New Research on Population and Climate: The Impact of Demographic Change on Carbon Emissions

Presented by:

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Based on work by:

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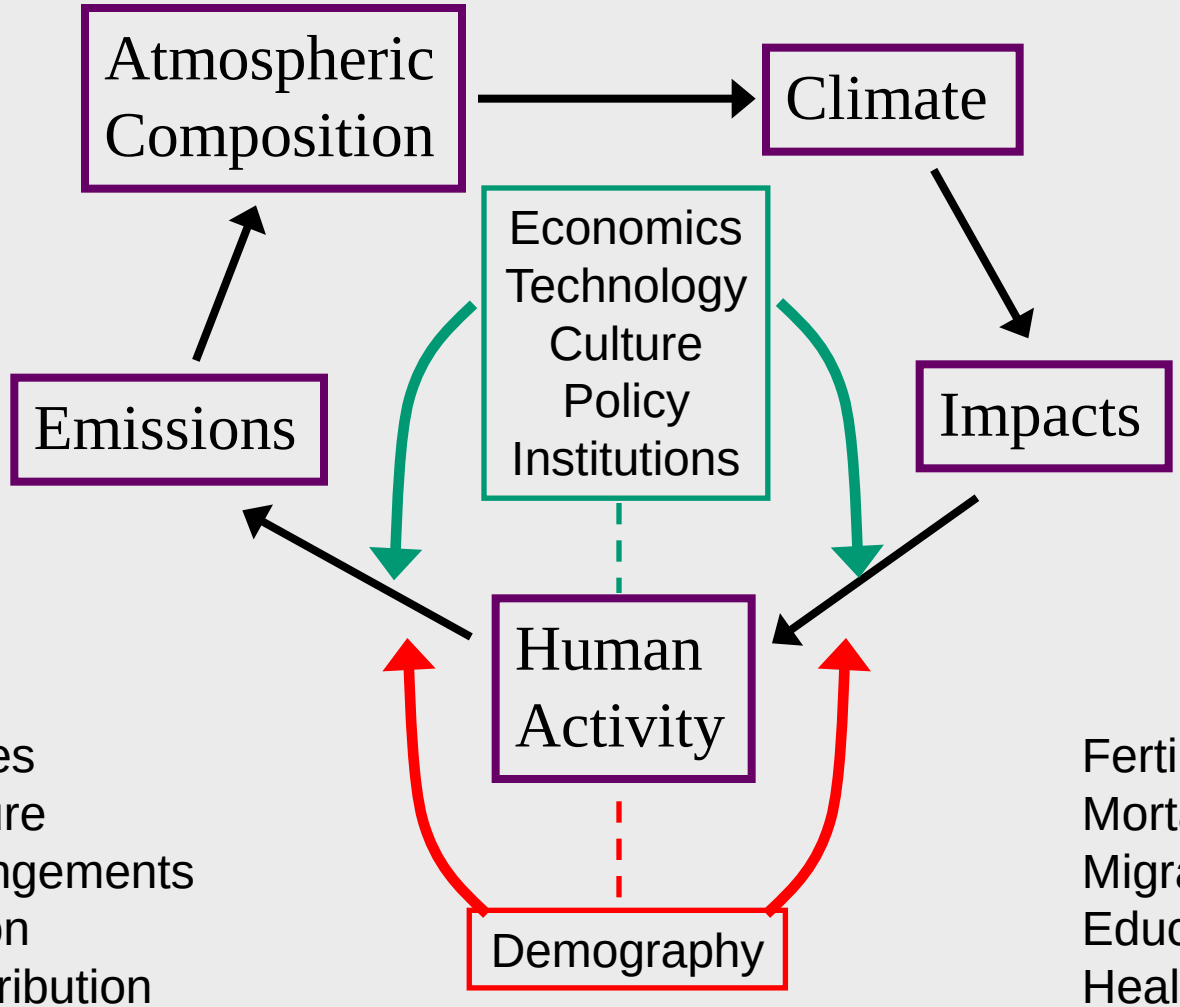
Population and Climate Change



Growth rates
Age structure
Living arrangements
Urbanization
Spatial distribution

Fertility
Mortality
Migration
Education
Health

Types of Population-Emissions Studies

Analyzing historical relationships

How have demographic factors influenced past trends in greenhouse gas emissions?

Estimating effect of a single birth and descendants

What are the emissions associated with a single person's activities over his or her lifetime, including reproduction?

Modeling future scenarios

How would different future population outcomes affect emissions?

Existing Conclusions

Slower population growth and lower fertility would reduce greenhouse gas emissions significantly in the long term and would ease adaptation to climate change

Population-related policies are “win-win” with respect to climate change

Why this topic has not gained traction

Demographic effects are not large enough to merit attention

Conclusions may not be credible

- **Relatively simple analyses**
  - *Do not include interactions between demographic change and economic growth*
- **Focus only on population size**
  - *Ignore effects of aging and urbanization*
- **Unfamiliar methods**
  - *Do not use models familiar to climate change researchers*

