



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

science for global insight

# Systems Science for Global and Regional Transitions

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Chief Executive Officer  
IIASA

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IIASA, International Institute for Applied Systems Analysis

# THE EARLY 1970s





1972

# 22 NATIONAL MEMBER ORGANIZATIONS



➤ International, independent, interdisciplinary



➤ Research on major global problems



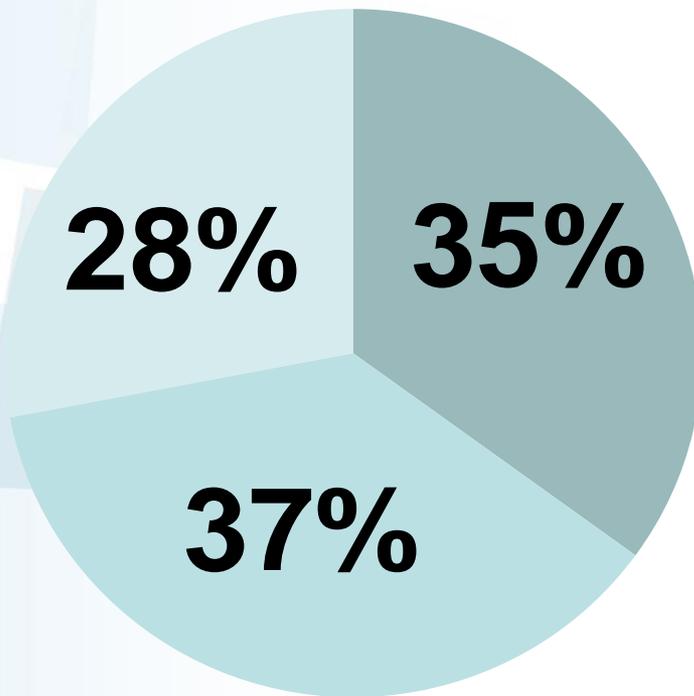
➤ Solution oriented, integrated systems analysis



# 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 2013**
- **~2050 researchers from some 65 countries** involved in IIASA's research network **in 2013**

# INTERDISCIPLINARY

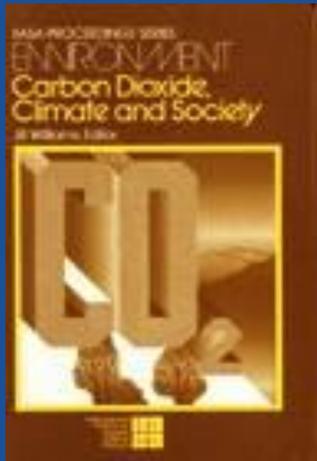


- Natural Scientists & Engineers
- Social Scientists
- Mathematicians and others

# EXTERNAL FUNDING 2008 - 2013

- € 65 million external funding above NMO contributions
- Part of a total funding portfolio of € 290 million of the external projects in which IIASA is involved. Much being used in collaborative networks with NMO countries
- 7 ERC Grants

# EXAMPLES OF EARLY RESEARCH



1978



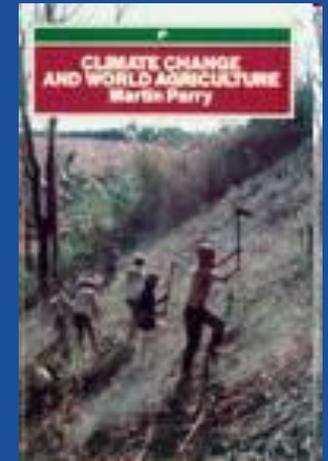
1981



1983



1986



1990

# 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

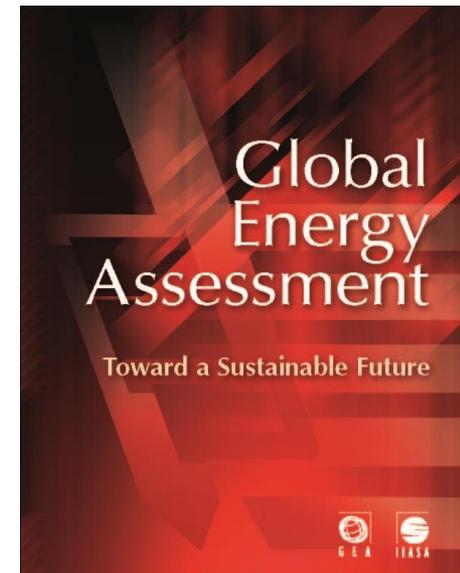
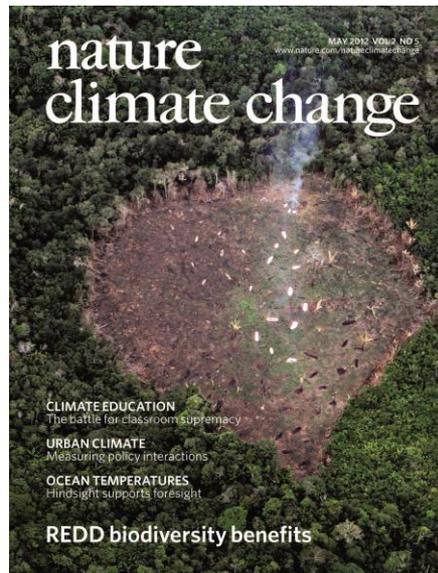
- **Advances in Modeling Dynamic Systems**
- **Extreme events, Systemic Risks and Robust Solutions**
- **Integrated Modeling and Decision Support**
- **Advanced Systems Analysis Forum**

# INEXTRICABLY LINKED



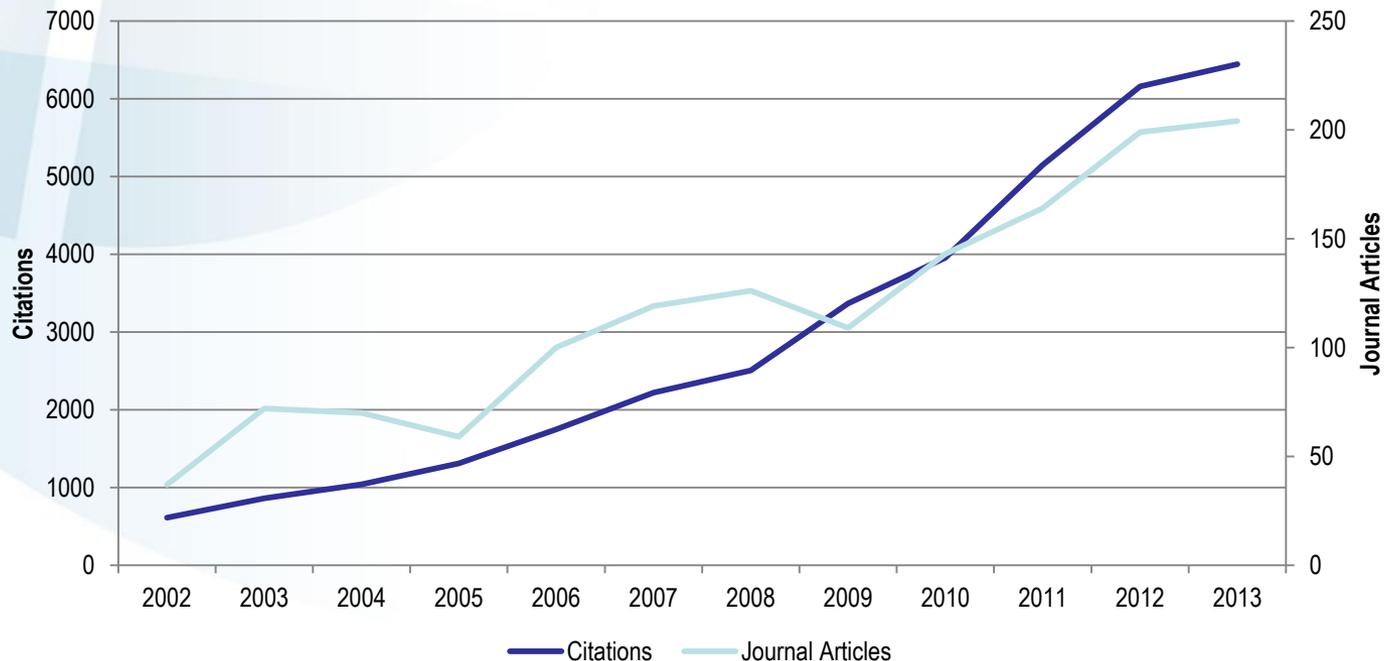
# SCIENTIFIC OUTPUT

## Highly Published



# JOURNAL ARTICLES & CITATIONS

	2010	2011	2012	2013
Peer-reviewed journal articles according to SCOPUS	143	164	199	270
Citations of IIASA publications according to SCOPUS	3955	5145	6157	7500



# IIASA AS THE EXPERT ADVISOR

IIASA researchers take part in 60 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



# GAINS policy applications

## Convention on Long-range Transboundary Air Pollution

- |      |  |
|------|--|
| 1994 | Second Sulphur Protocol                          |
| 1999 | Gothenburg Multi-pollutant/multi-effect Protocol |
| 2012 | Revision of the Gothenburg Protocol              |



## European Union

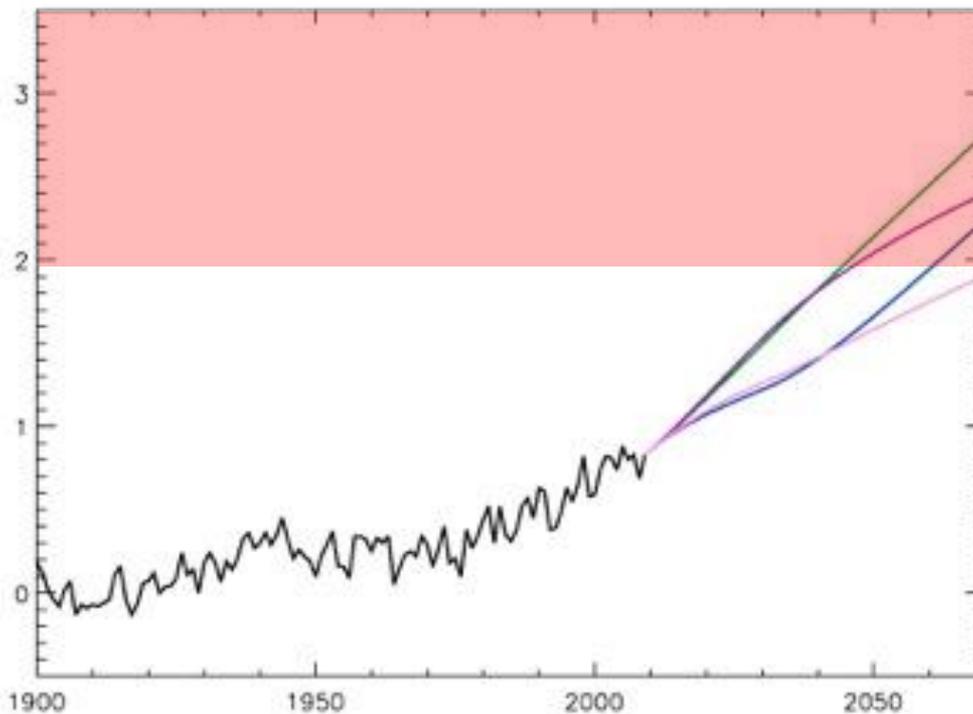
- |      |                                      |
|------|--------------------------------------|
| 1999 | National Emission Ceilings Directive |
| 2004 | Thematic Strategy on Air Pollution   |
| 2010 | Energy & Climate package, etc.       |
| 2013 | Revision of the Thematic Strategy    |

Further analyses for UNFCCC, Arctic Council, UNEP, Chinese, Japanese and Korean Governments

# GAINS identified 16 key air quality measures that, together with CO<sub>2</sub> mitigation, increase chances to stay below the 2° target



