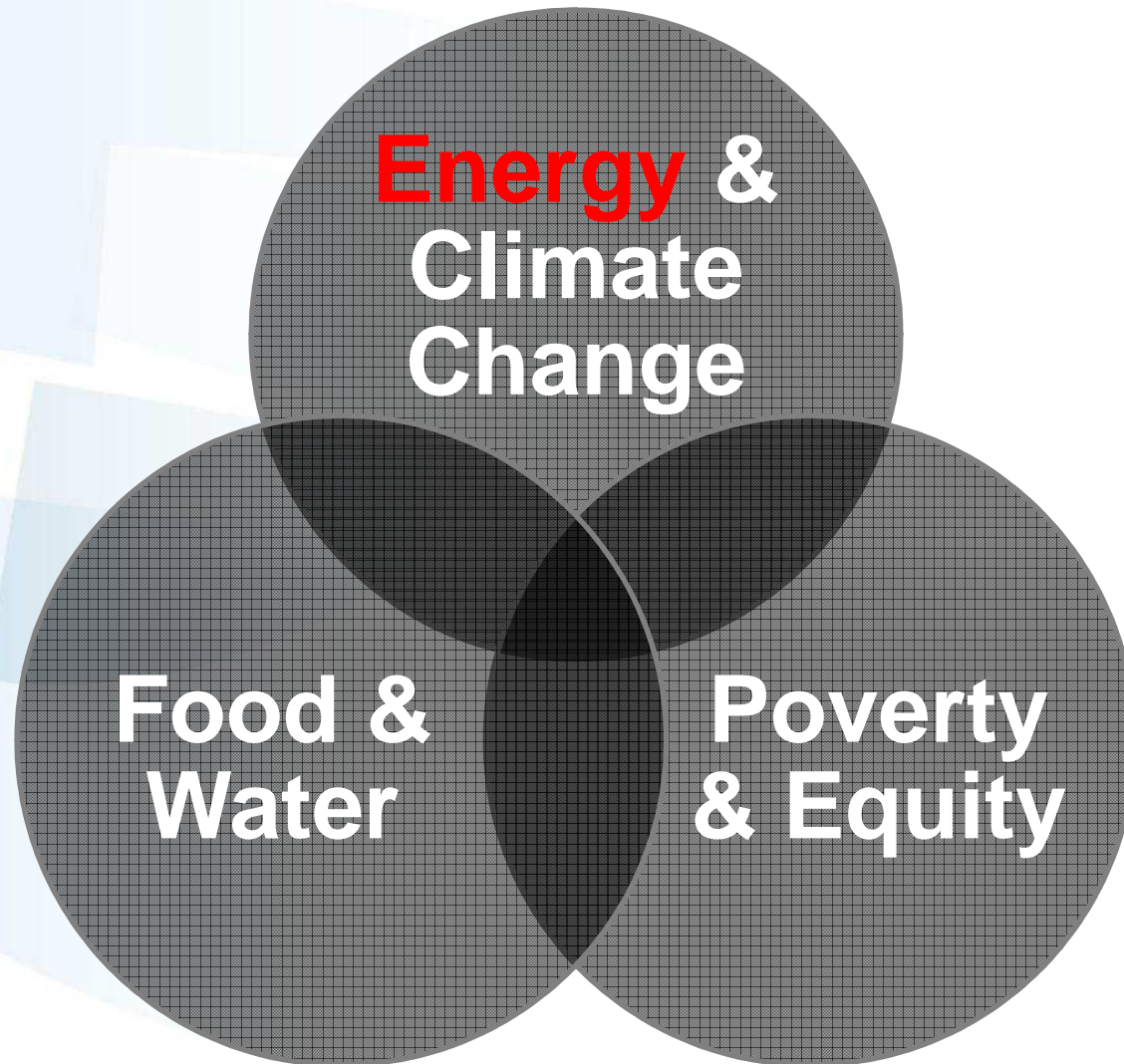
- **Advances in Modeling Dynamic Systems**
- **Extreme events, Systemic Risks and Robust Solutions**
- **Integrated Modeling and Decision Support**
- **Advanced Systems Analysis Forum**



**IIASA helps to put
the puzzle together**



INEXTRICABLY LINKED





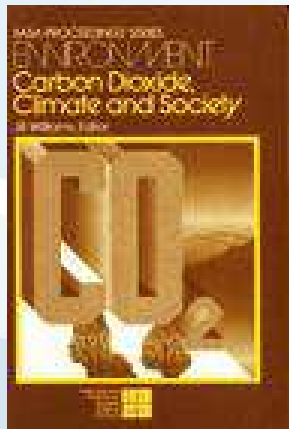
2012 INTERNATIONAL YEAR OF
SUSTAINABLE ENERGY
FOR ALL

2030 Energy Goals

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

Aspirational & Ambitious but Achievable

ENERGY & CLIMATE CHANGE: BUILDING ON PAST SUCCESSES



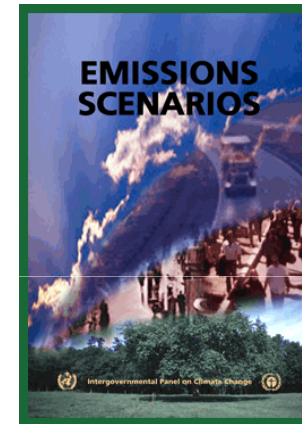
1976



1981

RAINS
helps
cut
sulfur
dioxide

1994



2000

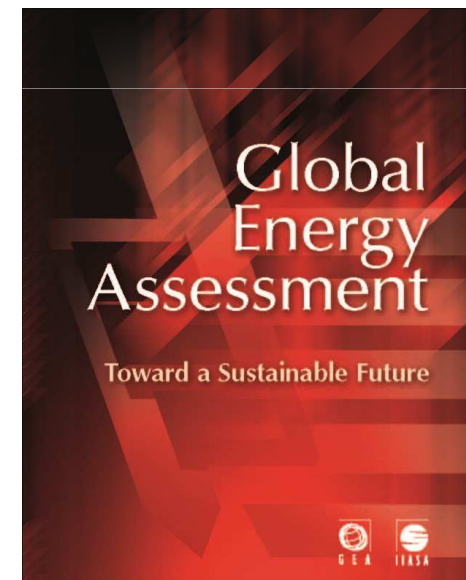
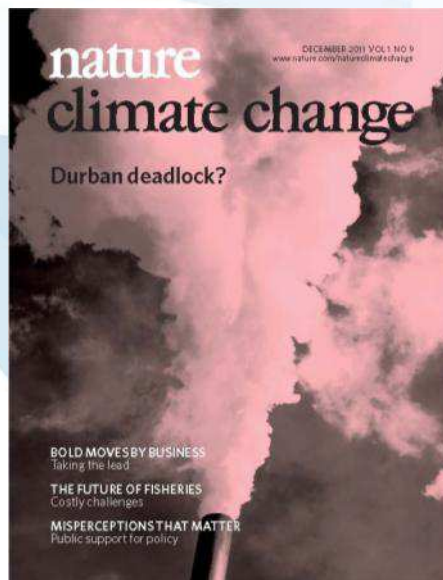
MESSAGE
has helped
over 80
countries
with energy
planning

