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science for global insight

Sustainable energy scenarios for the 21st century: the role of systems analysis

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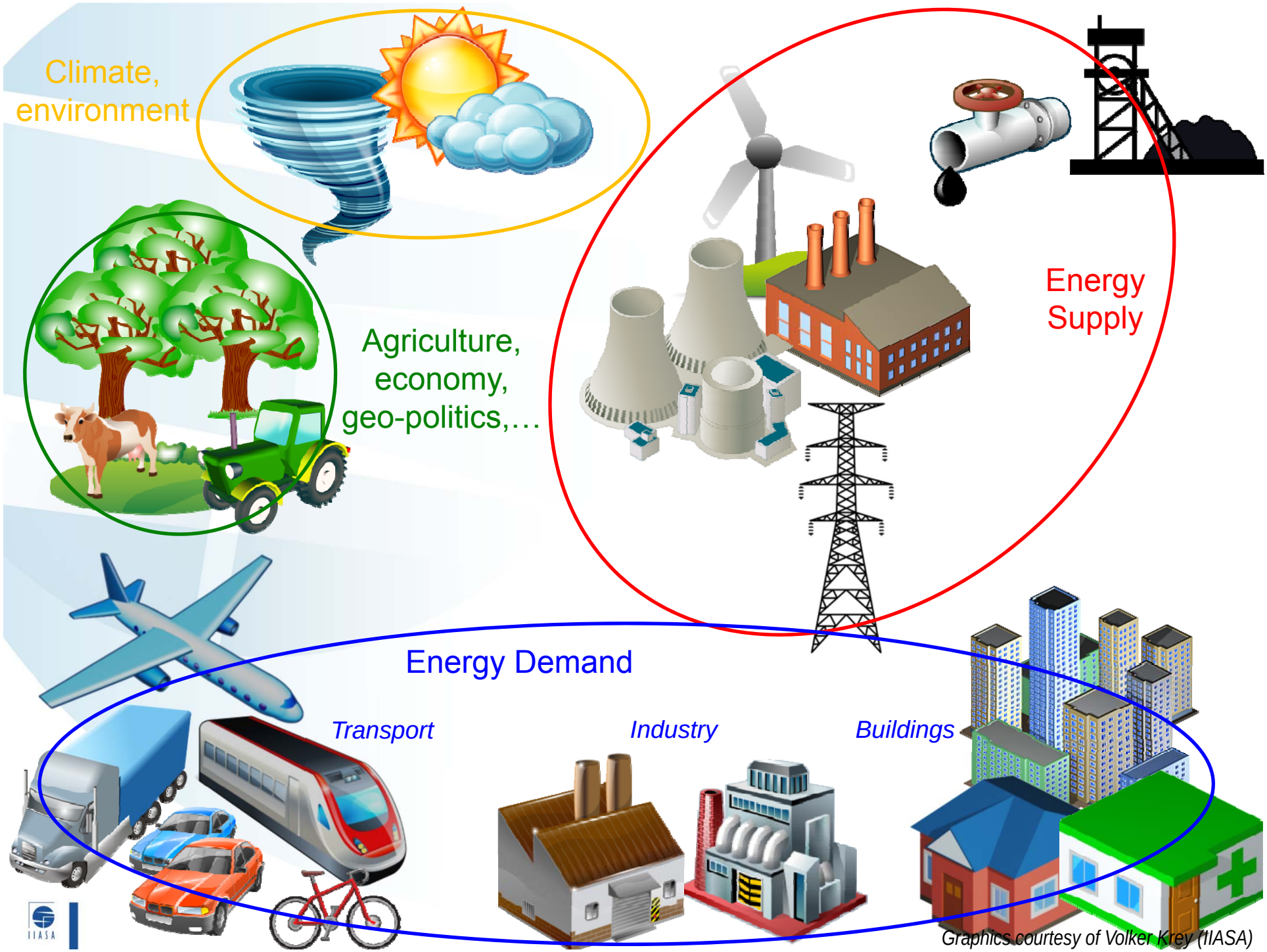
Acknowledgements:
Keywan Riahi, Volker Krey, Peter Kolp, Manfred Strubegger, Joeri Rogelj, Shilpa Rao, Markus Amann, Zig Klimont, Wolfgang Schoepp, Shonali Pachauri, Arnulf Gruebler, Nebojsa Nakicenovic, Jessica Jewell, Mathis Rogner, among others…

