

Systems Science Approach to Future Earth

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Summer

summer
temperate
Rough winds
summer
hot
fair fair
nature summer
fair
shade
time
life

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.

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		

IIASA IS COLLABORATING WITH FUTURE EARTH TO PROVIDE SYSTEMS SCIENCE TO SUPPORT GLOBAL, REGIONAL AND NATIONAL TRANSITIONS TO SUSTAINABILITY



June 2015

Future Earth Scientific and Engagement Committees meeting & International Symposium & Public Lecture: "Science-Policy in a Global Context"



The Science & Technology Alliance
for Global Sustainability



IIASA

futureearth
research for global sustainability

THE EARLY 1970s







**23 MEMBER COUNTRIES
NATIONAL MEMBER ORGANISATIONS**



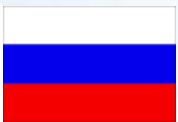
➤ **International, independent,
interdisciplinary**



➤ **Research on major global
problems**



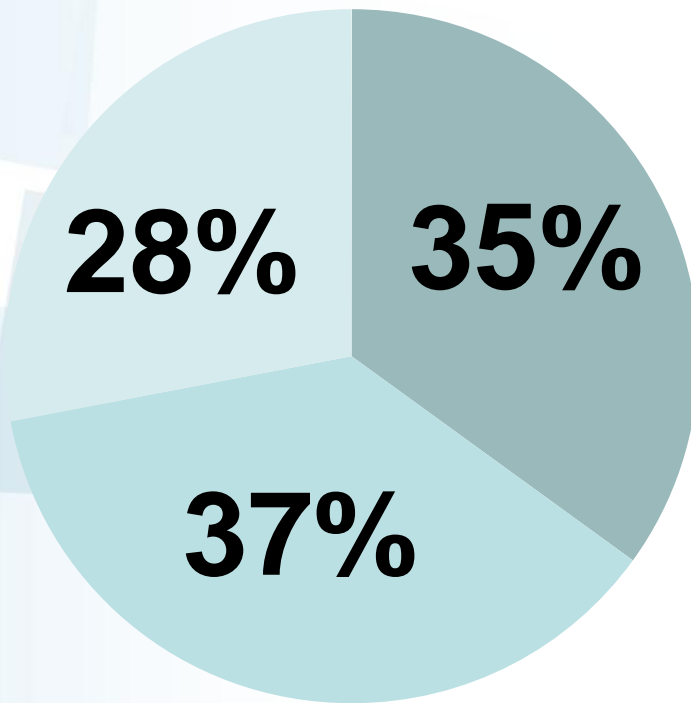
➤ **Solution oriented, integrated
systems analysis**



IIASA TRULY INTERNATIONAL

- 1,445 visitors & collaborators in 2014
- Plus ~25% of IIASA alumni (3,505 people worldwide) remain actively involved in IIASA research
- Plus ~600 partner institutions
- In sum, ~2500 researchers from some 65 countries involved in IIASA's research network (external faculty)
- And it is not just research networks: IIASA researchers took part in 112 advisory boards and steering committees in 2014

INTERDISCIPLINARY



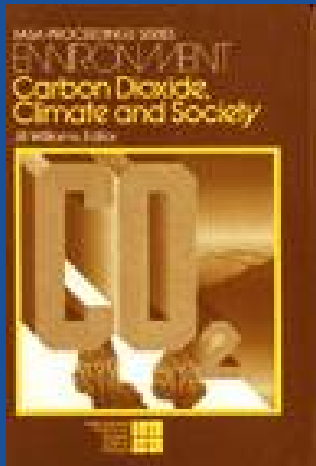
- Natural Scientists & Engineers
- Social Scientists
- Mathematicians and others

IIASA AS THE EXPERT ADVISOR

IIASA researchers take part in 100 + advisory boards and steering committees, including:

- Leadership Council of the Sustainable Development Solutions Network (SDSN) – input to define Sustainable Development Goals (SDGs)
- UN Secretary General Technical Group on Sustainable Energy for All
- Advisory Council of the German Government on Global Change (WBGU)
- Arctic Council
- UN Food and Agriculture Organization Land and Water Division