2010

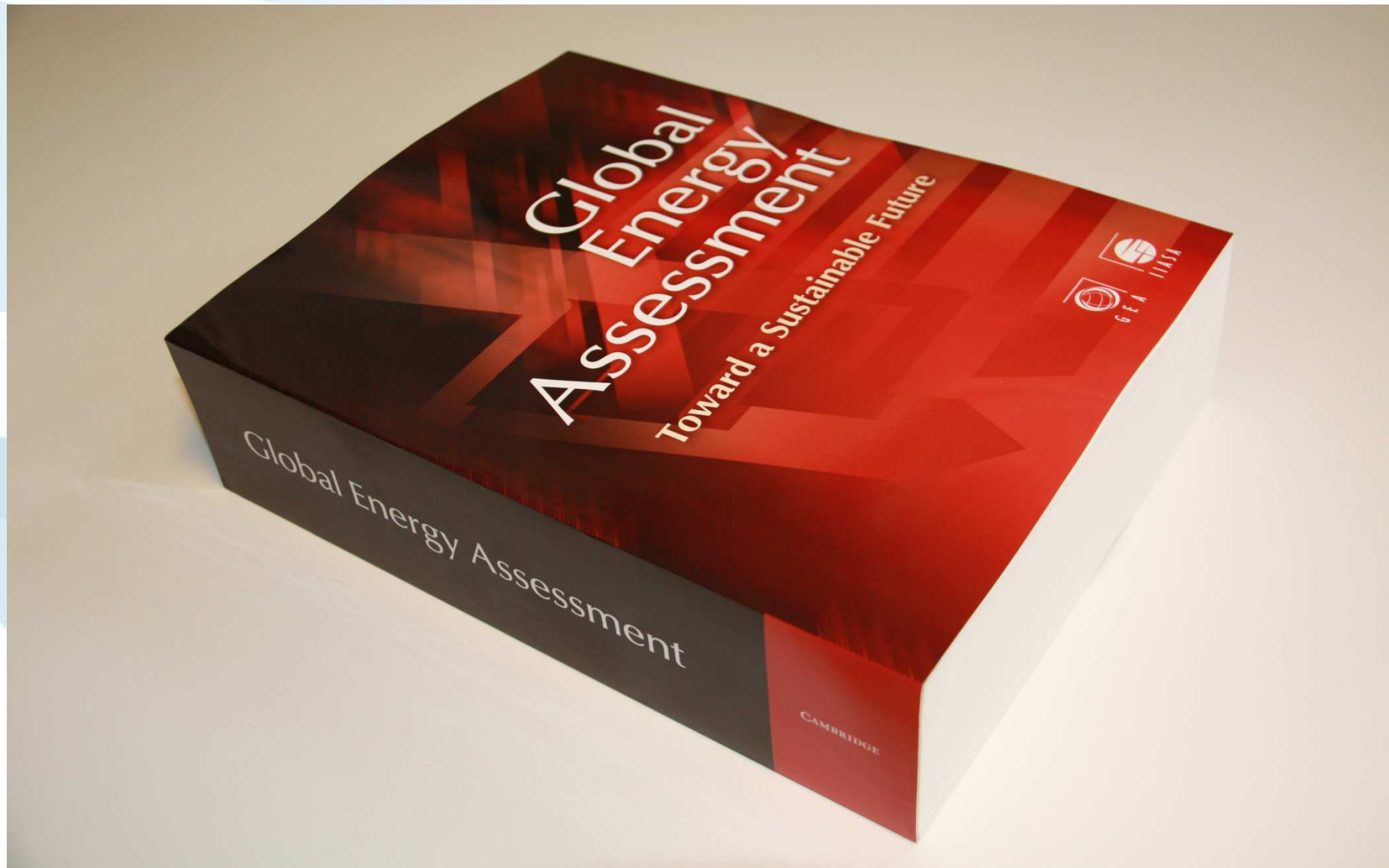
RESEARCH HIGHLIGHTS

Energy and Climate Change

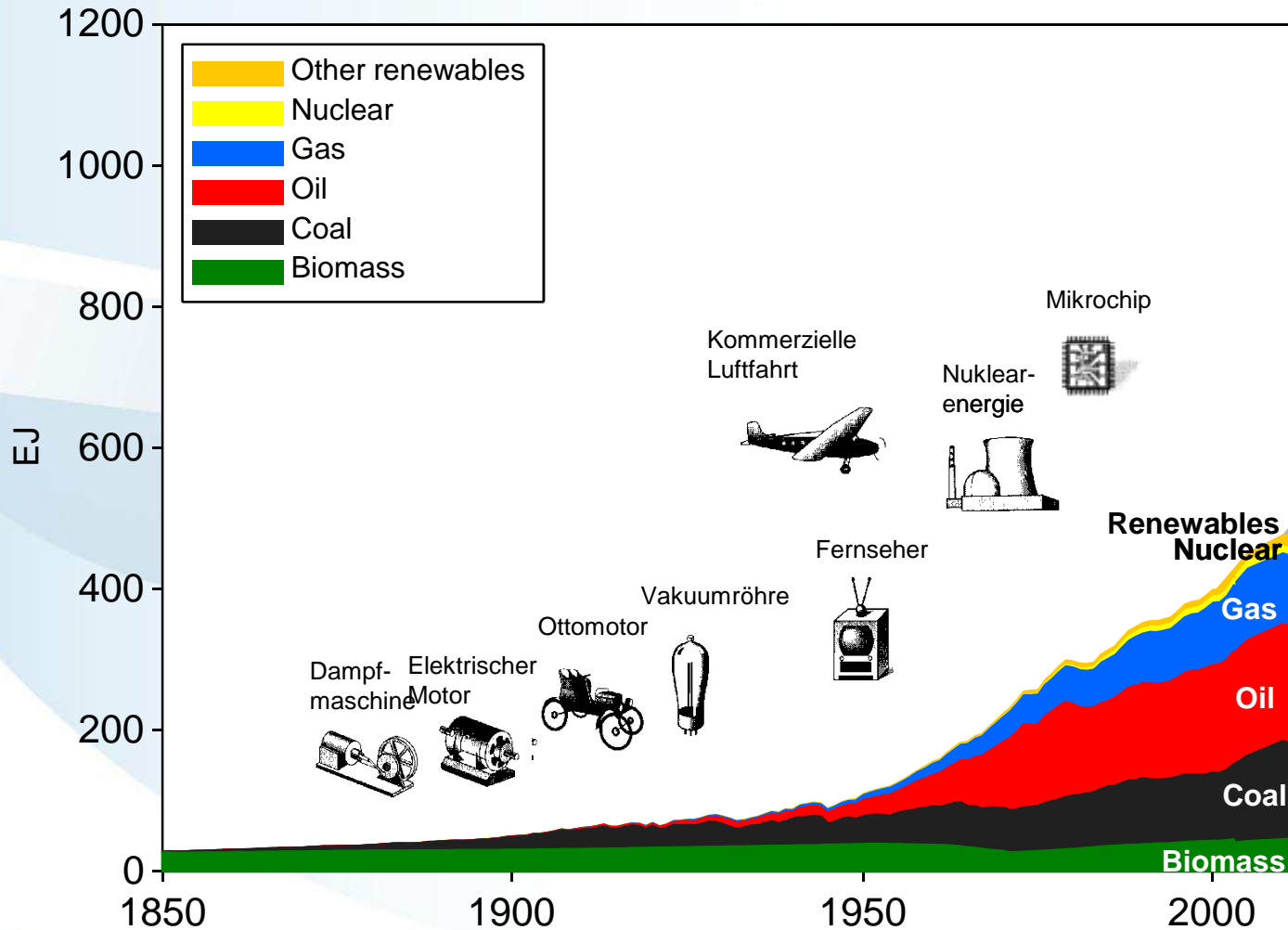
Highly Published



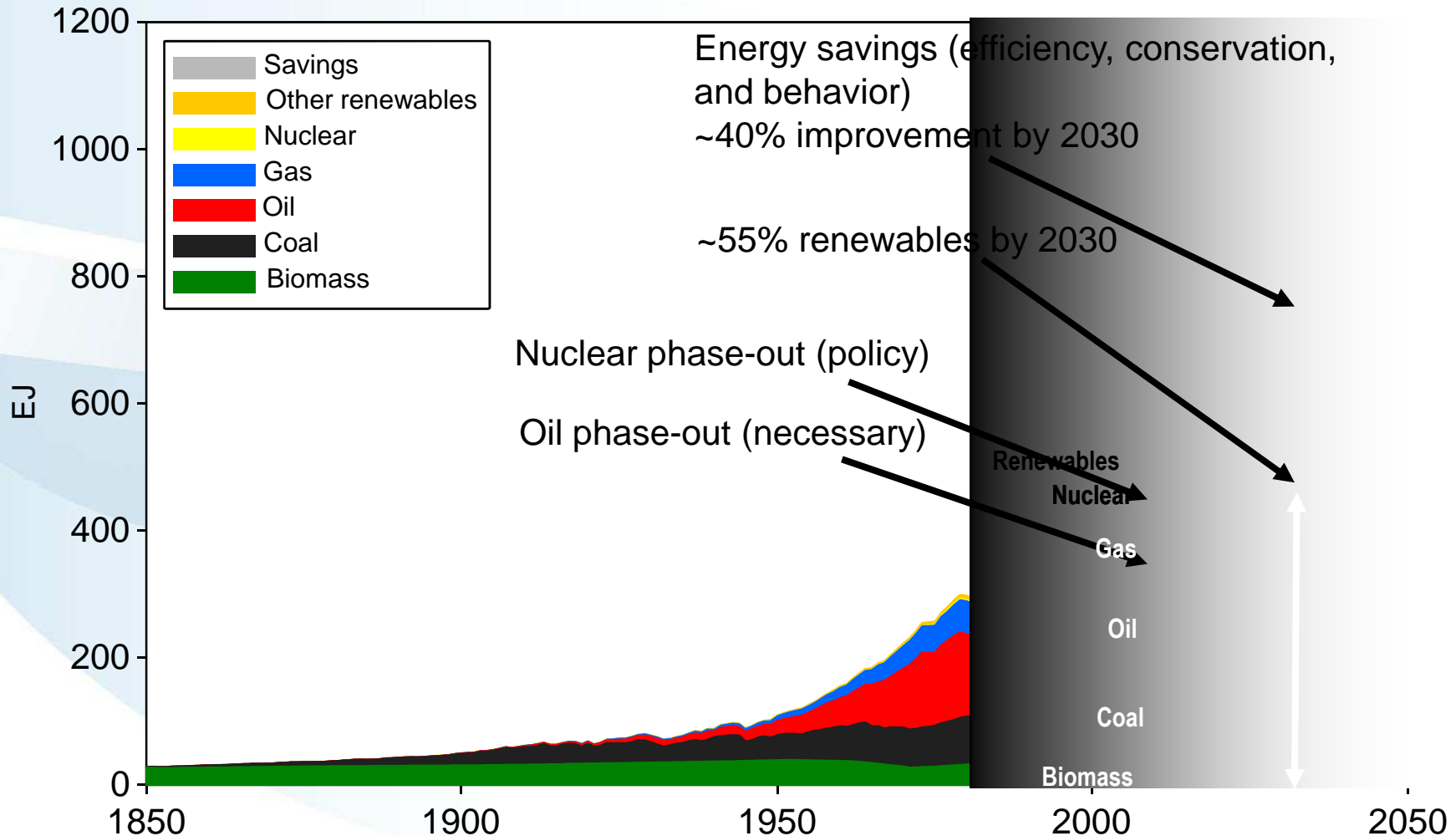
www.GlobalEnergyAssessment.org



Global Primary Energy



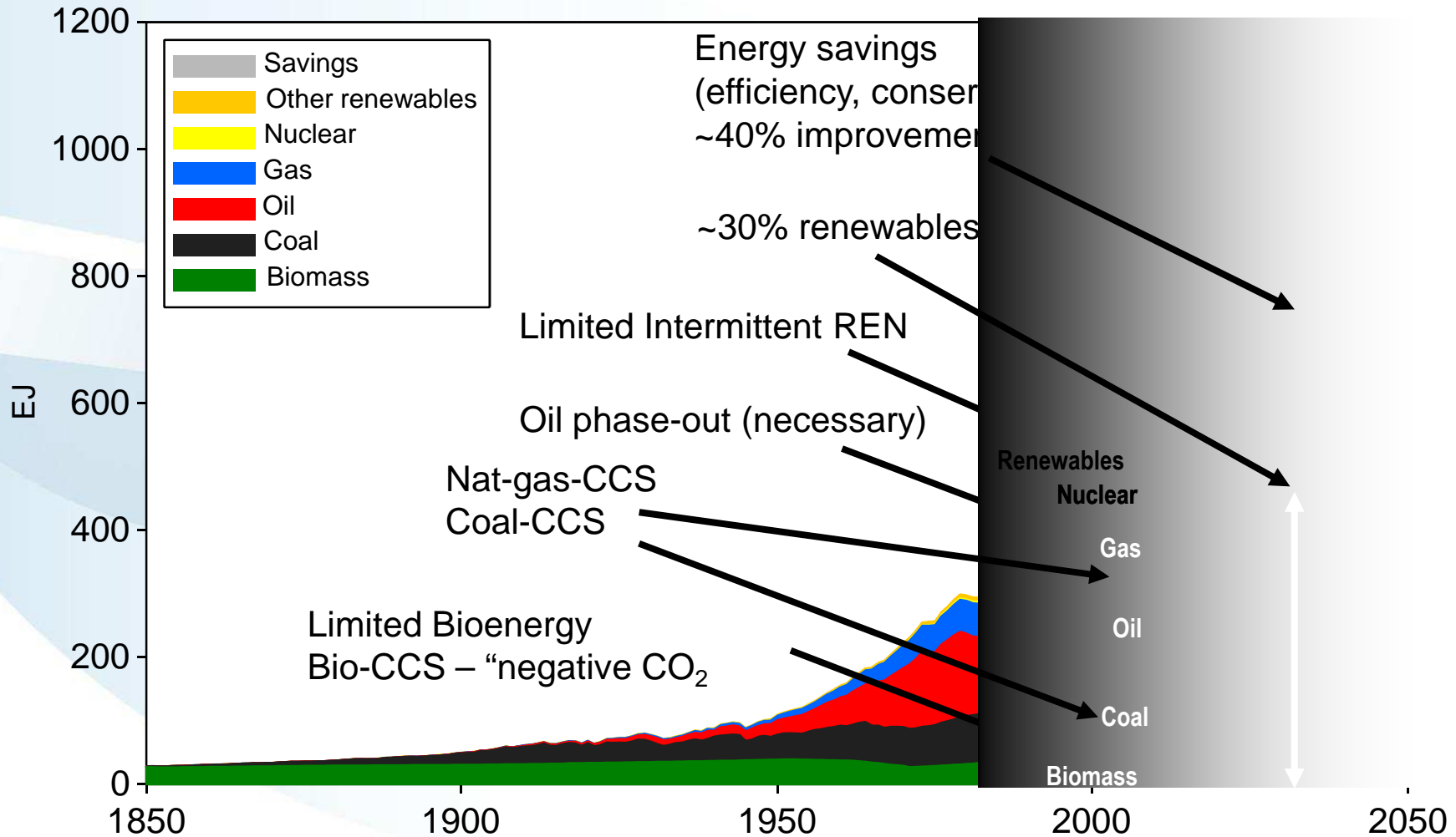
Global Primary Energy no CCS, no Nuclear



