

# The Energy Program

## Current and Future Research Directions

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*Royal Society, London*

*December 2, 2016*

# Energy transformation and future pathways



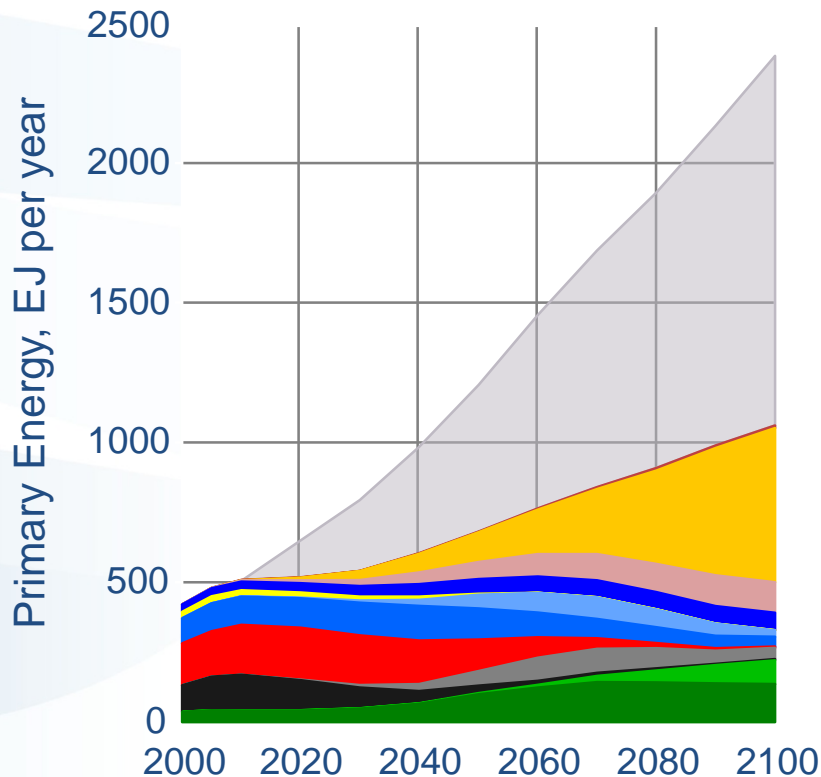
Climate Change



Land Use & Forests



Water



Energy Security



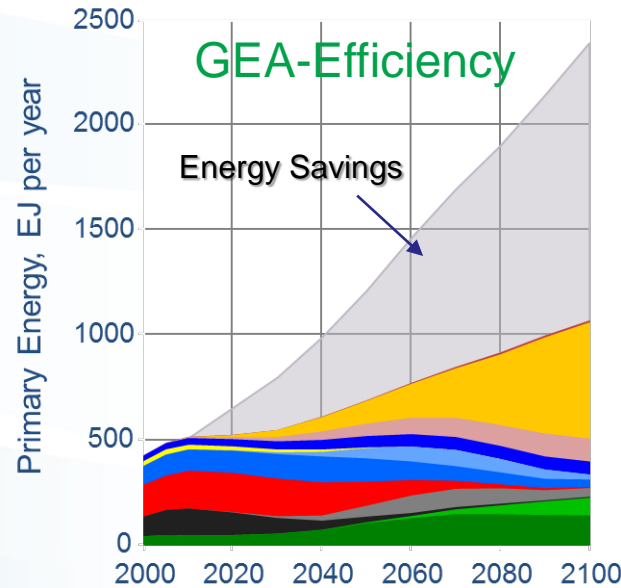
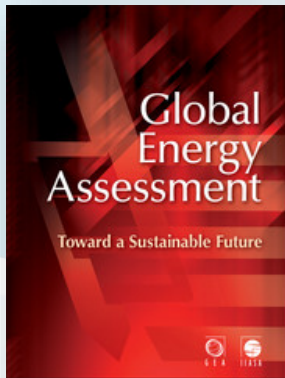
Energy Poverty