Global temperature 1900-2070



**Reference scenario**

IEA World Energy Outlook 2009

**CO<sub>2</sub> measures**

IEA 450 ppm scenario 2009

**Near-term measures**

IIASA set of 16 measures  
for CH<sub>4</sub> and black carbon

**CO<sub>2</sub> + 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 no. 6065; p. 183-189

<http://gains.iiasa.ac.at>

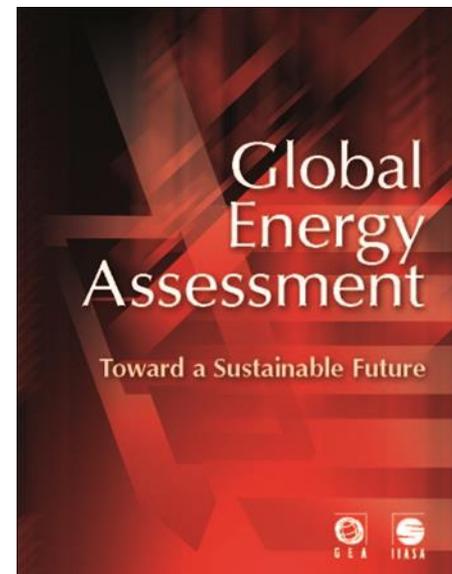
# RESEARCH INTO POLICY (Example 1)

- 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

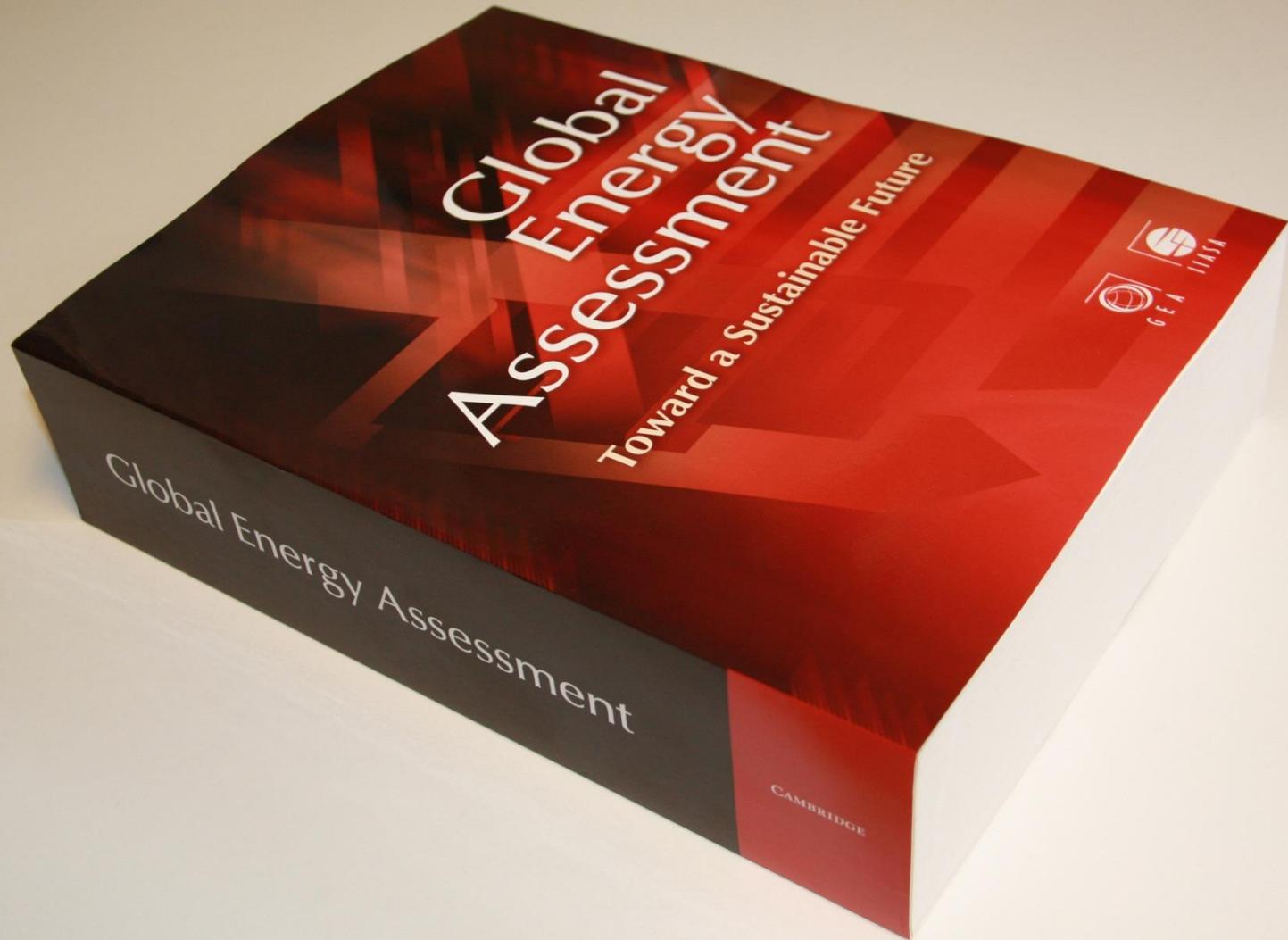


# RESEARCH INTO POLICY (Example 2)

- 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](http://www.GlobalEnergyAssessment.org)





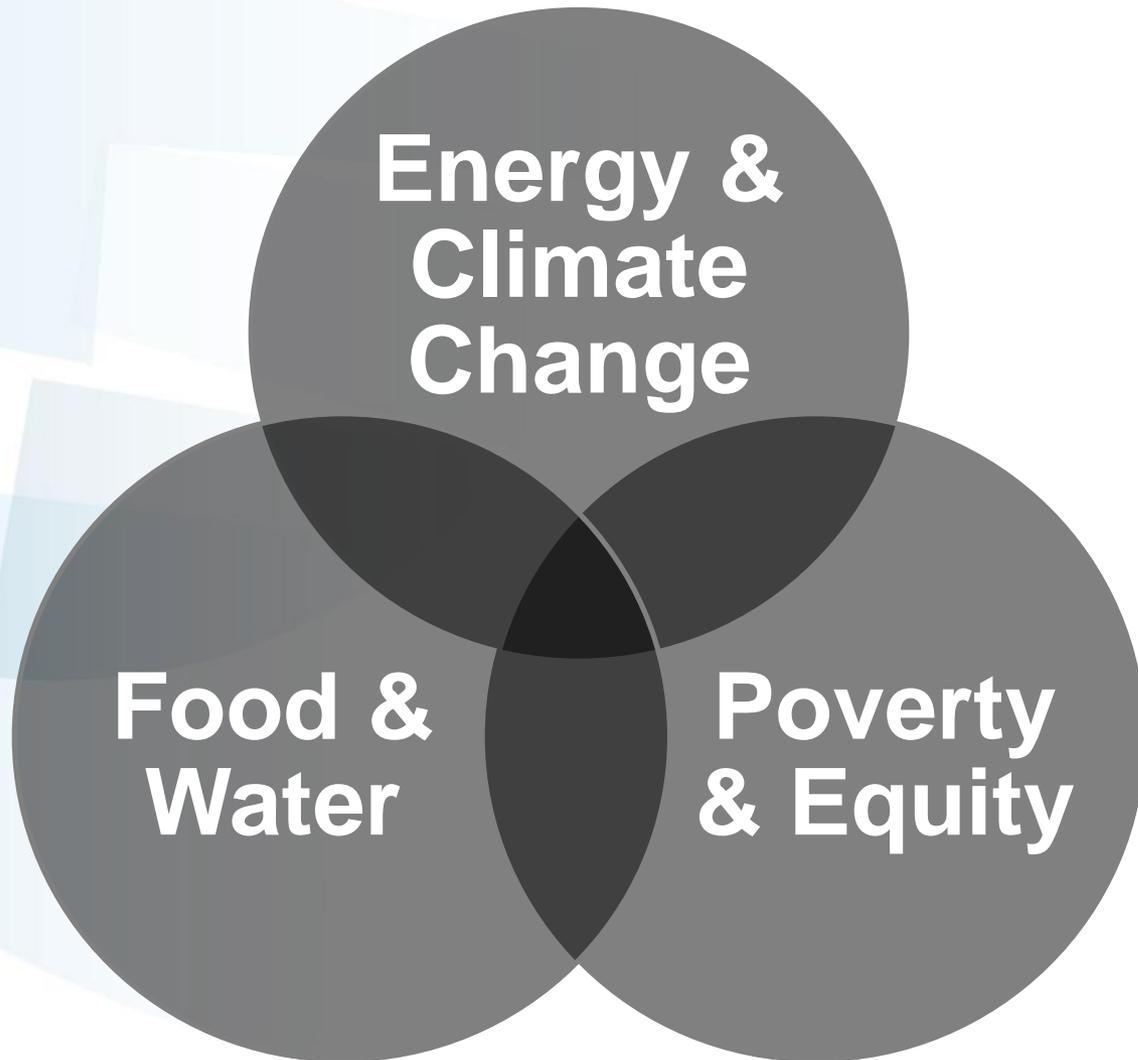
2012 INTERNATIONAL YEAR OF  
SUSTAINABLE ENERGY  
FOR ALL

## **2030 Energy Goals**

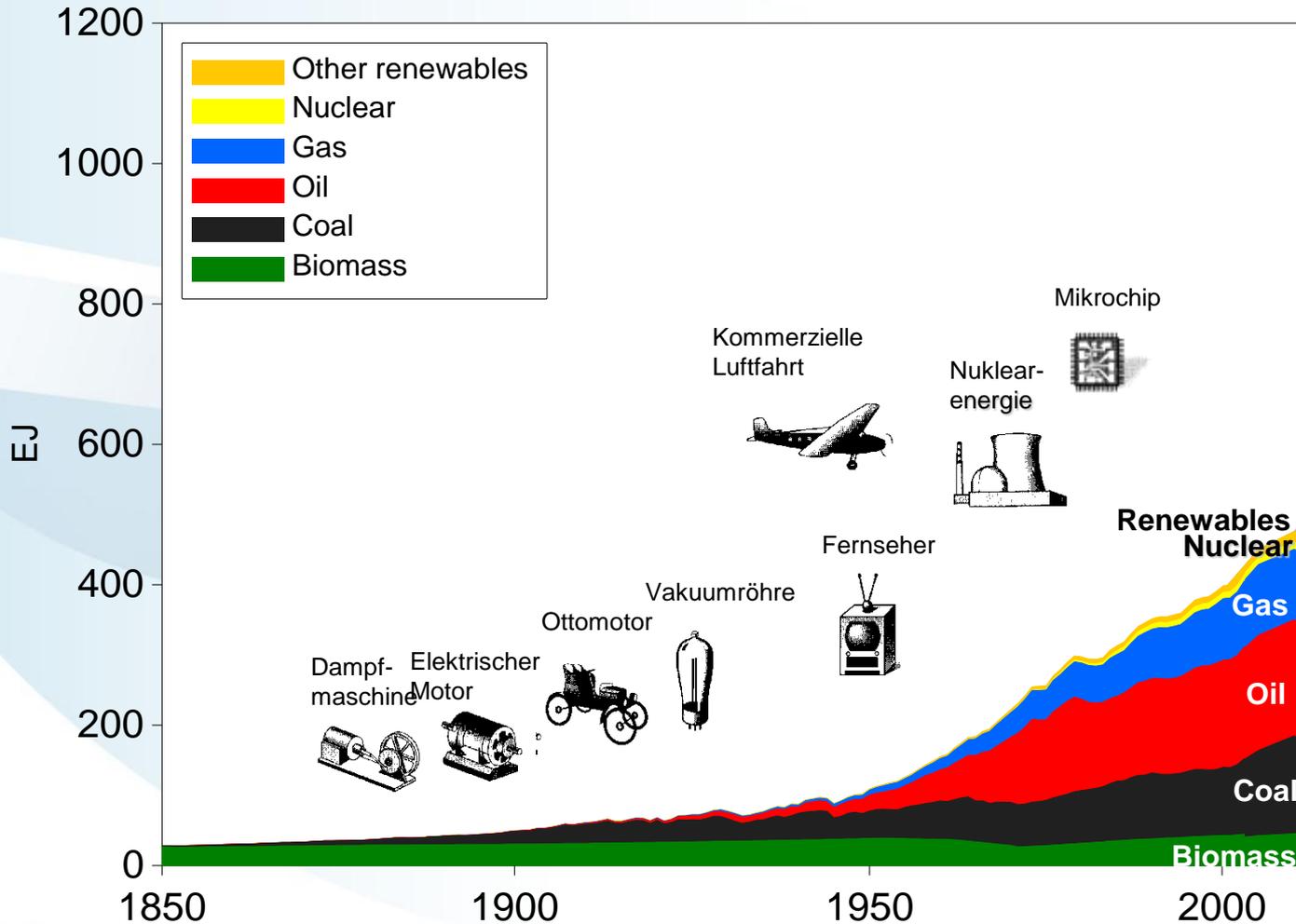
- Universal Access to Modern Energy
- Double Energy Efficiency Improvement
- Double Renewable Share in Final Energy

