

# **New land emissions scenarios and modeling innovations**

**Land Modeling Subgroup  
Steven Rose (US EPA)**

*EMF-22 Working Group Meeting  
Climate Change Control Scenarios  
Tsukuba, Japan, December 12-14, 2006*

# Subgroup goals

- Support overall scenarios analyses – mitigation, climate, (impacts)
  - Generate new scenarios
    - Improve underlying biophysical and economic modeling
    - Understand model differences

# Subgroup Agenda

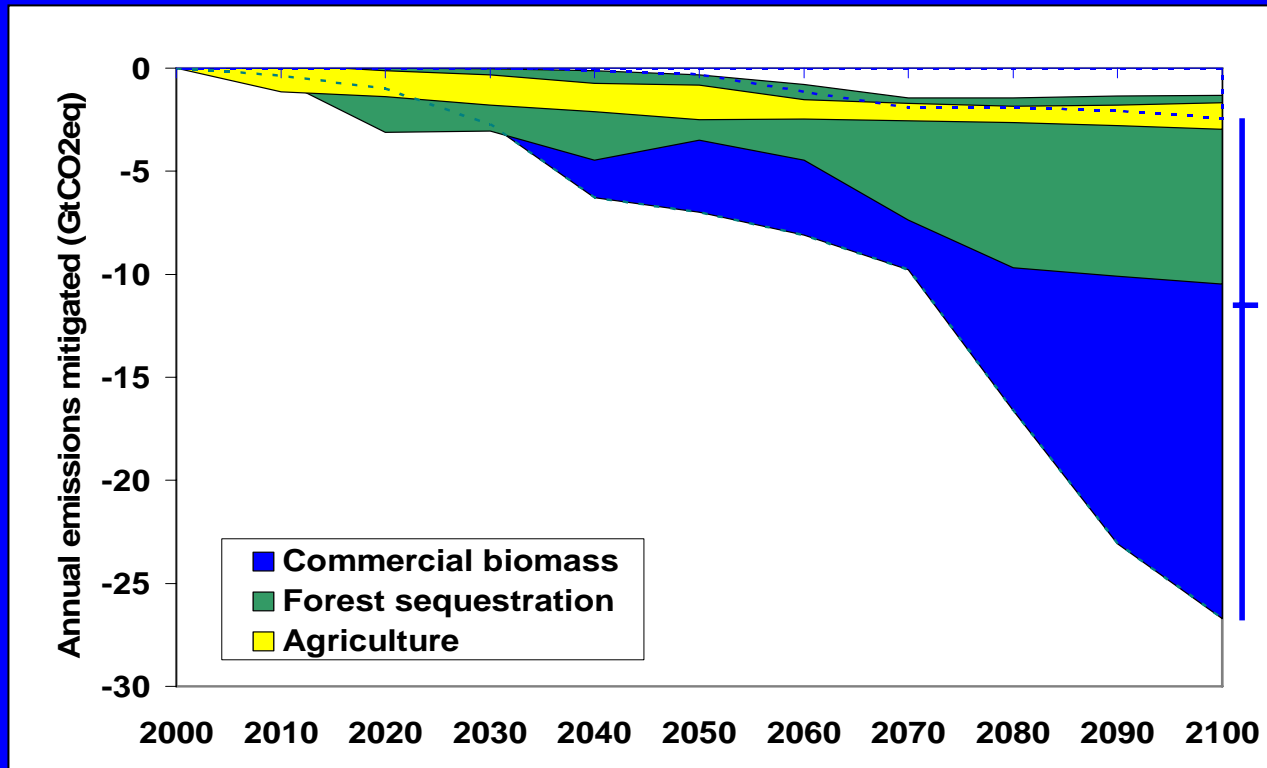
- Part A: Scenarios from a coordination experiment and other new scenarios
  - Culminates tomorrow with a discussion of lessons learned and prospects for broad coordination
- Part B: Methodological advances and future prospects