Hadera EnergyTech Conference
April 4th, 2016 (Tel Aviv, Israel)

"integrated assessment is an attempt to combine information, analysis and insights from the physical and social sciences to address the nature of climate change and to develop possible policy responses to it"

John P. Weyant, *Climatic Change* 95, pp. 317–323 (2009)

- Examples of *global* integrated assessment and energy-economy models (cost-effectiveness analysis):
  - AIM, GCAM, IMAGE, MESSAGE, REMIND, TIAM, WITCH, …
- Insights fed into IPCC AR5 WG3 in a big way, via model inter-comparisons (AMPERE, LIMITS, EMF27, …)


Climate,
environment
Agriculture,
economy,
geo-politics,…
Energy
Supply
Energy Demand
Transport
Industry
Buildings
Graphics courtesy of Volker Krey (IIASA)

UNFCCC COP21: 2015 Paris Climate Conference

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

195 countries have agreed, by consensus, to reduce their greenhouse gas emissions "as soon as possible" and to do their best to keep global warming "to well below 2 degrees C".

Image sources: GIY(www.globalinstituteforyouth.org/2015/09/less-than-100-days-left-are-youth-ready-for-cop-21-paris/); COP21 (www.cop21paris.org/)

United Nations'
Post-2015 Sustainable Development Goals (SDGs)