**Aspirational & Ambitious but Achievable**

# INEXTRICABLY LINKED

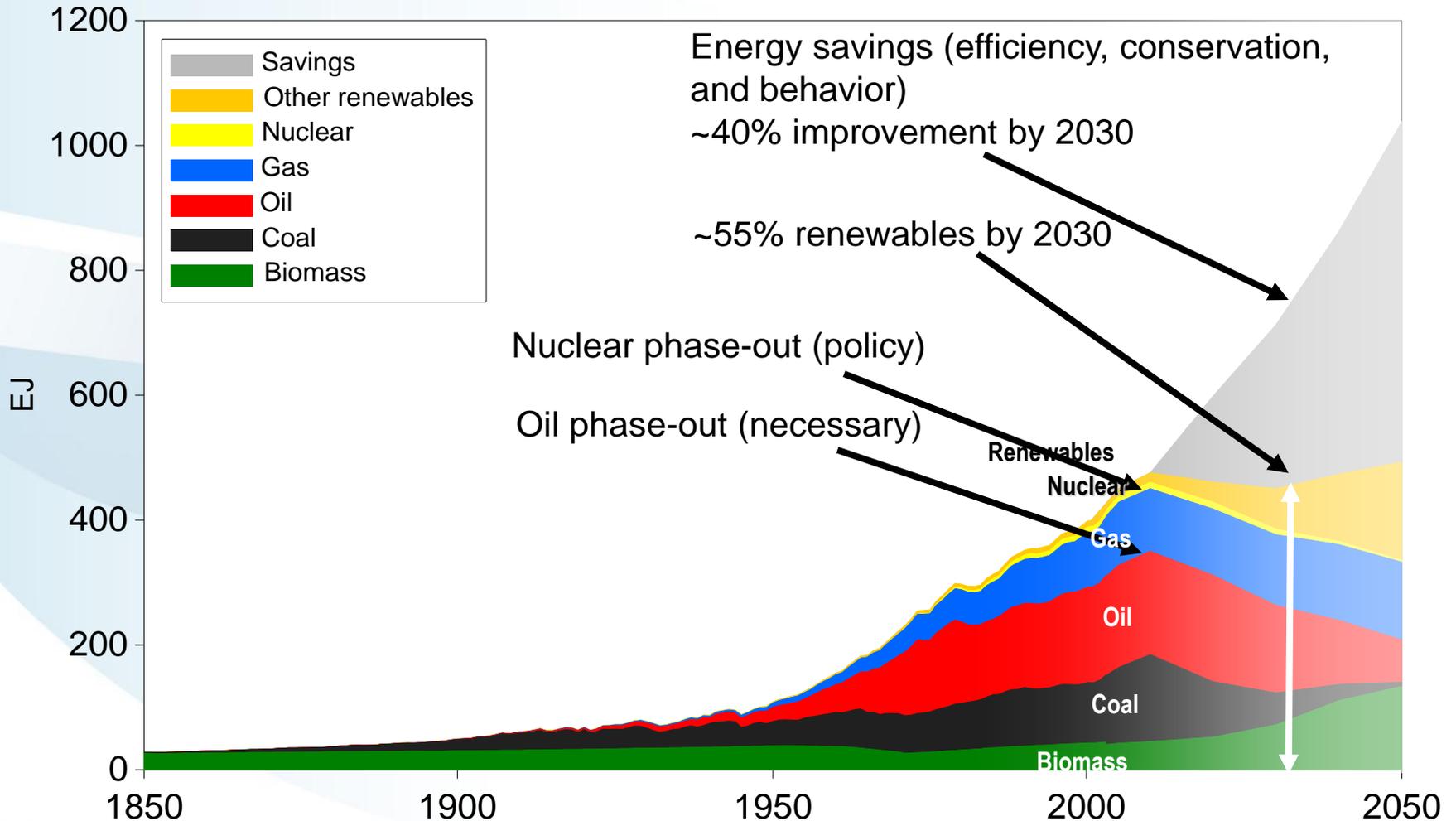


# Global Primary Energy



# Global Primary Energy

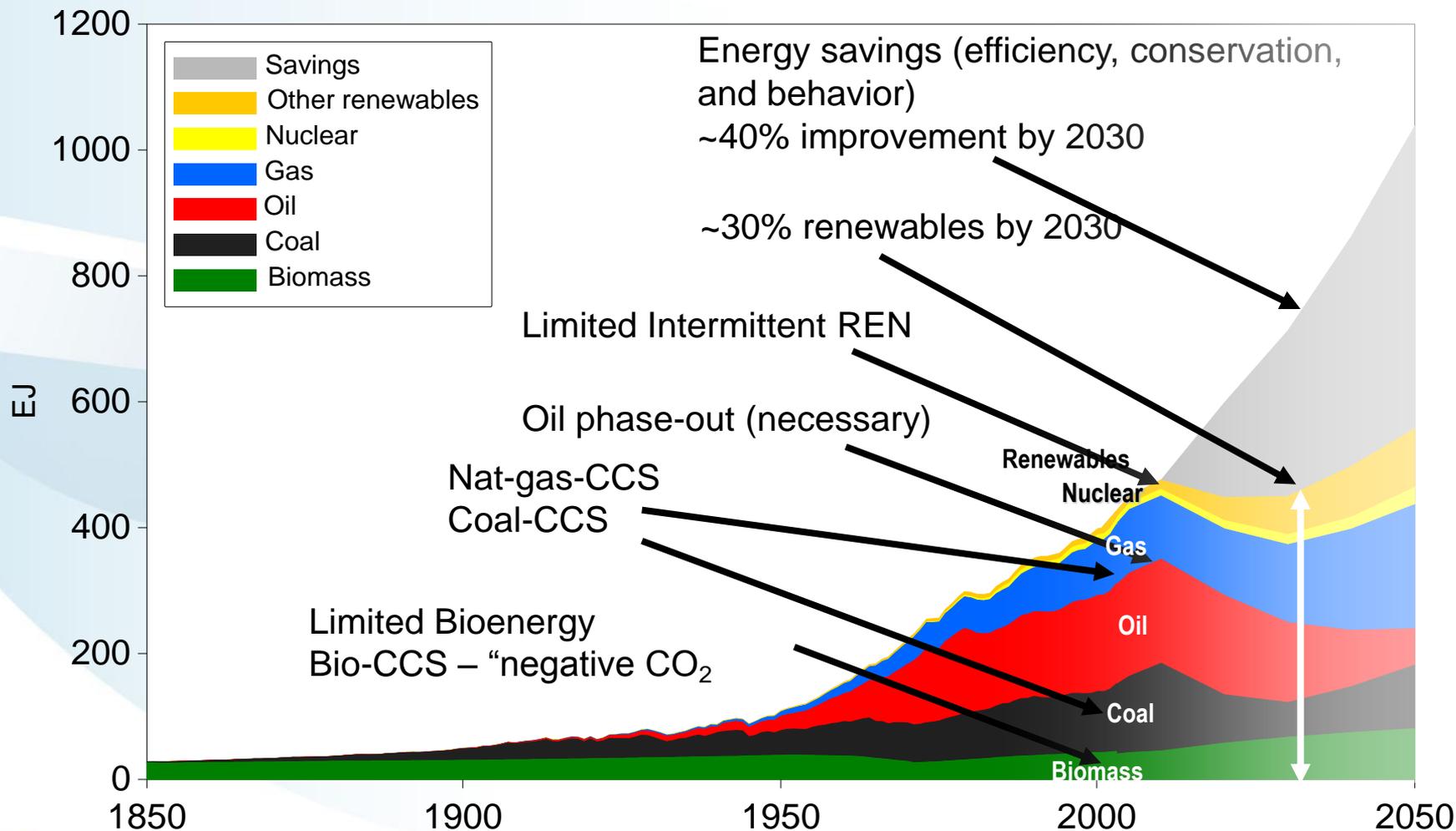
## no CCS, no Nuclear



Source: Riahi et al, 2012

# Global Primary Energy

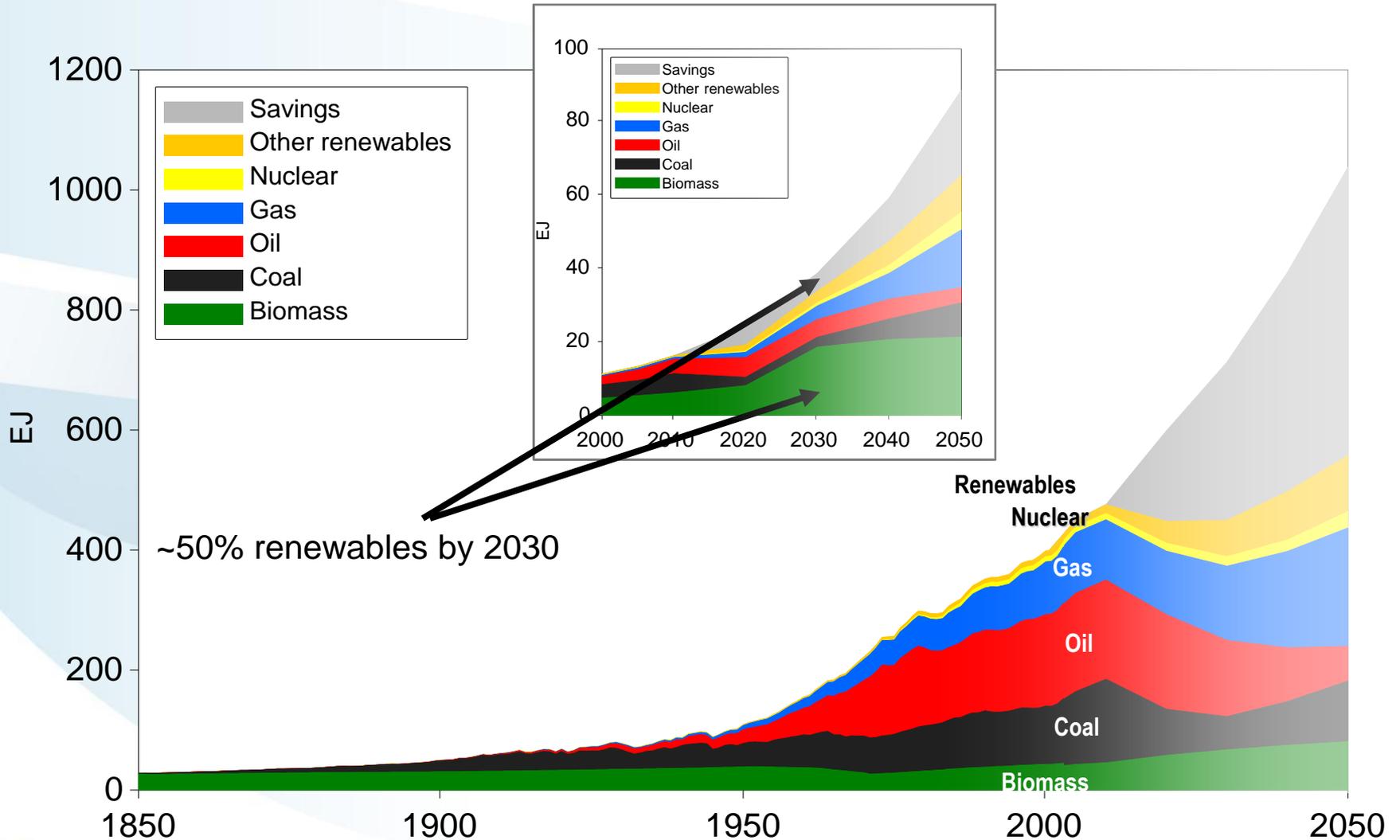
## lim. Bioenergy, lim. Intermittent REN