# Since Washington

- New literature
  - EMF-21 papers, van Vuuren et al. (2006), Riahi et al. (2006), Rokitansky et al. (2006)
  - EMF report on the land in stabilization – forthcoming
- Significant room for improvement. Tremendous development effort, e.g.,
  - Land-use competition
  - Mitigation competition
  - Forest dynamics
  - Non-co2 – inventory data, mitigation cost estimates, and modeling
  - Avoided deforestation
  - Spatial modeling
  - Biofuels
  - Food demand
  - Climate feedbacks

**Poised for subgroup scale scenarios modeling exercise!!**

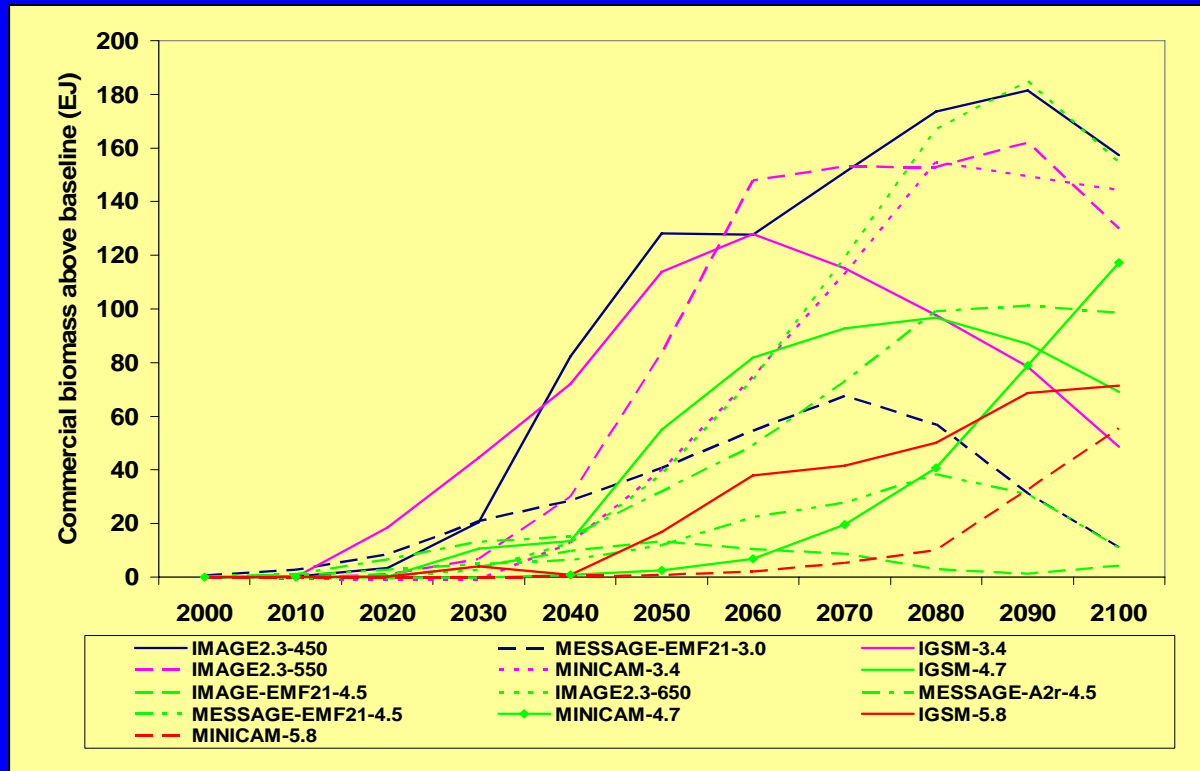
# Land in stabilization



Source: Derived from EMF report

- Significant stabilization role: 20-40% of cumulative 2000-2100 abatement (457-1259 GtCO<sub>2</sub>eq)
  - Agriculture and forestry early and growing
  - Biofuels dominate land strategy later and overall

# Biofuels in stabilization



Sources:  
EMF report,  
USCCSP (2006)

## Abatement:

- Up to 7 GtCO<sub>2</sub> in 2050 and 27 GtCO<sub>2</sub> in 2100
- 4 to 30 % of cumulative abatement over the century