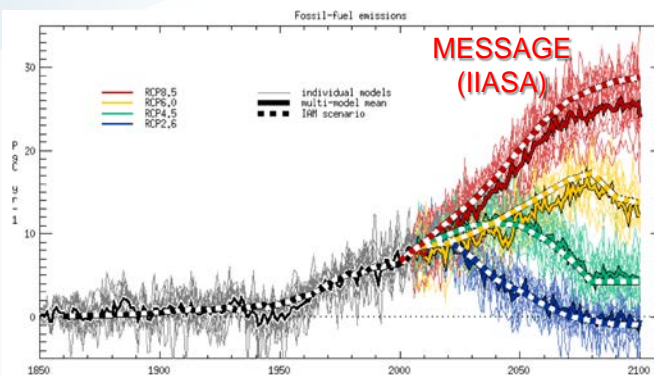
Air Pollution

In the context of diverse objectives

# Science-policy Contribution and Leadership

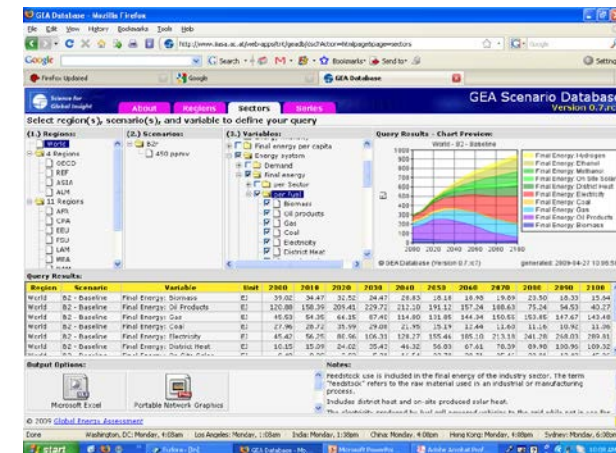


Representative Concentration Pathways (RCPs)

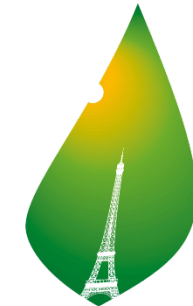
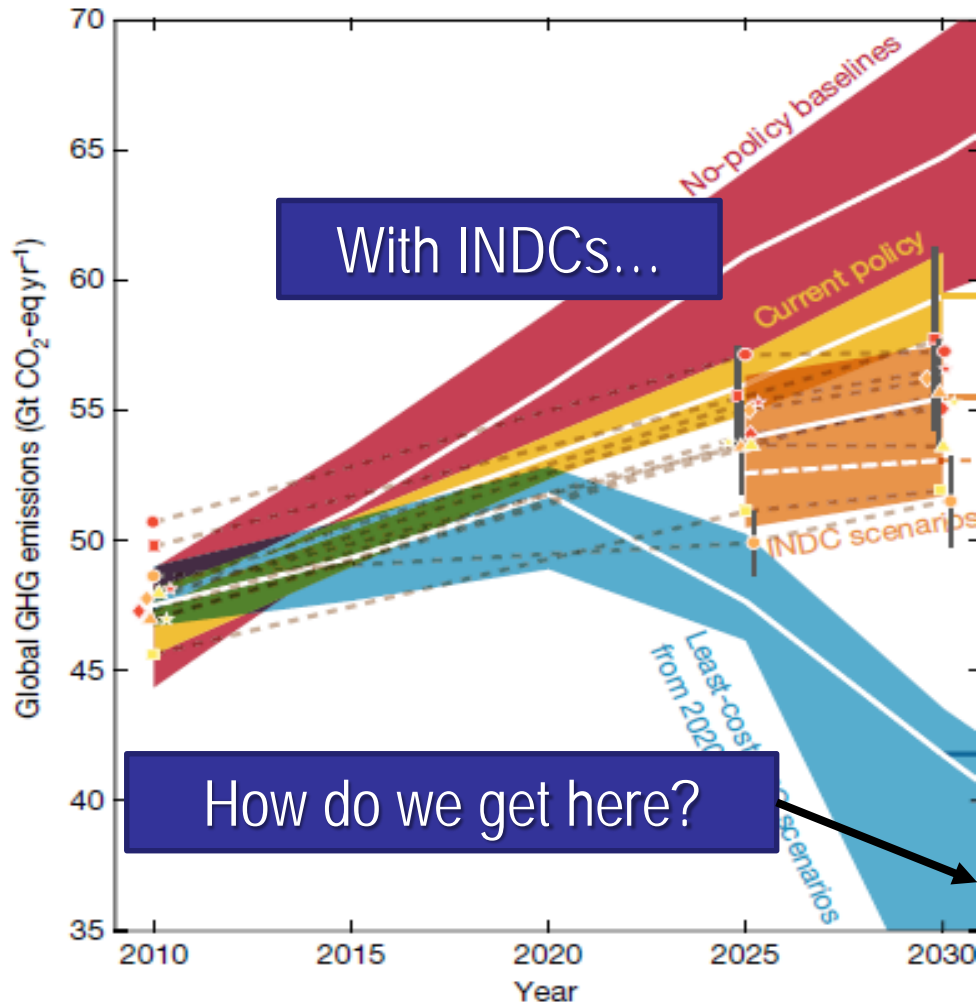