Source: Riahi et al, 2012

# Global Primary Energy

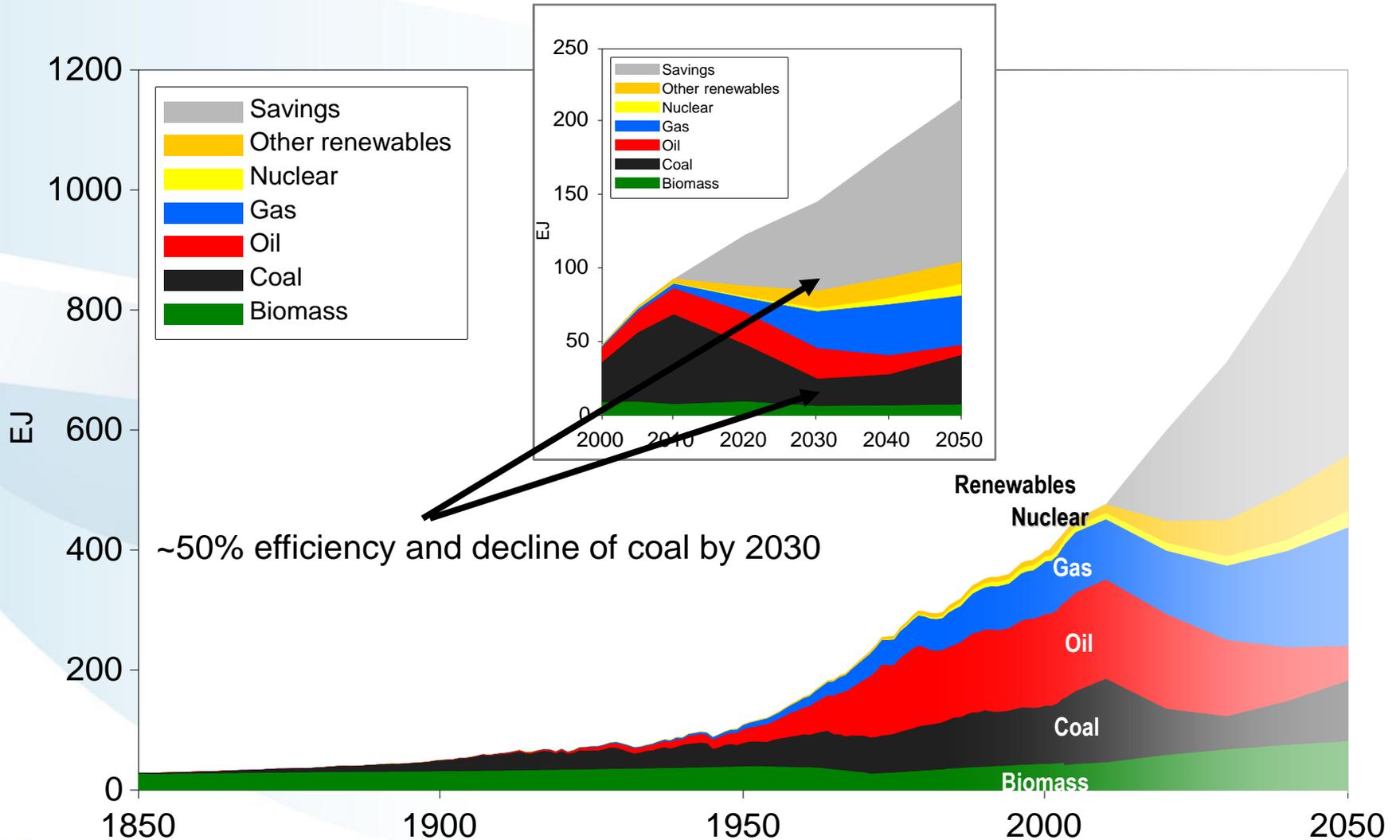
## Sub-Saharan Africa



Source: Riahi et al, 2012

# Global Primary Energy

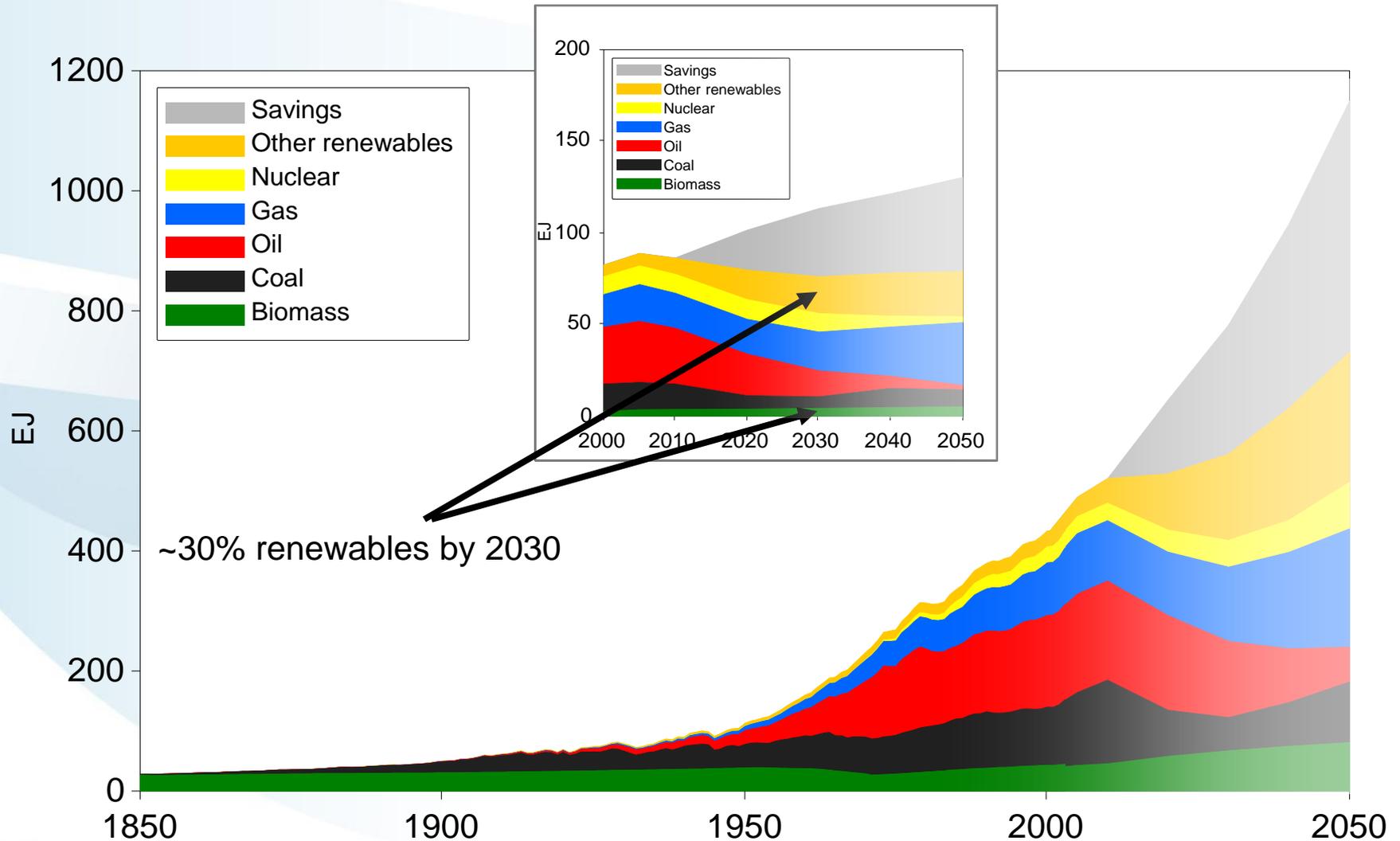
## China



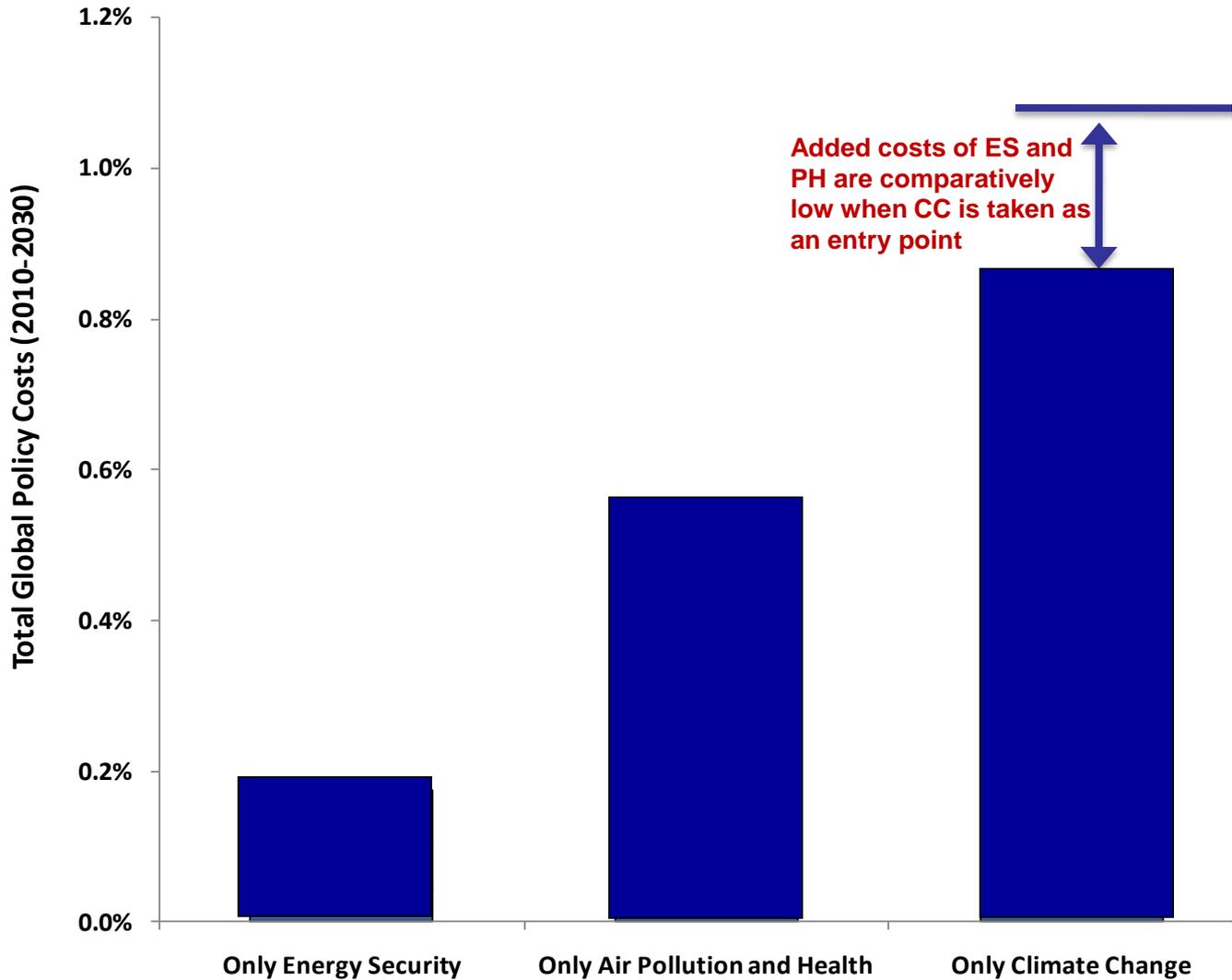
Source: Riahi et al, 2012

# Global Primary Energy

## Europe



# Energy Policy Costs (% GDP)



# Republic of Korea and IIASA Highlights (2008-2014)

June 2014

# RESEARCH PARTNERS

- 18 institutions in Korea, including:
  - Greenhouse Gas Inventory and Research Center of Korea (GIR)
  - Korea Advanced Institute of Science and Technology (KAIST)
  - Korea Forest Research Institute (KFRI)
  - Korea University
  - Konkuk University (KU)
  - Ministry of Land, Infrastructure and Transport
  - National Institute of Environmental Research of Korea (NIER)
  - Pukyong National University
  - Science and Technology Policy Institute (STEPI)
  - Seoul National University