Source: Riahi et al, 2012

Global Primary Energy

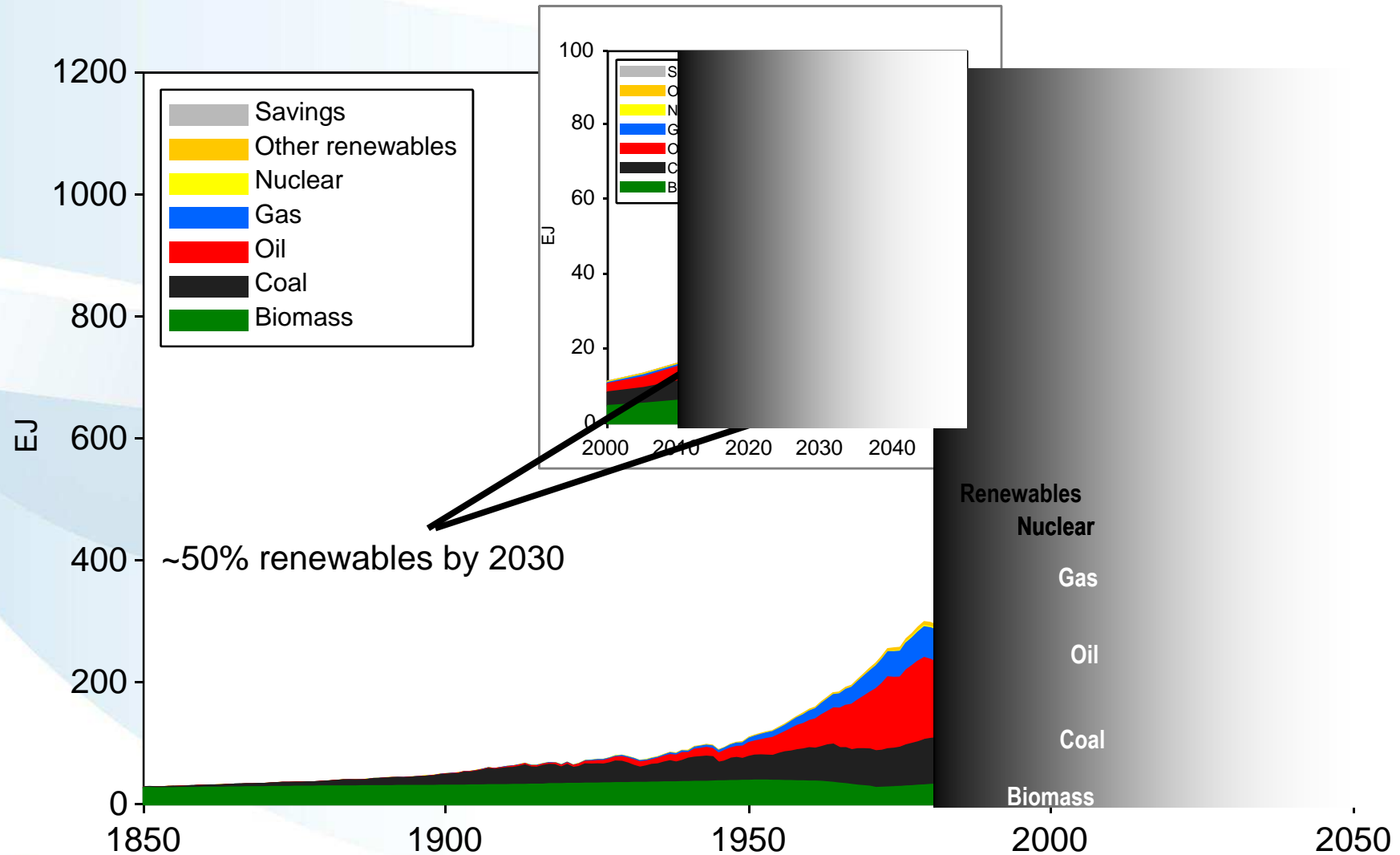
lim. Bioenergy, lim. Intermittent REN



Source: Riahi et al, 2012

Global Primary Energy

Sub-Saharan Africa



~50% renewables by 2030

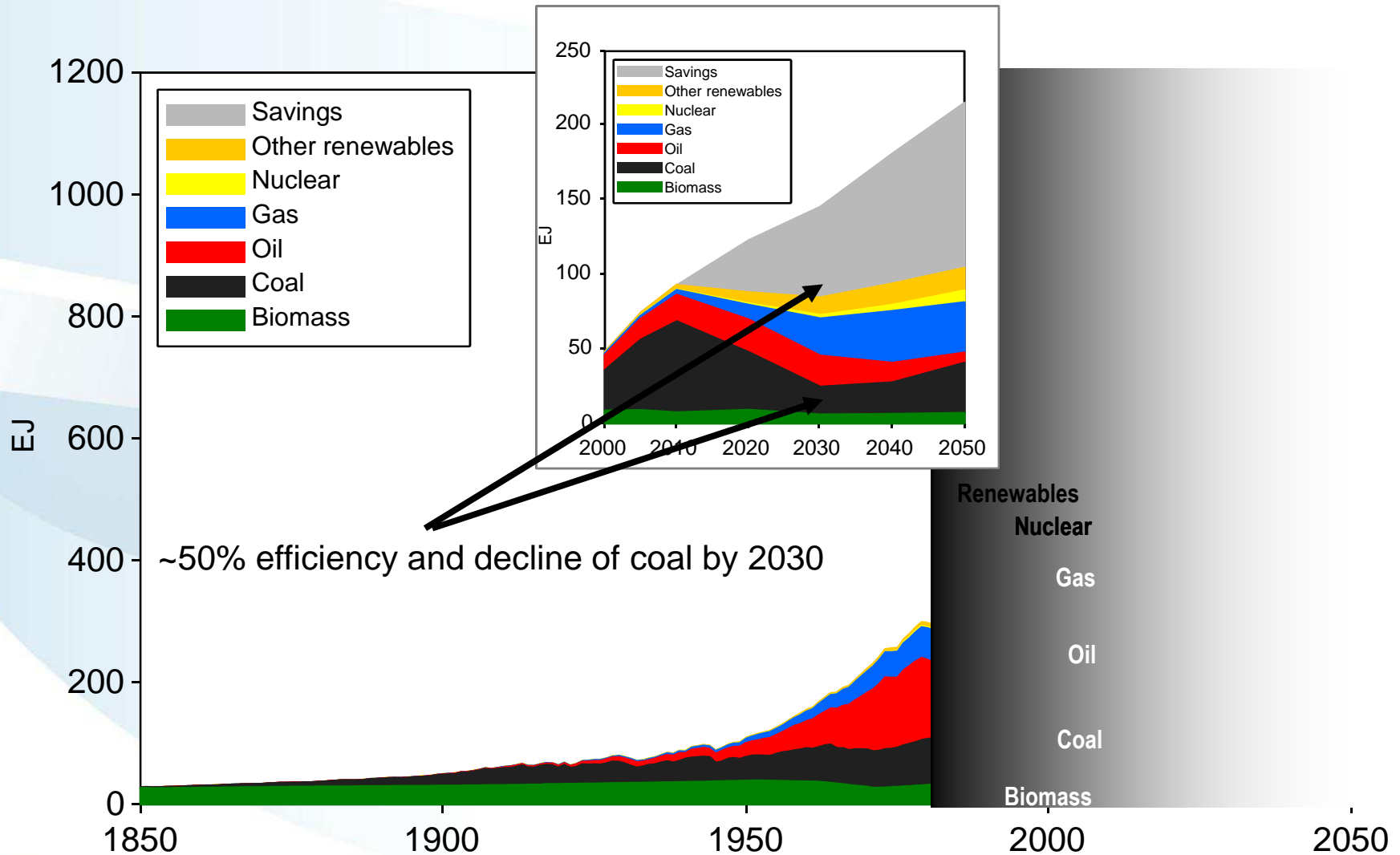
Renewables
Nuclear
Gas
Oil
Coal
Biomass

Source: Riahi et al, 2012



Global Primary Energy

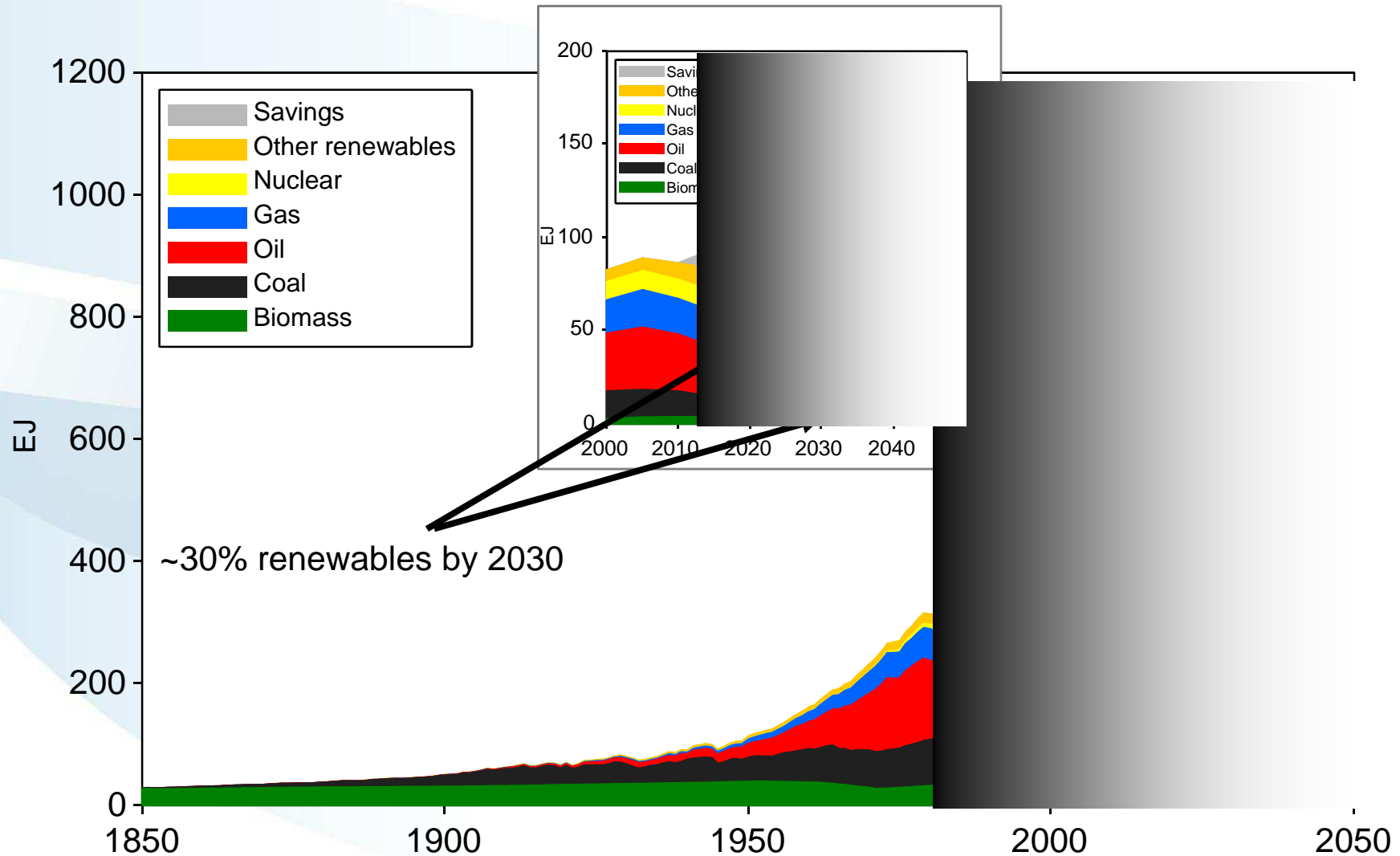
China



Source: Riahi et al, 2012

Global Primary Energy

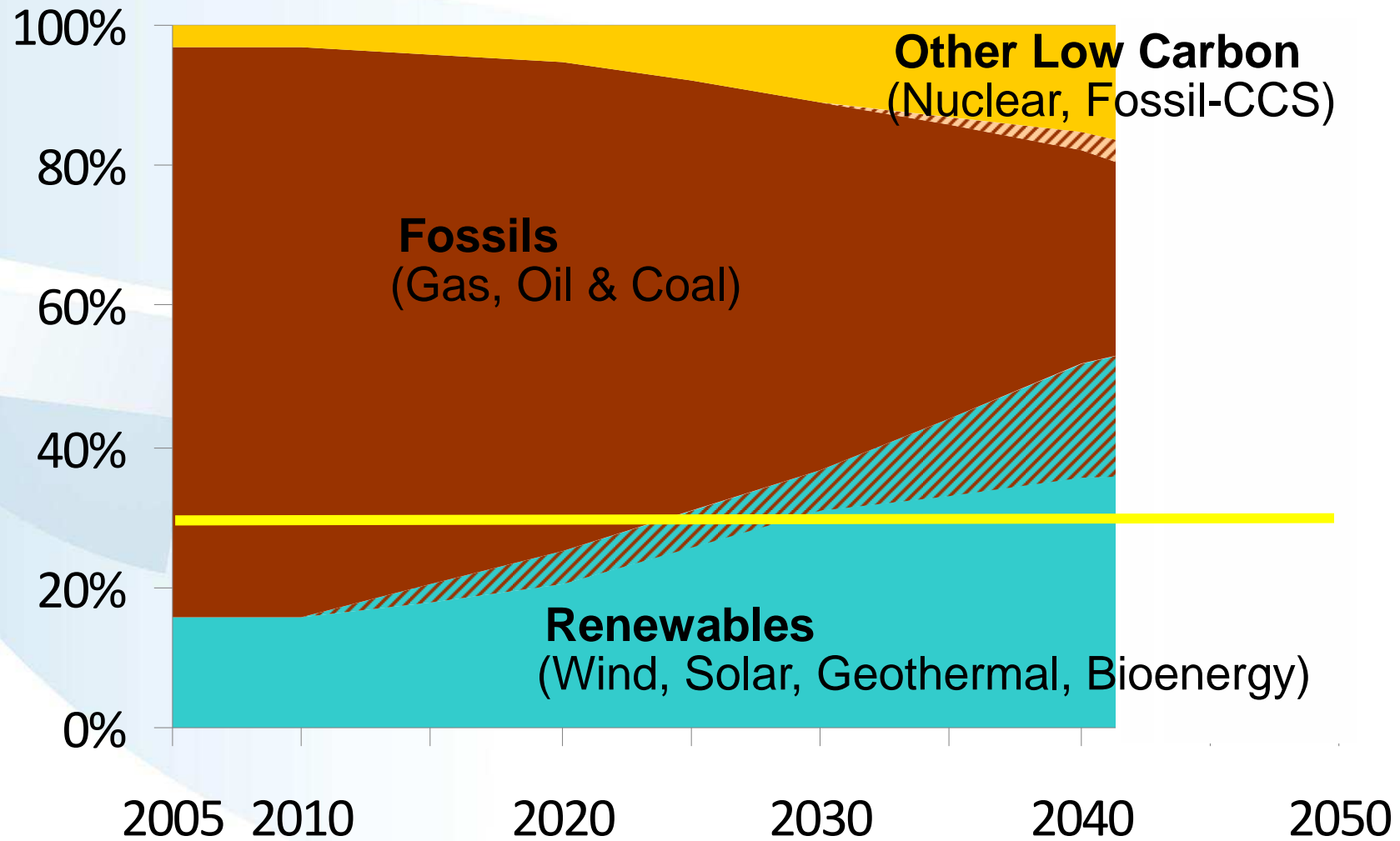
Europe



Source: Riahi et al, 2012



Final Energy Transformations

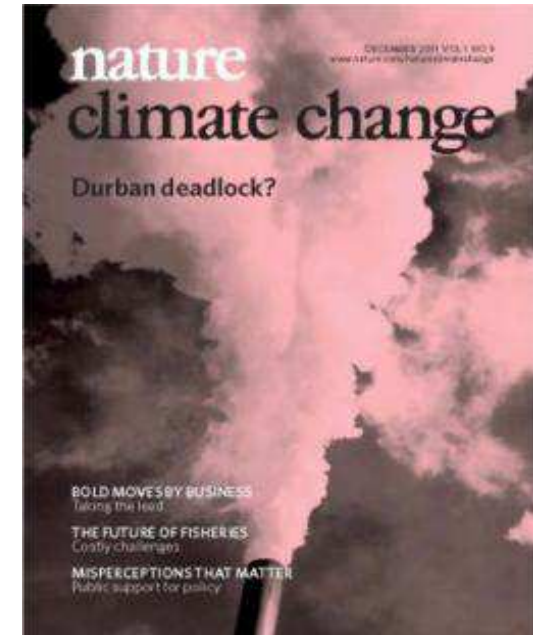
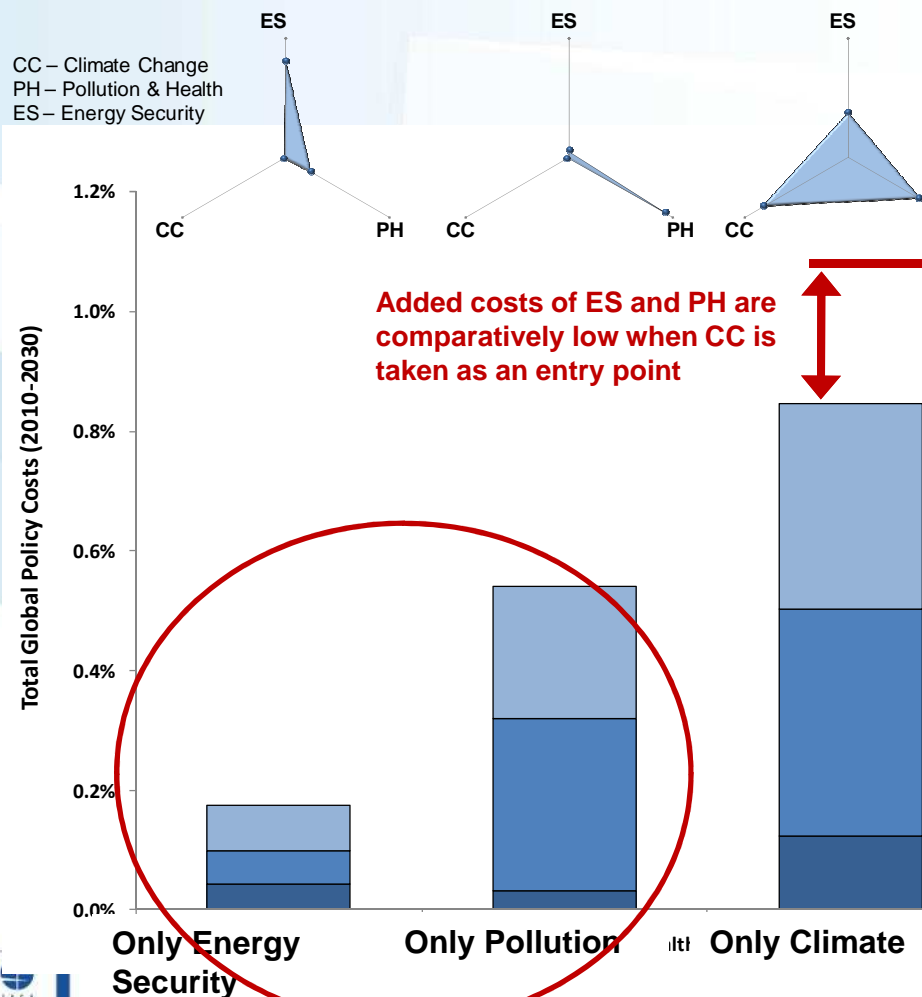


www.GlobalEnergyAssessment.org

Towards a more Sustainable Future

- ➔ Universal access is a pre-condition for overcoming poverty and feasible if all stake-holders work together.
- ➔ Energy transformation **will bring multiple co-benefits for health, security, climate change**
- ➔ Financing requirements are huge but achievable with right and sustained policies