Shared Socioeconomic Pathways (SSPs)

IPCC Scenario Database



# Post-Paris climate policy analysis



COP21 · CMP11  
**PARIS 2015**  
UN CLIMATE CHANGE CONFERENCE



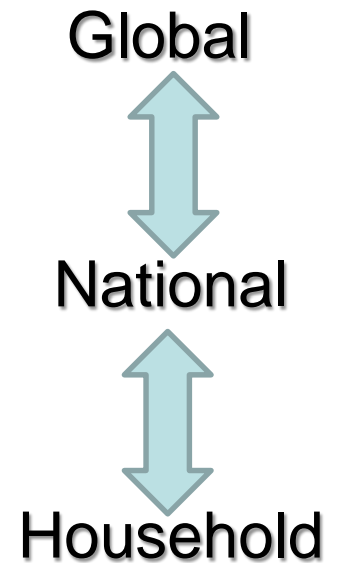
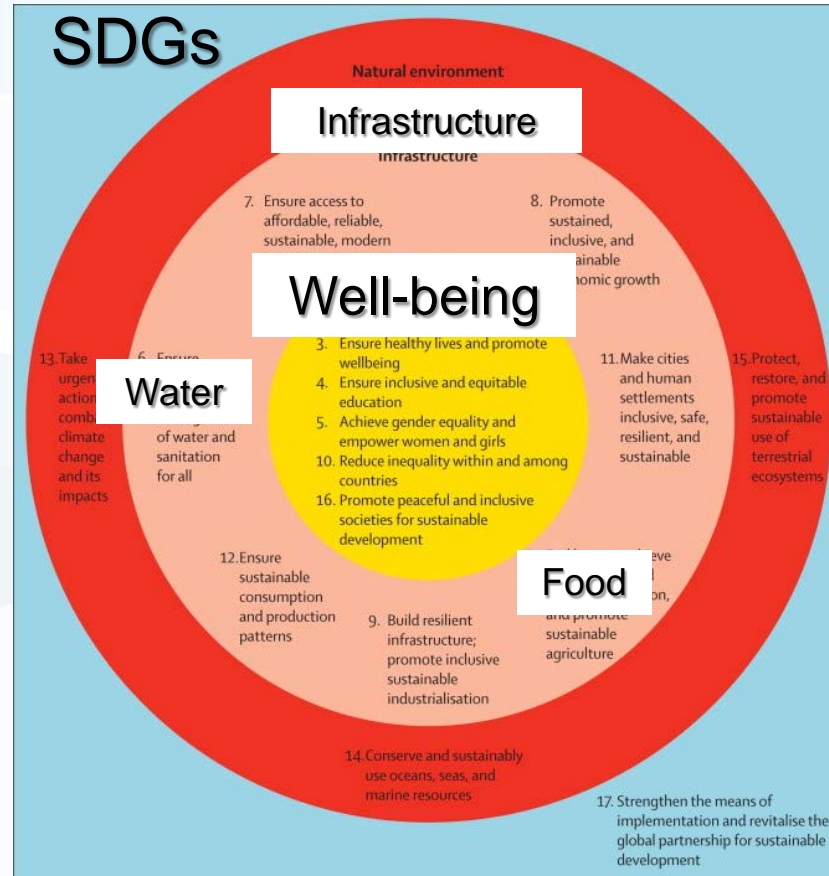
Rogelj et al, Nature, 2016