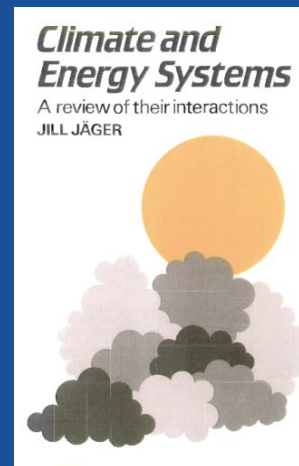
EXAMPLES OF EARLY RESEARCH



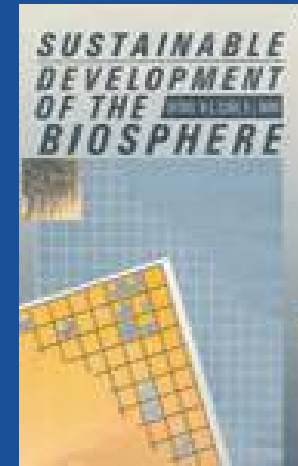
1978



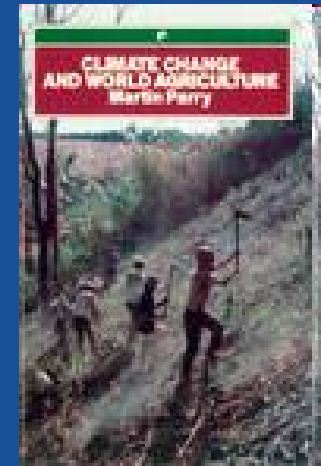
1981



1983

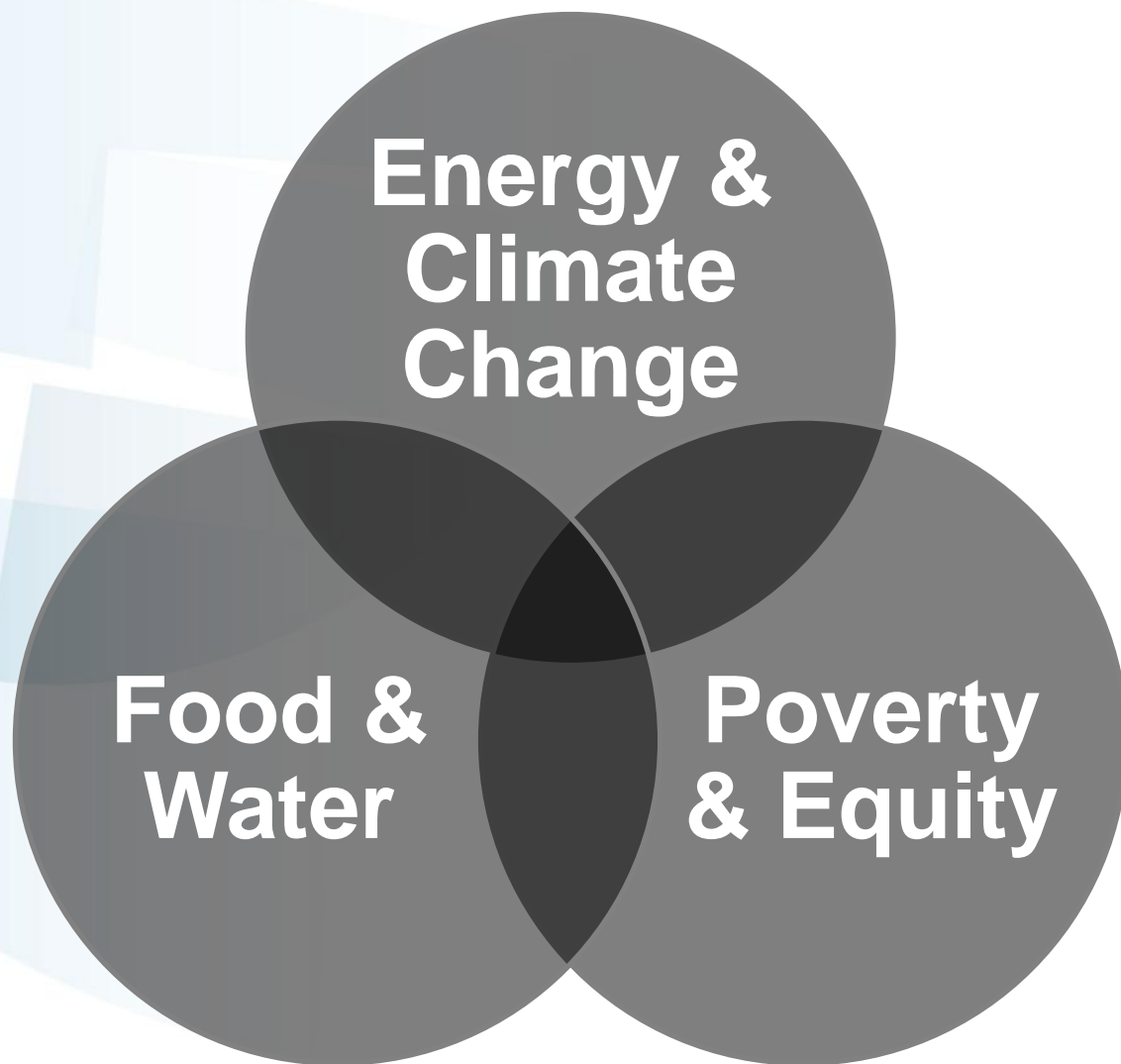


1986



1990

GLOBAL CHALLENGES INEXTRICABLY LINKED



IIASA'S SYSTEMS SCIENCE APPROACH

RESEARCHING GLOBAL CHALLENGES

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

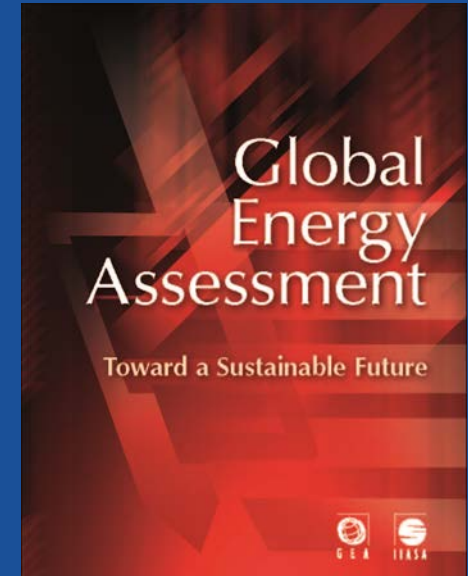


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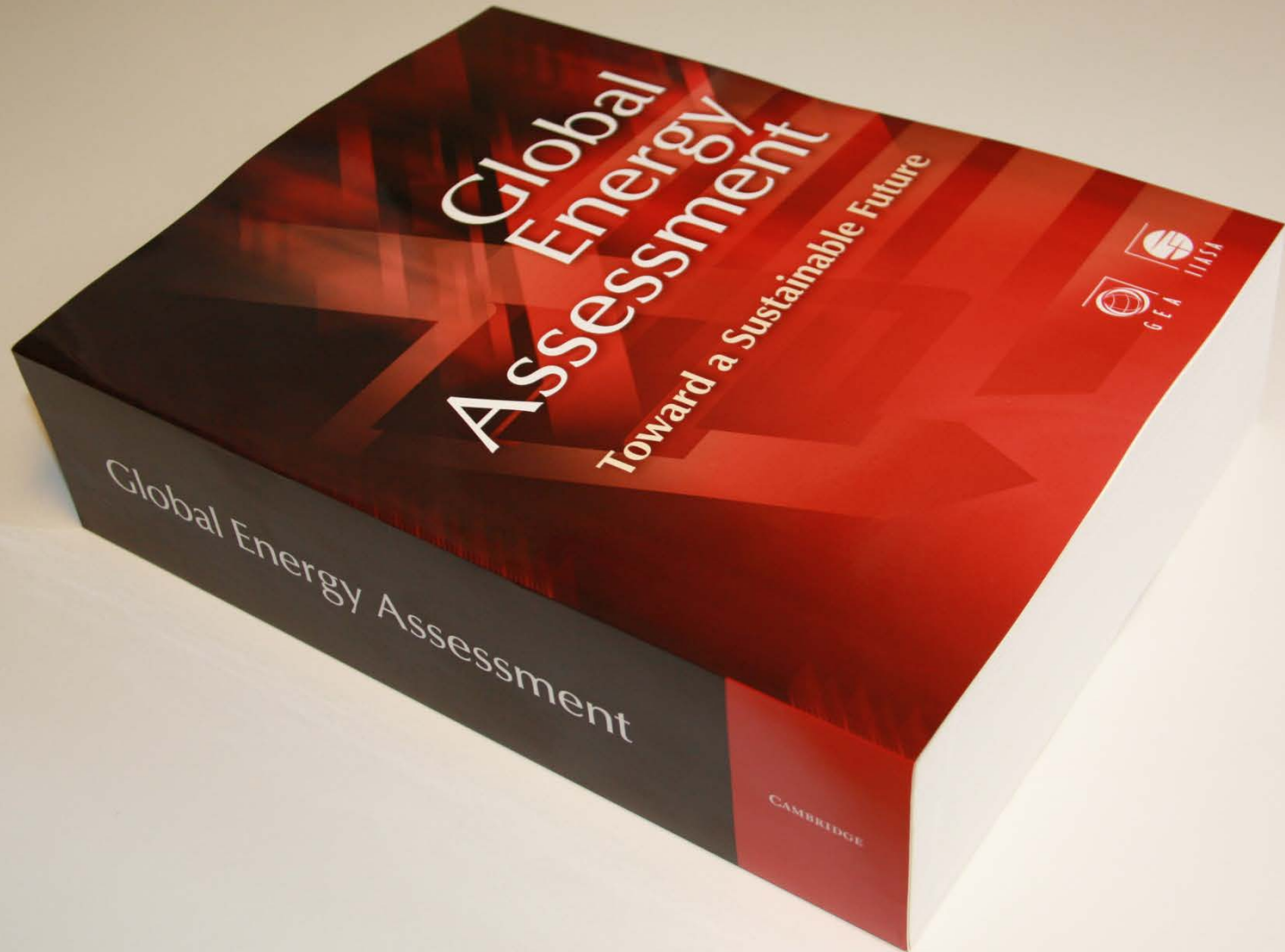
**Systems
Analysis**

Benefits of Systems Approach: Bridging across research and policy making silo's (Example 1)

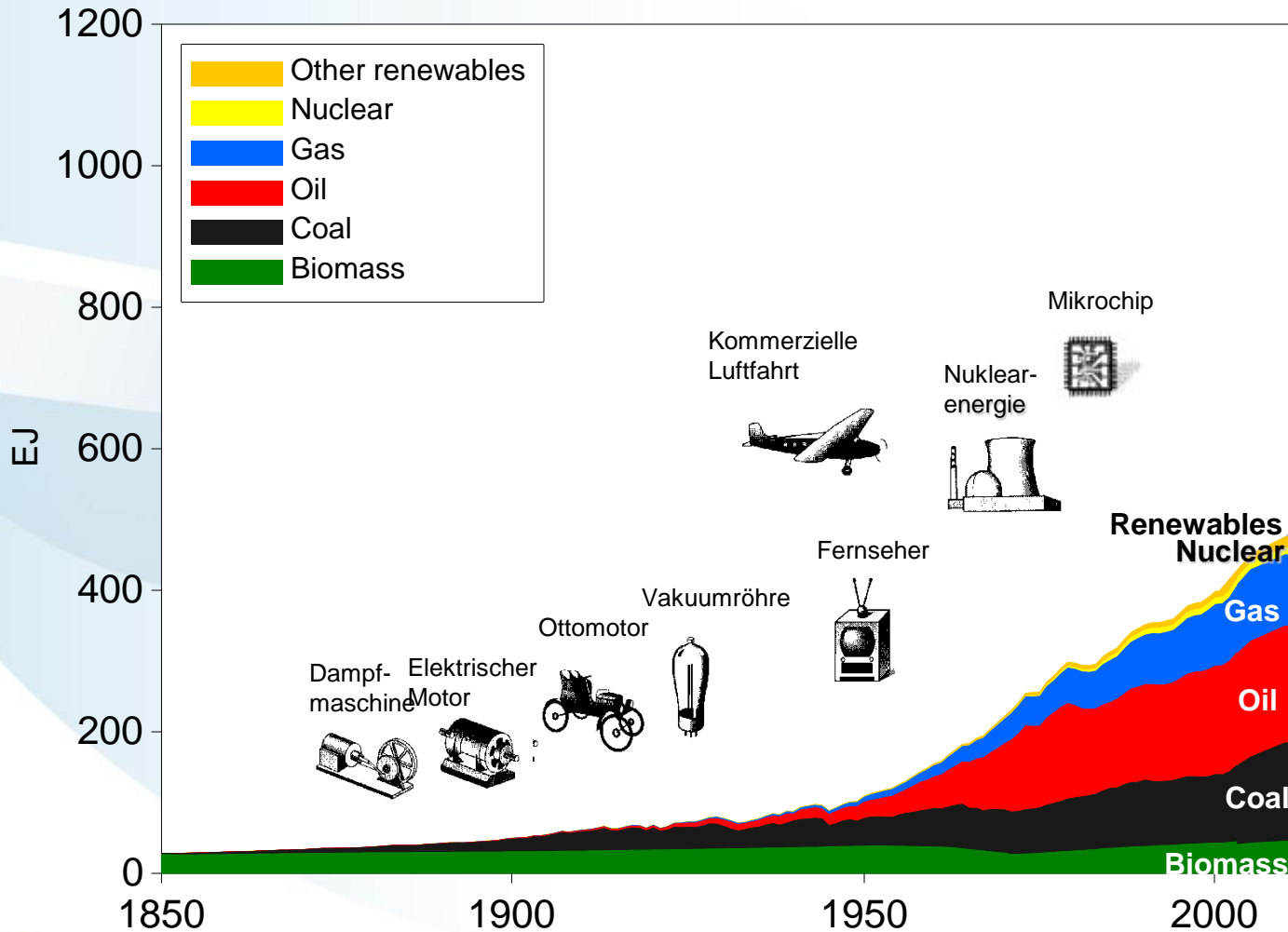
- 2006-12: Global Energy Assessment involving 500 experts around the world
- 2009 to date: GEA provides critical input to Un Secretary-General's Sustainable Energy For All Initiative including defining the aspirational yet feasible objectives:
 1. Ensure universal access to modern energy services
 2. Double the global rate of improvements in energy efficiency
 3. Double the share of renewable energy in the global energy mix