SYNERGIES OF MULTIPLE ENERGY OBJECTIVES



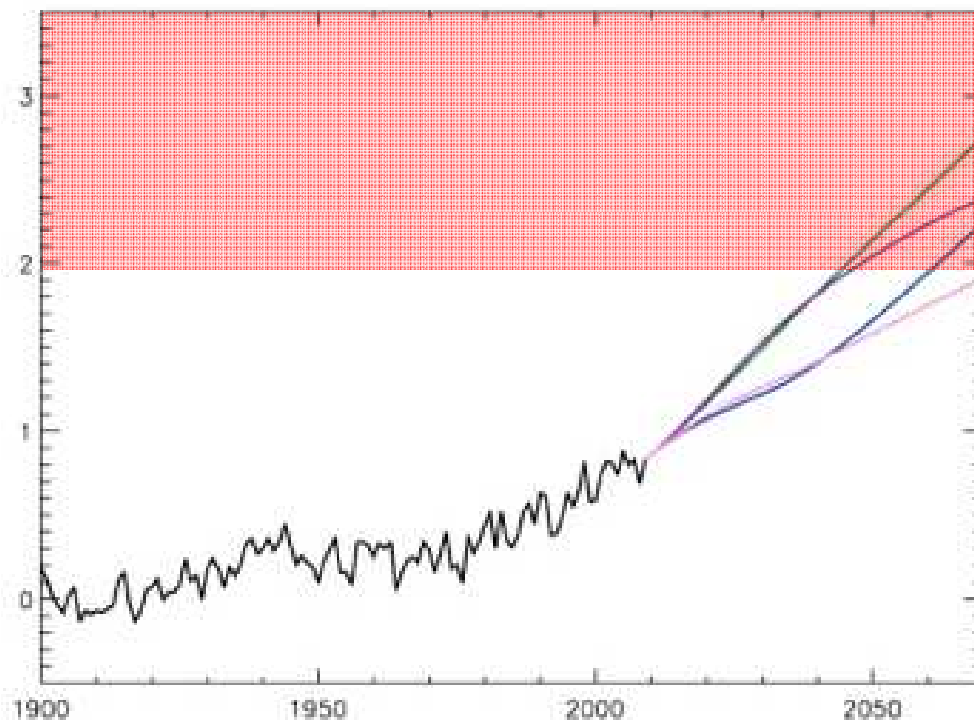
Integrated Climate-Pollution-Security Policies

“Single minded” approaches for multiple challenges

GAINS identified 16 key air quality measures that, together with CO₂ mitigation, increase chances to stay below the 2° target



Global temperature 1900–2070



Source: Shindell et al., *Science* (2012), 335/6065:183–189

Reference Scenario

IEA World Energy Outlook 2009

CO₂ Measures

IEA 450 ppm scenario 2009

Near-term Measures

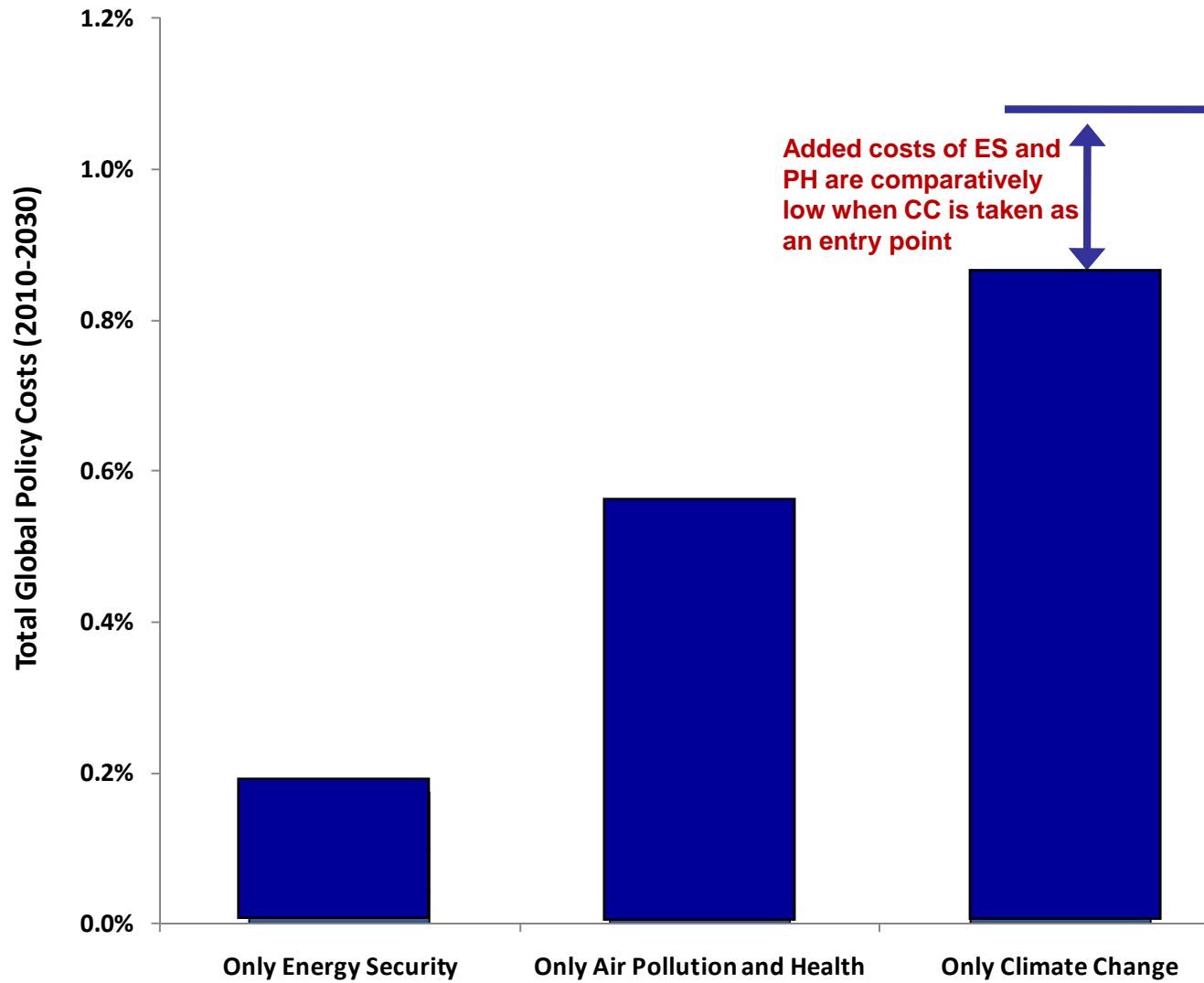
IIASA set of 16 measures for CH₄ and black carbon

CO₂ + Near-term Measures

These 16 measures are

- win (for air quality),
- win (for near-term climate change)
- win (for economic development)

Energy Policy Costs

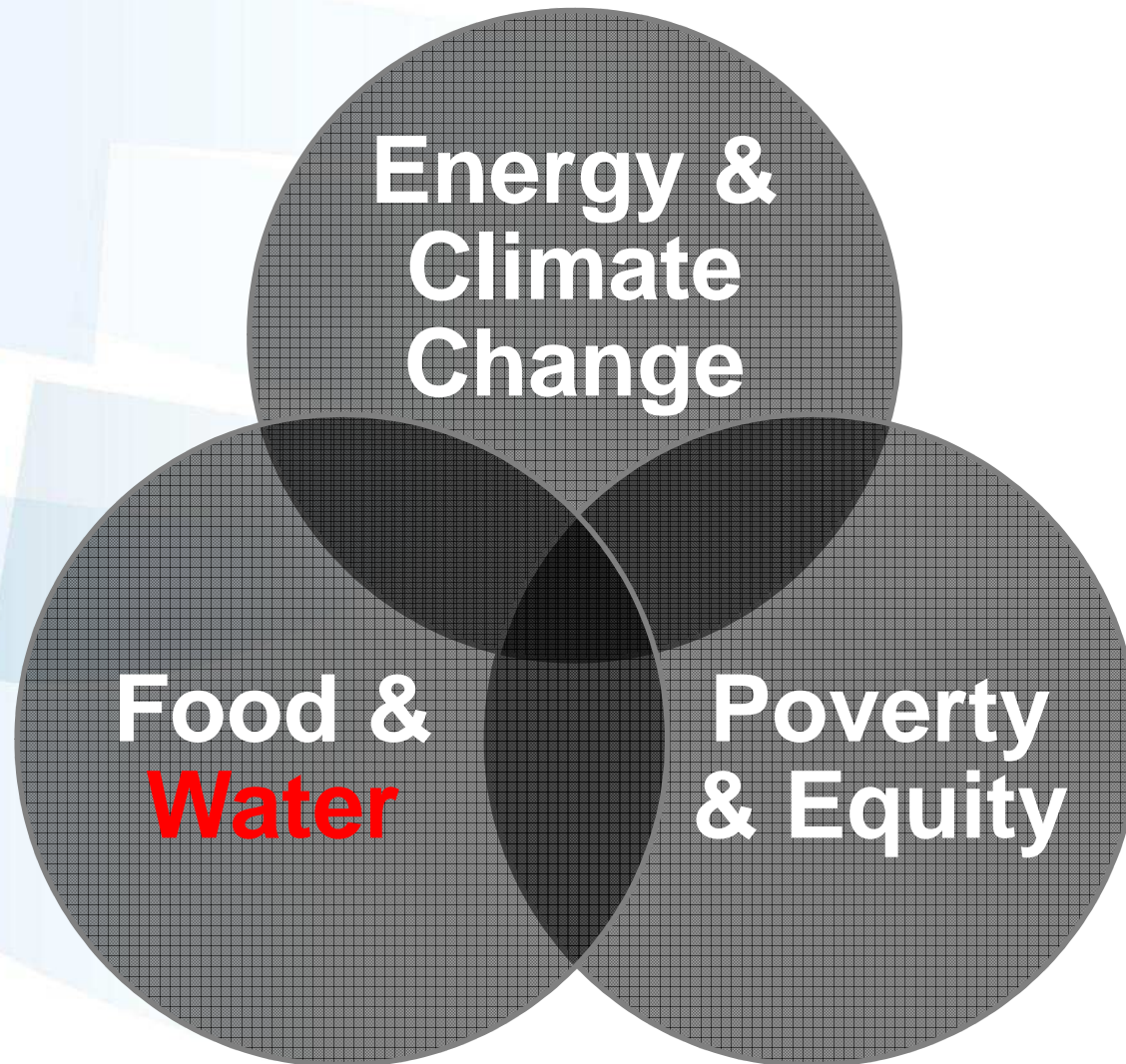


Source: McCollum, Krey, Riahi, 2012

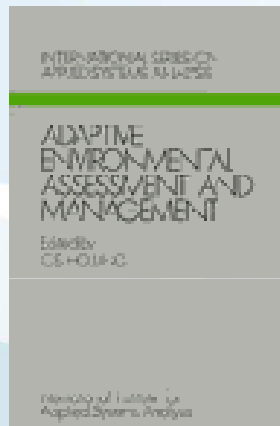
Global Energy Assessment



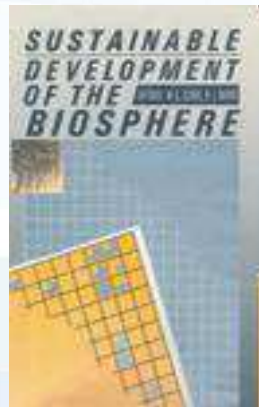
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FOOD & WATER: BUILDING ON PAST SUCCESSES