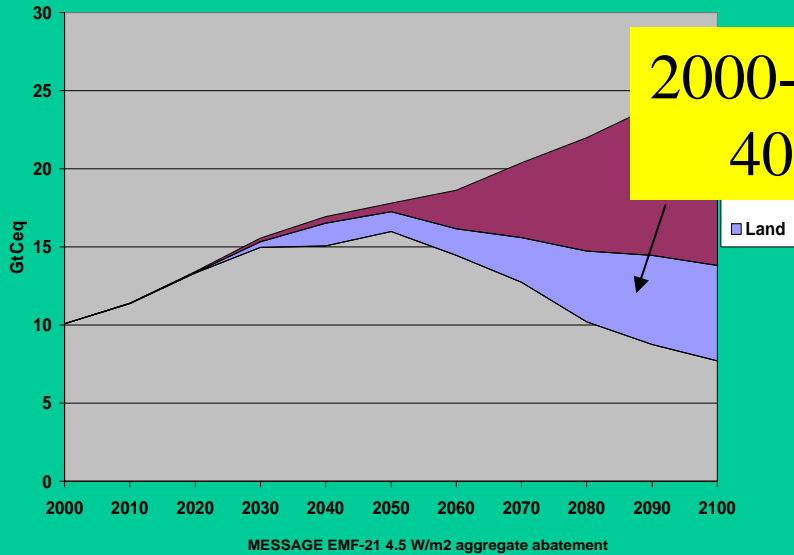
## Energy:

- 51 to 88 EJ in 2050 for 4-5 W/m<sup>2</sup> scenarios (7-14% of total TPES)
- 93 to 150 EJ in 2050 for 3.25-4 W/m<sup>2</sup> scenarios (14-28 %)
- 8 to 23 % of cumulative total primary energy 2000-2100