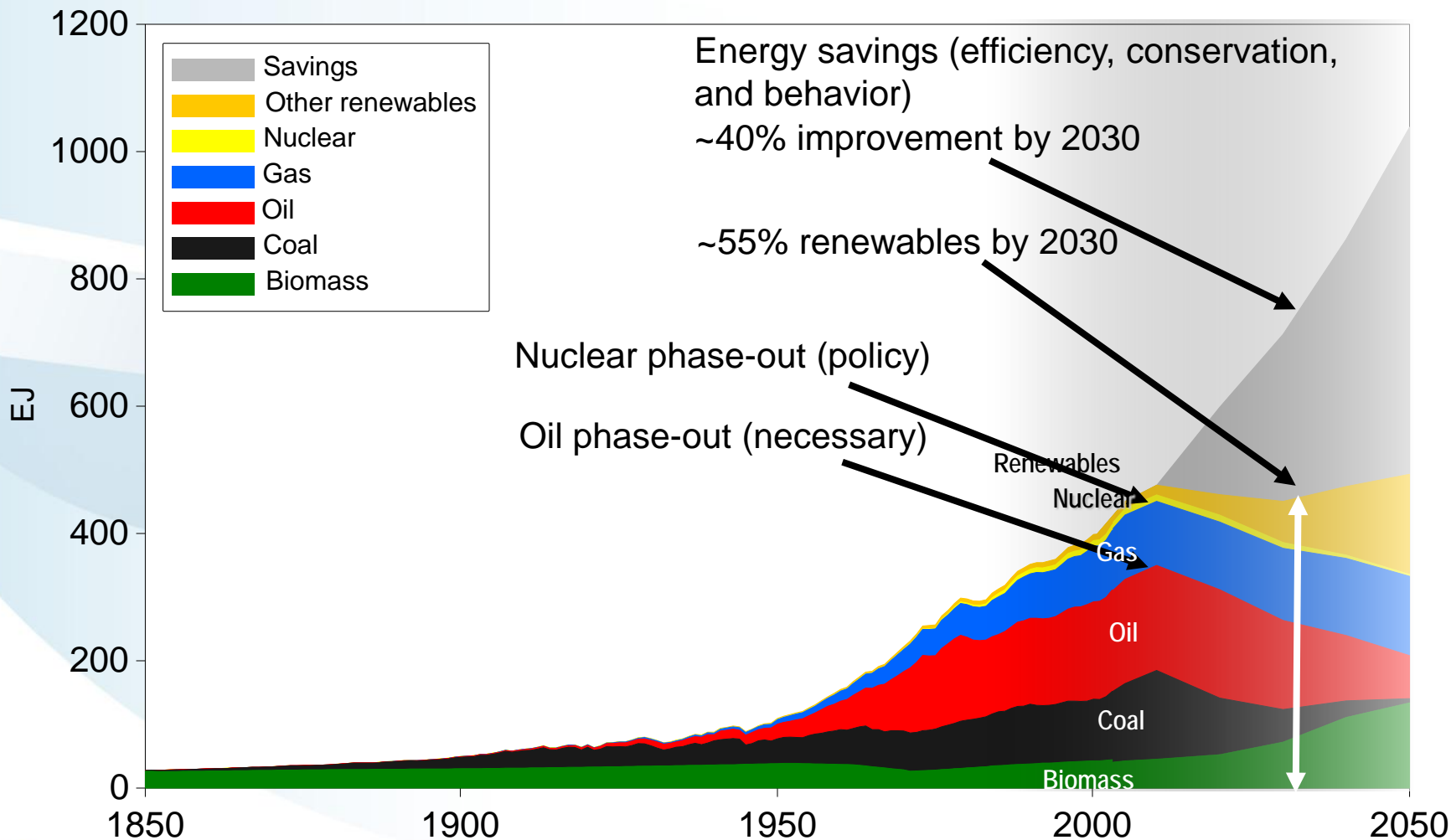
www.GlobalEnergyAssessment.org



Global Primary Energy



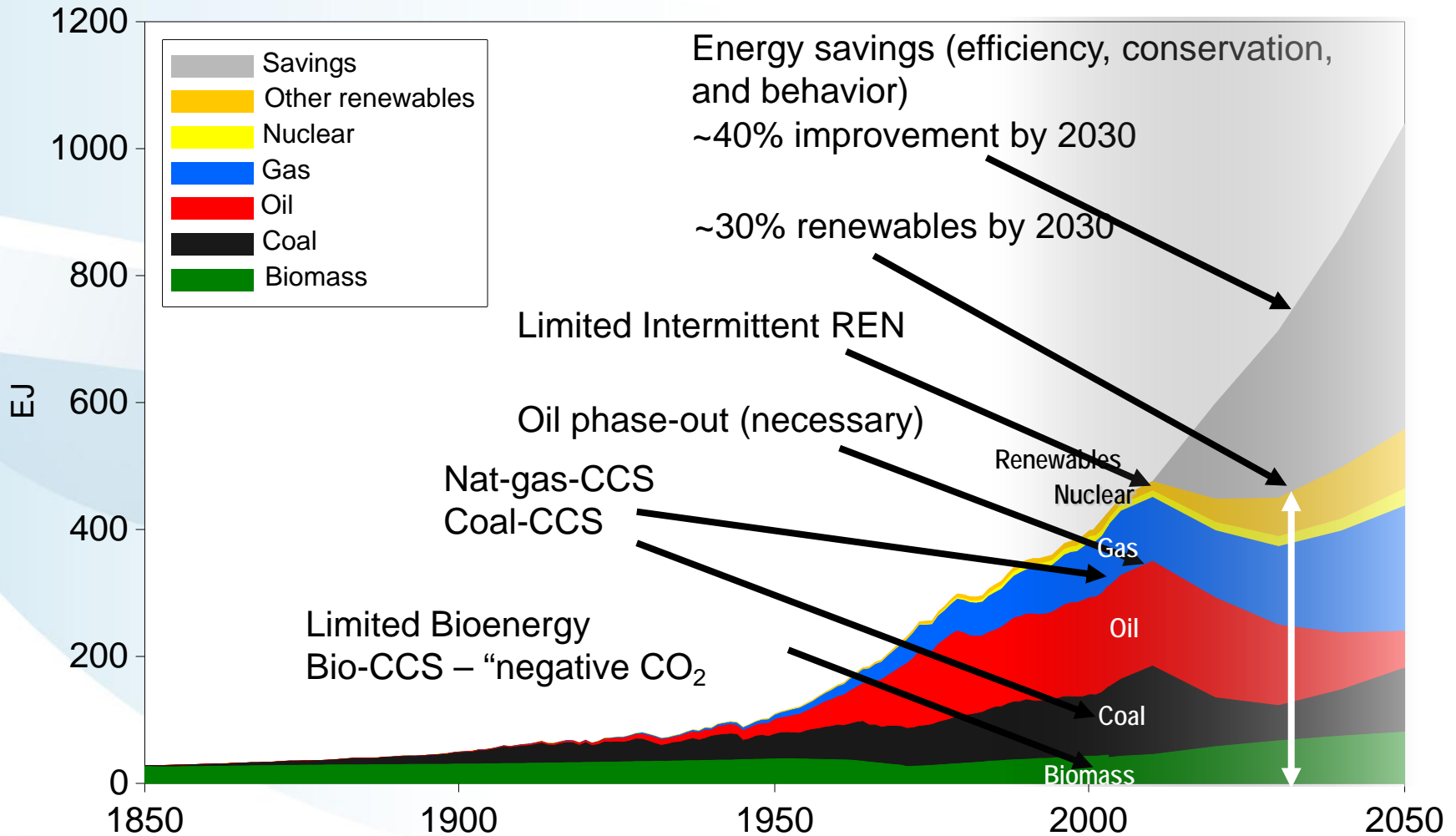
Global Primary Energy no CCS, no Nuclear