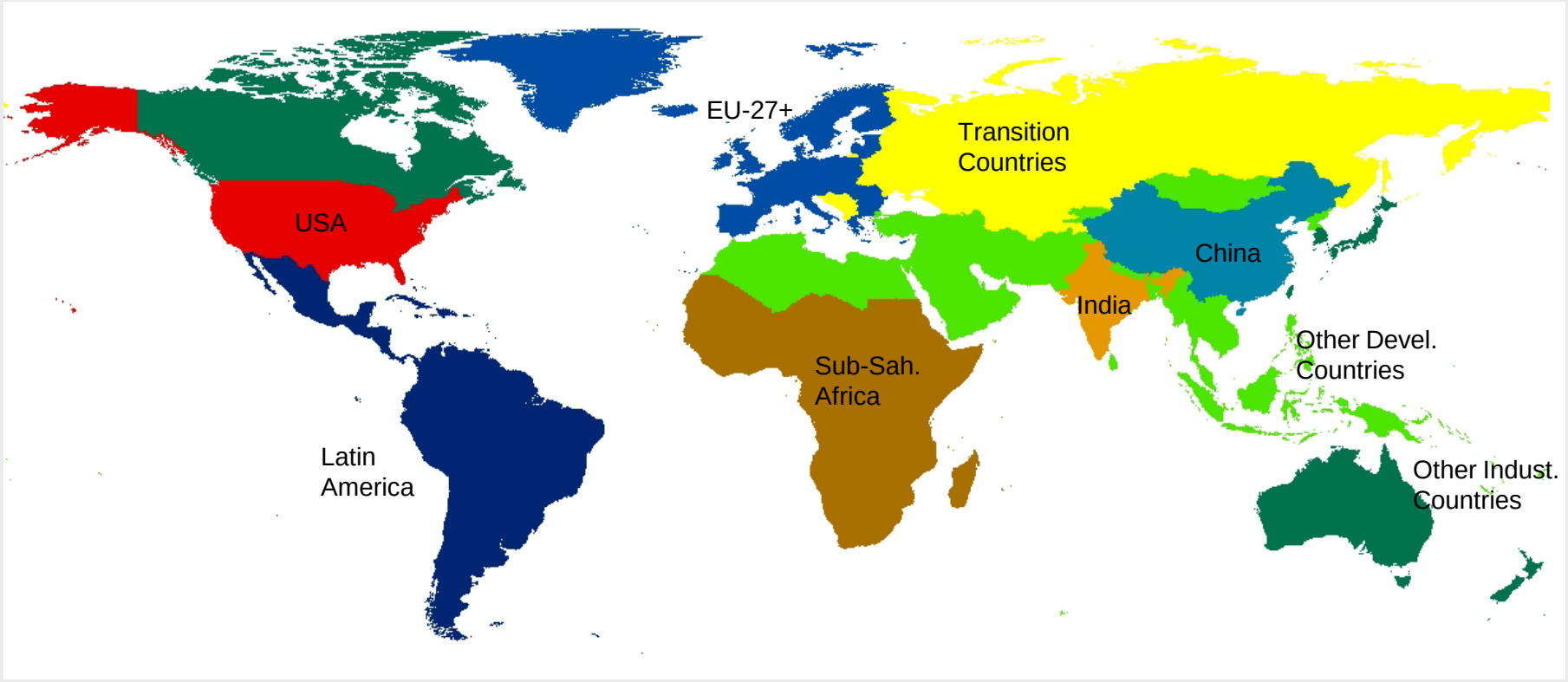
Our Analysis

“Integrated Assessment Model”

Long-term population/household projections

100-year emissions scenarios

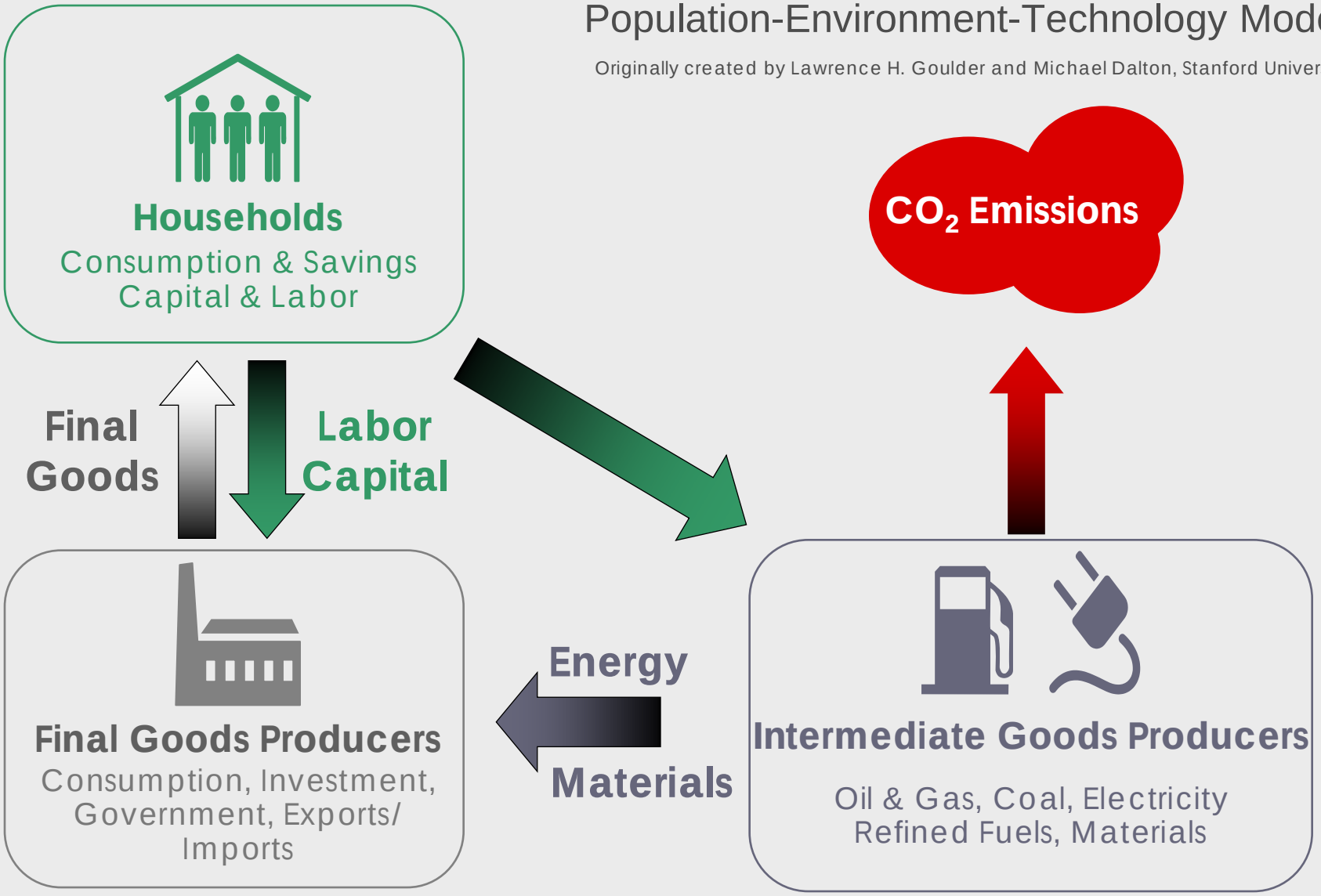
9-Region “CGE” Model, with Trade



PET Model

Population-Environment-Technology Model

Originally created by Lawrence H. Goulder and Michael Dalton, Stanford University



What's "in" the model

Population growth rate → Per capita economic growth rate

Aging/Urbanization → Economic growth
Changing labor supply (exogenous)
Changing savings rates (endogenous)