Source: https://sustainabledevelopment.un.org/

‘Sustainable development’ means overcoming several energy challenges

Energy Poverty

Energy Security

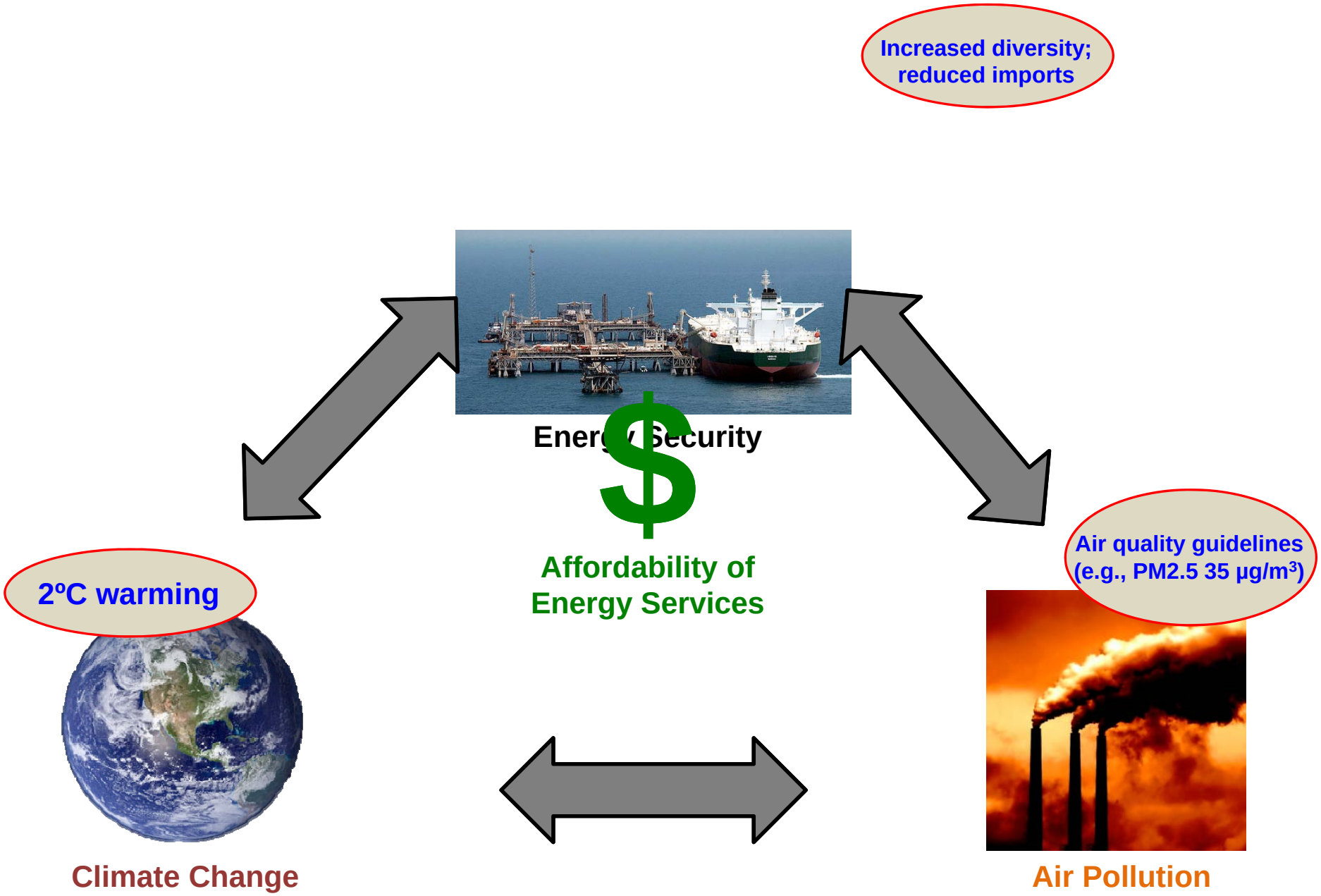
Food Security & Biodiversity

Climate Change

Water Scarcity

Air Pollution

Image sources: NASA, http://www.powernewsnetwork.com/white-house-releases-plan-to-cut-oil-imports-by-13-by-2025/1798/, http://wheresmyamerica.wordpress.com/2007/08/26/i-cant-see-my-america/, http://www.americanprogress.org/issues/green/report/2009/05/14/6142/energy-poverty-101/, http://today.uconn.edu/blog/2010/12/reclaiming-water-a-green-leap-forward/, http://te.wikipedia.org/wiki/%E0%B0%A6%E0%B0%B8%E0%B1%8D%E0%B0%A4%E0%B1%8D%E0%B0%B0%E0%B0%82:Forest_Osaka_Japan.jpg


Increased diversity; reduced imports
Energy Security
$
Affordability of Energy Services
2ºC warming
Climate Change
Air quality guidelines (e.g., PM2.5 35 µg/m³)
Air Pollution