Source: Riahi et al, 2012

Global Primary Energy

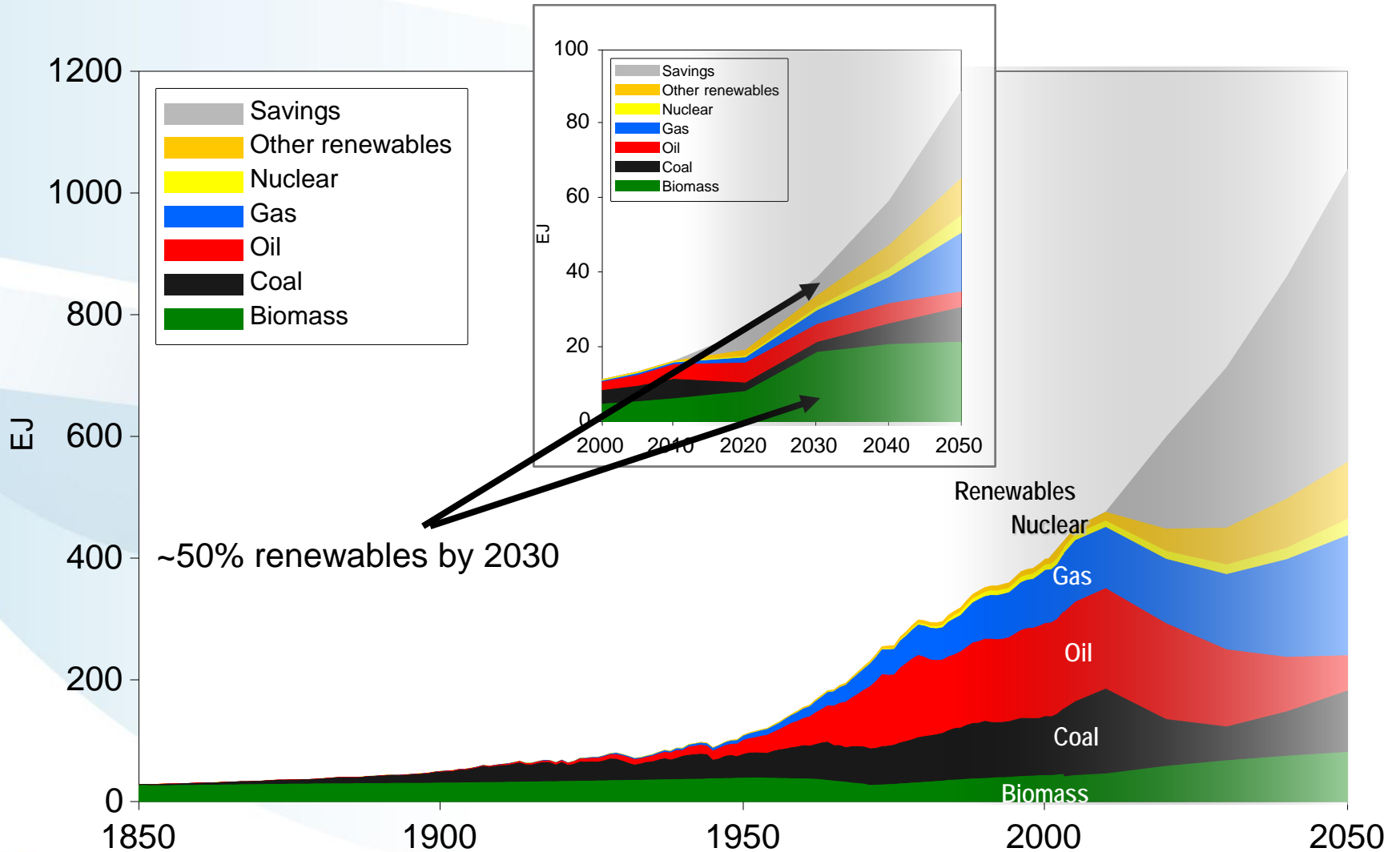
lim. Bioenergy, lim. Intermittent REN



Source: Riahi et al, 2012

Global Primary Energy

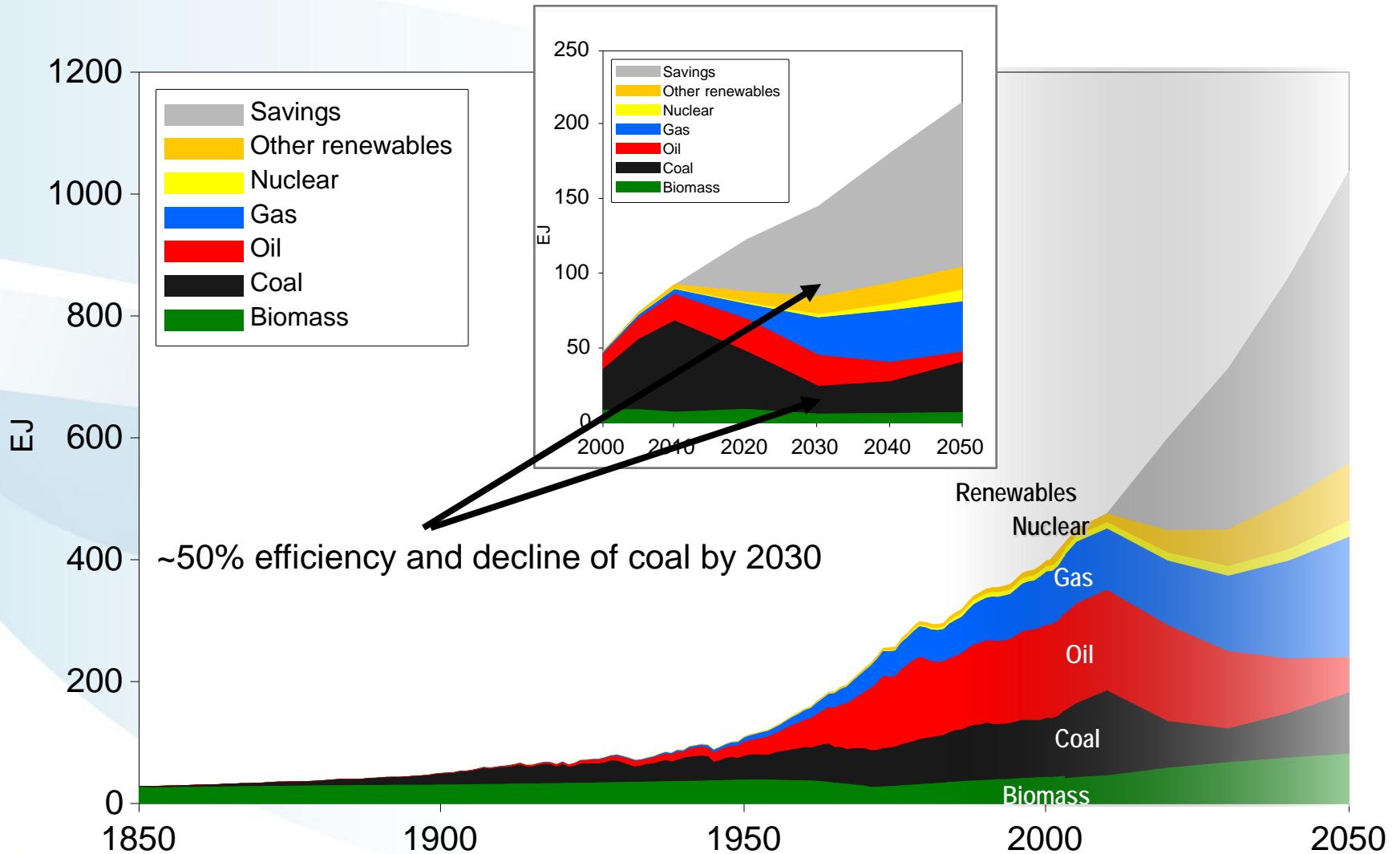
Sub-Saharan Africa



Source: Riahi et al, 2012

Global Primary Energy

China

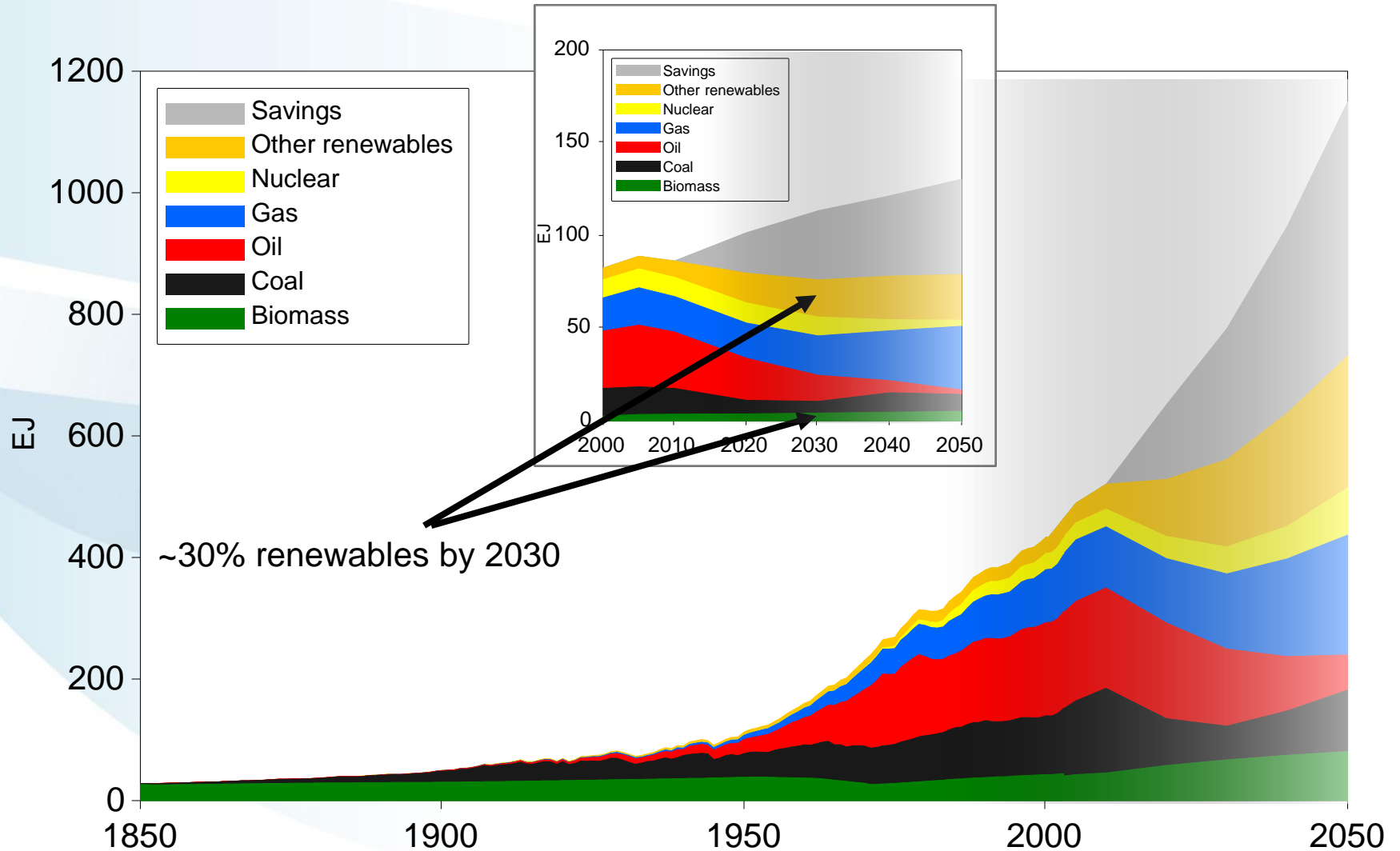


~50% efficiency and decline of coal by 2030

Source: Riahi et al, 2012

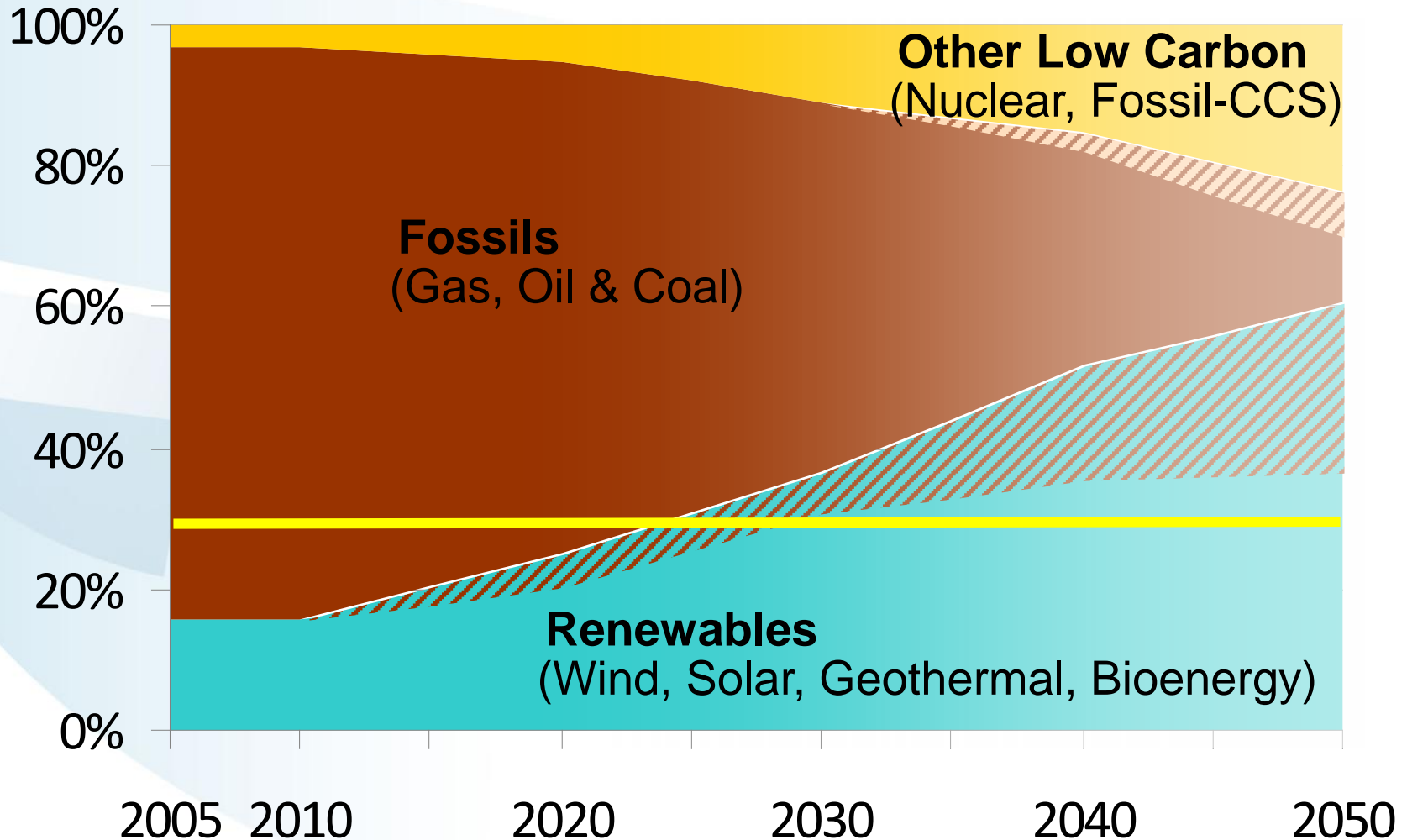
Global Primary Energy

Europe

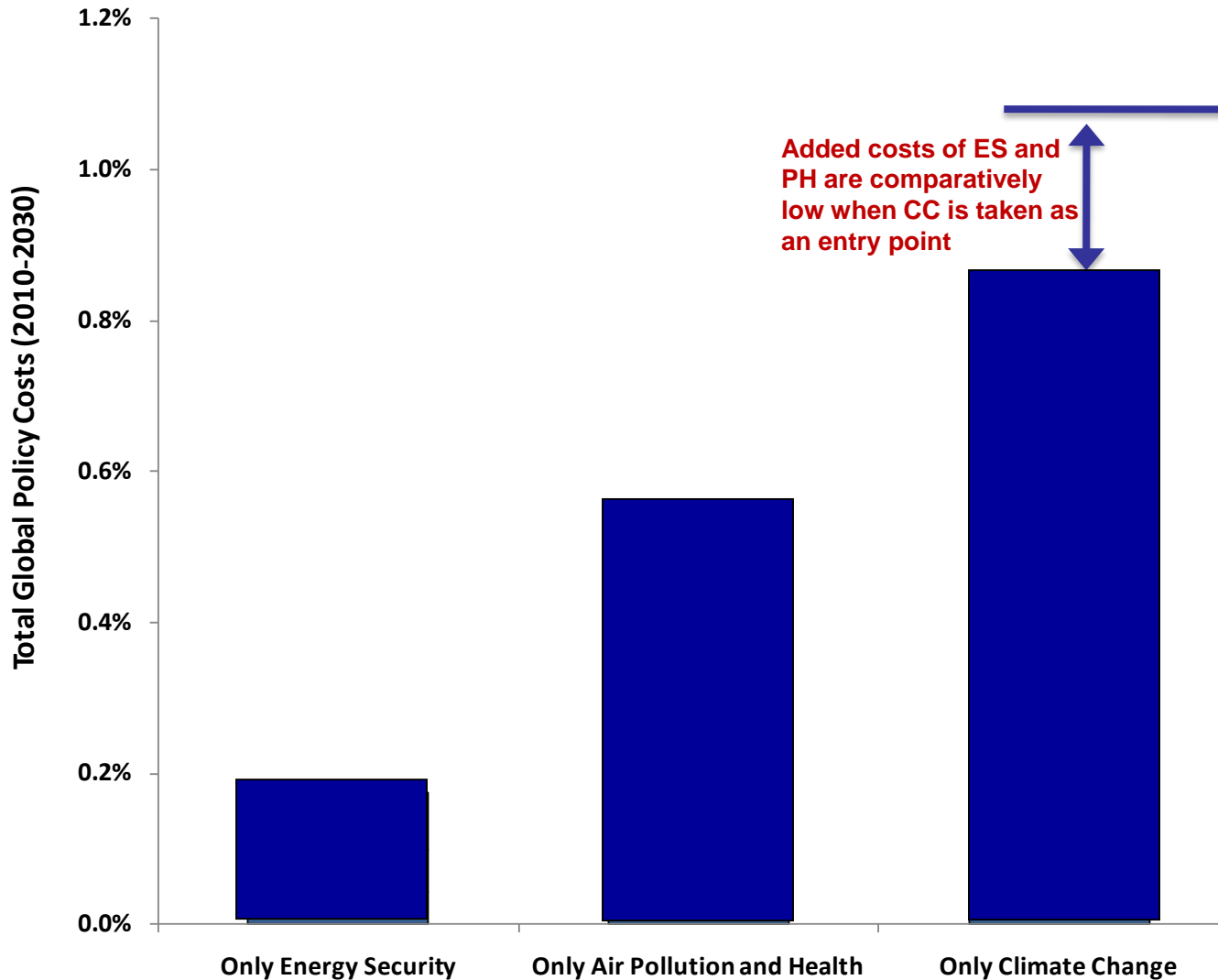


~30% renewables by 2030

Final Energy Transformations



Multiple Benefits of Integrated Policies



Source: McCollum, Krey, Riahi, 2012

Benefits of Systems Approach: Bridging across research and policy making silo's (Example 2)