Aging/Urbanization → Consumption patterns
Changing consumption preferences

What's NOT "in" the model

Lower fertility → higher female labor force participation

Increased human capital → higher labor productivity

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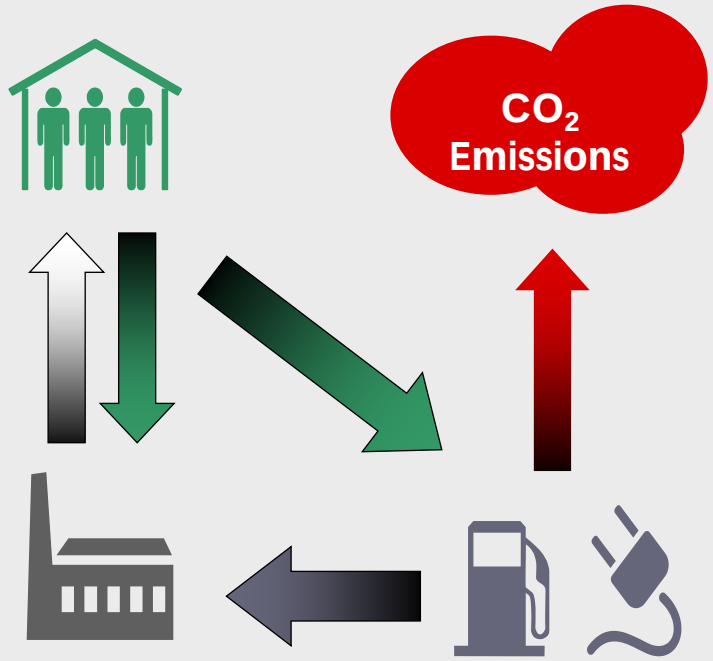
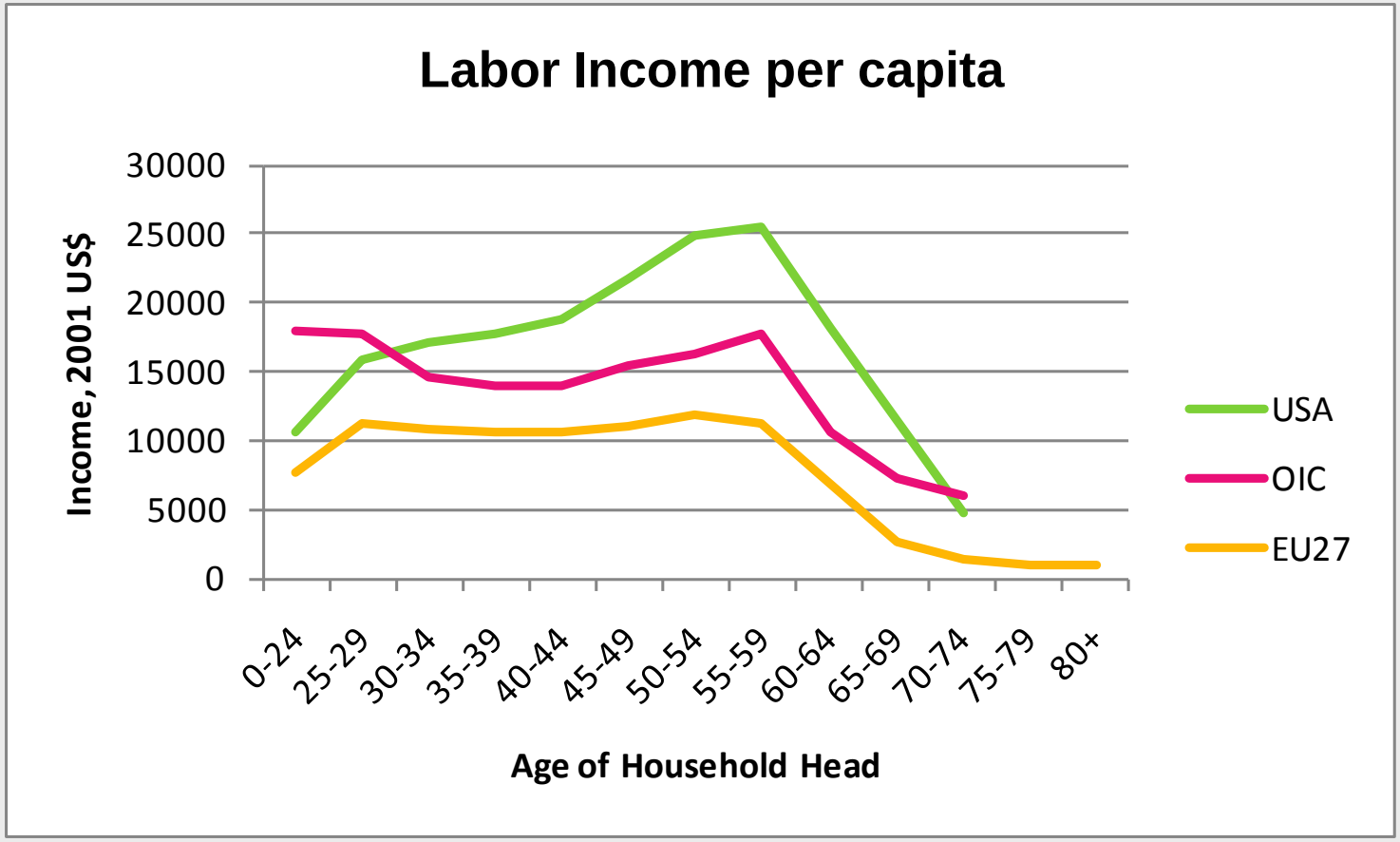
CURRENT DATA (Year 2000)



Disaggregating Households by Age, Size, Urban/Rural, Consumption Goods

Data from 35 countries; 800,000 households surveyed;
61% of global population represented



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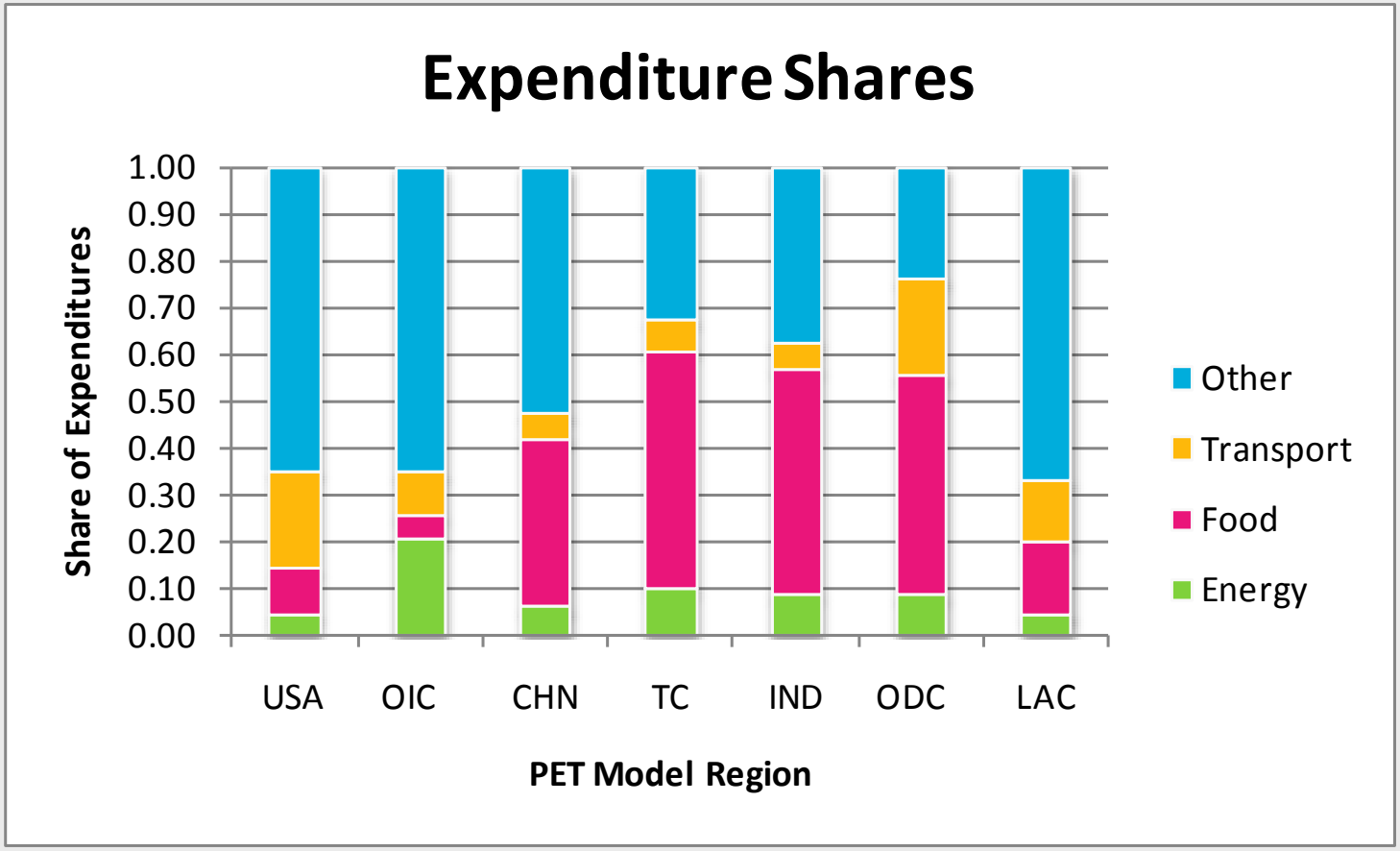