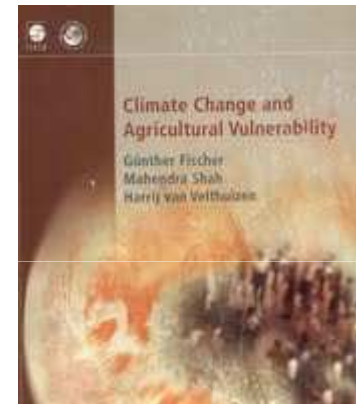
1975



1986

Database
of Russian
forest and
land
resources

2002



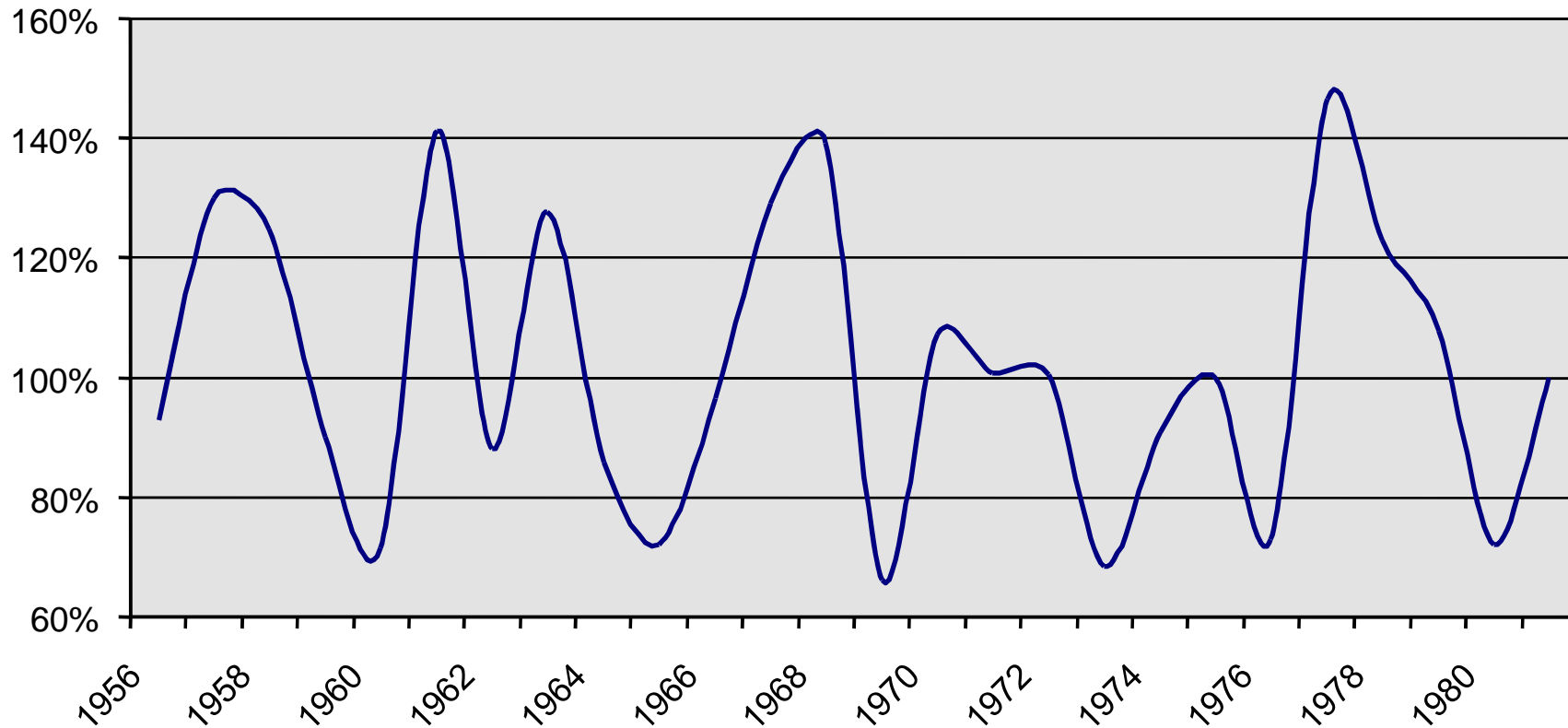
2002

Shrinking
Fish

2004

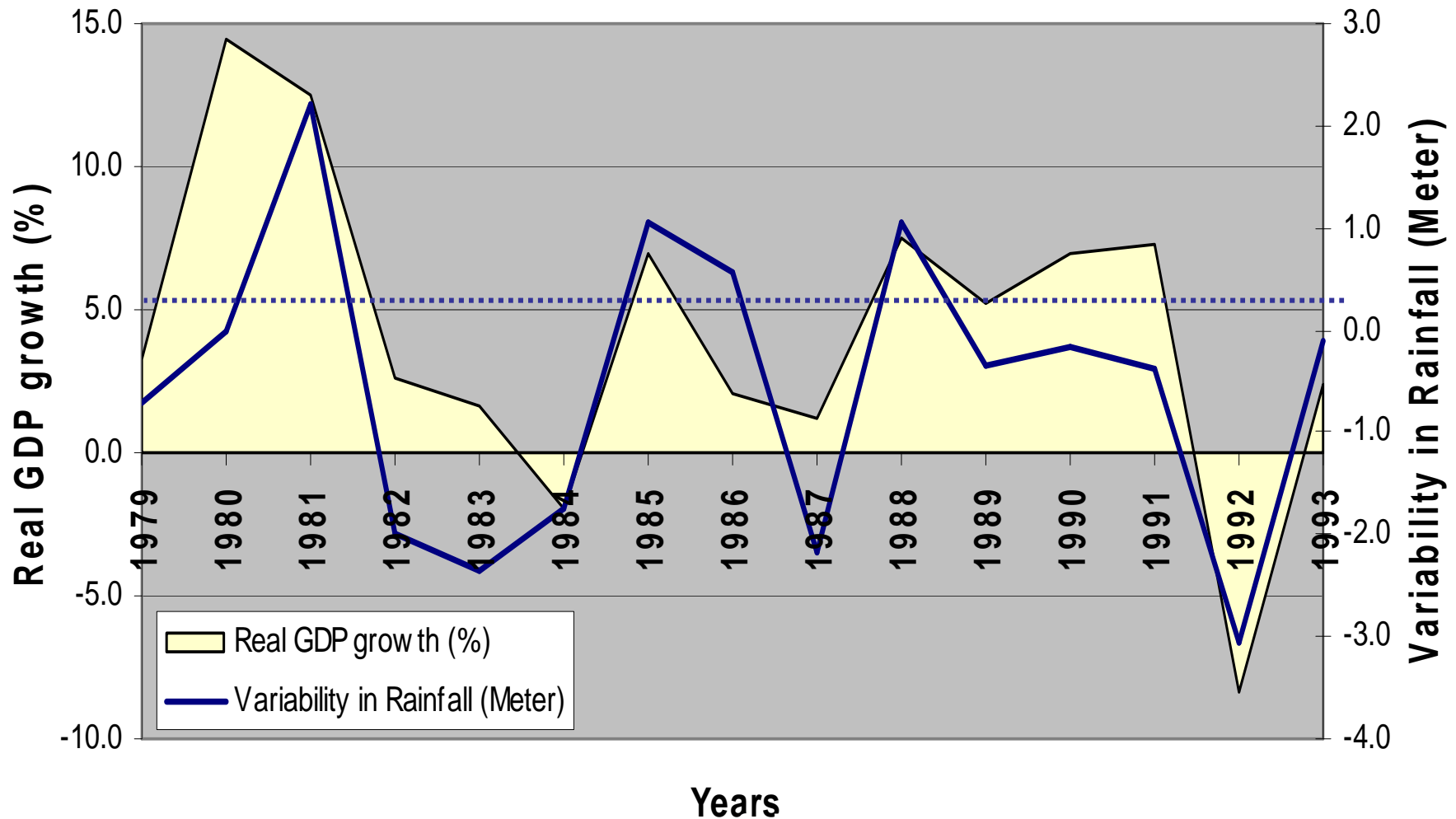
System: Water – Climate – Poverty – Equity Nexus

Kenya: extreme rainfall variability around mean



rainfall affects growth....

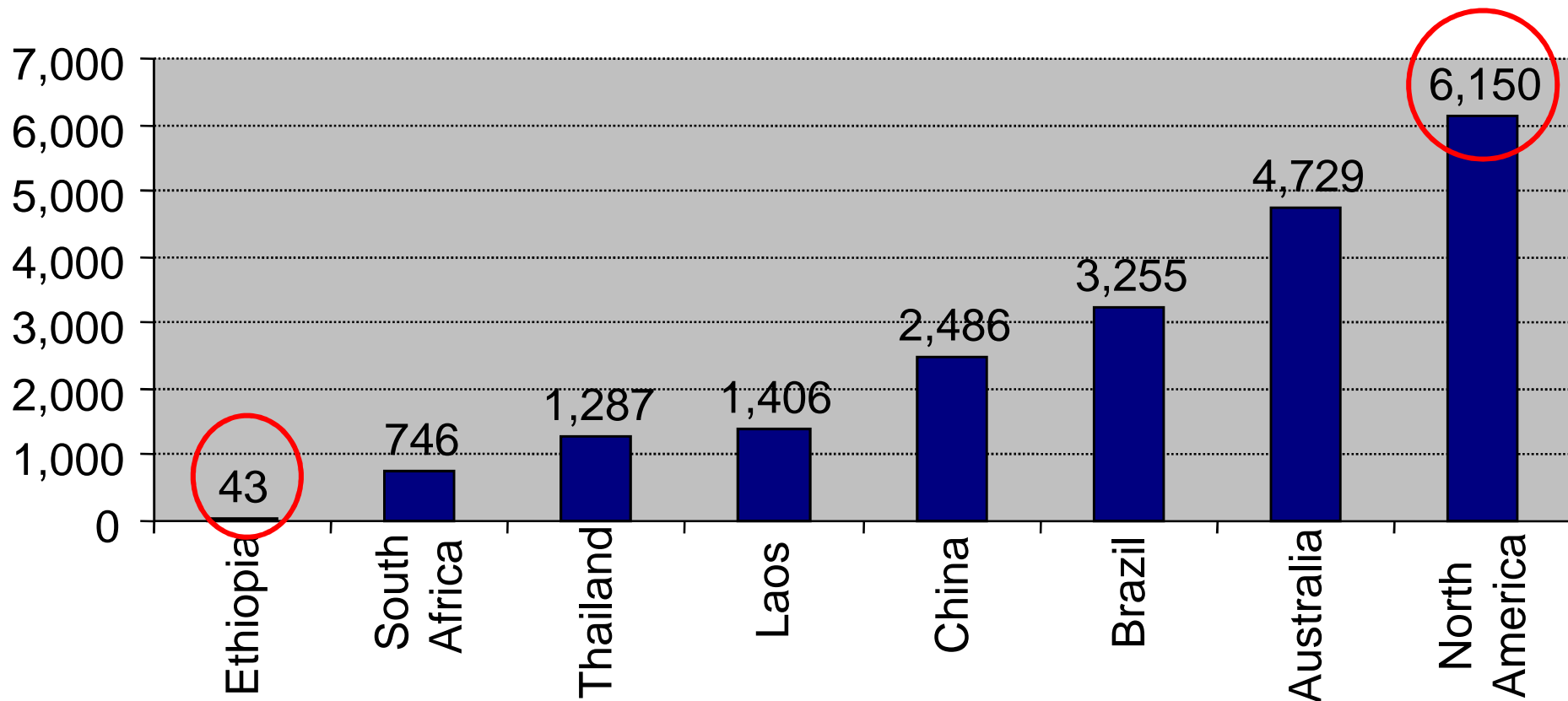
the case of Zimbabwe



Water – Climate - Poverty – Equity - Nexus

Infrastructure gap in water storage

Water storage per person (m3)



The cost of water security

Country	Additional Storage needed per person (m ³)	Storage investments required per person (US\$)	Storage Investments Required (US\$ Billion)	Period needed at 5% current GDP investment per year (no pop. inc.) (Years)
Lesotho	751	939	1.7	44
Namibia	542	678	1.3	8
Nigeria	402	503	67.3	32
Ethiopia	555	694	46.2	144
Kenya	307	384	12.1	24
Tanzania	610	763	27.4	60
Uganda	511	639	17.9	58
Burkina Faso	152	190	2.5	22
Senegal	683	854	9.9	40
Algeria	239	299	9.8	4
Morocco	128	160	5.1	4