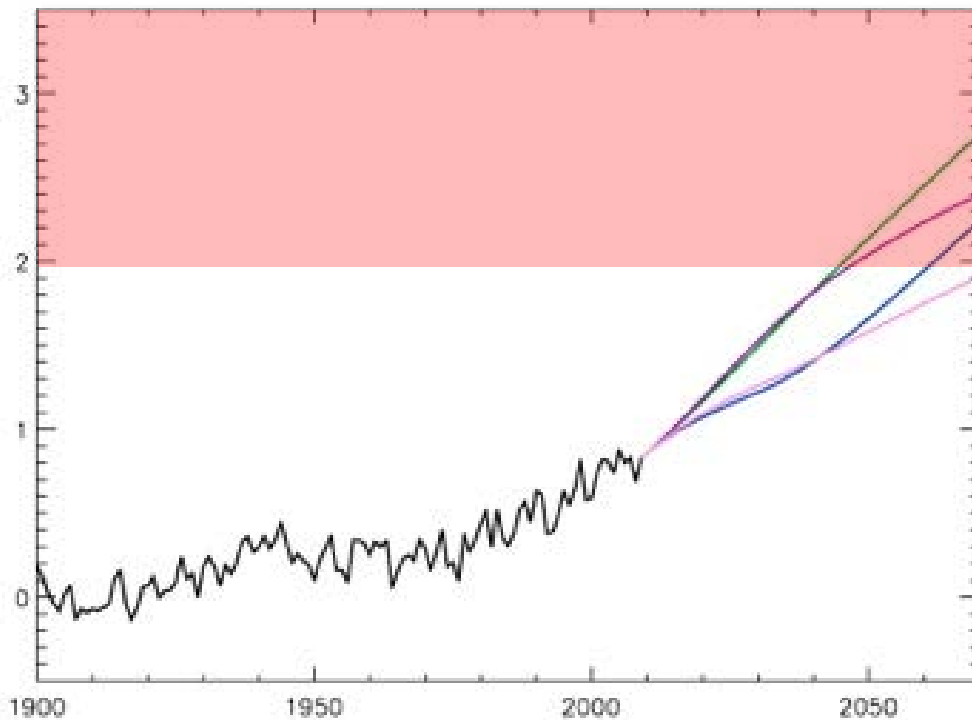
- 2011: IIASA model GAINS identifies 16 measures to curb the release of either black carbon or methane (pollutants that harm human or plant health while simultaneously exacerbating climate change).
- Feb 2012: US State Secretary Hillary Clinton launched the Climate and Clean Air Coalition to Reduce Short Lived Climate Pollutants
- Today, CCAC has 33 member countries, 39 International Organizations and IIASA's Markus Amann on scientific committee



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



Global temperature 1900–2070



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)

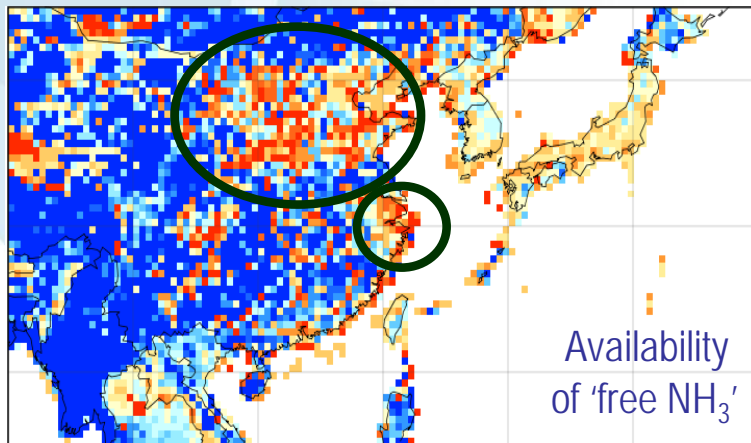
Source: Shindell et al., *Science* (2012), 335/6065:183–189

IS THE FORMATION OF SECONDARY INORGANIC AEROSOLS IN THE JINGJINJI REGION NH₃-LIMITED?

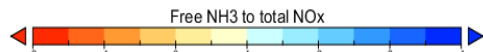


Daily views from the 300m tower in Beijing, May 2013

A large fraction of PM_{2.5} in China consists of secondary inorganic aerosols, also during episodes



Availability of 'free NH₃'



Severely NH₃ limited - NH₃ limited - Nitrate limited

World Bank support to China



Based on IIASA research:

2014: NH₃/nitrogen use efficiency adopted as the main direction of World Bank support for the JingJinJi Clean Air Action program of the Chinese government

Air quality seen as entry point for good N management practices

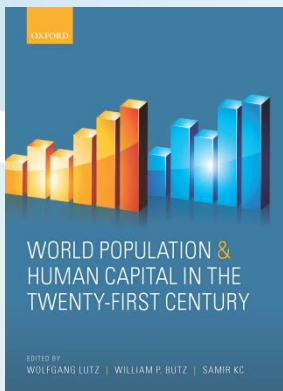
Benefits of Systems Approach: Bridging across research and policy making silo's (Example 3)

Jan 2014: European Commission announce 2030 climate and energy goals for a competitive, secure and low-carbon EU economy. These include:



- A reduction in greenhouse gas emissions by 40% below the 1990 level
- An EU-wide binding target for renewable energy of at least 27%

Goals were informed by an extensive impact assessment, for which IIASA researchers contributed data and model results to help policymakers understand future emissions, as well as the potential benefits and costs of various climate policies.



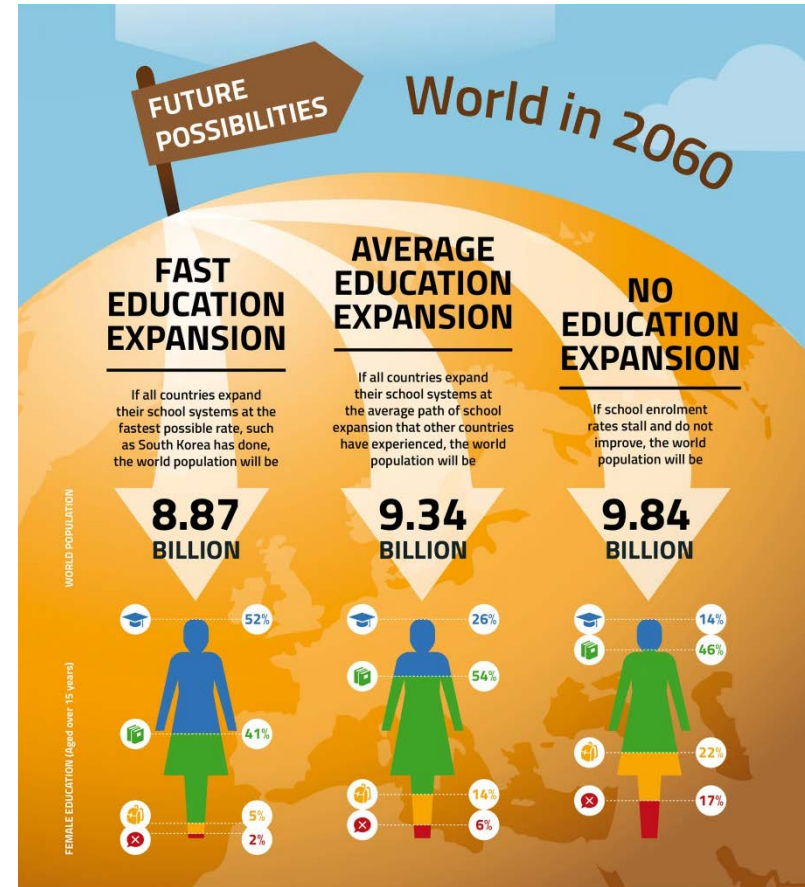
Benefits of Systems Approach: Bridging across research and policy making silo's (Example 4)

UN

80% probability that world population, now 7.2 billion, will increase to between 9.6 and 12.3 billion in 2100, with the median at 10.9 billion.

IIASA

Most likely scenario indicates that world population will increase to 9.2 billion by 2050, peak at 9.4 billion around 2070 and start a slow decline to 9.0 billion by the end of the century.





REVIEW

Global Human Capital: Integrating Education and Population

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

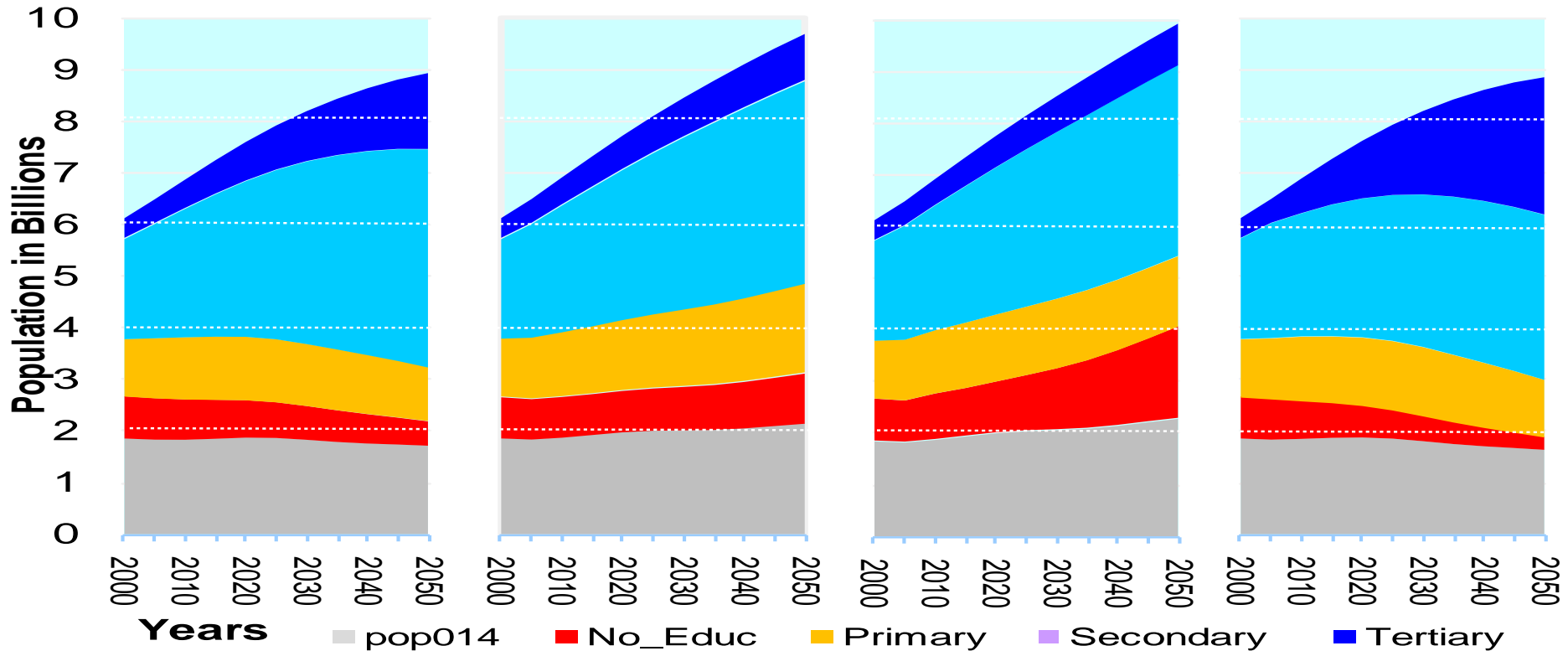
Almost universally, women with higher levels of education have fewer children. Better education is associated with lower mortality, better health, and different migration patterns. Hence, the global population outlook depends greatly on further progress in education, particularly of young women.