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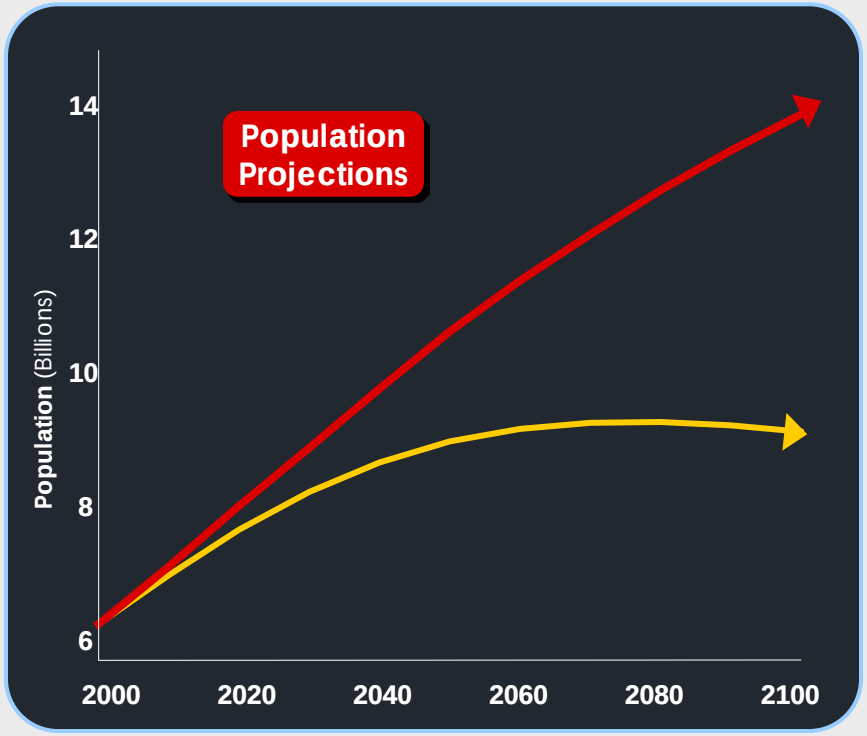
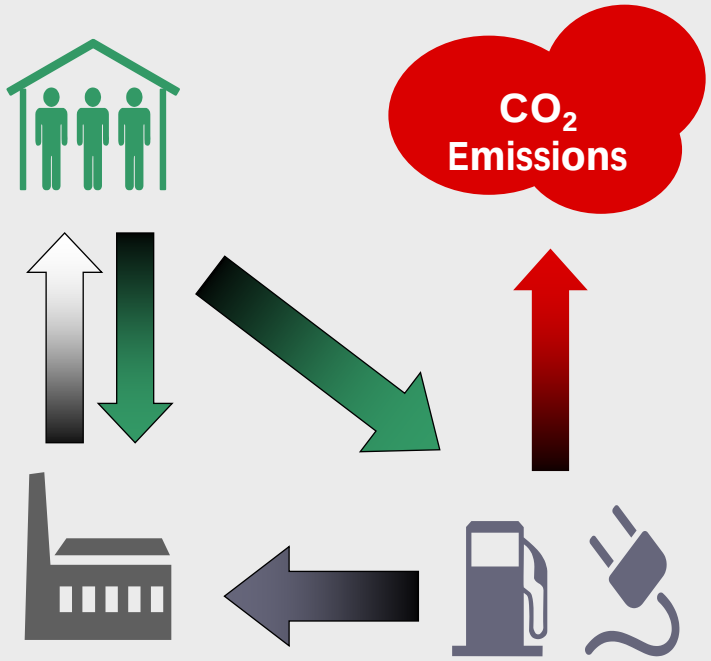
FUTURE ASSUMPTIONS