# RESEARCH COLLABORATIONS

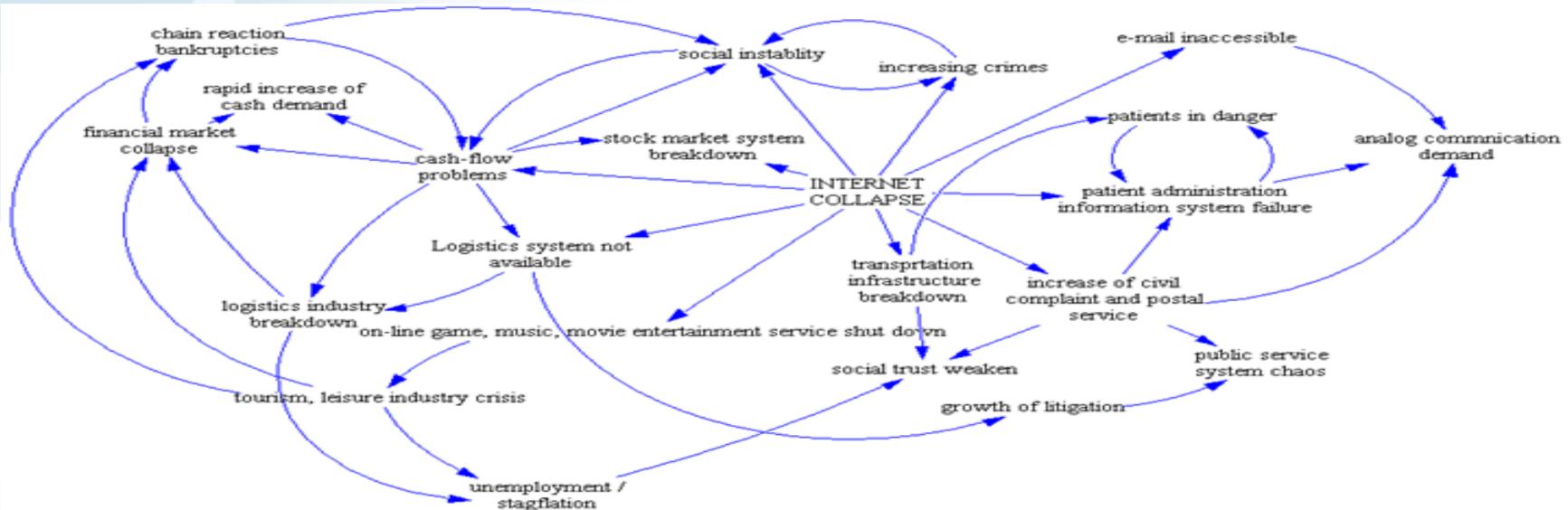
## Selected Highlights:

- Six shocks and Korea
- GAINS-KOREA
- Bioenergy with carbon capture and storage
- Water Futures and Solutions
- Projecting changing population in Korea
- Shrinking Korean Chum Salmon

# SIX SHOCKS AND KOREA

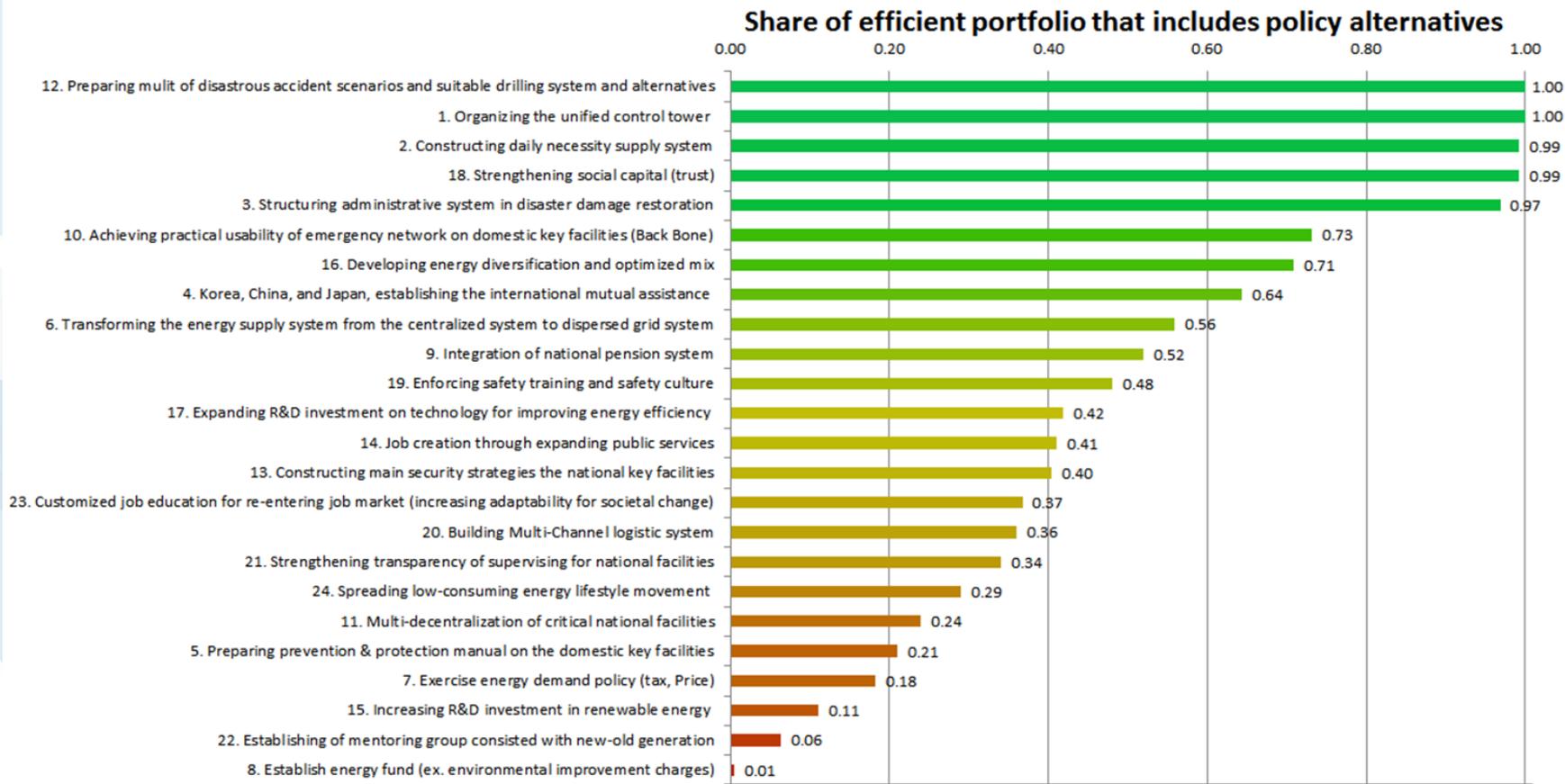
## Low probability but high impact events

- a collapse of the internet
- radical energy price change
- nuclear accident (in a neighboring country)
- food crisis
- a pandemic
- discontinuous transition in retirement age (up to 75 years)