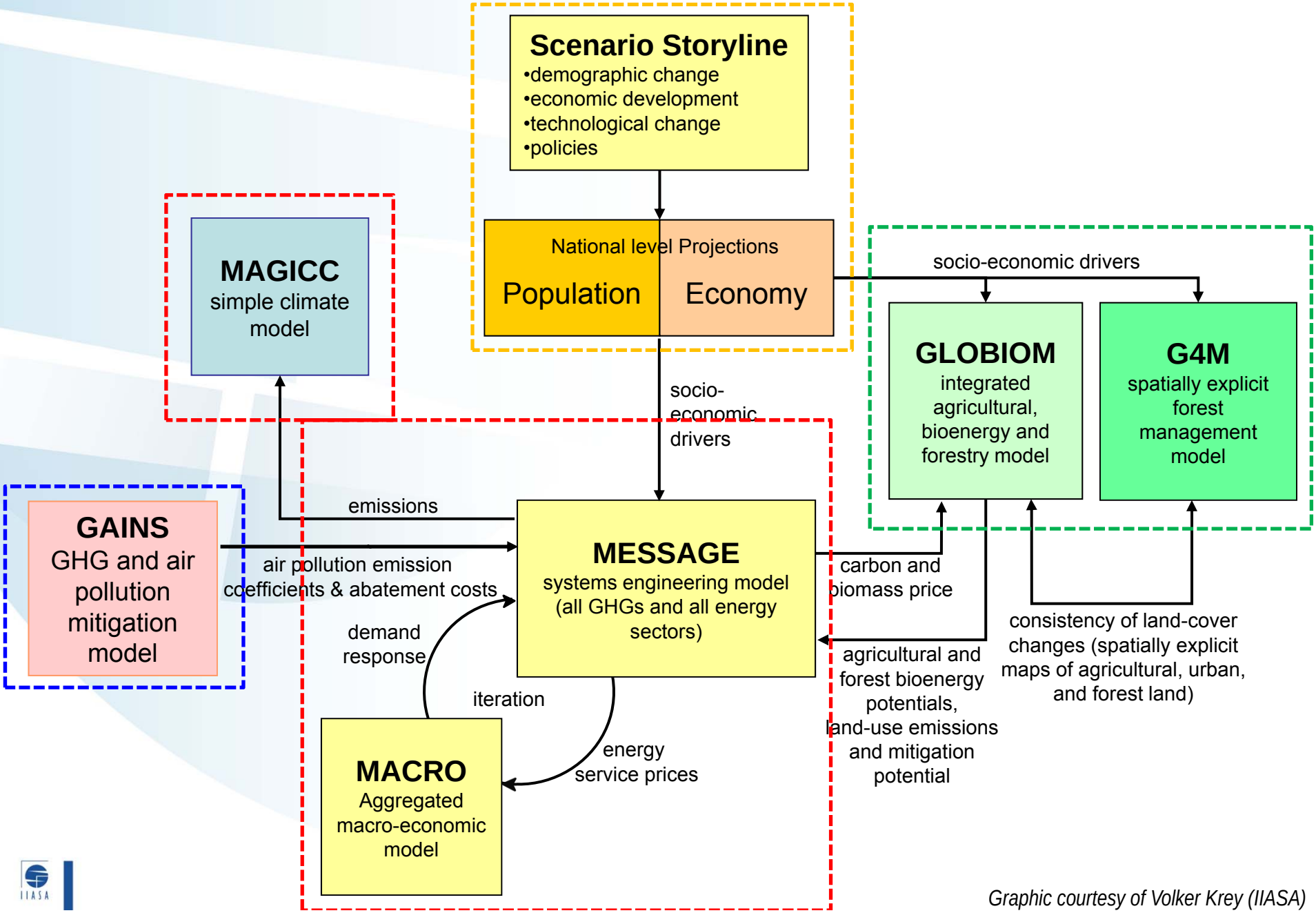
Modeled policies of varying stringency

Global warming	*Energy imports and diversity*	*Air pollution framework (PM, SO_2, NO_x, BC, …)*
> 4°C	Business-as-usual	No further improvement
⋮		
3°C	Weak effort	Current legislation
⋮		
2°C	Moderate effort	Stringent legislation
⋮		
1.5°C	Stringent effort	Maximum feasible reduction
39 levels	*4 levels*	*4 levels*

Increasing stringency ↓

Increasing stringency ↓

IIASA Integrated Assessment Framework



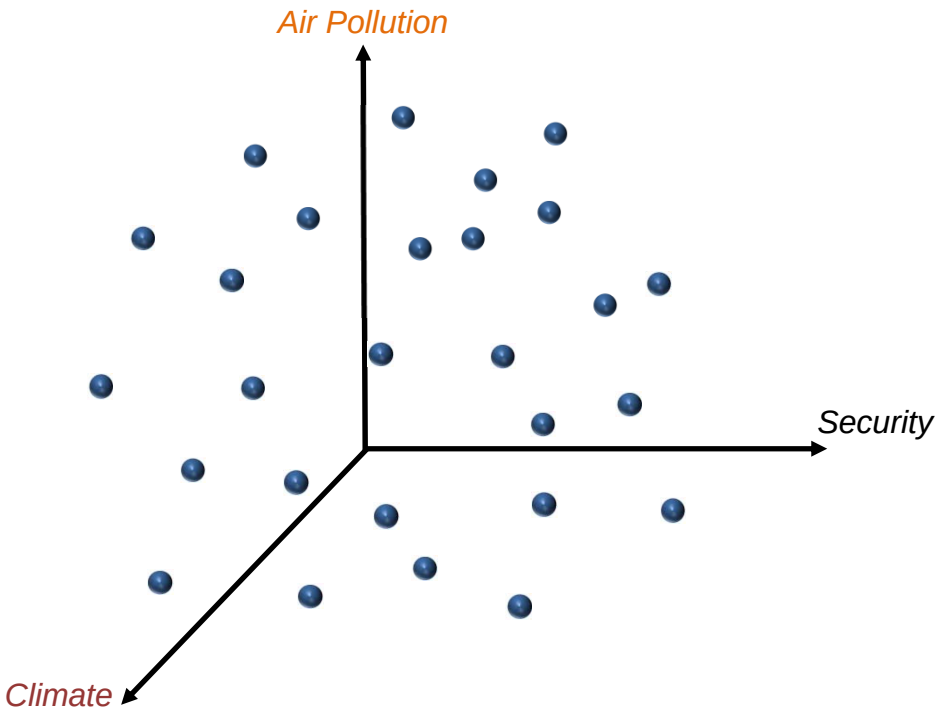
Graphic courtesy of Volker Krey (IIASA)

Generated a large scenario ensemble

Climate Change

Energy Security

Air Pollution



>600 unique scenarios spanning the feasible scenario space (energy-climate-pollution-security futures)

Ref: McCollum, D., V. Krey, K. Riahi et al., "Climate policies can help resolve energy security and air pollution challenges." *Climatic Change* (2013).