Demographic Projections

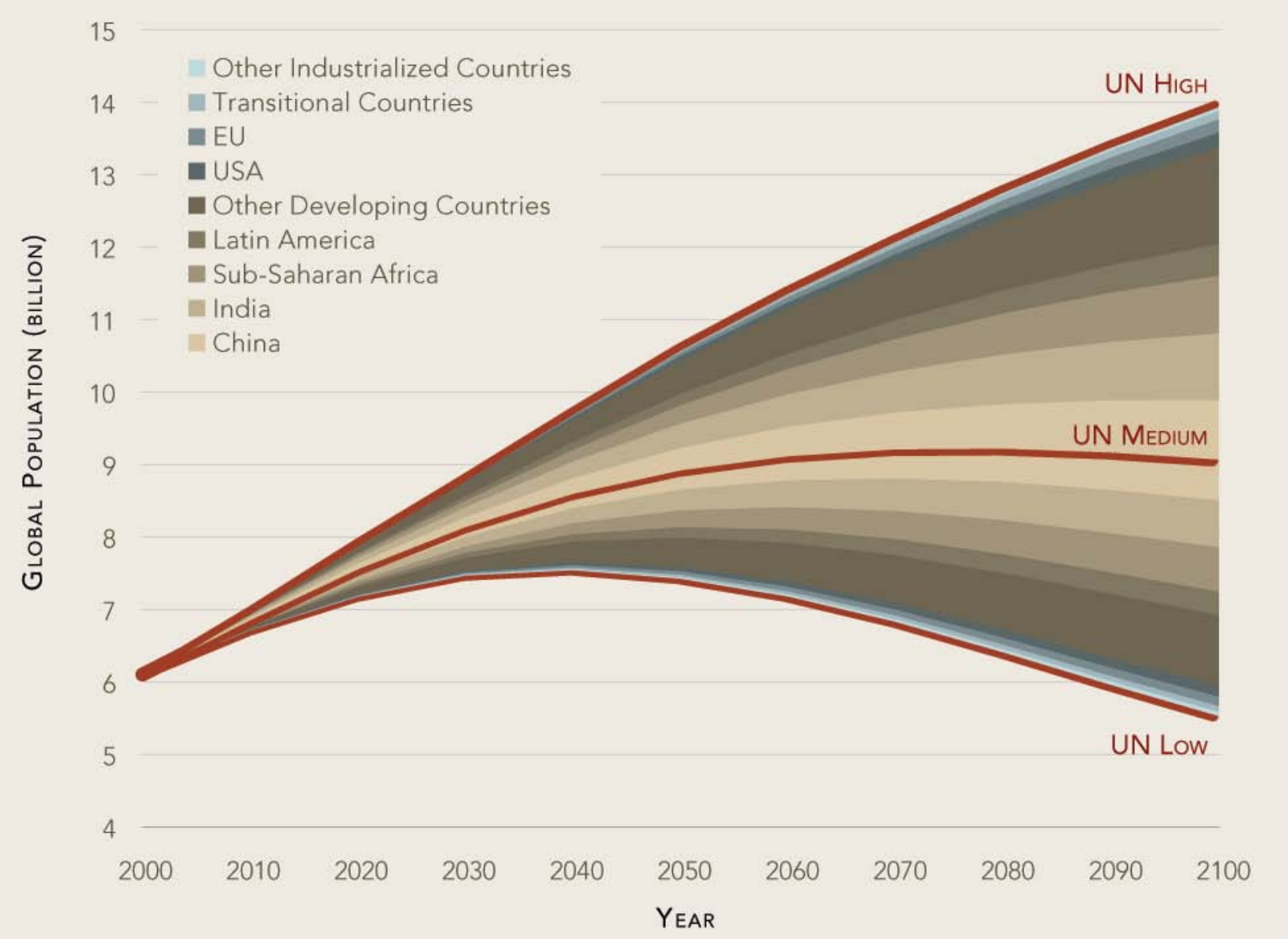
Population and Urbanization

- UN 2003 Long-range Projections
- IIASA extrapolation of UN 2005 Urbanization Projections
- Multi-state Projections for India and China

Households

- Constant headship rates, distinguished by age, size, and urban-rural residence
- Changing headship rates over time in China, USA
- Sub-Saharan Africa excluded