GET

CER

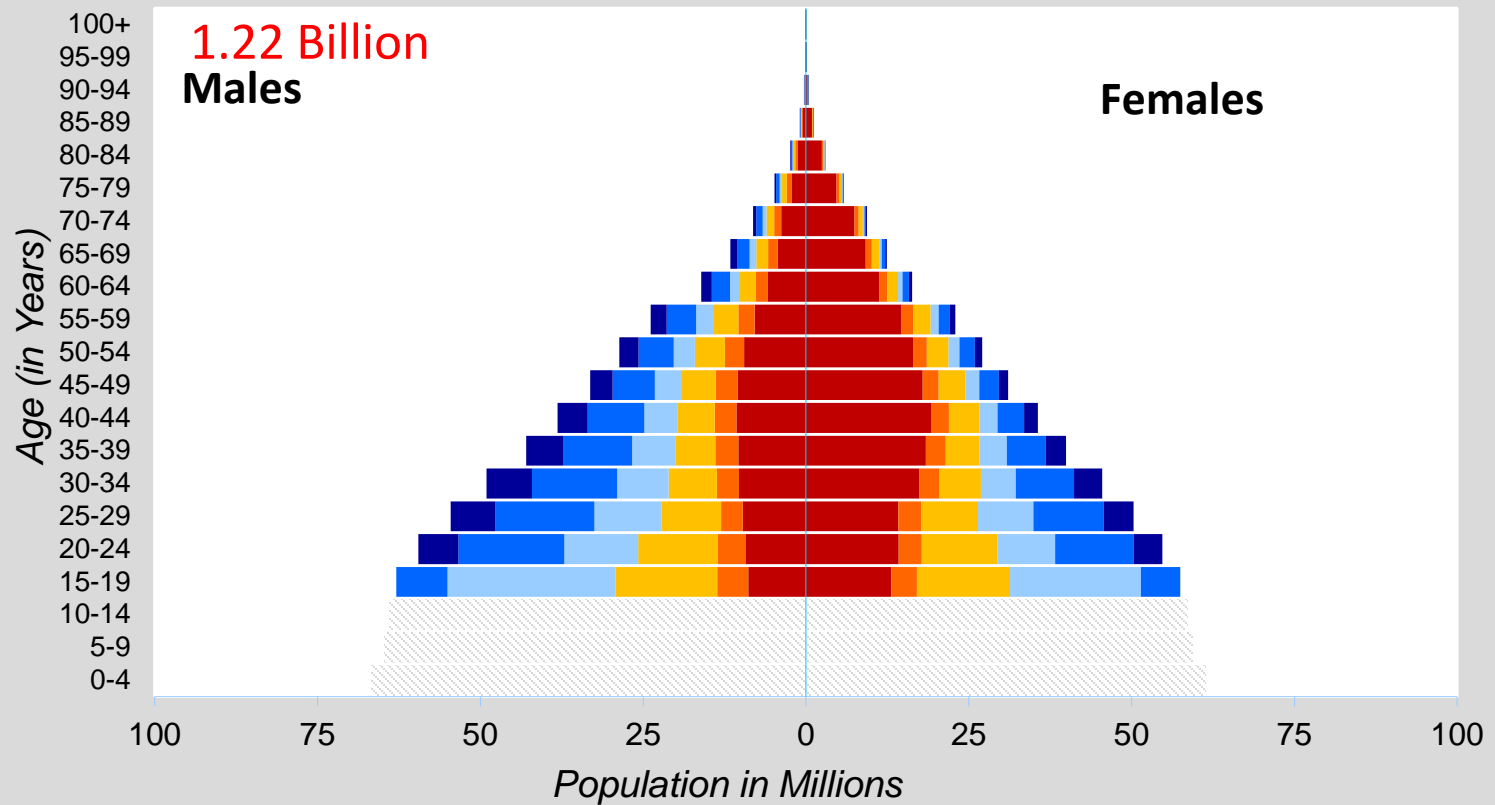
CEN

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PROJECTING INDIA'S FUTURE POPULATION

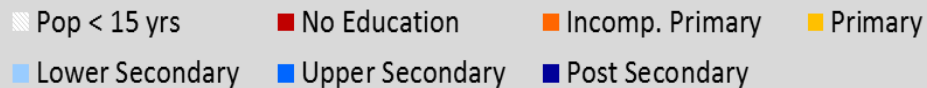
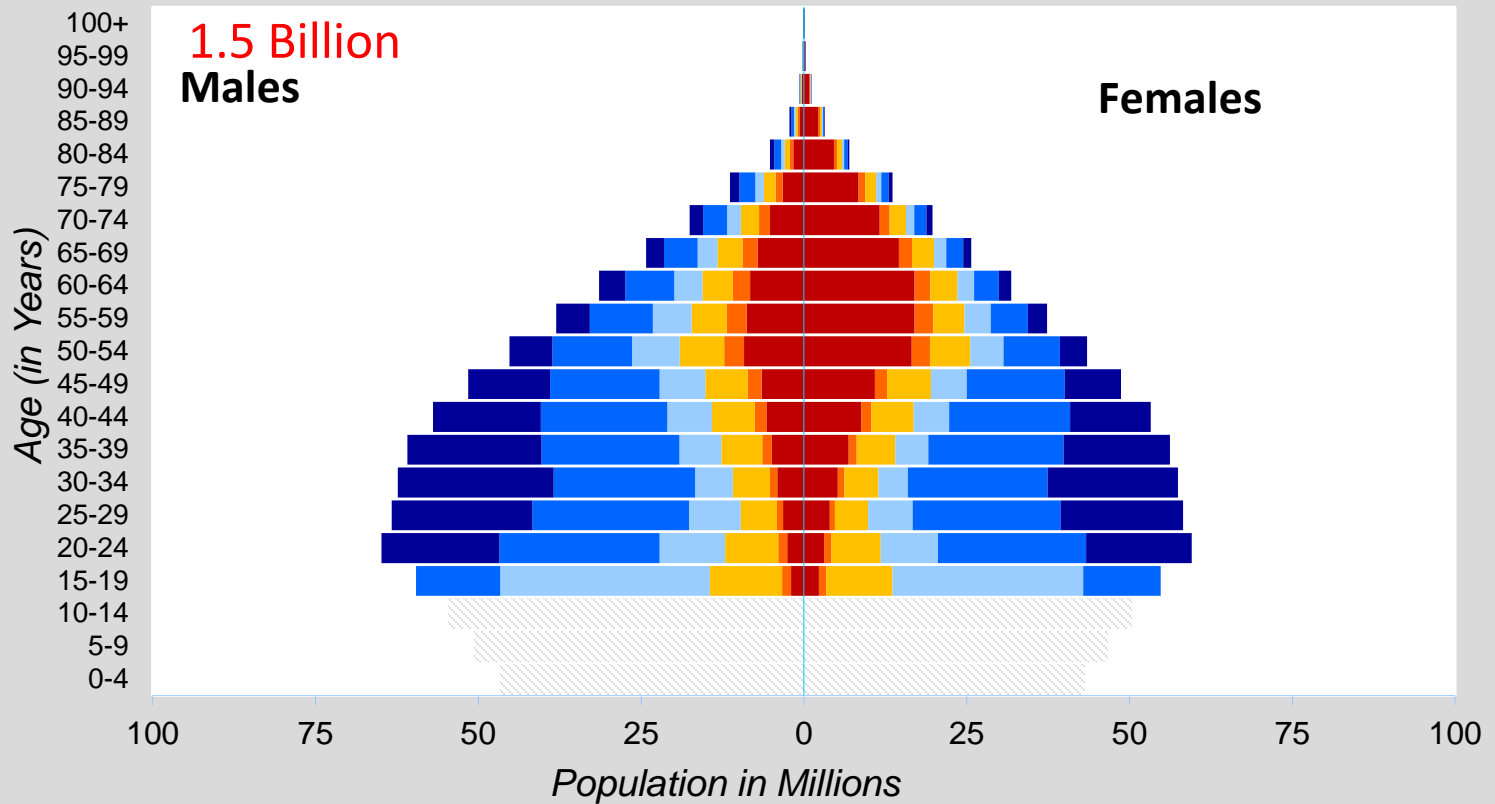
India - Base Year 2010



- ▨ Pop < 15 yrs
- No Education
- Incomp. Primary
- Primary
- Lower Secondary
- Upper Secondary
- Post Secondary

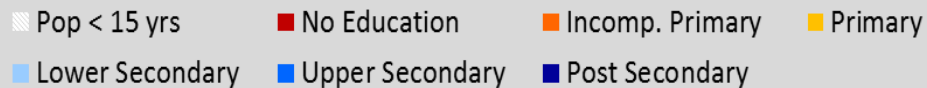
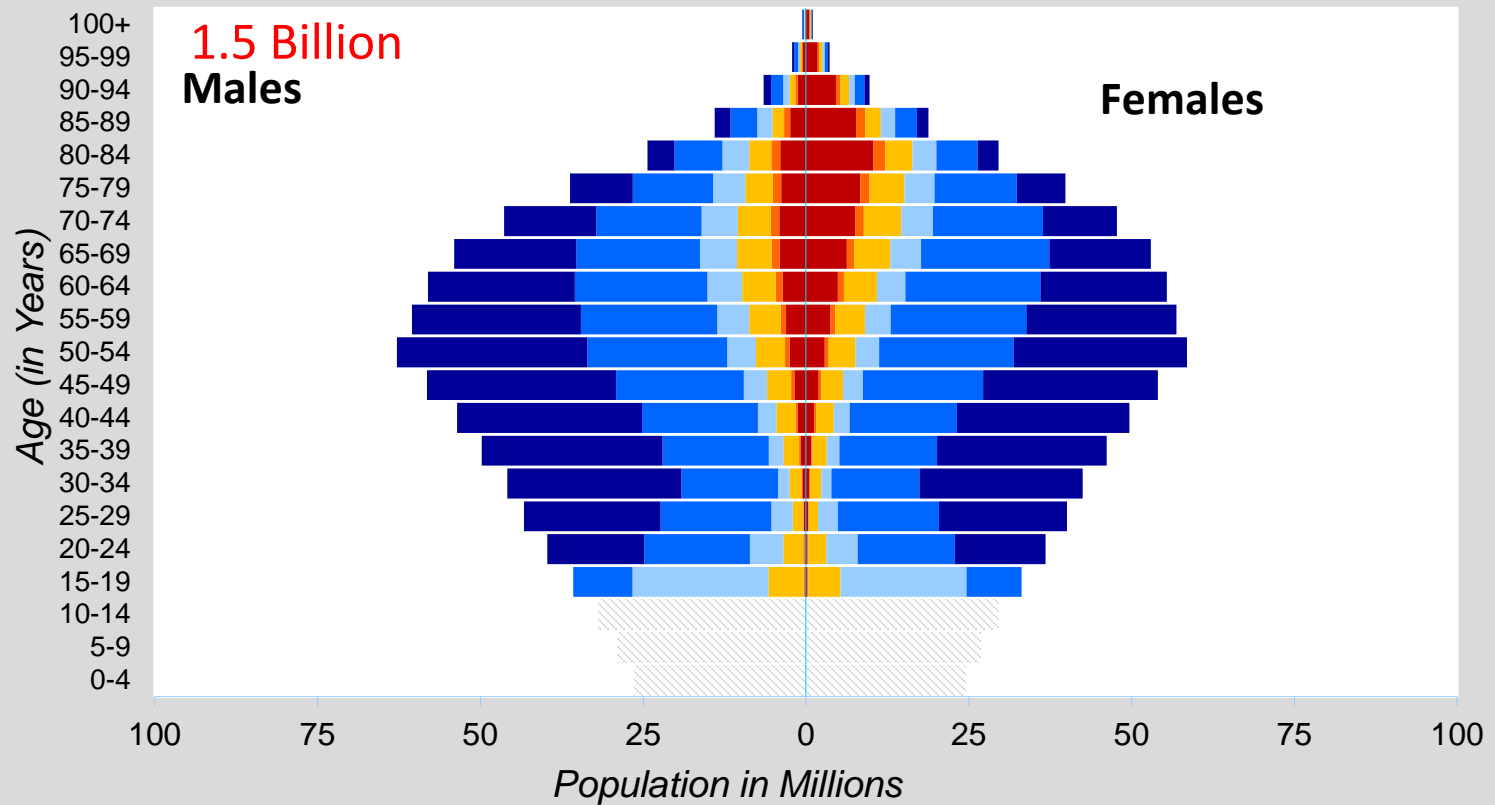
PROJECTING INDIA'S FUTURE POPULATION