Water Futures and Solutions Initiative

WFEAS

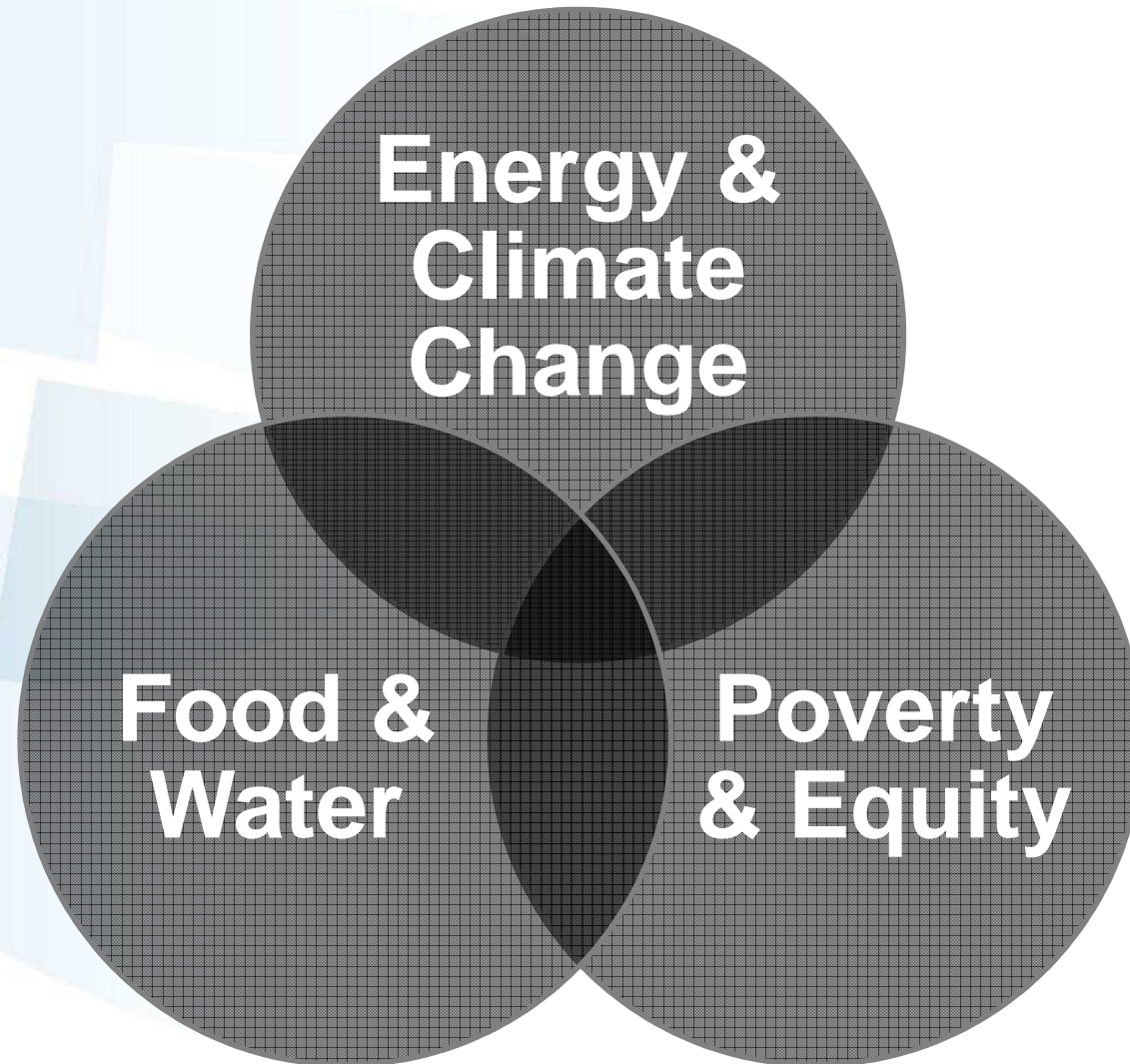


International Water Association



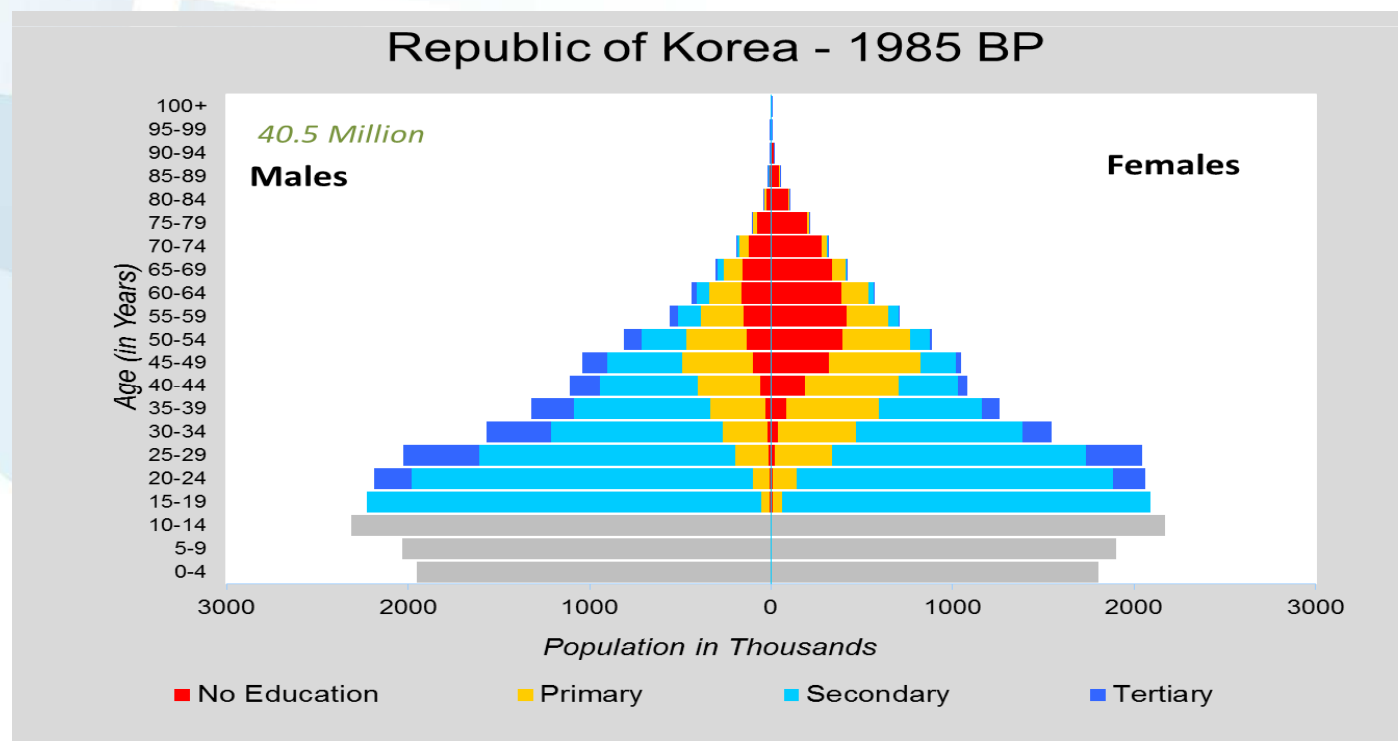
WaterFutures
4theWorld.

Human Population and the Role of Education

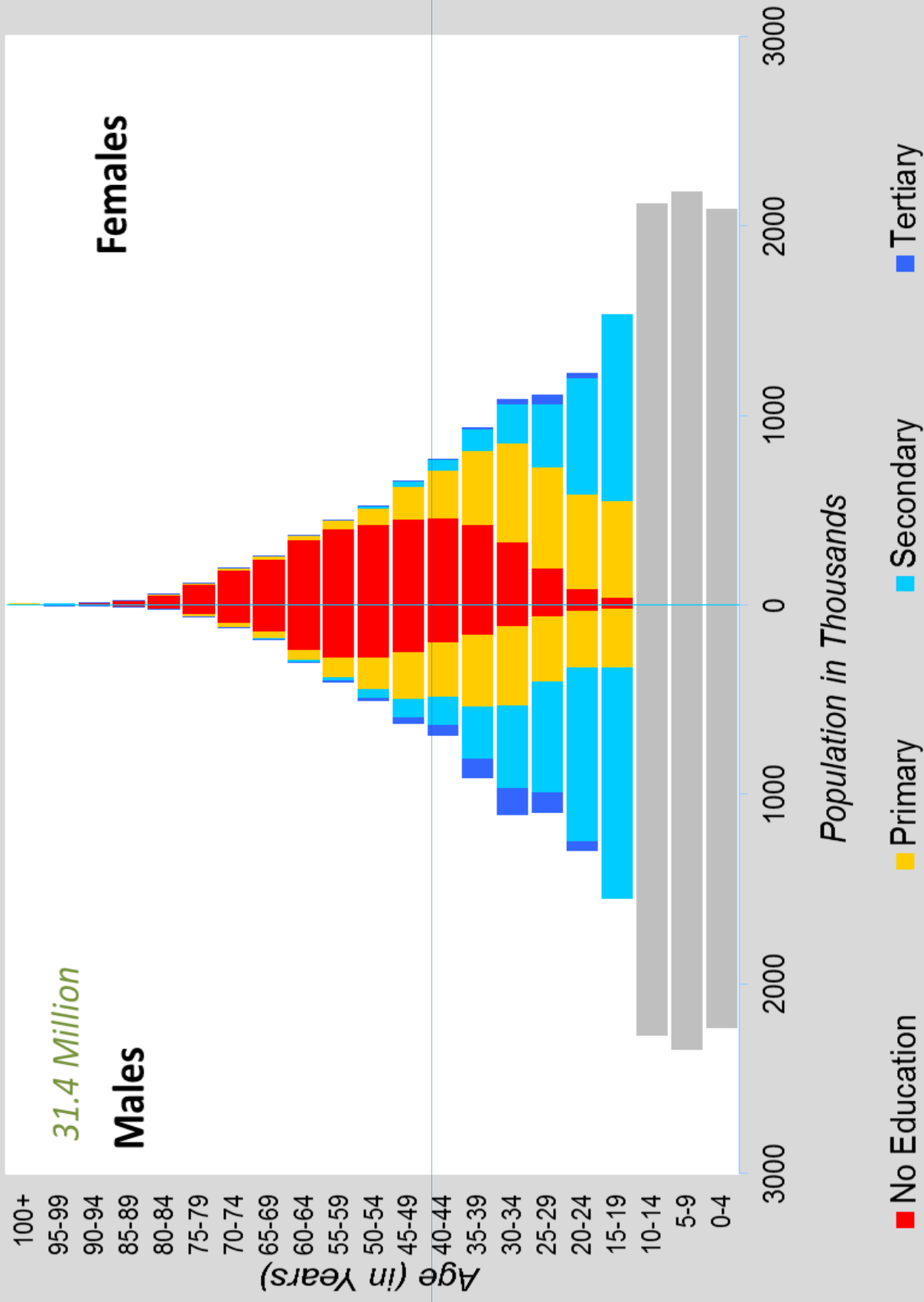


Population Dynamics by Age, Sex and Level of Education

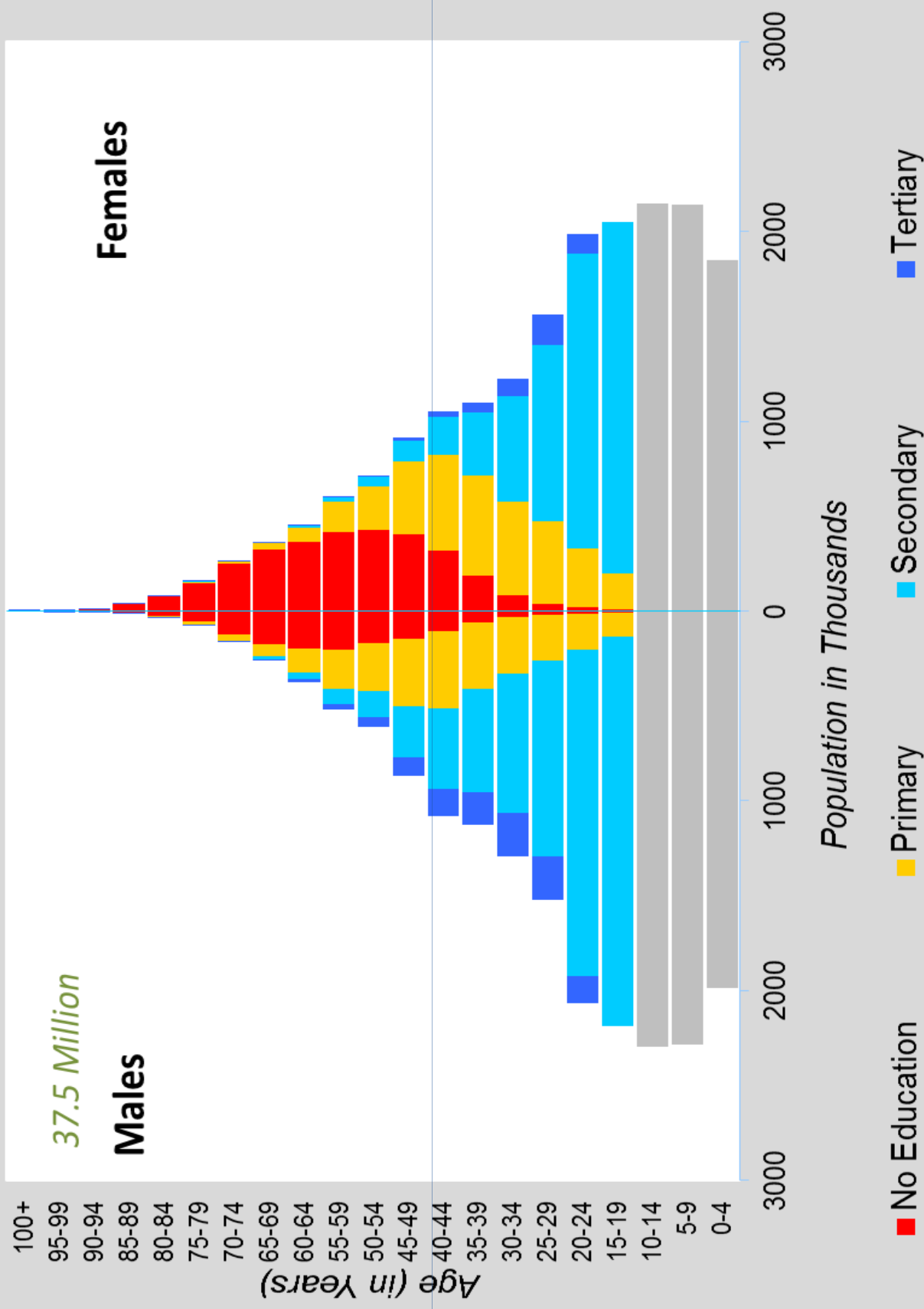
- Inter-generational equity versus intra-generational equity.
- Does the future well-being depend on current inequality?
- At the core of IIASA's equity and poverty theme.
- The demographic foundations of social and economic change