Three Population Projections



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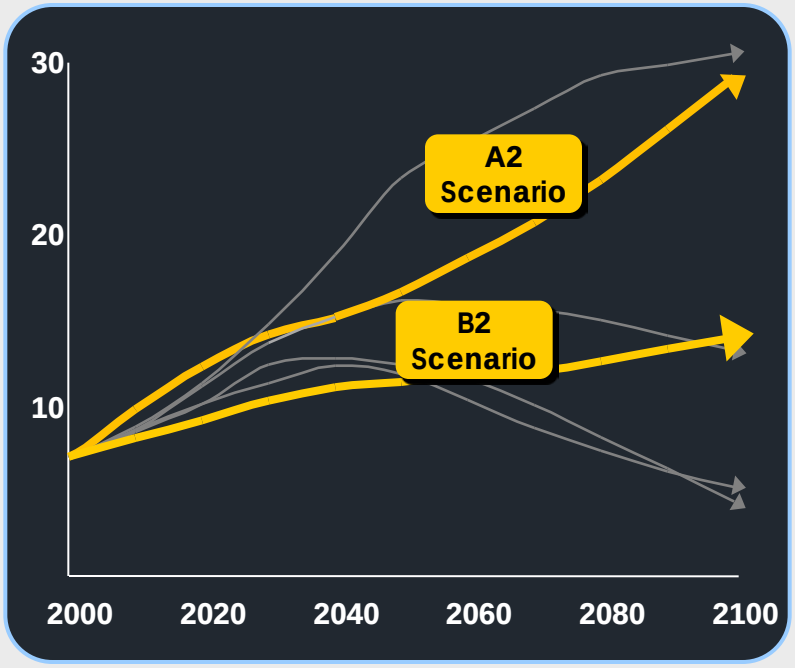
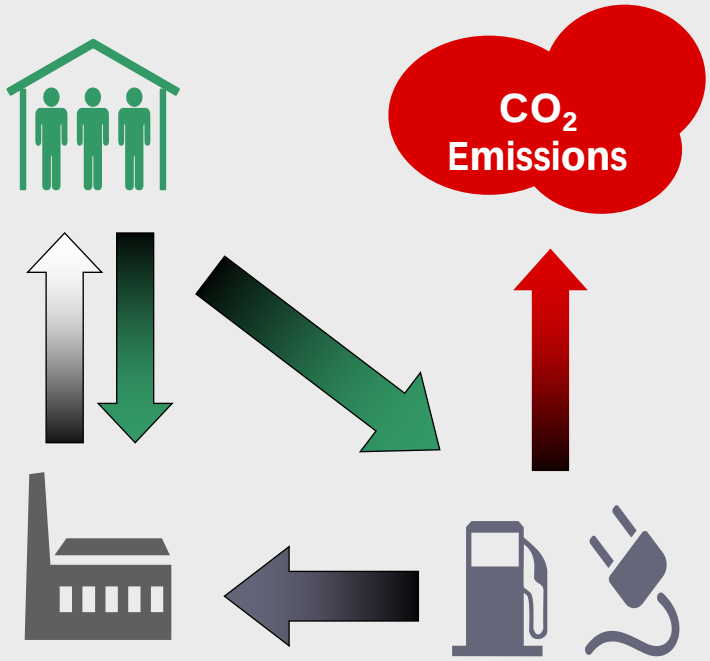
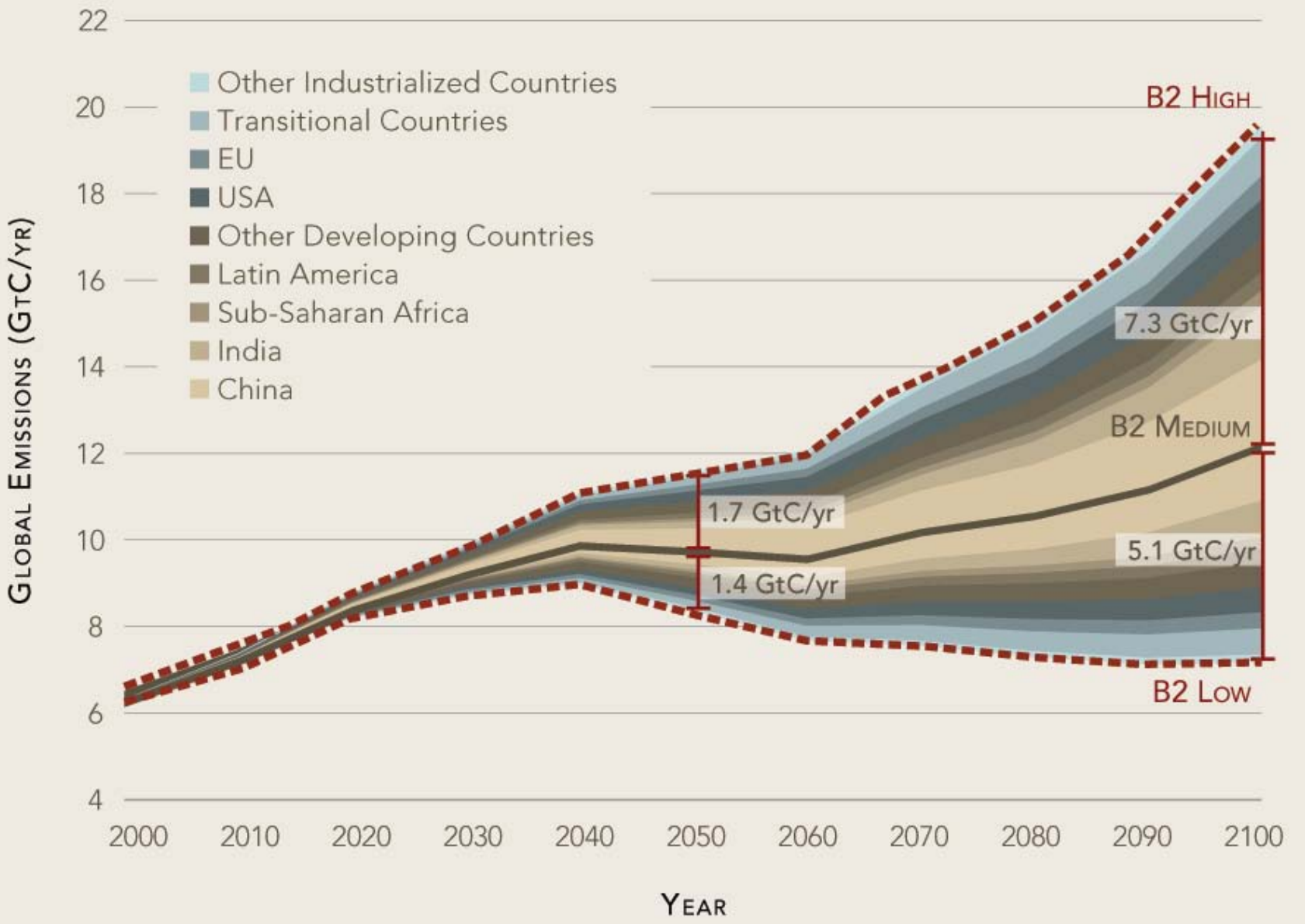
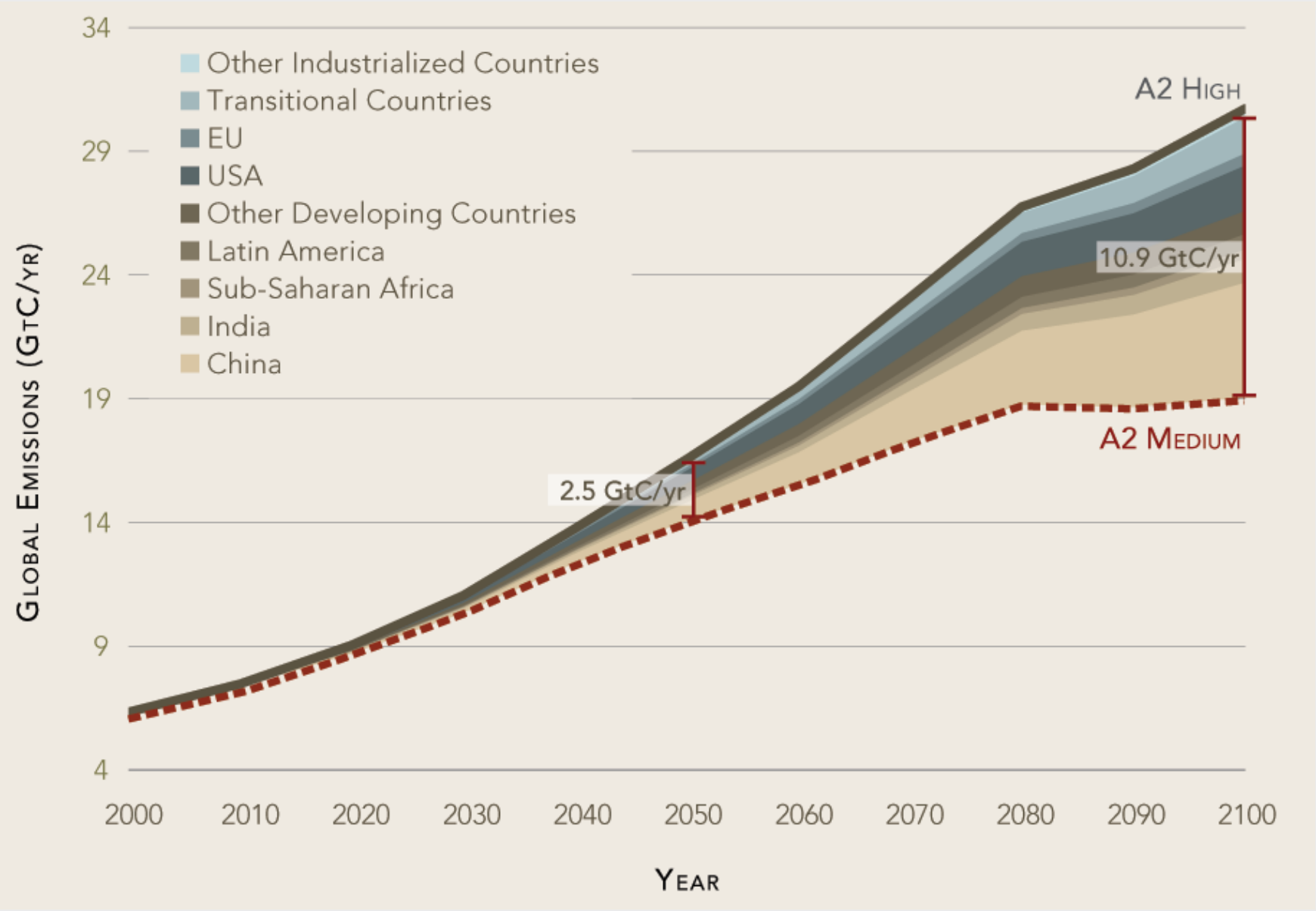