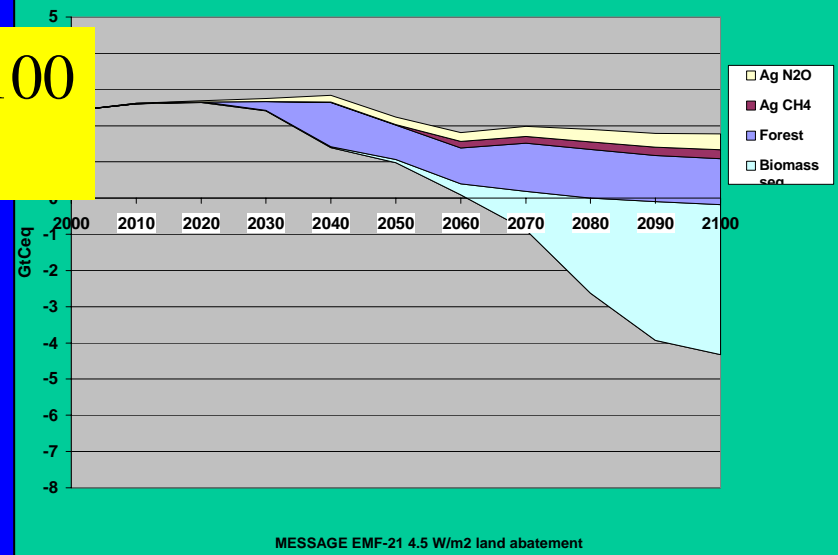
# Sample 4.5 W/m<sup>2</sup> scenarios

GRAPE

## Overall abatement

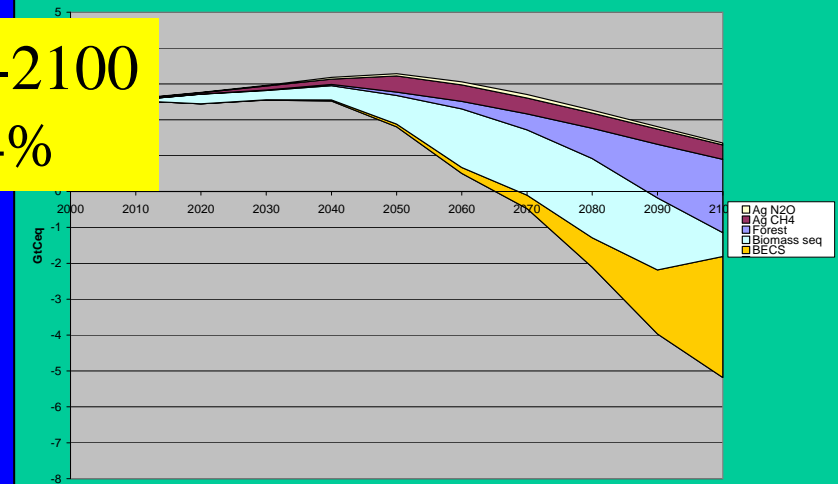
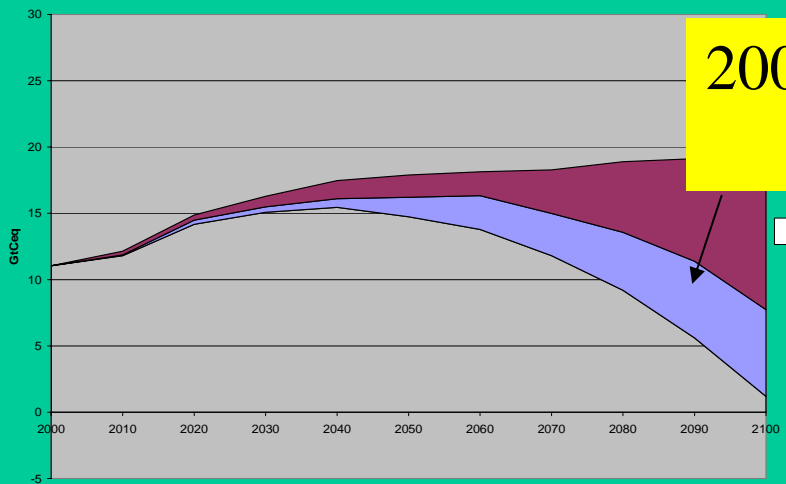


## Land abatement



MESSAGE

2000-2100  
44%



# Subgroup goals

- Support overall scenarios analyses – mitigation, climate, (impacts)
  - Generate new scenarios
    - Improve underlying biophysical and economic modeling
    - Understand model differences



# Part A: Coordinated scenarios

- Broad subgroup agreement on value of coordination and desire to participate
- However,
  - Coordination design questions – many model structures
  - Some models completing development
- Therefore, initial coordination experiment proposed and developed – “Give it a try”
  - Guinea pigs: IMAGE, DIMA/MESSAGE, GRAPE, GFAM, GCOMAP, and FASOMGHG2
  - Goal: inform design of a “full” subgroup coordination exercise

# Initial coordination guidelines

- Feel free to run your own baseline scenario in juxtaposition to the coordinated baseline scenario
- As for the coordinated data, only use what makes sense.
  - (1) do not force your model to mimic variables it solves for
    - Interesting to compare the endogenous and exogenous scenario results.
  - (2) if you cannot use the data as is, feel free to be creative (e.g, use growth rates instead of levels).
- Each model has unique data requirements. Please ask if you require additional input data that you would like to be consistent with the data already provided (e.g., acreage).
- Request to report particular results

# Coordinated baseline scenarios

- *Sensitivities on your own baseline scenario*
  - Reduce your food/feed crop technological change rates by 50%
  - Increase your food/feed crop technological change rates by 50%
  
- *Coordination scenario without climate/atmospheric feedbacks*
  - Variables
    - Population – regional and global (millions)
    - GDP (at MER) – regional and global (billions 1990 US\$)
    - Agricultural technological change (average annual growth, %) – crop and livestock
    - Source: Millennium Ecosystem Assessment Adapting Mosaic scenario (MA-AM) – storyline comparable to SRES B2
  - Technological change for other sectors – modeler’s discretion.
    - Could consider SRES B2 tech change assumptions
  - Climate policy – assume no climate policies
  