India - Projections 2030 - SSP1



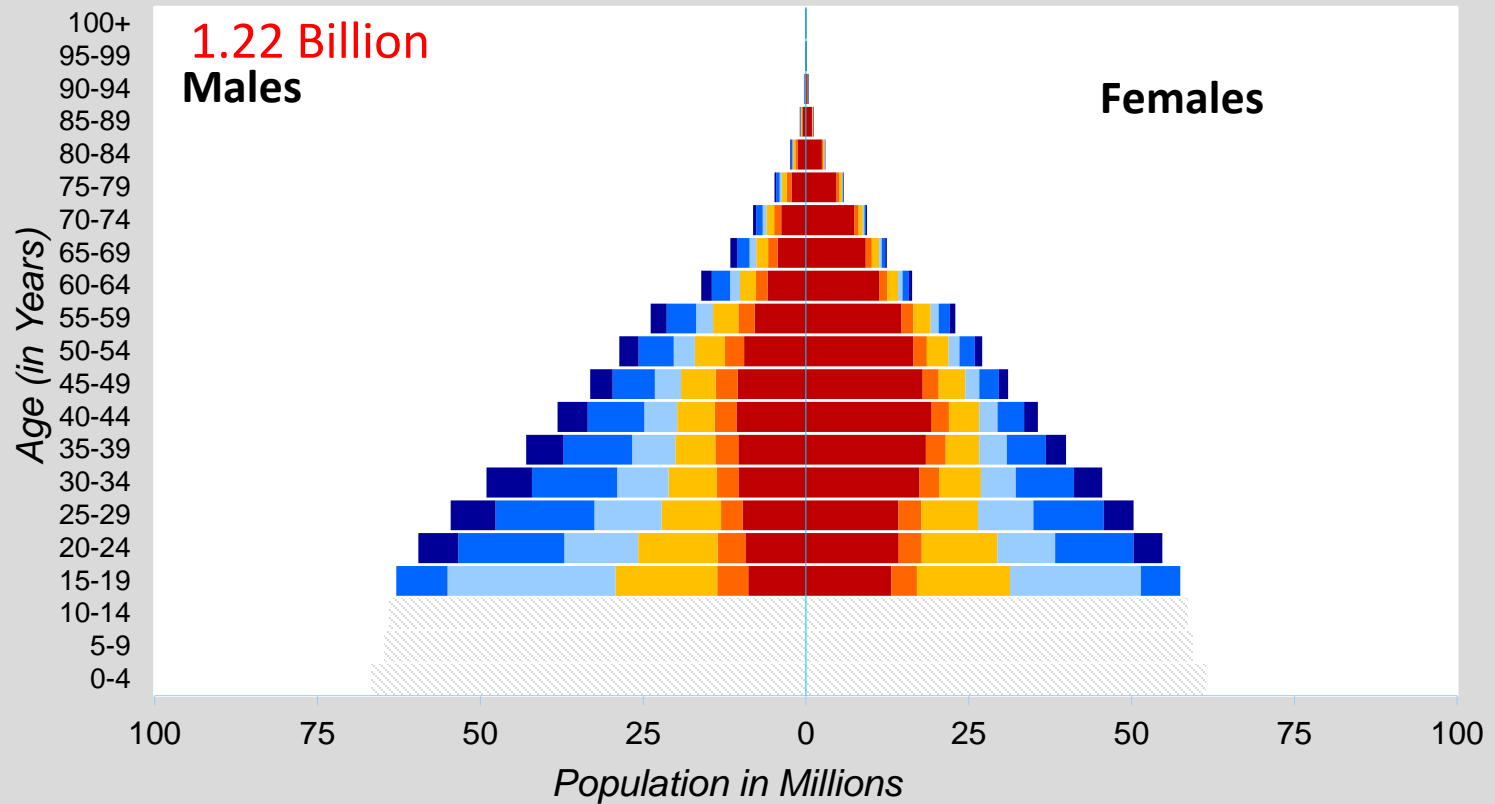
PROJECTING INDIA'S FUTURE POPULATION

India - Projections 2060 - SSP1



PROJECTING INDIA'S FUTURE POPULATION

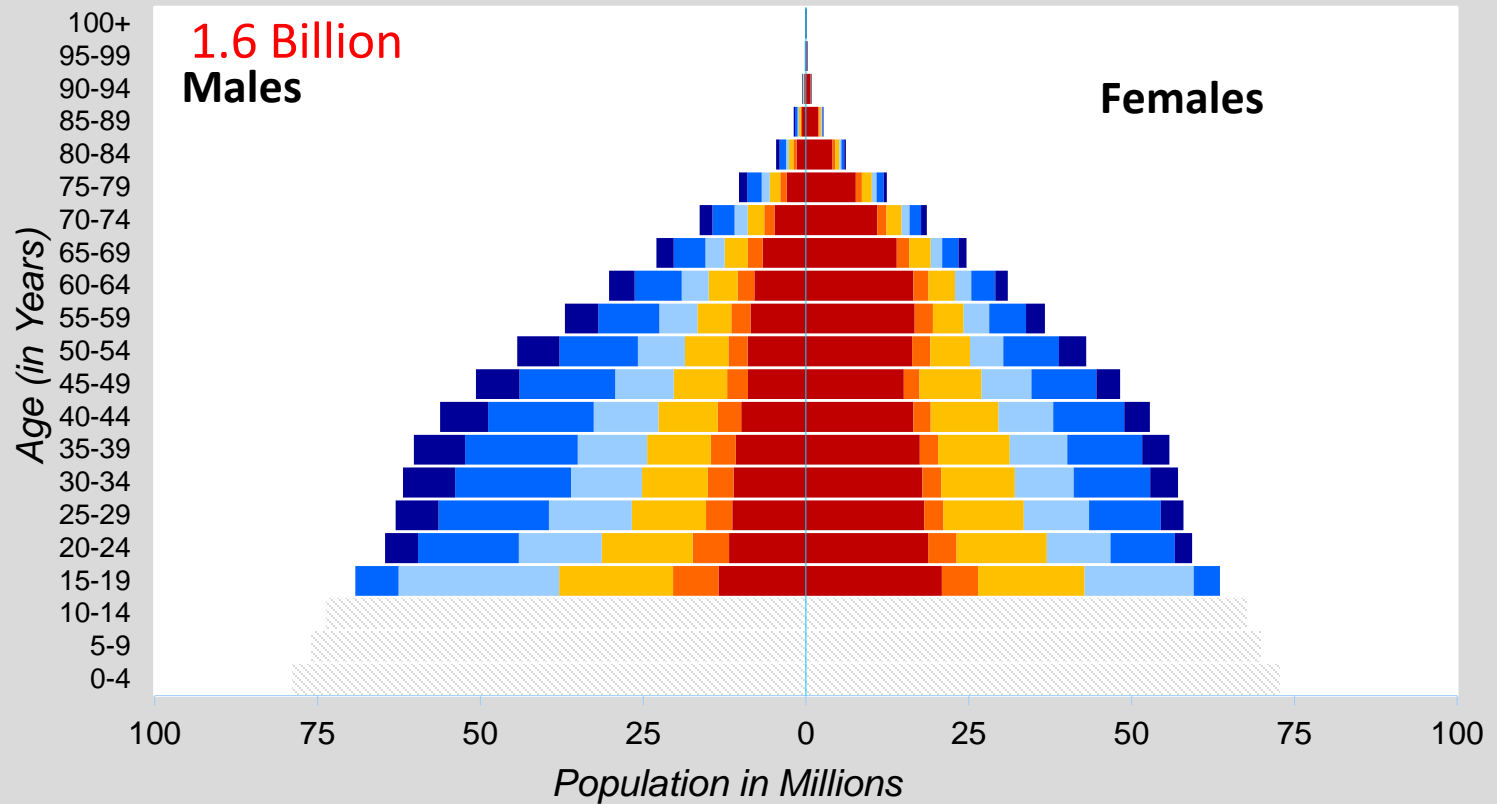
India - Base Year 2010



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PROJECTING INDIA'S FUTURE POPULATION

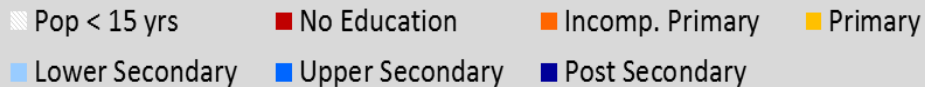
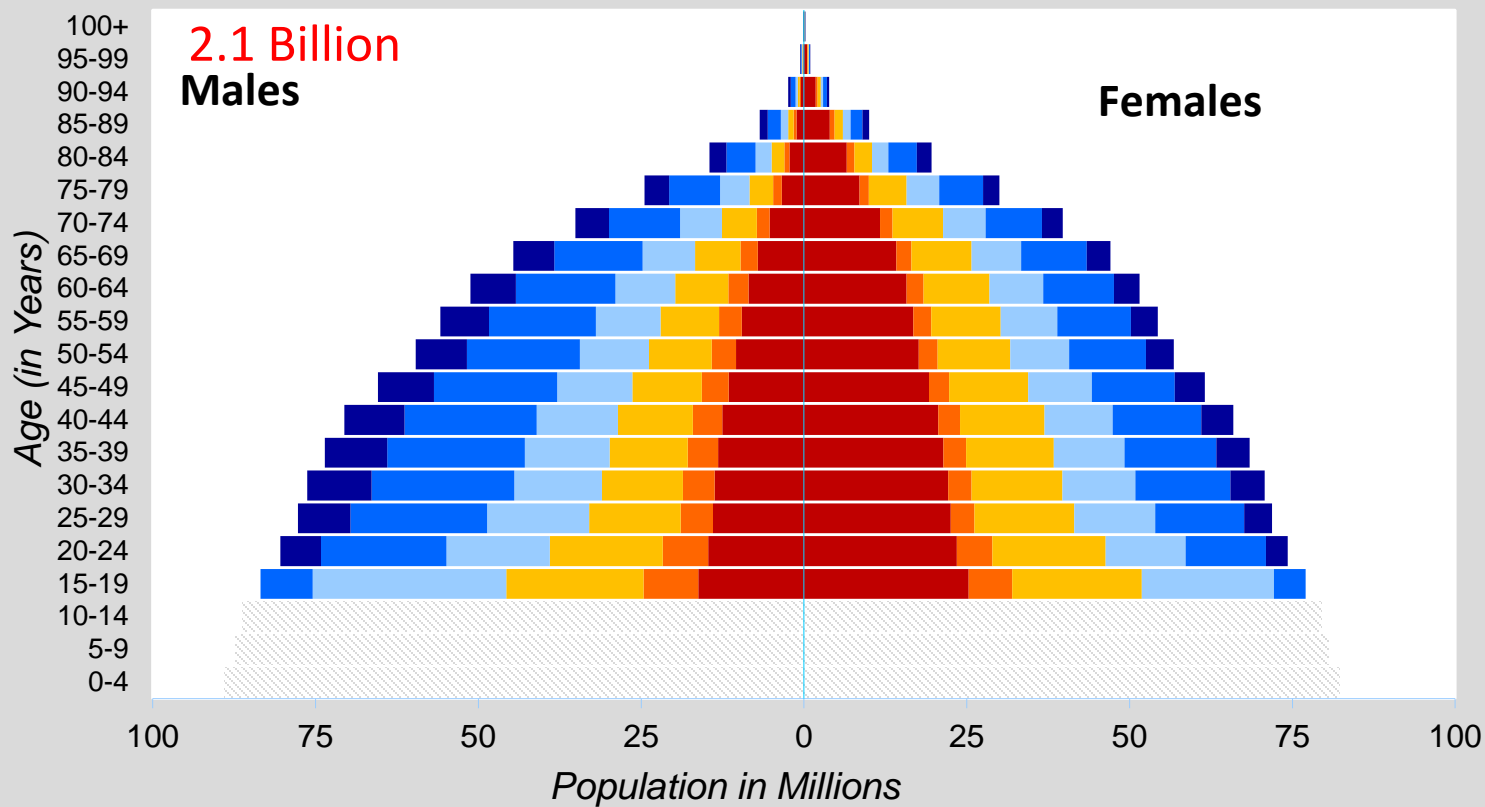
India - Projections 2030 - SSP3