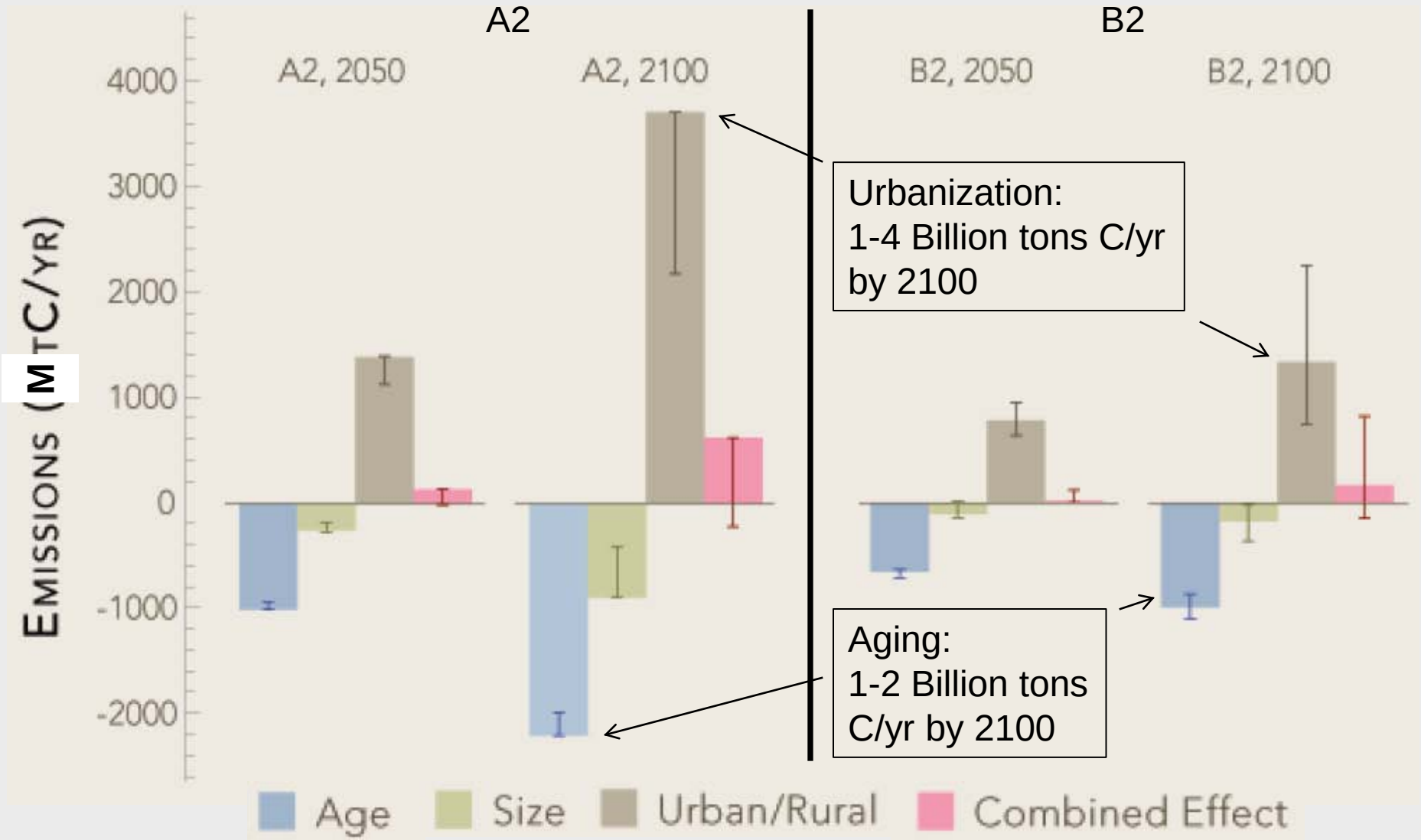
B2: Three Emissions Projections



A2: Two Emissions Projections



Compositional Effects on Global Emissions



Are emissions reductions large or small?

5 – 11 billion tons carbon per year in long term

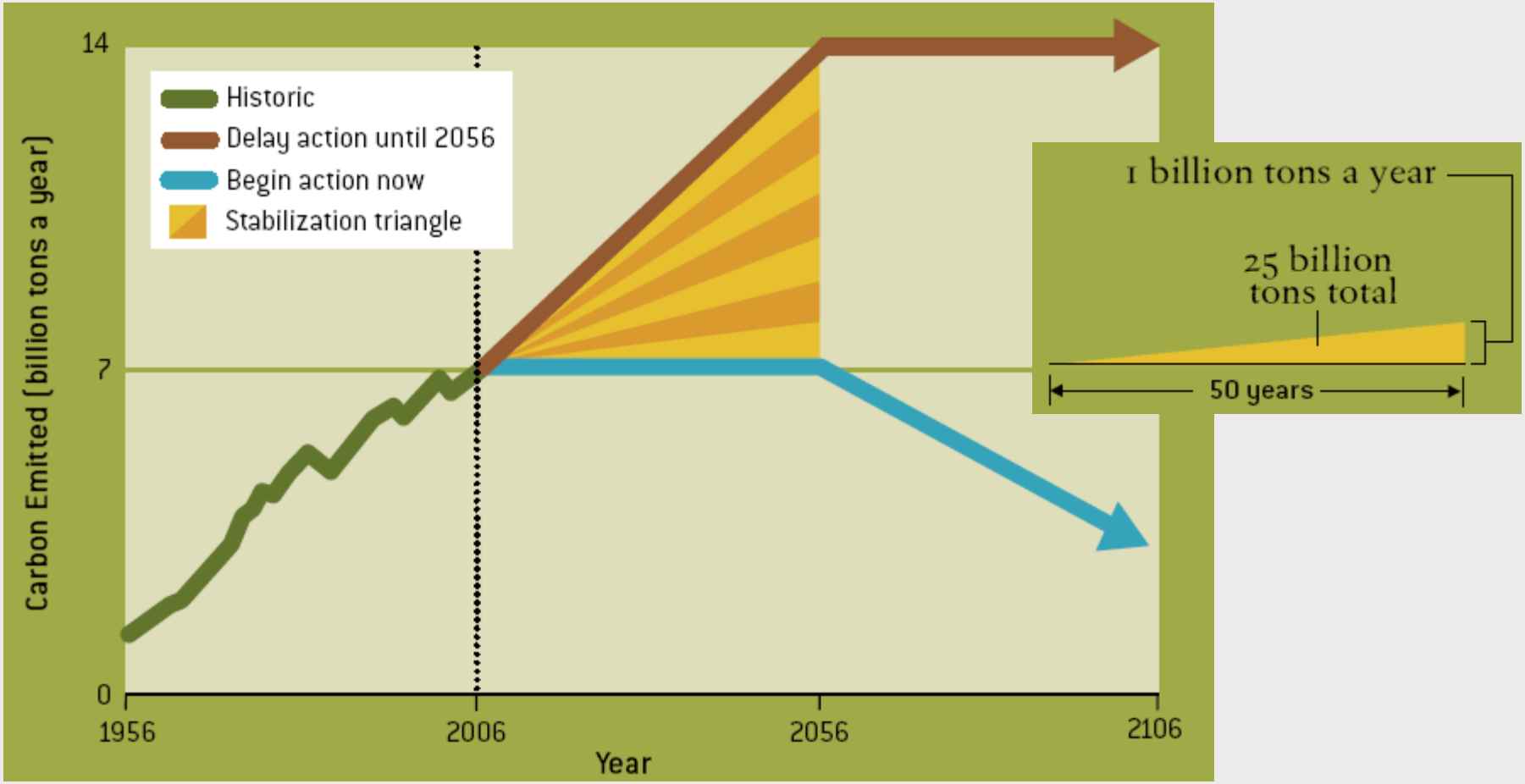
1.4 – 2.5 billion tons carbon per year in 2050