- *Coordination scenario with climate/atmospheric feedbacks*
  - “Turn on” the climate/atmospheric feedbacks with the MA-AM baseline

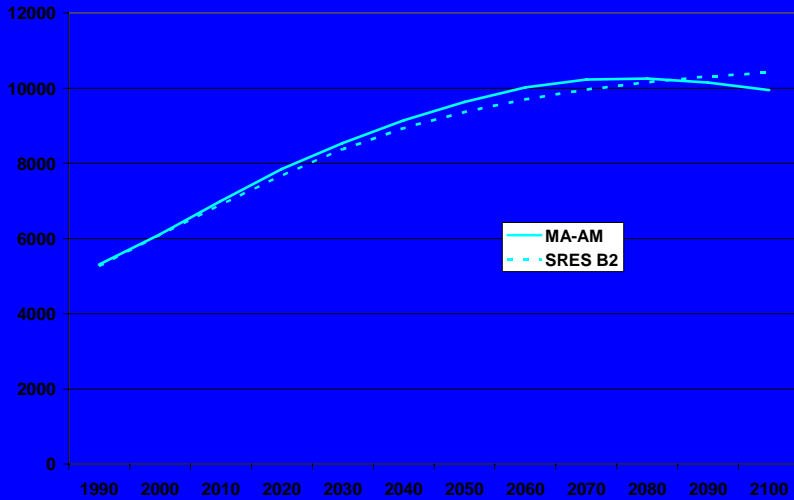
# Coordinated mitigation scenarios

## “If you run, please consider...”

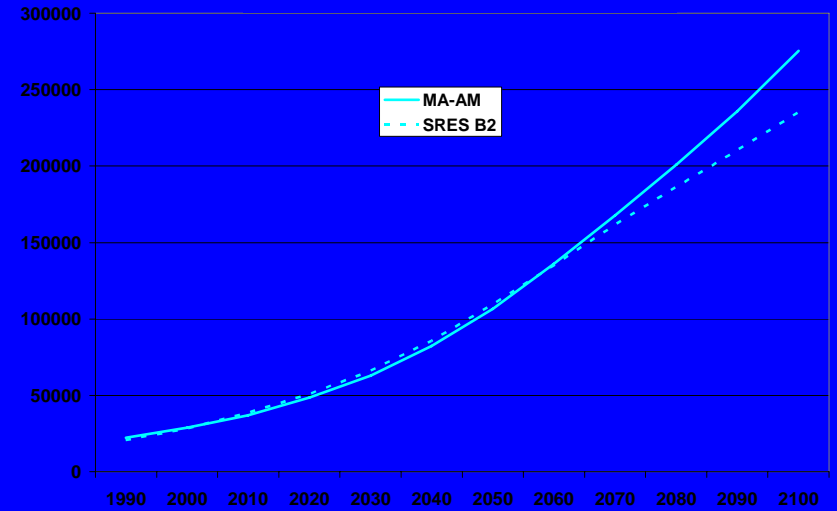
- Use MA-AM baseline
  - Modeler’s choice with or without climate/atmospheric feedbacks
- For IAMs, 650 ppm CO<sub>2</sub>eq stabilization with multigas and sinks mitigation options
- For CGE and PE models, two carbon price paths produced from EMF-21 4.5 W/m<sup>2</sup> runs
  - In the future, provide carbon prices produced from the IAM’s stabilization scenarios with a coordinated baseline

# Data overview - Global

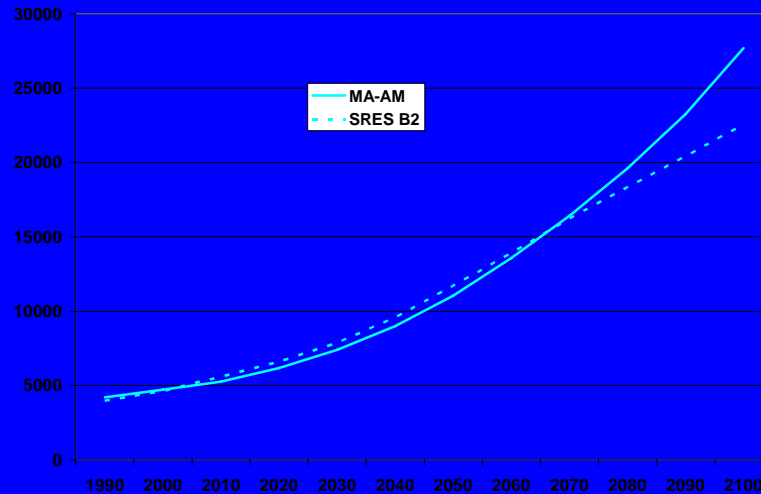
## Population (millions)