Pop < 15 yrs
 No Education
 Incomp. Primary
 Primary
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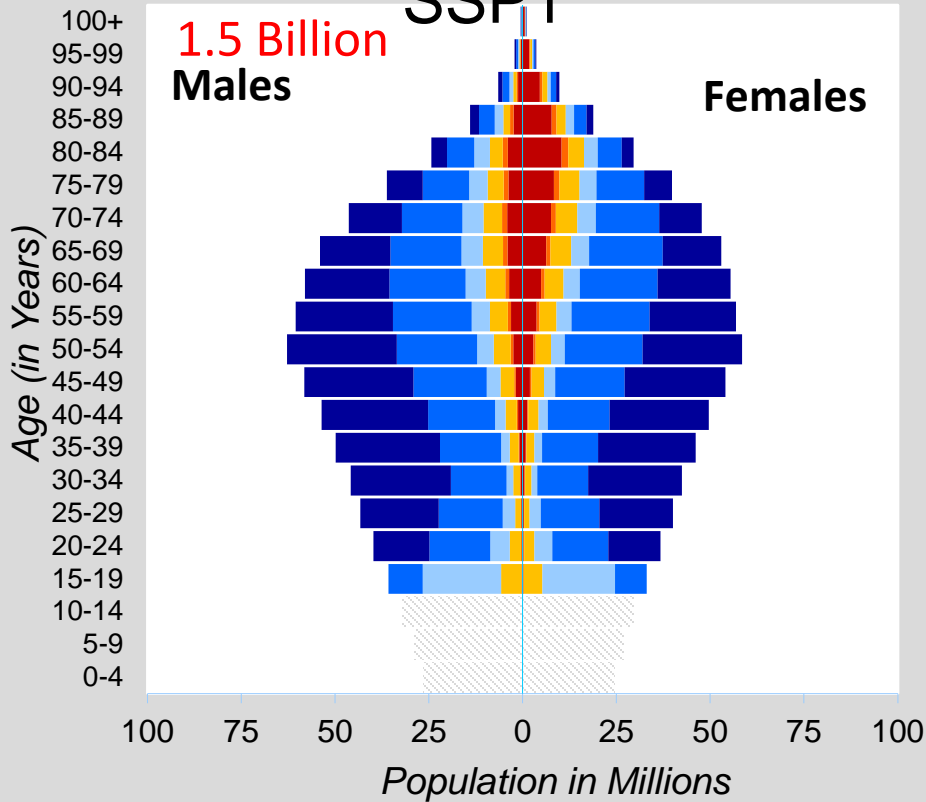
PROJECTING INDIA'S FUTURE POPULATION

India - Projections 2060 - SSP3

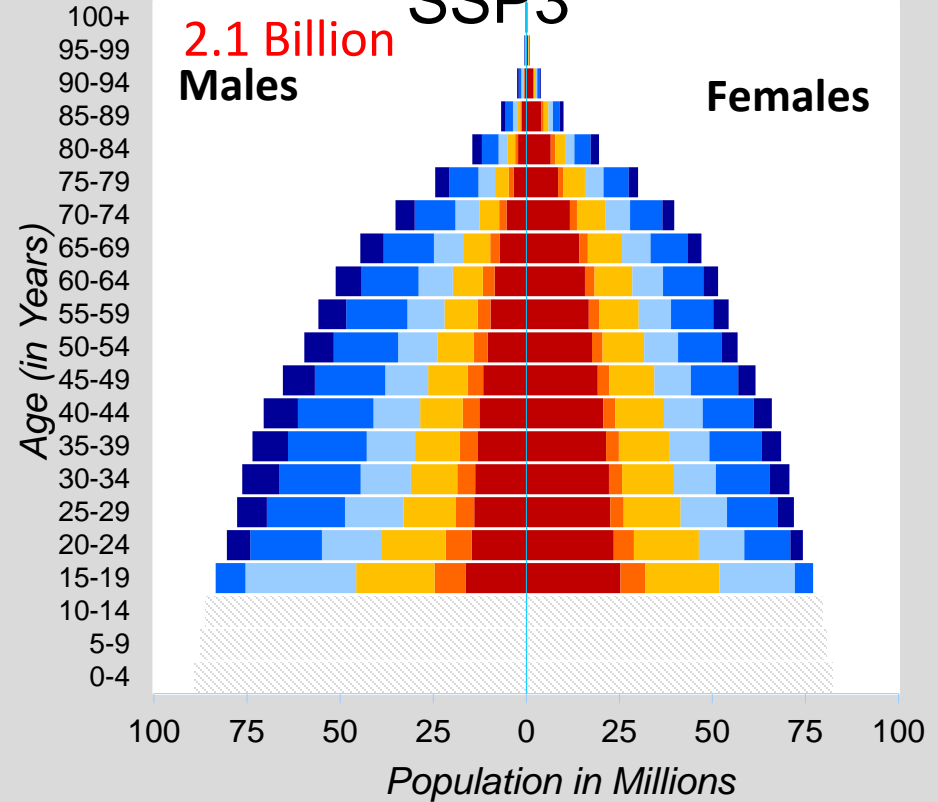


IMPACT OF EDUCATION ON POPULATION

India - Projections 2060 - SSP1



India - Projections 2060 - SSP3



Pop < 15 yrs
 No Education
 Incomp. Primary
 Primary
 Lower Secondary
 Upper Secondary
 Post Secondary

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?**

ACADEMIC TRAINING AND CAPACITY BUILDING

New paradigms

New curricula

New funding architecture

Revised academic career 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

POSITIVE PARADIGMS
NEW PARTNERSHIPS

Y2015: Transformational Change – Main Events

Event	Time	Location	Link
SE4ALL Forum	May 17 th – 21 st , 2015	NYC, USA	http://www.se4allforum.org/
Vienna Energy Forum 2015	June 18 th -20 th , 2015	Vienna, Austria	http://www.viennaenergyforum.org/
Our Common Future Under Climate Change – International Scientific Conference	July 7 th -10 th , 2015	Paris, France	http://www.commonfuture-paris2015.org/
Third International Conference on Financing for Development	July 13 th -16 th , 2015	Addis Ababa, Ethiopia	http://www.un.org/esa/ffd/overview/third-conference-ffd.html
The United Nations summit for the adoption of the post-2015 development agenda	Sept. 25 th – 27 th , 2015	NYC, USA	https://sustainabledevelopment.un.org/post2015/summit
UNFCCC COP 21	Nov. 30 th - Dec. 11 th , 2015	Paris, France	http://www.cop21.gouv.fr/en



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SUSTAINABLE DEVELOPMENT
SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS



Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship

THE EARTH INSTITUTE
COLUMBIA UNIVERSITY

The World in 2050 (TWI2050)

Integrating knowledge on SDSN pathways to global
sustainable development

Inaugural Meeting @ IIASA
10-12 March 2015



IIASA, International Institute for Applied Systems Analysis

science for global insight

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

The World in 2050 “Consortium”

- AIMES
- Future Earth
- Centre for Integrated Studies on Climate Change
- 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 Lab (JGCRI)
- National Center for Atmospheric Research (NCAR)
- National Institute for Environmental Studies (NIES)
- UN Population Division
- UNEP- World Conservation Monitoring Centre (UNEP-WCMC)
- World Bank
- Organisation for Economic Co-operation and Development (OECD)
- Potsdam Institute for Climate Impact Change (PIK)
- PBL - Netherlands Environmental Assessment Agency
- Stanford University
- Stockholm Resilience Centre
- The City University of New York (CUNY)
- Tsinghua University



United Nations Environment Programme

World Conservation Monitoring Centre



Thank you and hope to welcome you soon at IIASA !



IIASA IN 2014



International Institute for Applied Systems Analysis
Issue 38, June 2015 [View this email in your browser](#)



IPCC Expert Meeting: Climate research community looks into future scenarios

In May, climate experts gathered at IIASA at an Expert Meeting of the Intergovernmental Panel on Climate Change (IPCC), to discuss and further develop new socioeconomic scenarios as shared tools for climate research.

The new scenarios are planned to allow a more integrated assessment of mitigation, adaptation, and climate change impacts across the entirety of IPCC work in the future. IIASA has been instrumental in the development of new scenarios for the IPCC including the Shared Socioeconomic Pathways (SSPs) and the Representative Concentration Pathways (RCPs) used in the Fifth Assessment Report. [Read More>>](#)

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IIASA NEWS



New research analyzes policies needed to limit climate change to a more stringent 1.5°C limit by 2100. [More>>](#)



A new study shows that geography is a key factor determining how big the impact is of biofuel production on climate. [More>>](#)

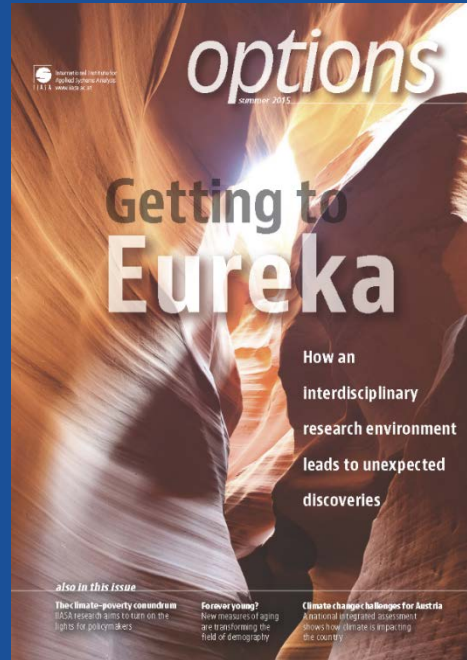


Featured Video
Kandeh Yumkella
[Science Policy in a Global Context](#)

IIASA IN BRIEF

IIASA IN DEPTH

EVENTS



also in this issue

Their climate-poverty conundrum
USC research hints to turn on the lights for policymakers

Forever young?
New research on aging are transforming the field of demography

Climate change challenges for Austria
Austrian integrated assessment shows how climate is impacting the country

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