Emissions reductions relevant to population-related policies?

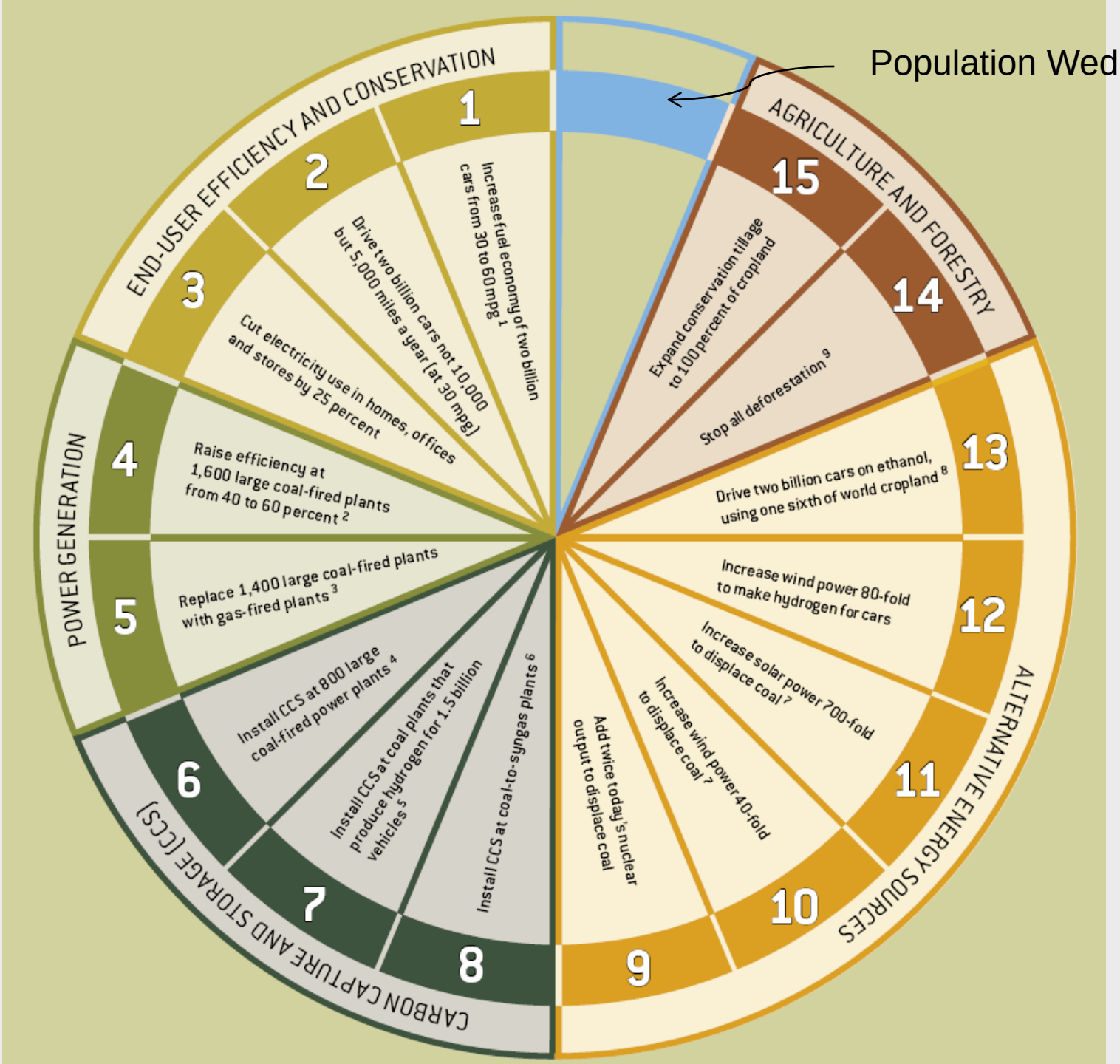
Exclude already-low fertility industrialized country regions and China

Developing countries (excluding China) plus U.S. account for about half of reductions

Stabilization “Wedges”



Source: Socolow & Pacala, 2006.


Population Wedge?
END-USER EFFICIENCY AND CONSERVATION
1
Increase fuel economy of two billion cars from 30 to 60 mpg [1]
2
Drive two billion cars not 10,000 but 5,000 miles a year (at 30 mpg)
3
Cut electricity use in homes, offices and stores by 25 percent
POWER GENERATION
4
Raise efficiency at 1,600 large coal-fired plants from 40 to 60 percent [2]
5
Replace 1,400 large coal-fired plants with gas-fired plants [3]
CARBON CAPTURE AND STORAGE (CCS)
6
Install CCS at 800 large coal-fired power plants [4]
7
Install CCS at coal plants that produce hydrogen for 1.5 billion vehicles [5]
8
Install CCS at coal-to-syngas plants [6]
ALTERNATIVE ENERGY SOURCES
9
Add twice today's nuclear output to displace coal
10
Increase wind power 40-fold to displace coal [7]
11
Increase solar power 700-fold to displace coal [7]
12
Increase wind power 80-fold to make hydrogen for cars
13
Drive two billion cars on ethanol, using one sixth of world cropland [8]
AGRICULTURE AND FORESTRY
14
Stop all deforestation [9]
15
Expand conservation tillage to 100 percent of cropland

Conclusions

Compositional change matters

- **Aging can have significant negative impact on emissions in industrialized countries, in the long run**
- **Urbanization can have significant positive impact on emissions in developing countries, over next few decades**

Slower population growth cannot solve the climate problem, but it can help

- **Largest impact on emissions occurs after 2050**
- **By 2050, slower population growth could reduce emissions 1.4-2.5 billion tons C/yr, about half that in currently high-fertility regions**

Thank You

Funders

European Young Investigators (EURYI) program
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