# Energy transformation in the context of Human Development

Deeper Sectoral Linkages

Energy-Land-Water-Food

Nexus

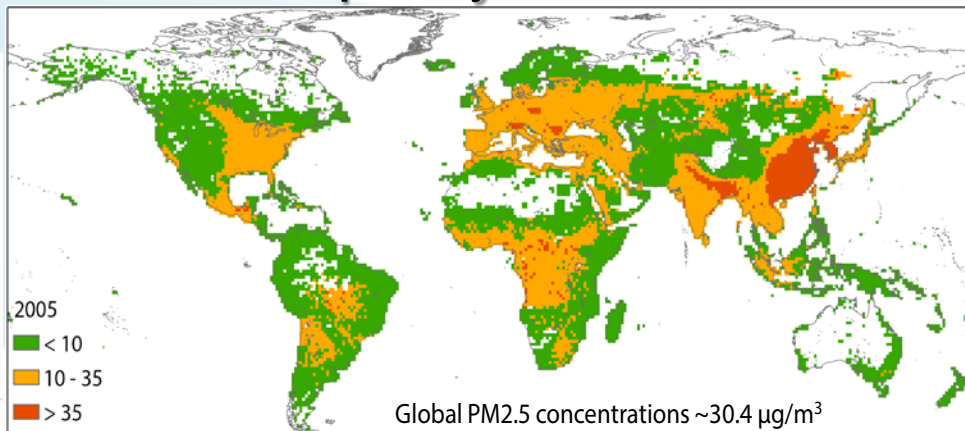


Waage et al. 2015, *The Lancet*



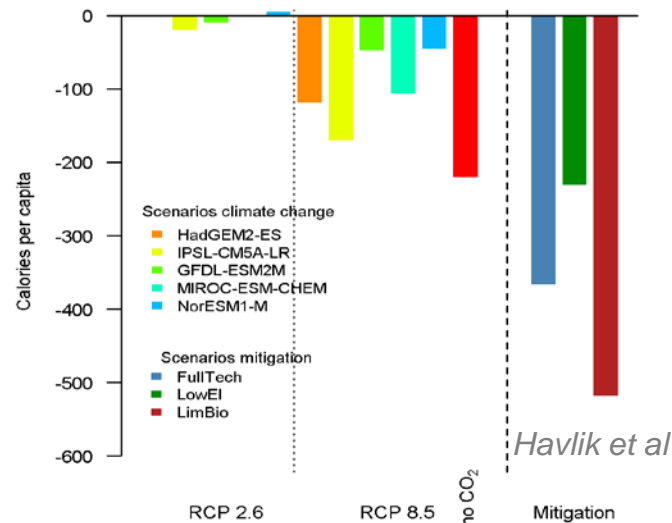
# Few IAM-SDG applications exist

## Air quality & health

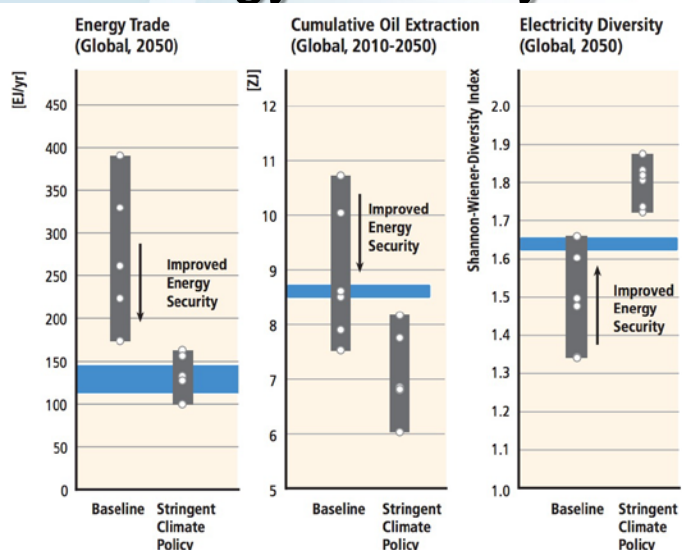


Riahi & Rao et al, 2012