# SIX SHOCKS AND KOREA

## Prioritizing policies that maximize resilience



# GAINS – KOREA

## Display Maps with Ambient Concentrations and Deposition

**Parameter selection**

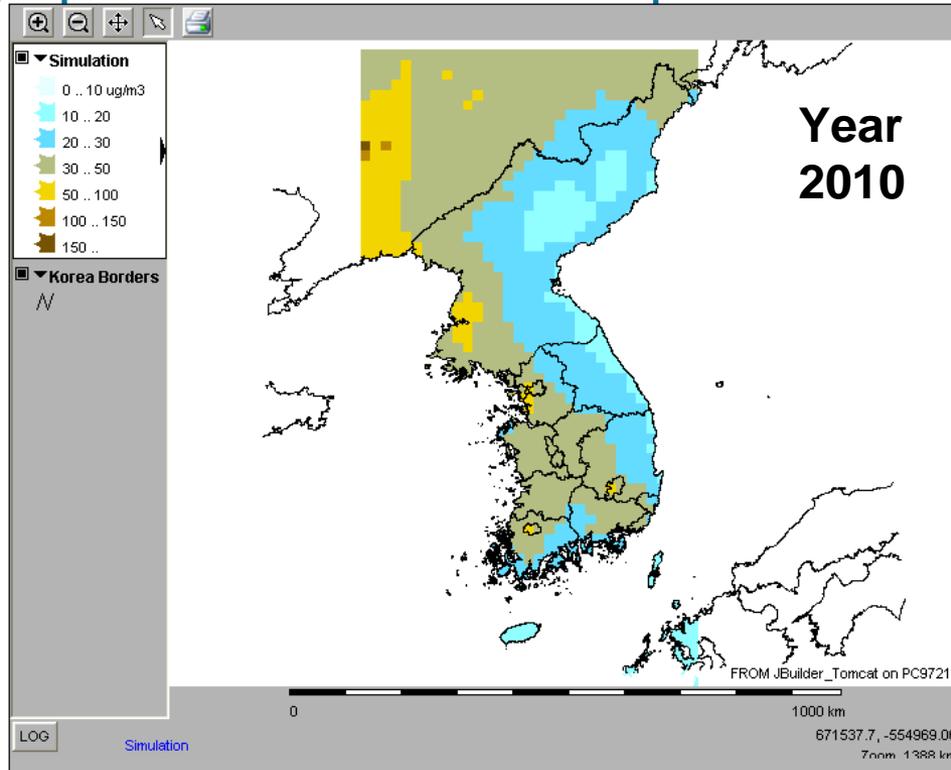
**Map Domain**  
Korea

**Emission Pattern / Year**  
All scenarios  
MFR\_Korea (CALC)  
2010

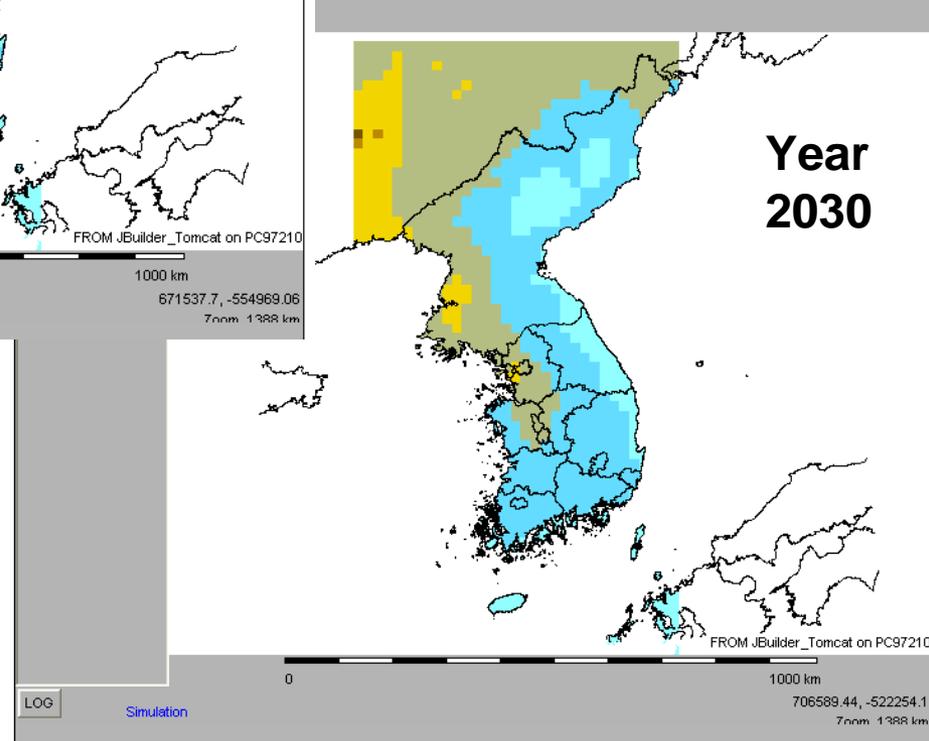
**Indicator / Legend**  
Air quality  
KOREA  
TC default set  
Concentration  
PM2.5  
\* PM Asia [ug/m3]  
\* ... standard legend

**Source**  
total

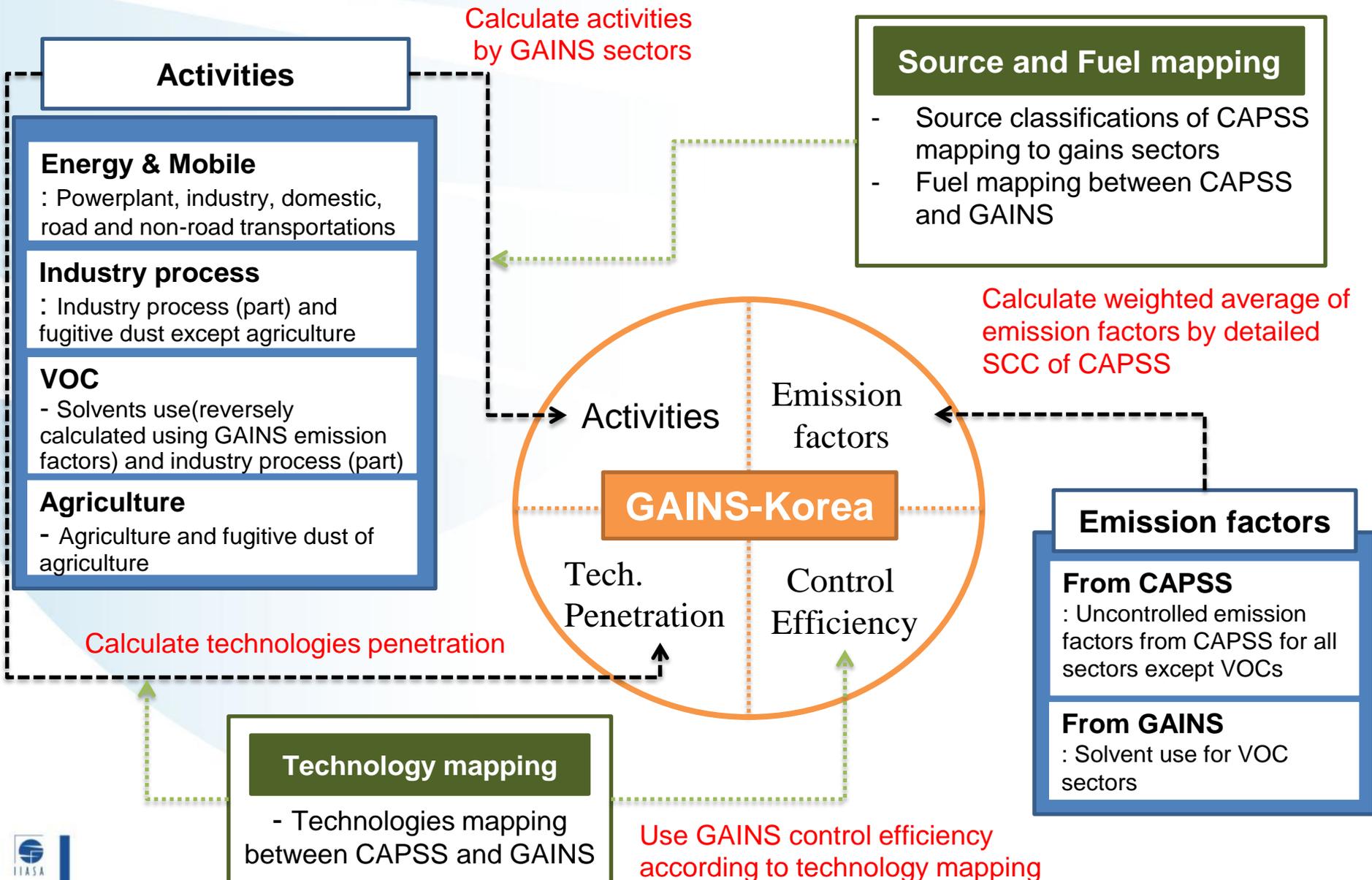
Show Map  
Export data  
Legend lin.  
Legend stat  
Legend log.



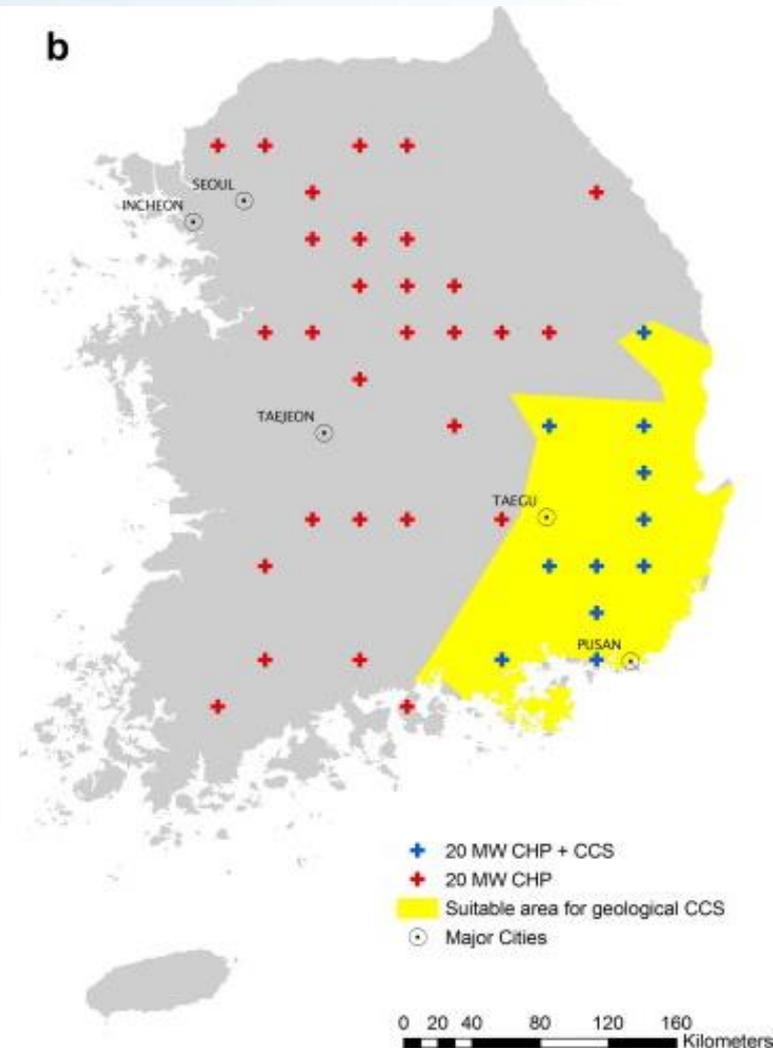
## Concentrations and Deposition



# BUILDING GAINS-KOREA



# BIOENERGY WITH CARBON CAPTURE & STORAGE (BECCS)



- Optimal location of green-field biomass plants (20 MW) in Korea
- Red shows bioenergy plants without carbon capture and storage
- Blue indicates BECCS unit locations on a light yellow background (geologically suitable formation for capture and storage of carbon).

Kraxner F, Aoki K, Leduc S, Kindermann G, Fuss S, Yang J, Yamagata Y, Tak K & Obersteiner M (2014). BECCS in South Korea - Analyzing the negative emissions potential of bioenergy as a mitigation tool. *Renewable Energy*, 61:102-108

# WATER FUTURES AND SOLUTIONS

An integrated analysis of global water challenges and solutions

Founding Partners:

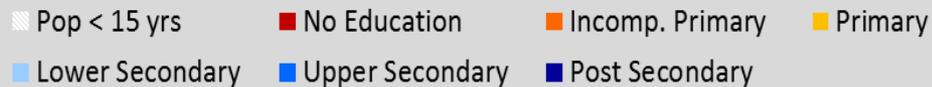
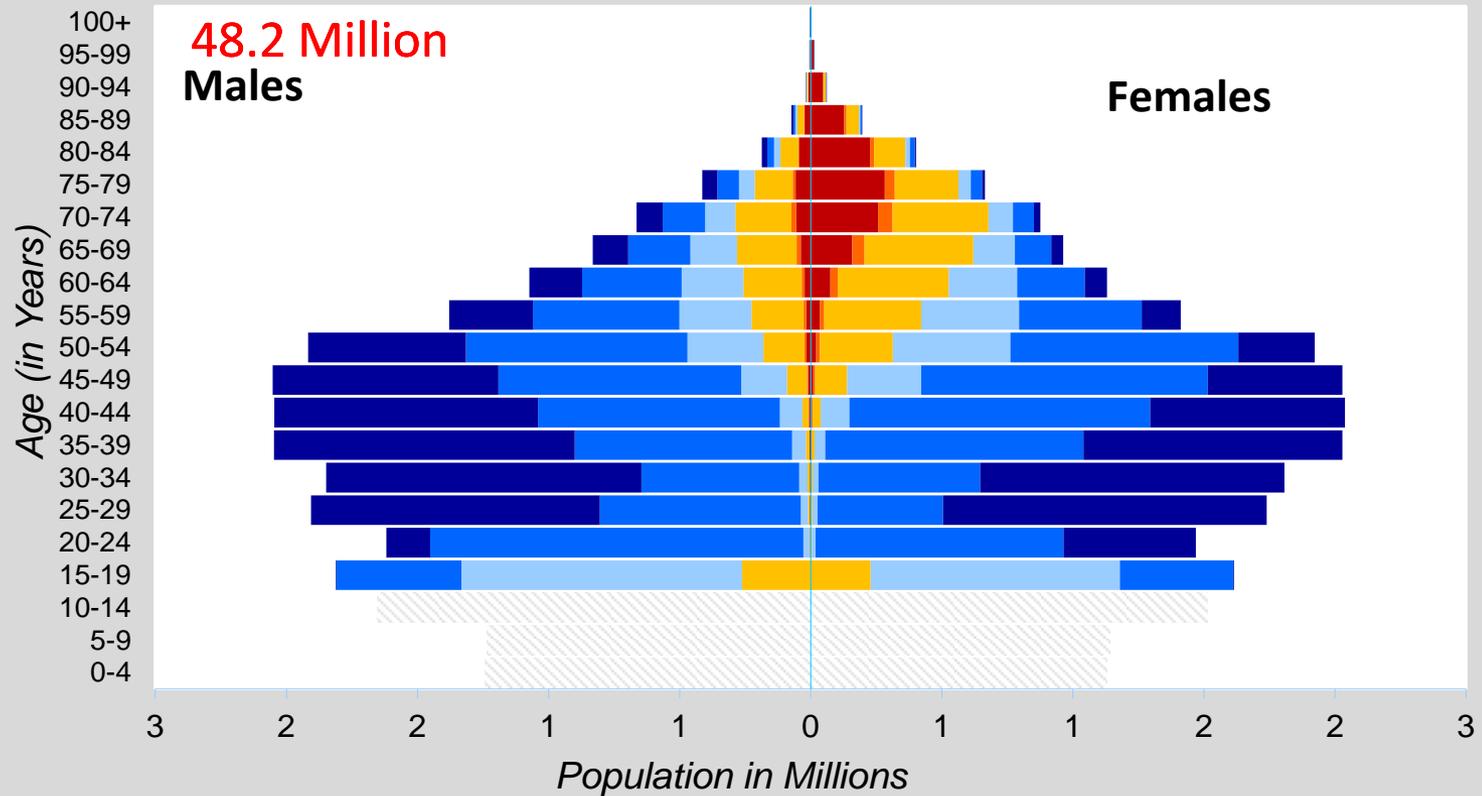