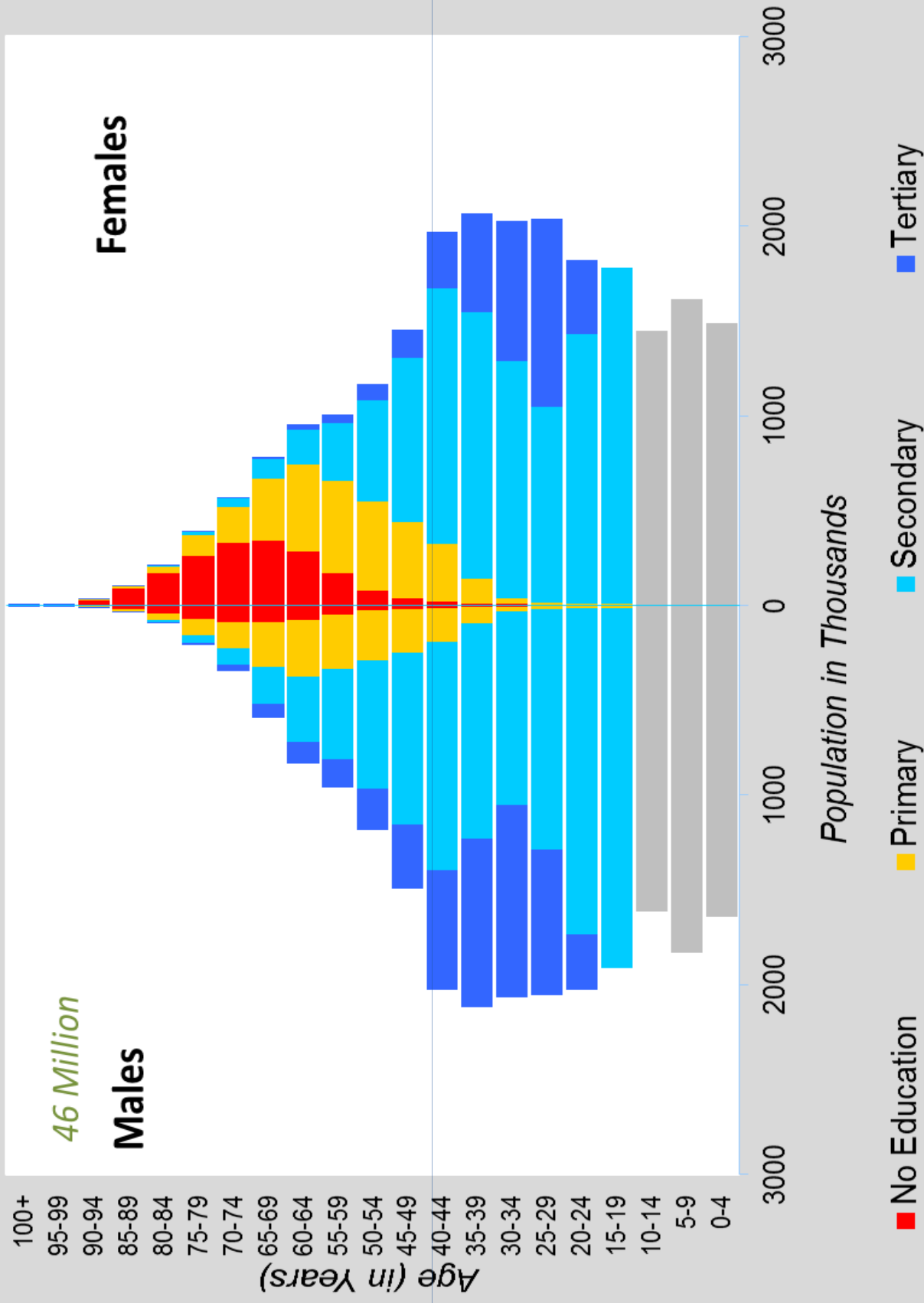
Republic of Korea - 1970 BP



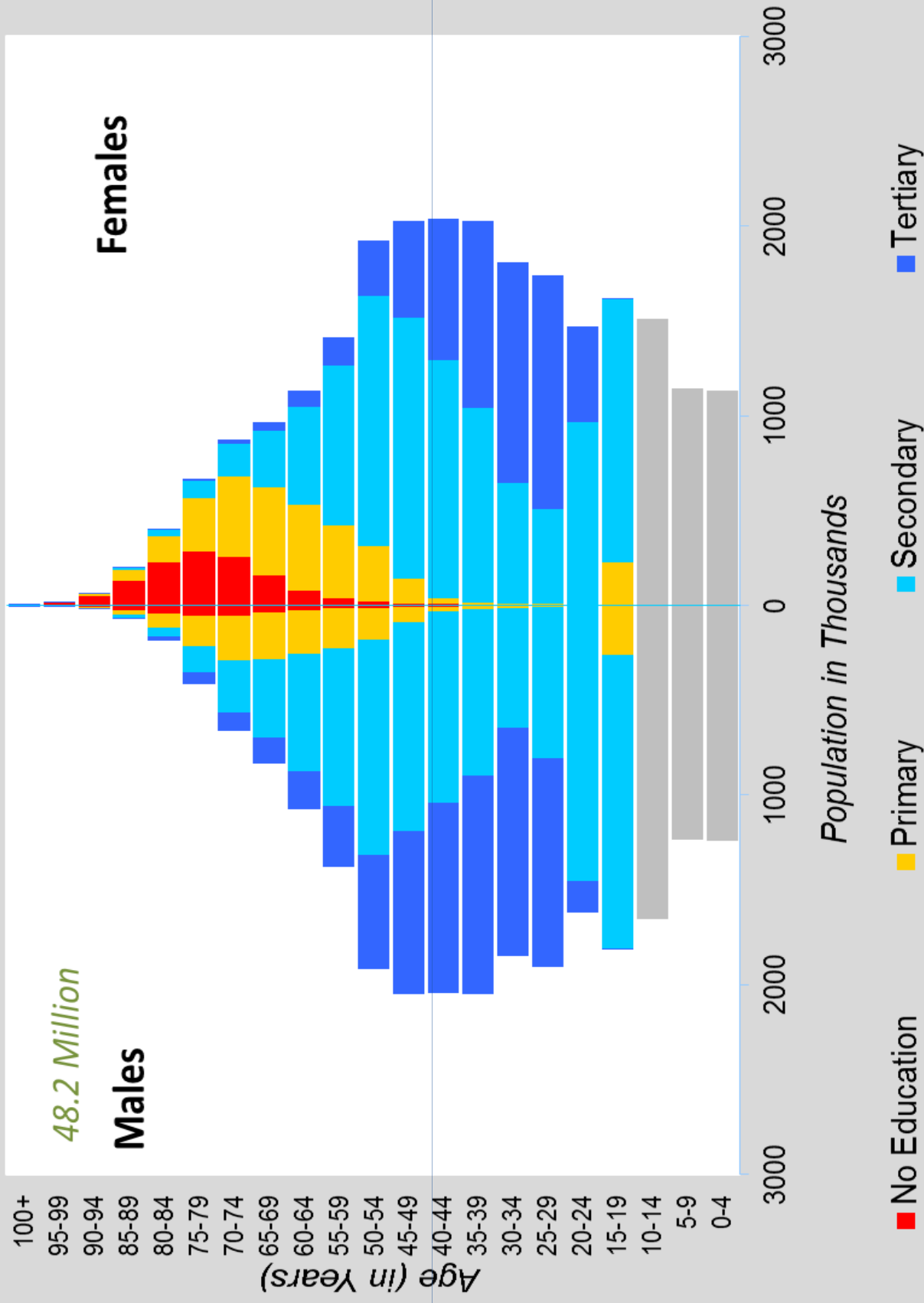
Republic of Korea - 1980 BP



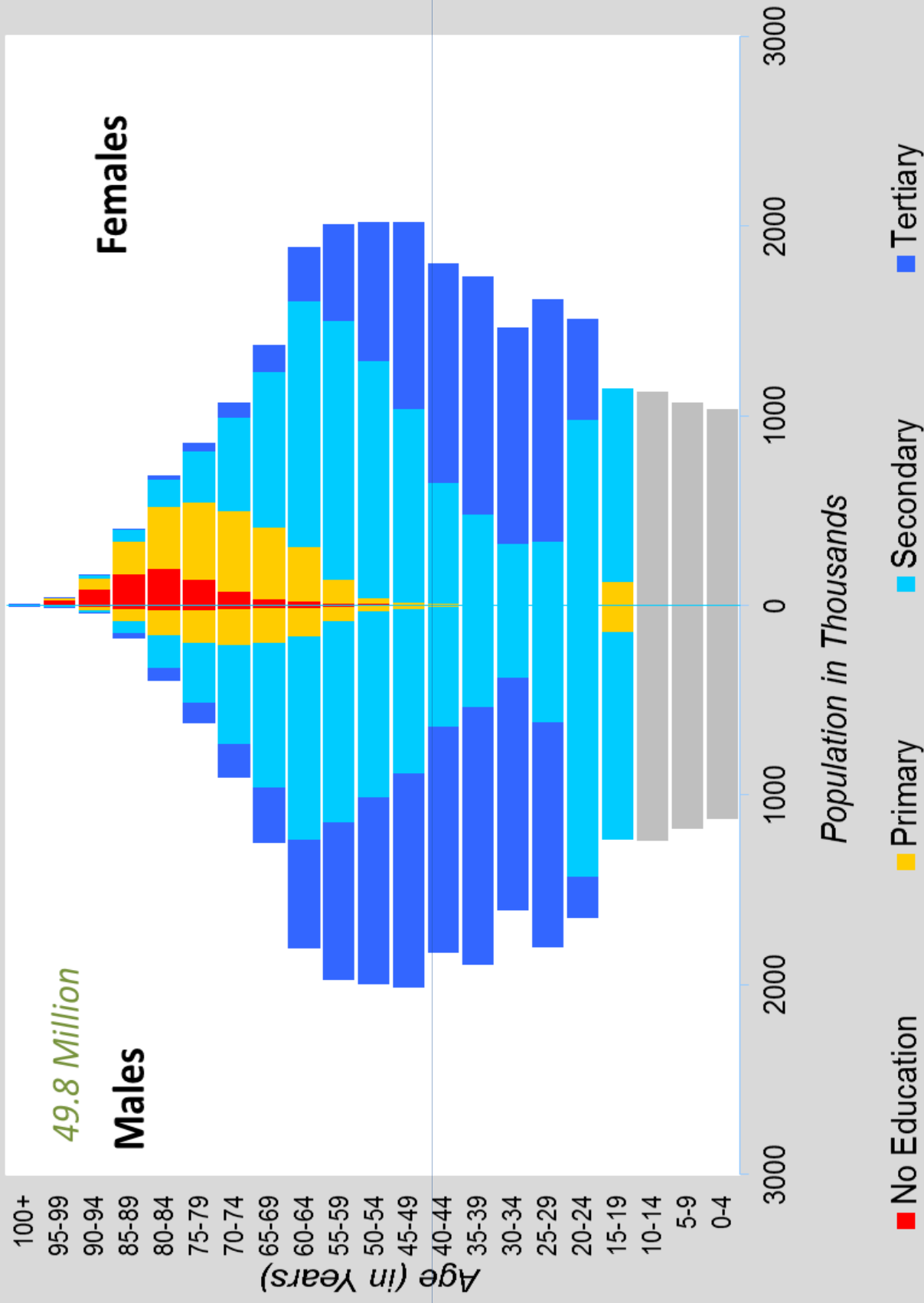
Republic of Korea - 2000 BP



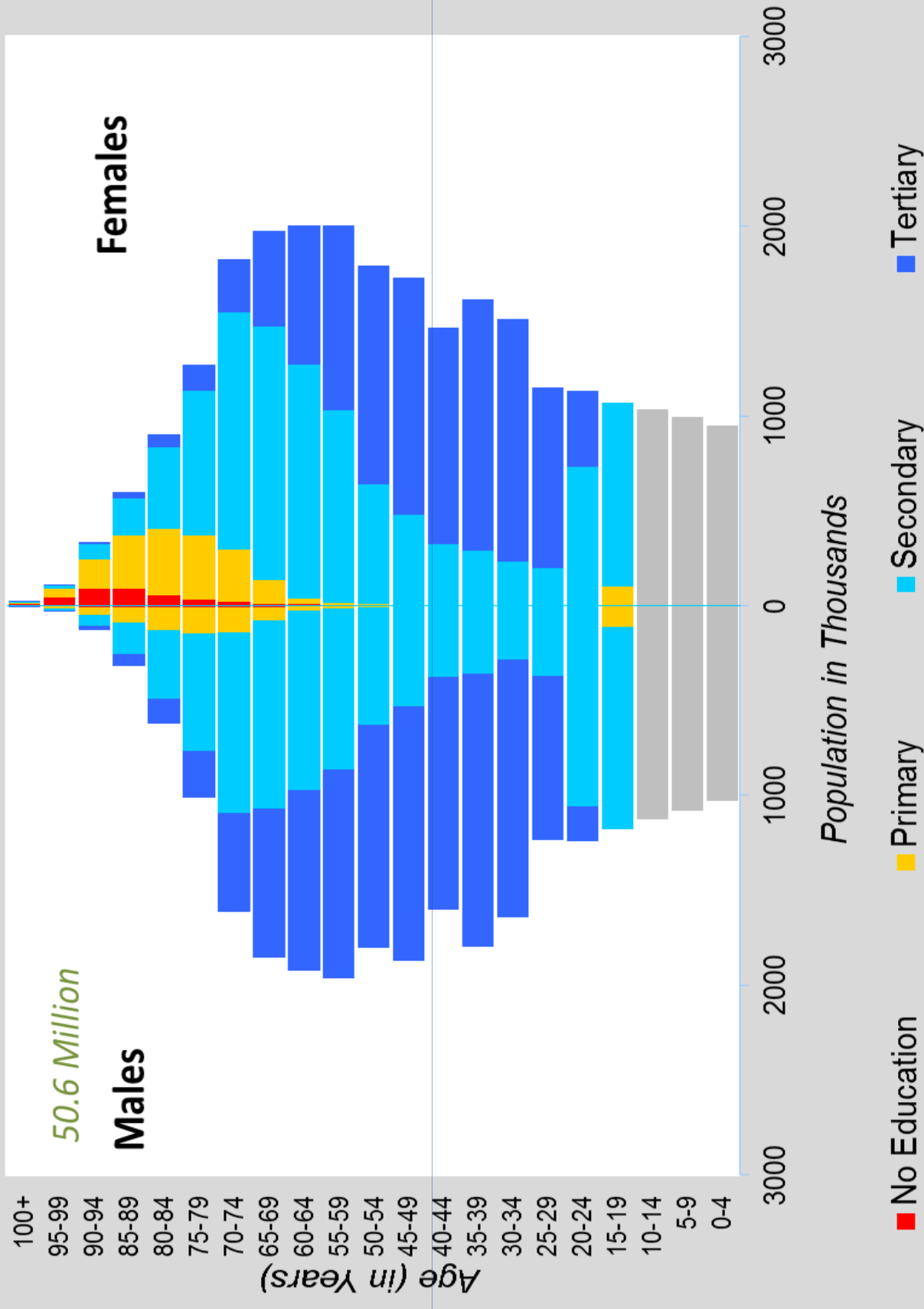
Republic of Korea - 2010



Republic of Korea - 2020 GET



Republic of Korea - 2030 GET



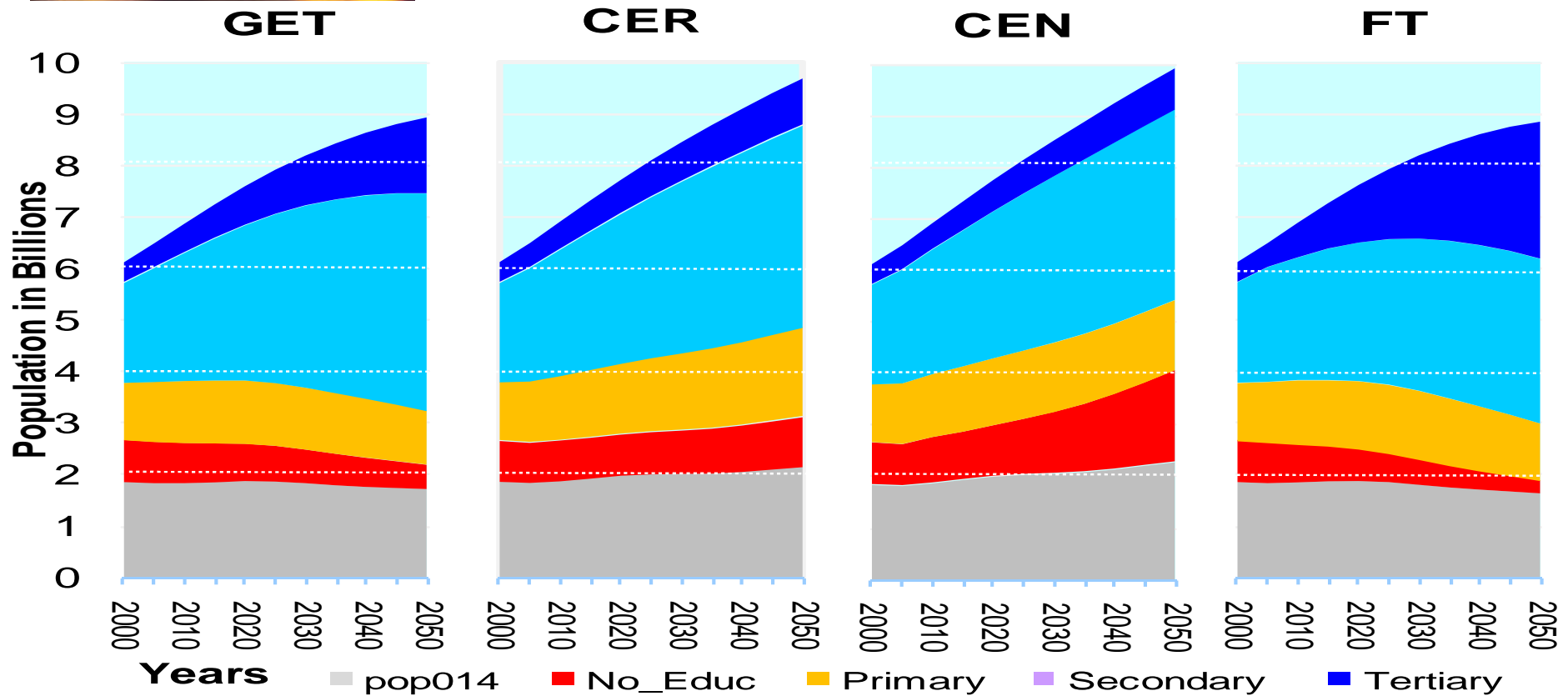


REVIEW

Global Human Capital: Integrating Education and Population

Wolfgang Lutz^{1,2,3,4*} and Samir KC^{1,2}

Almost universally, women with higher levels of education have fewer children. Better education is associated with lower mortality, better health, and different migration patterns. Hence, the global population outlook depends greatly on further progress in education, particularly of young women.



ECONOMICS

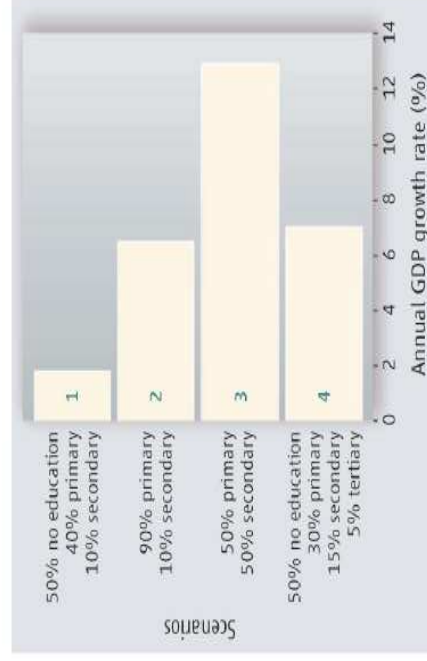
The Demography of Educational Attainment and Economic Growth

Complementing primary education with secondary education in broad segments of the population is likely to give a strong boost to economic growth.

Wolfgang Lutz,^{1*} Jesus Crespo Cuaresma,² Warren Sanderson³

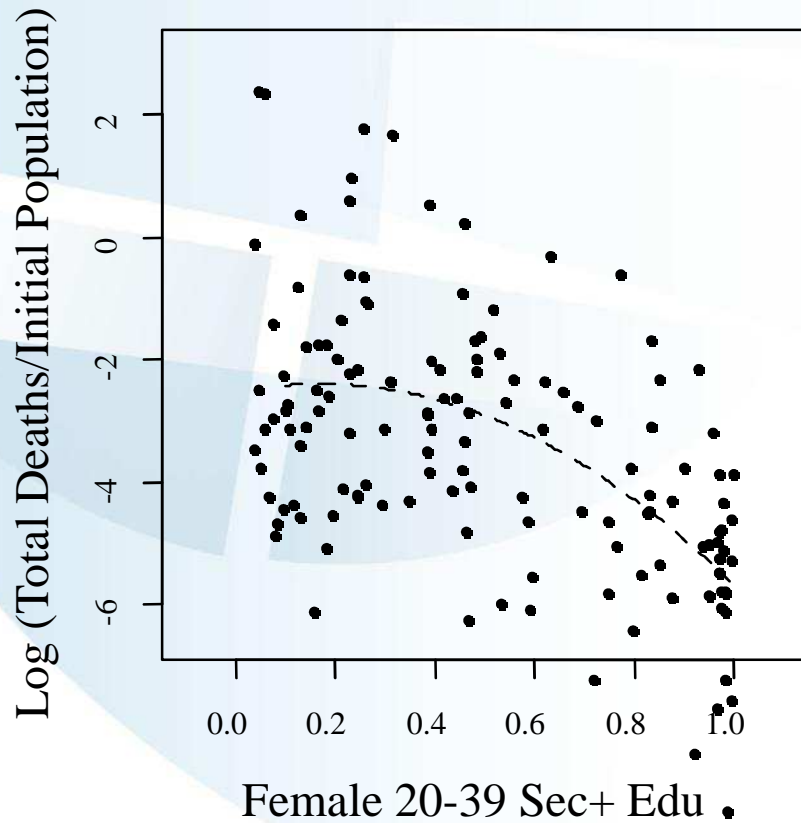
Human capital, age structure and economic growth

- The age distribution of educational attainment plays a key role on the effects of human capital on growth.
- Strong effects of secondary education.
- A small simulation exercise for a stereotype African developing country:

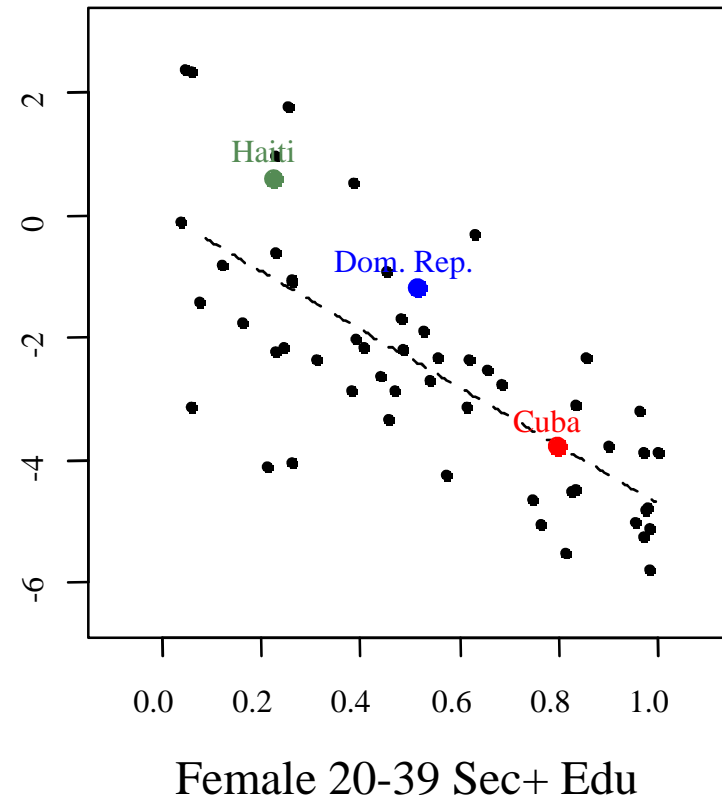


Education and Deaths from Natural Disaster

All countries available



Countries with more than 30 disasters



Source: Total number of deaths (1980 – 2010) is from the Emergency Events Database (EM-DAT) at the Centre for Research on the Epidemiology of Disasters (CRED).

Rough winds
summer

summer
temperate

fair
nature

fair

hot

summer

fair

time

shade

life

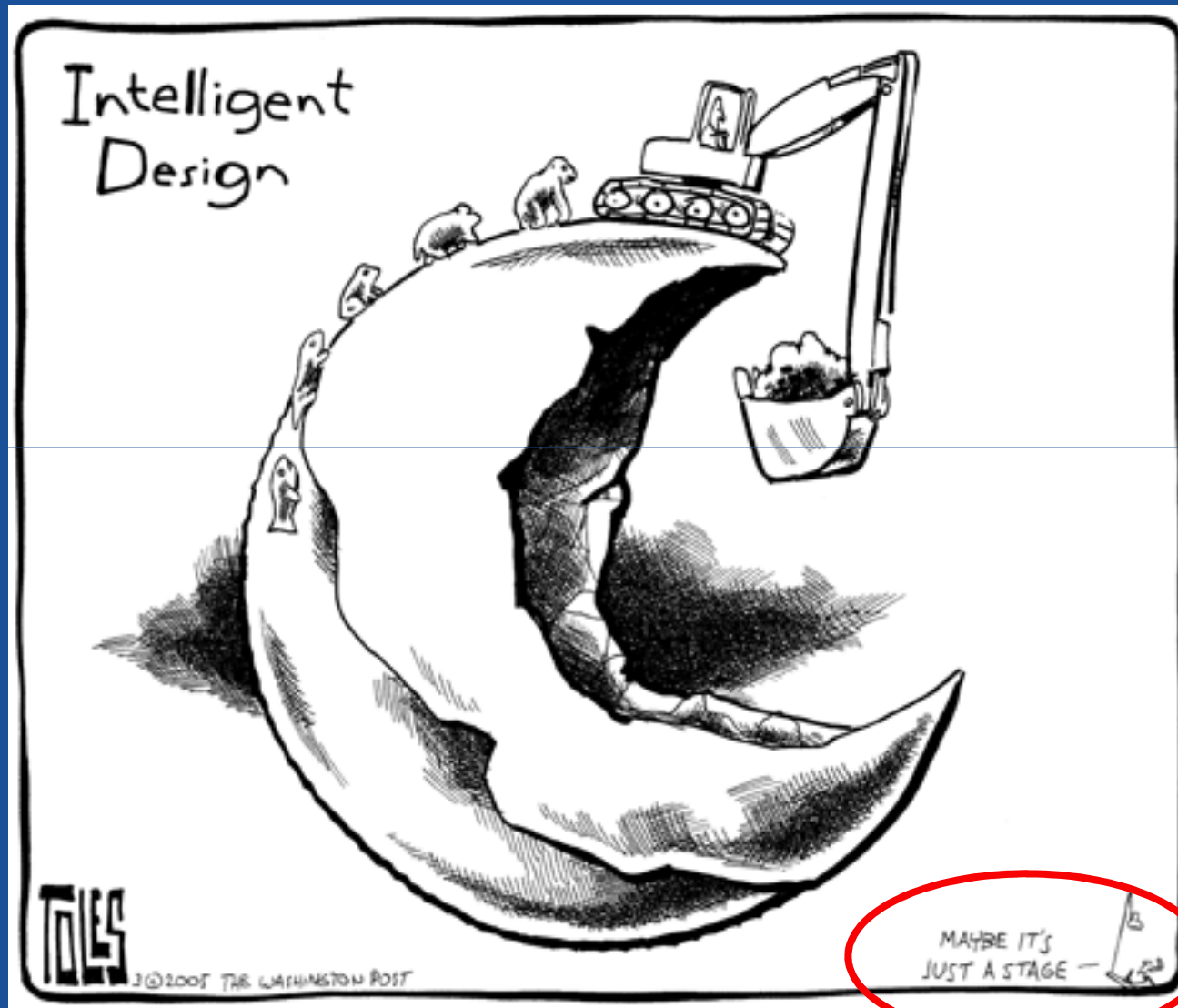
Summer

Shall I Compare Thee To A Summer's Day?

by William Shakespeare

Shall I compare thee to a summer's day?