## Food security

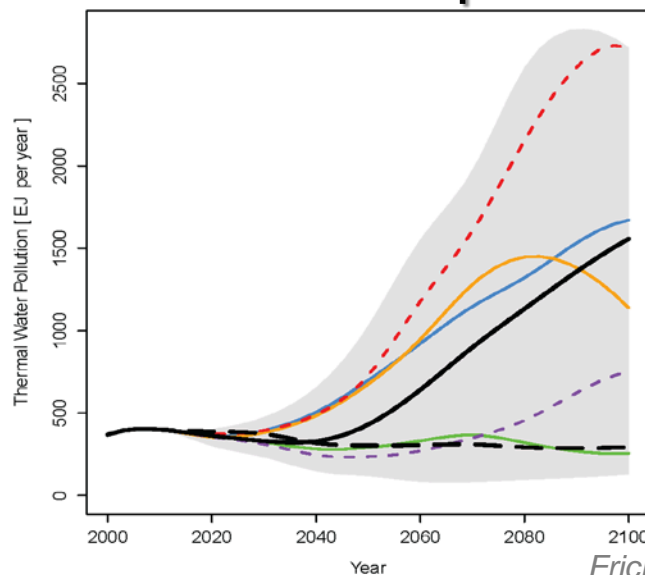


## Energy Security



Jewell et al, 2013; IPCC 2014

## Thermal water pollution



# Global ↔ national ↔ sub-national



Global energy++  
system representation  
**MESSAGE**

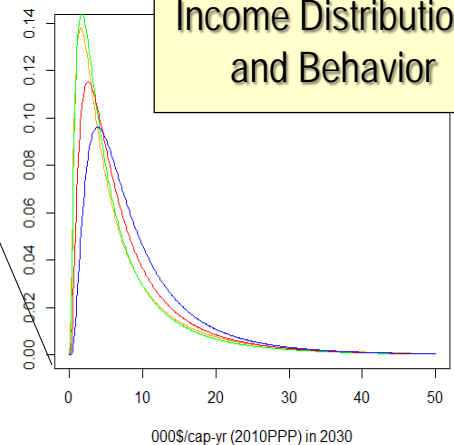
Detailed sub-national  
energy++ system  
**MESSAGE-Brazil**