Synergies of *energy efficiency and decarbonization* accrue in multiple dimensions

1. **Co-benefits for air pollution and human health**

   → improved air quality

   (22-32 million fewer disability-adjusted life years globally in 2030)

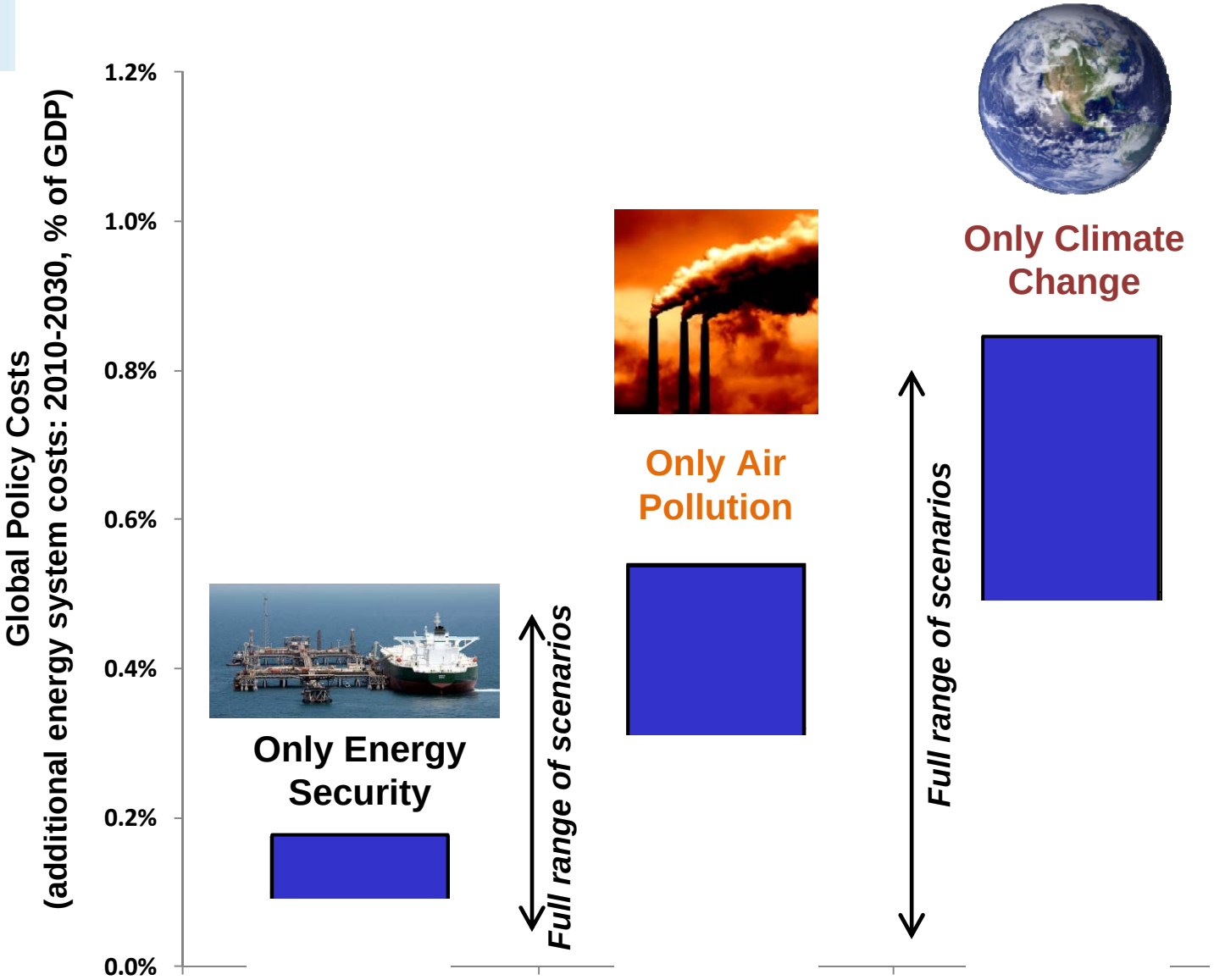
2. **Synergies for improved energy security**

   → more dependable, resilient, and diversified energy portfolios

3. **Cost savings and spillovers**

   → up to $600 billion/yr globally in reduced pollution control and energy security expenditures by 2030 (0.1-0.7% of world GDP)