## GDP (billions)

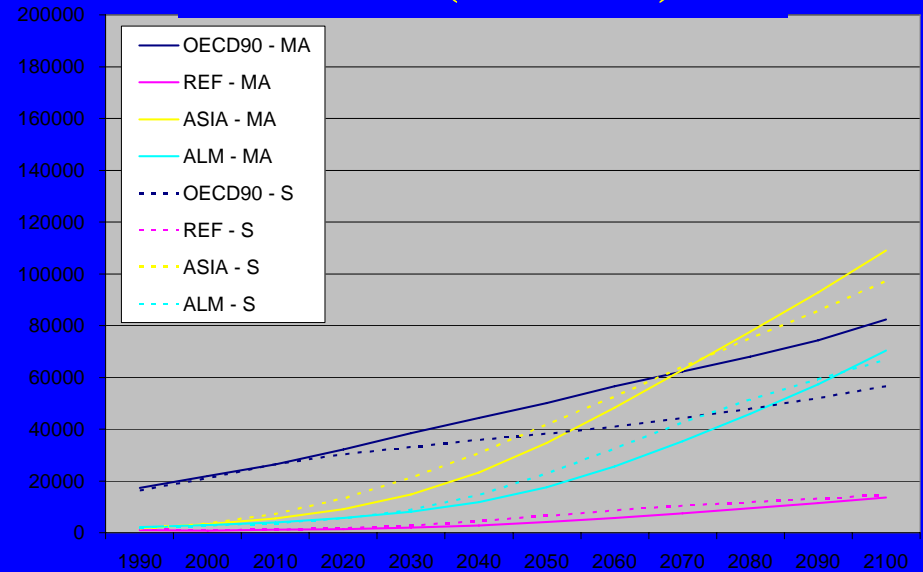


## GDP per capita

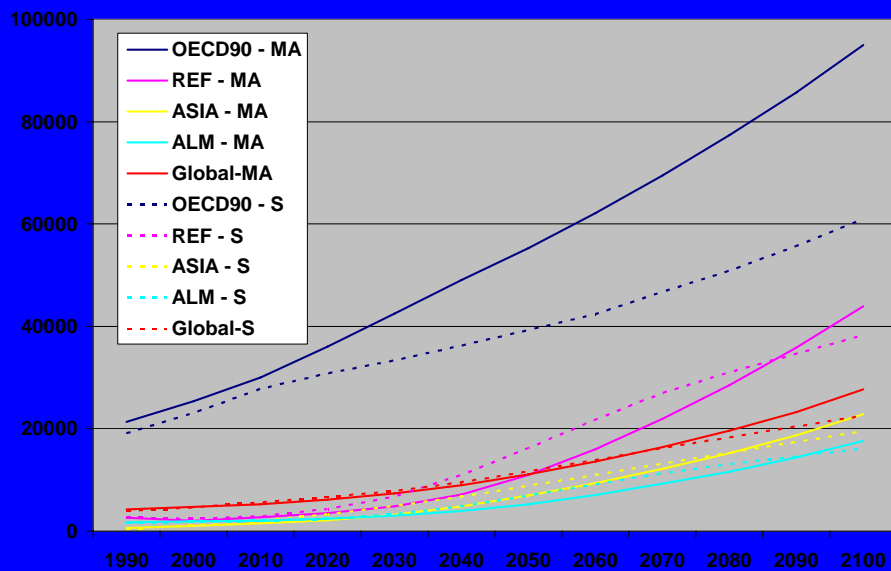


# Data overview – Regional

## GDP (billions)

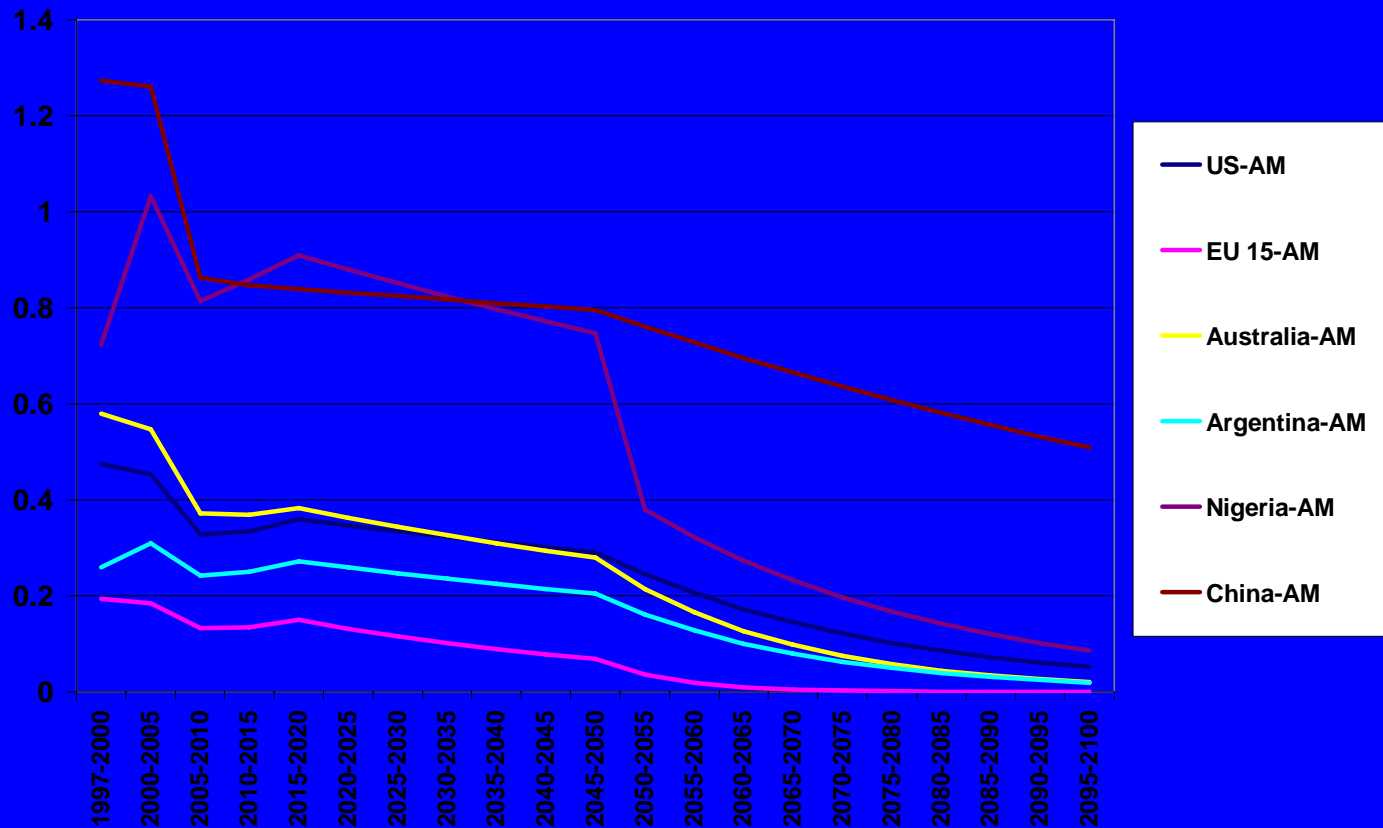


## GDP per capita



# Data overview – Ag. tech. change e.g., Beef annual yield growth (%kg/head)

Beef Annual Yield Growth (% kg/head)



**Next:**  
**The Experimenters**