Thou art more lovely and more temperate.
Rough winds do shake the darling buds of May,
And summer's lease hath all too short a date.
Sometime too hot the eye of heaven shines,
And often is his gold complexion dimm'd;
And every fair from fair sometime declines,
By chance or nature's changing course untrimm'd;
But thy eternal summer shall not fade
Nor lose possession of that fair thou ow'st;
Nor shall Death brag thou wander'st in his shade,
When in eternal lines to time thou grow'st:
So long as men can breathe or eyes can see,
So long lives this, and this gives life to thee.

The UN Millennium Ecosystem Assessment



Washington Post
30 March 2005

Systems Science and Effective Science to Policy Interface

**What is needed in order to get
out of our “silos” ?**

and

**To fully benefit from Systems
Approaches?**

VISION.....

If one does not know to
which port one is
sailing, no wind is
favorable

Seneca (c. 4 BC-AD 65)



Photo: David McGrath



Positive Narratives

...global transformation challenges presents opportunities for social, economic and business innovations rather than merely a threat....



ACADEMIC TRAINING AND CAPACITY BUILDING

**New paradigms towards
trans-and inter-disciplinarity**

New curricula

New funding architecture

Revised academic carrier incentives

Political, Societal and Economic Governance

Trans-sectoral (nexus) policies
Trans- sectoral budgeting & investments
Long term policies & investments
Re-definition of governmental subsidies
Revival of trans-boundary regional cooperation

NEW PARTNERSHIPS

New Partnerships



- New Global Think Tank announced by IIASA and European Alpbach Forum in Sept 2013
 - To initiate a new dialogue and partnership between **top-academia, governments, businesses and civil society** for an integrated systematic approach to fair globalization



IIASA

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Thank you and welcome soon at IIASA!



science



IIASA, International Institute for Applied Systems Analysis