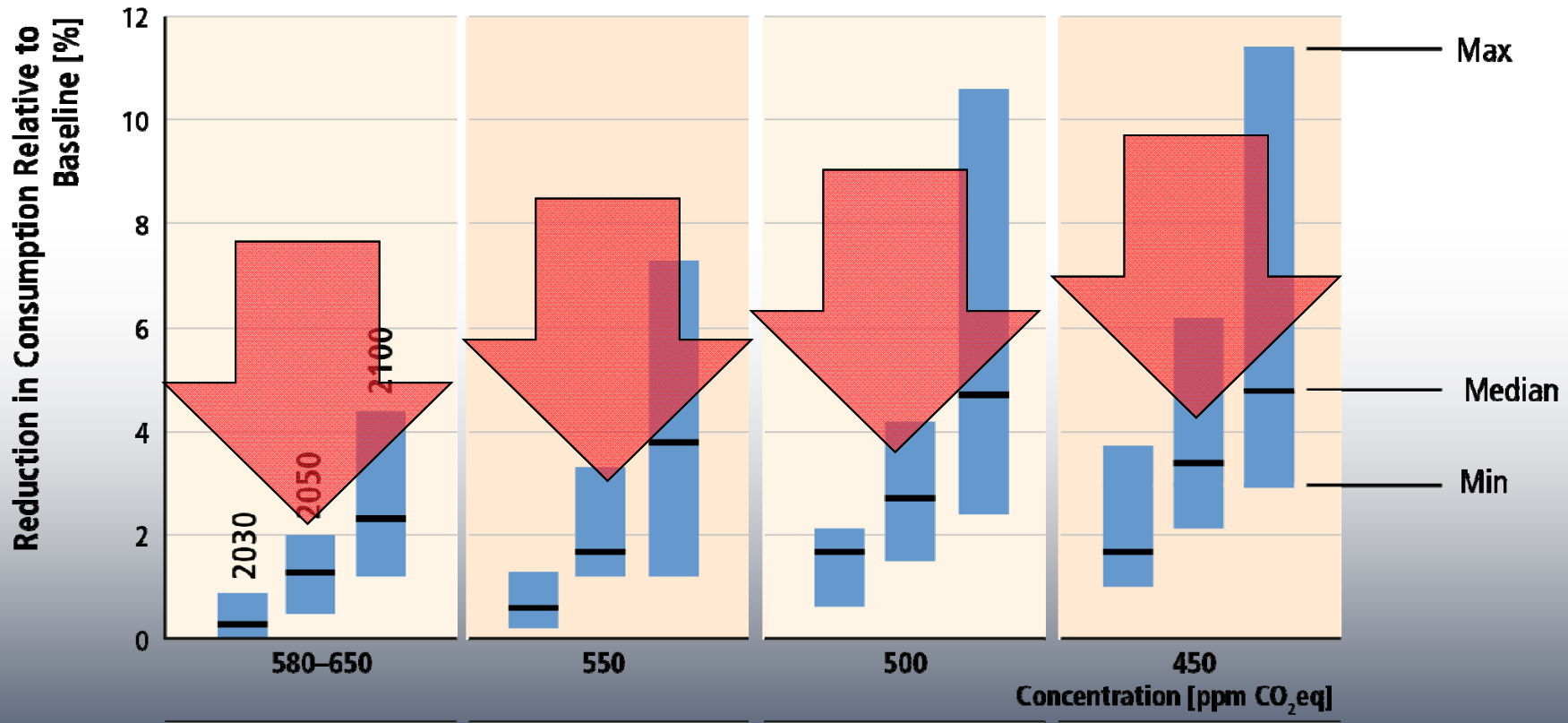
An integrated approach saves >$5 trillion (~0.5% of GDP)



Ref: McCollum, D., V. Krey, K. Riahi et al., "Climate policies can help resolve energy security and air pollution challenges." *Climatic Change* (2013).

IPCC WGIII AR5: Multi-model results from IAMs

Global costs rise with the ambition of the mitigation goal



Percentage Point Reduction in Annualized Consumption Growth Rate over 21st Century			
0.03 (0.01-0.05)	0.04 (0.01-0.09)	0.06 (0.03-0.13)	0.06 (0.04-0.14)

Source: Figure 6.21, Table SPM.2

Questions? Comments?

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