Preliminary results to be published at:



# PROJECTING CHANGING POPULATION IN KOREA

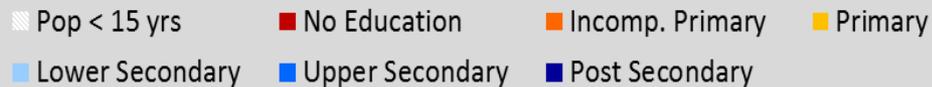
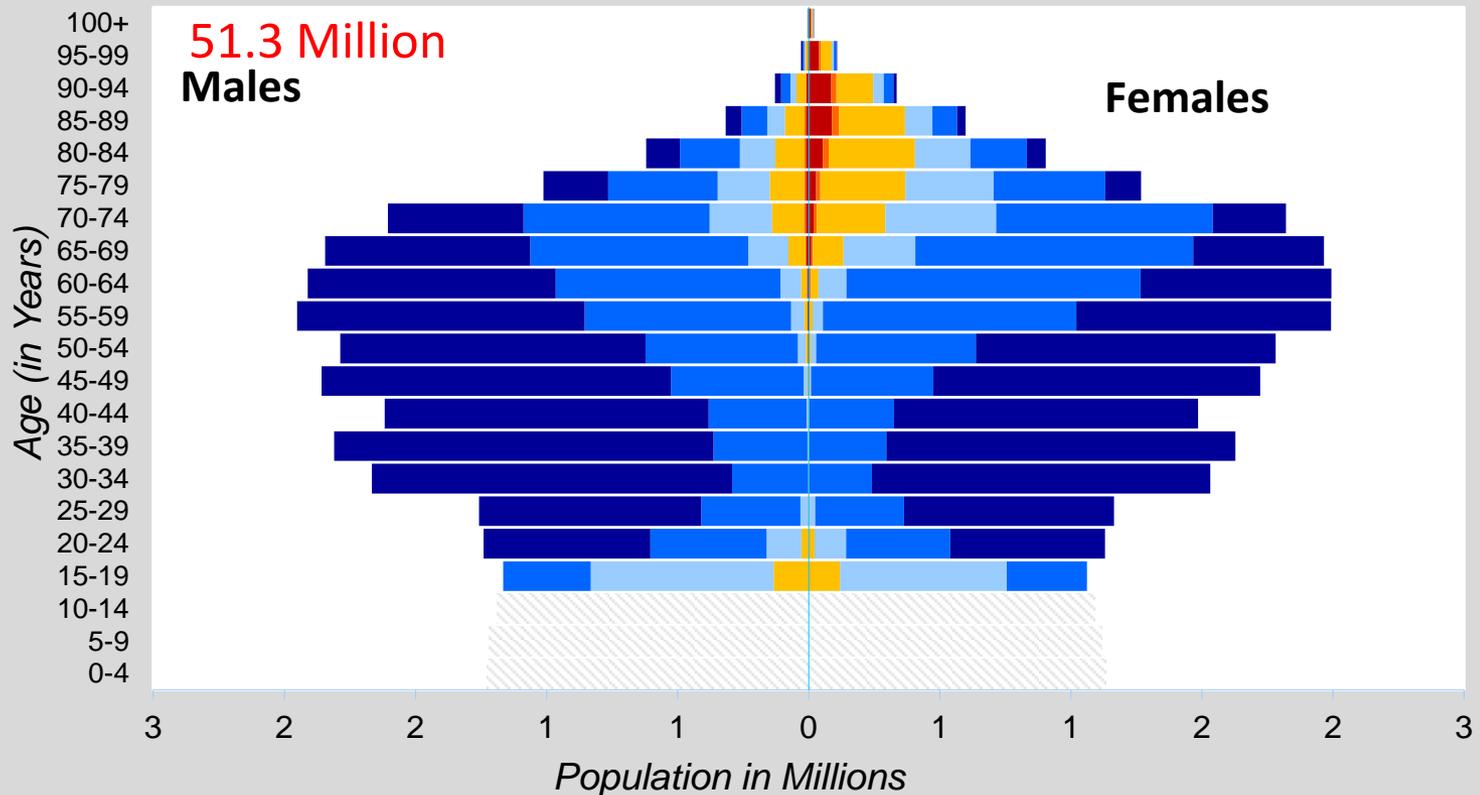
## Republic of Korea - Base Year 2010



# PROJECTING CHANGING POPULATION IN KOREA

## CONVENTIONAL DEVELOPMENT

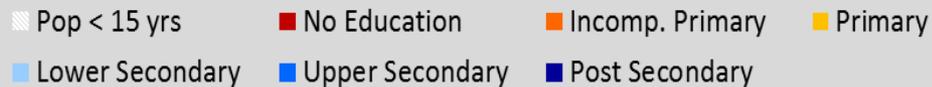
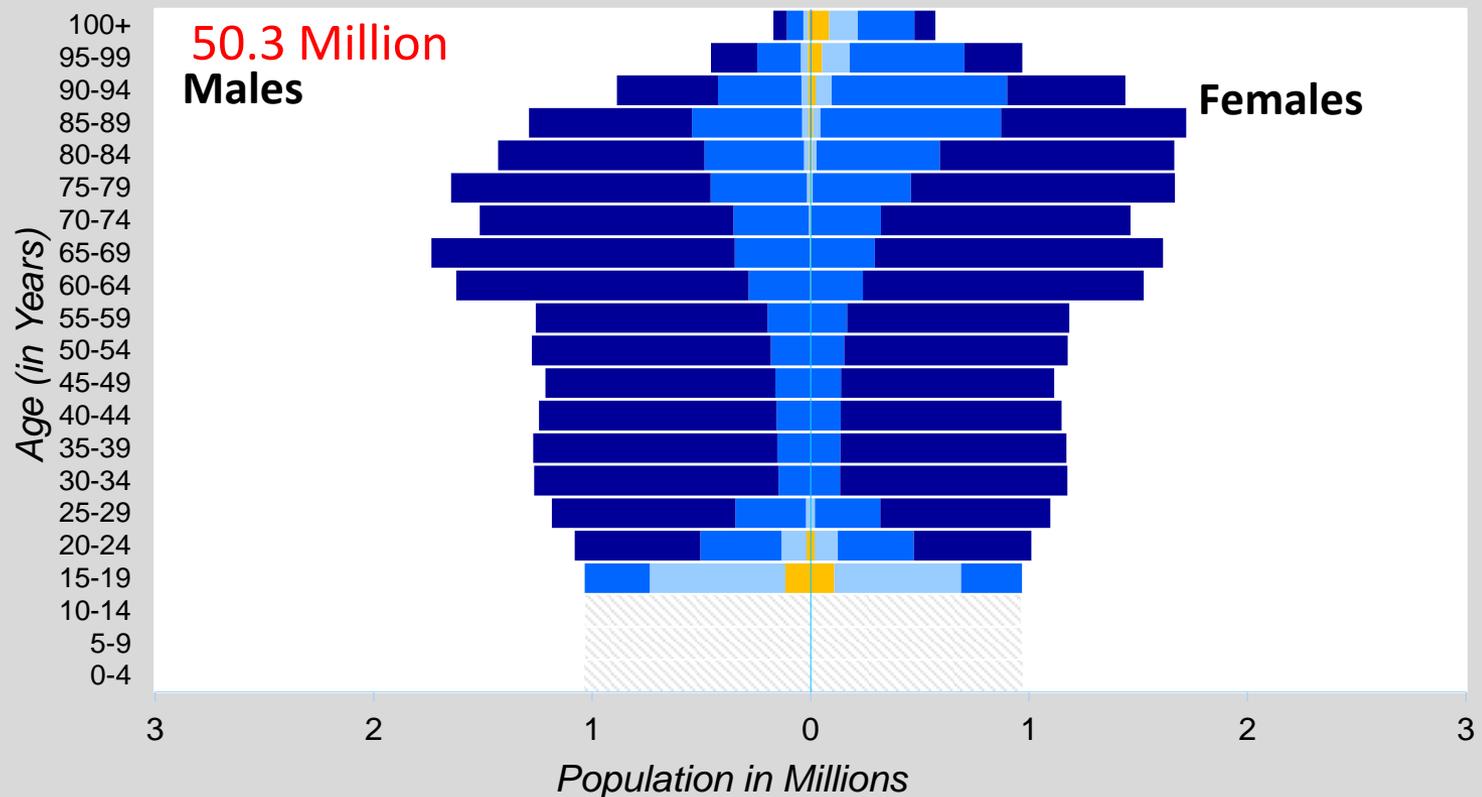
### Republic of Korea - Projections 2030 - SSP5