Detailed sub-national  
energy++ system  
**MESSAGE-India**



Income Distributions  
and Behavior

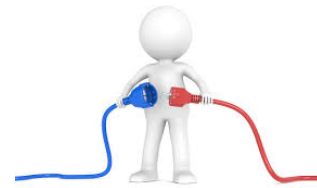


# Energy for Decent Living (ERC)

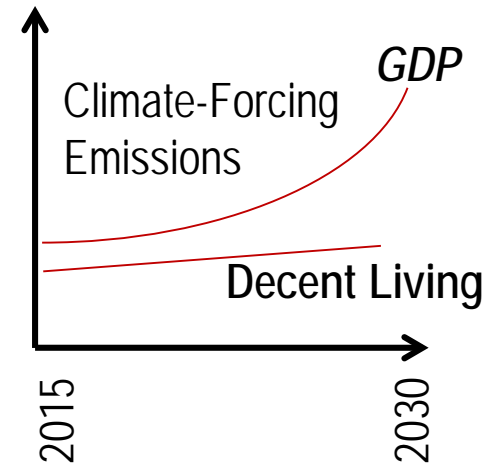
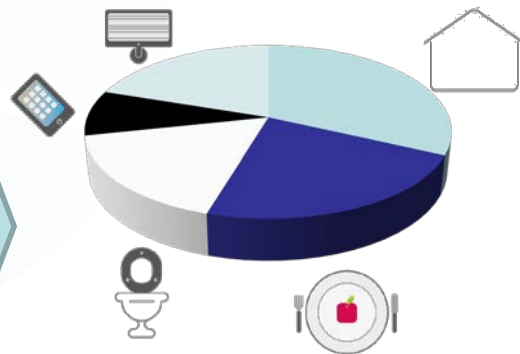
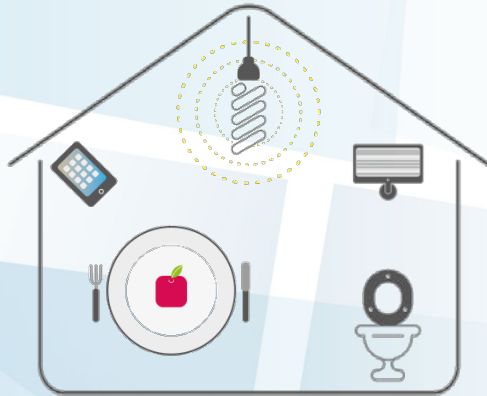
Decent Living



Energy Needs



Climate Change Scenarios



India

S.Africa

Indonesia

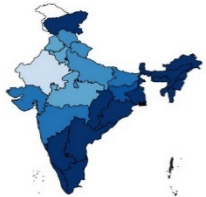
Brazil

China

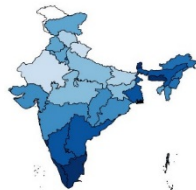


# Energy for Decent Living

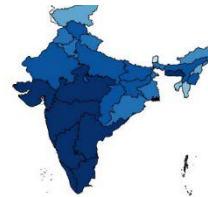
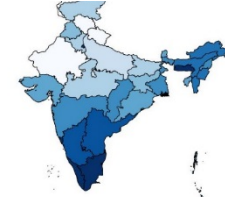
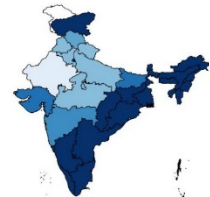
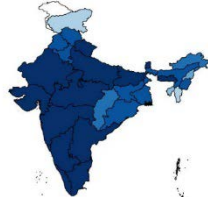
Iron



Zinc



Vit A



Deficiencies

**~50 million sub-standard homes**



**Eradicating “hidden hunger” can reduce GHG affordably for *all* but the poorest Indians**

**Durable shelter will require an energy infusion equivalent to 1/3<sup>rd</sup> annual use**

# UK Collaborations

## Post-Paris Climate



Adaptive mitigation pathways



Climate research/curriculum

IPCC/WGIII (J. Skea)

Scenario database

## Integrated Assessment



Transport behavior,  
End-use technology diffusion



AMPERE, ADVANCE

Mitigation pathways



## Energy and Human Development



'Low-carbon' well-being



Basic needs



Multidimensional poverty indicators