# PROJECTING CHANGING POPULATION IN KOREA

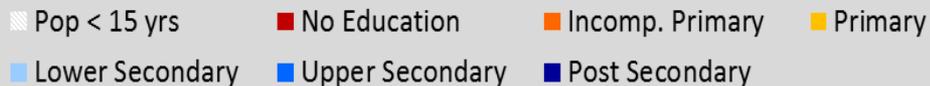
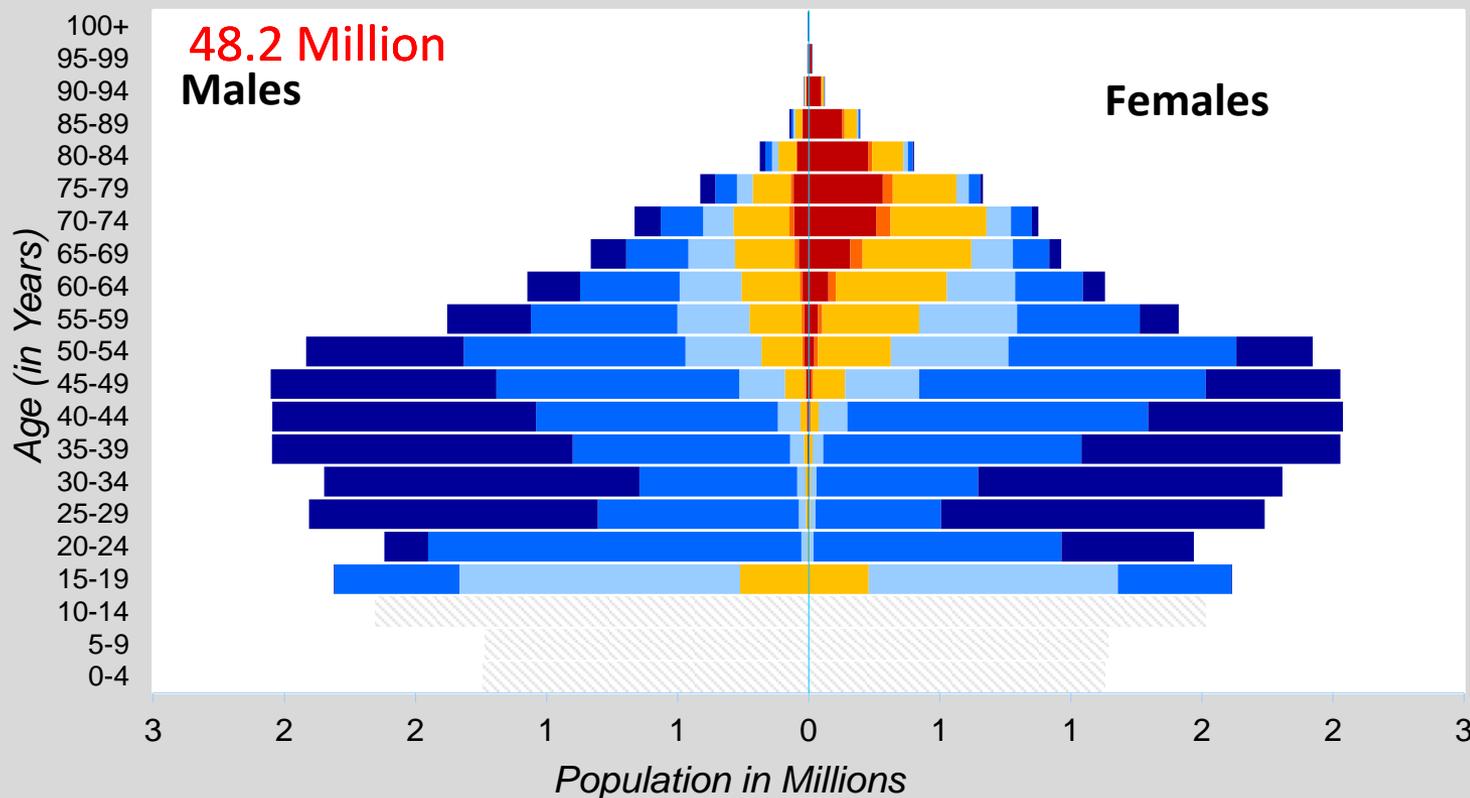
## CONVENTIONAL DEVELOPMENT

### Republic of Korea - Projections 2060 - SSP5



# PROJECTING CHANGING POPULATION IN KOREA

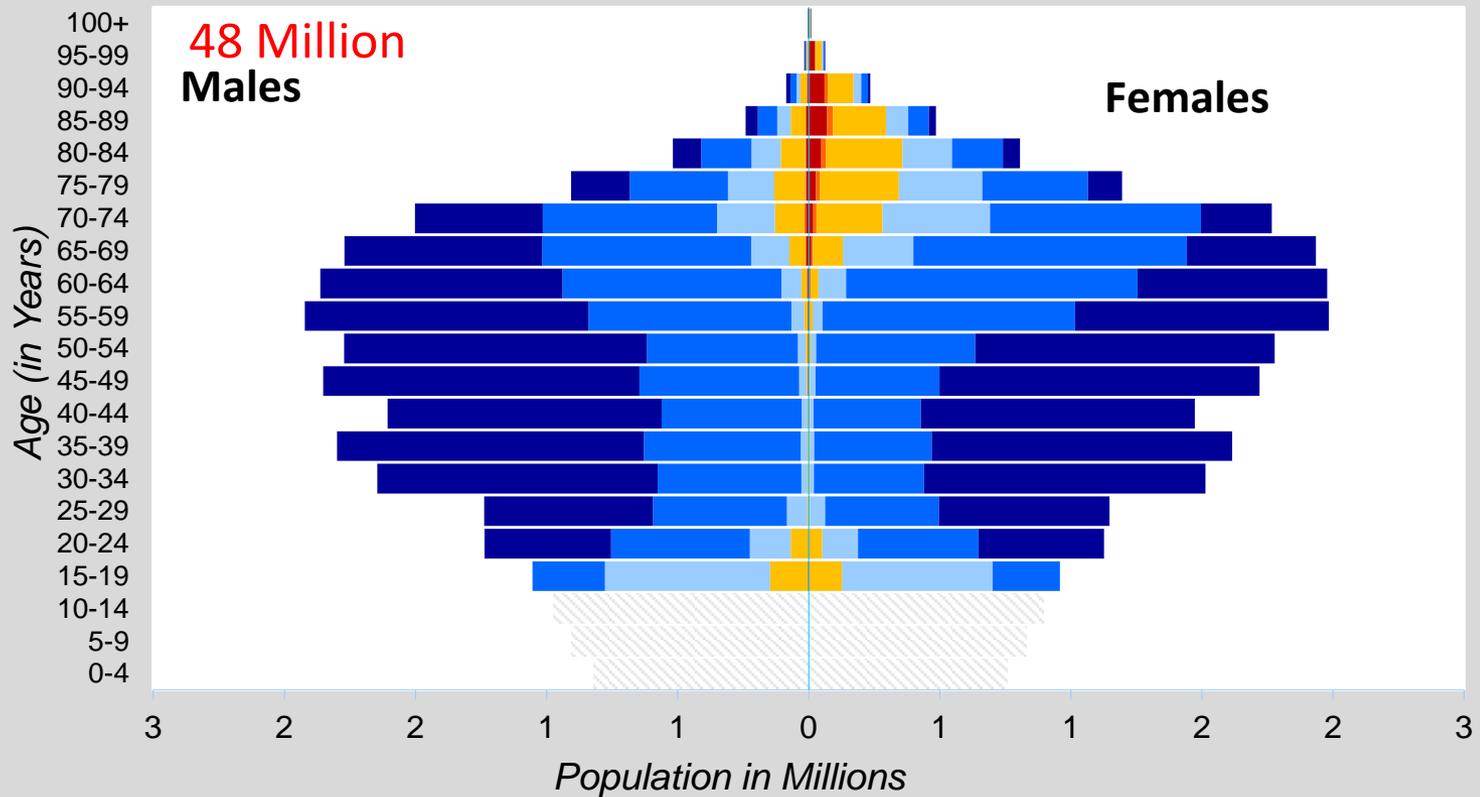
## Republic of Korea - Base Year 2010



# PROJECTING CHANGING POPULATION IN KOREA

## FRAGMENTATION

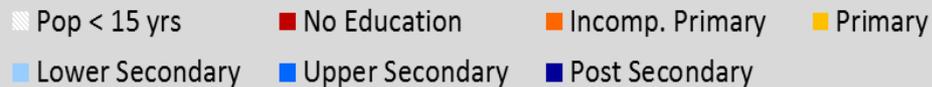
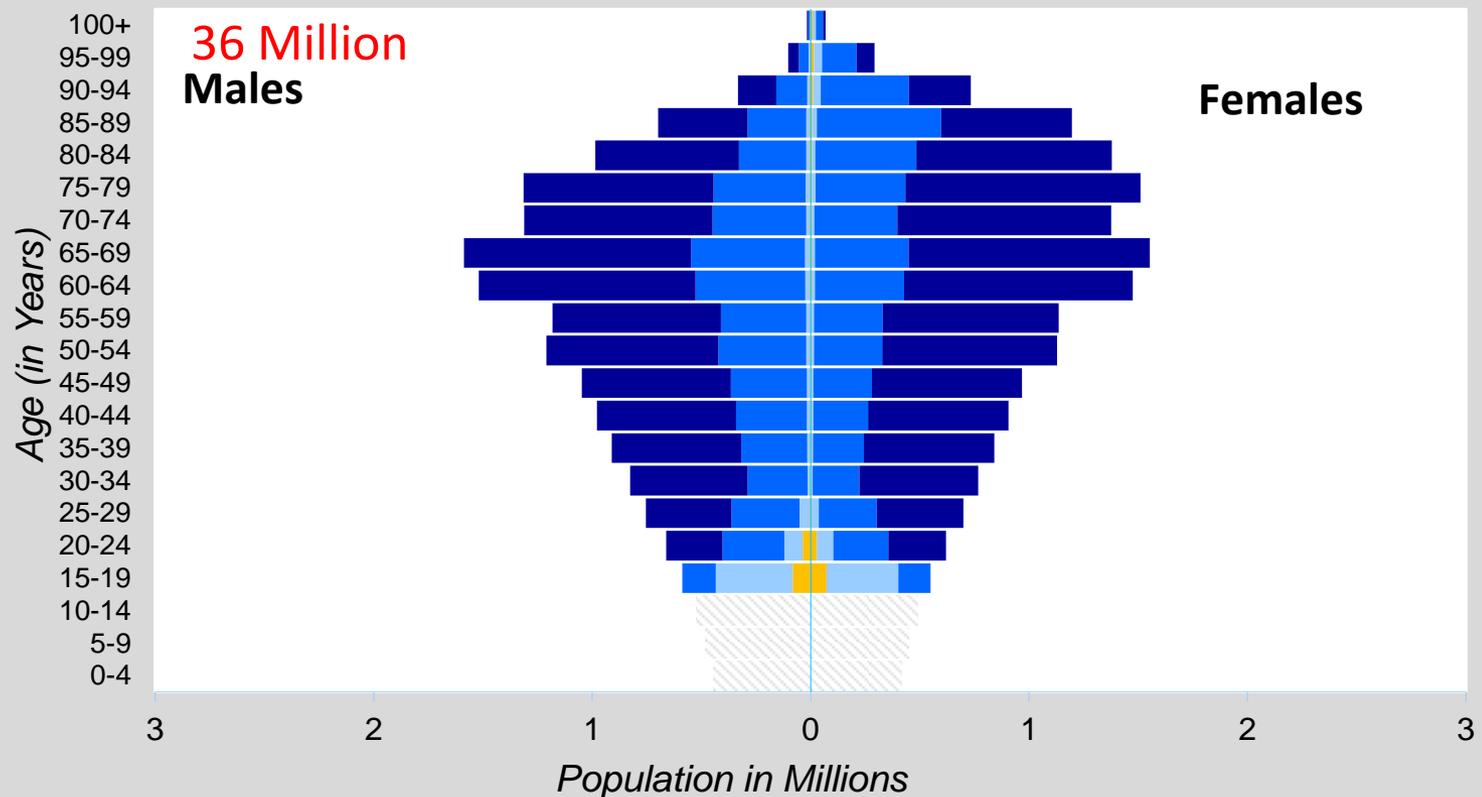
### Republic of Korea - Projections 2030 - SSP3



# PROJECTING CHANGING POPULATION IN KOREA

## FRAGMENTATION

### Republic of Korea - Projections 2060 - SSP3



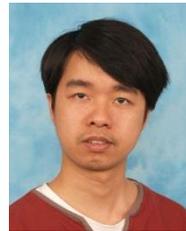
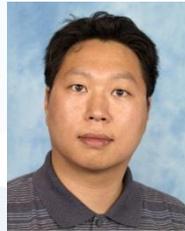
# SHRINKING KOREAN CHUM SALMON

- Changing environmental conditions (commercial fishing, climatic change) are changing the traits of fish (growth and size at maturation)
- ~ 30 case studies including Korean Chum Salmon
- Implications for future size of fish stocks, and that evolutionary changes can take a long time to reverse



# CAPACITY BUILDING

- 11 doctoral students from Korea have won places on IIASA's Young Scientists Summer Program since 2008.



# CAPACITY BUILDING

## Southern-African Young Scientist Summer Program: (SA-YSSP)

- Kyeongah Nah (SA-YSSP '12-'13 & University of Szeged), a Korean national, developed a model for predicting malaria incubation times under latitudinal and climate-induced changes in season lengths.





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# Thank you and hope to welcome you soon at IIASA !!



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