# Alternative Paths Toward Stabilization Some Challenges for New Scenarios

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Workshop on GHG Stabilization Scenarios, Sponsored by NIES and EMF
Tsukuba, Japan on January 22-23, 2004

# Stabilization Scenarios "Stylized Facts"

- Path-dependence of stabilization vs baseline
- Baseline more important than stabilization
- Uncertainty – probabilistic or distributions
- Stabilization reduces emissions uncertainties
- Consequences of lower economic growth
- Ancillary and avoided adaptation benefits
- Spatially explicit drivers, mitigation & impacts

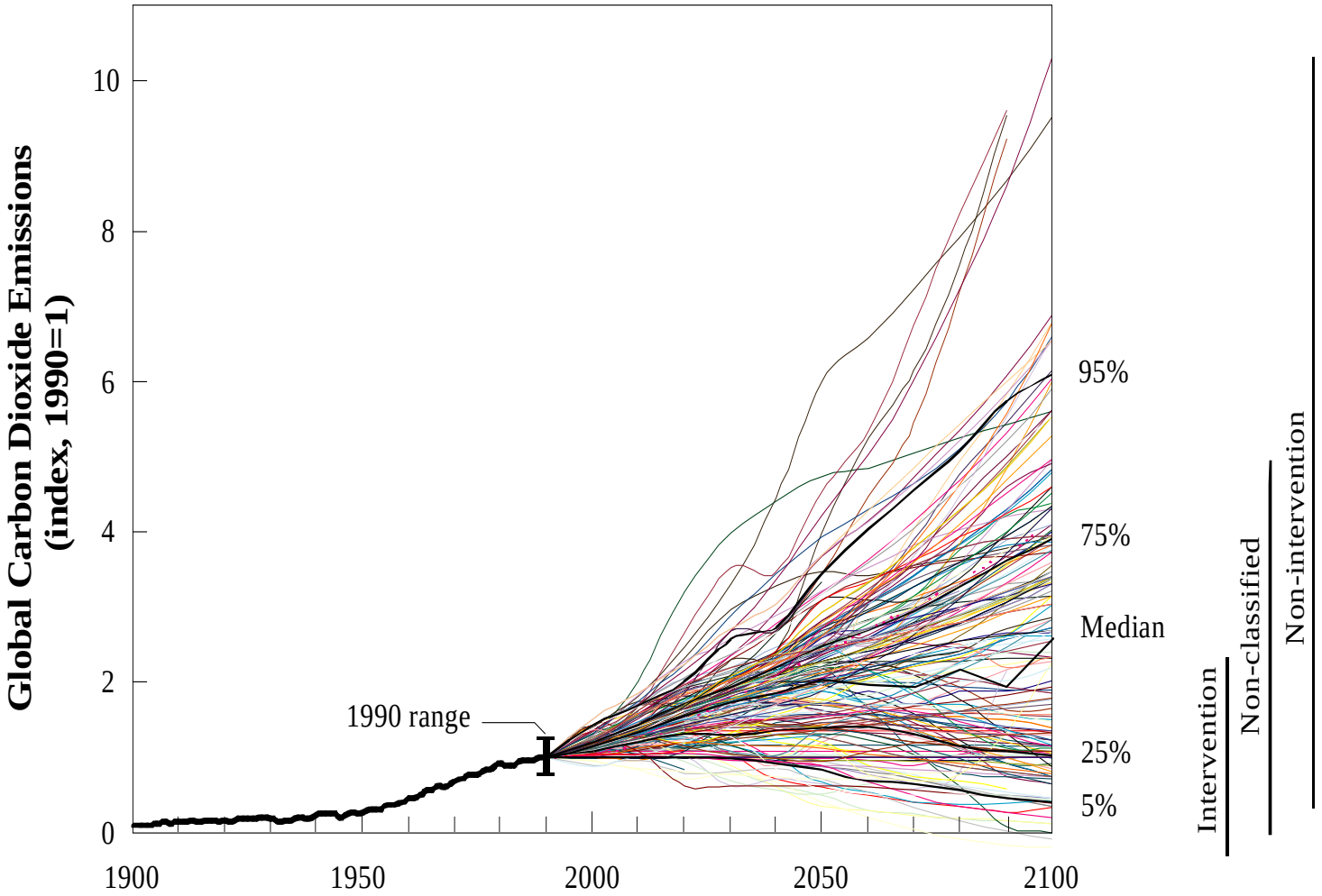

5th Session
WORKING GRO
Intergovernment Panel on climate change
Kathmandu, 8-15 March, 2000
TSU WG I


MADEIRA

Our dear friend and colleague is gone, leaving a void in our community and in our lives that can never be filled...

He will live forever in our hearts, in our thoughts and in our scientific work – and we'll continue to miss him every day!

# Carbon Dioxide Emissions

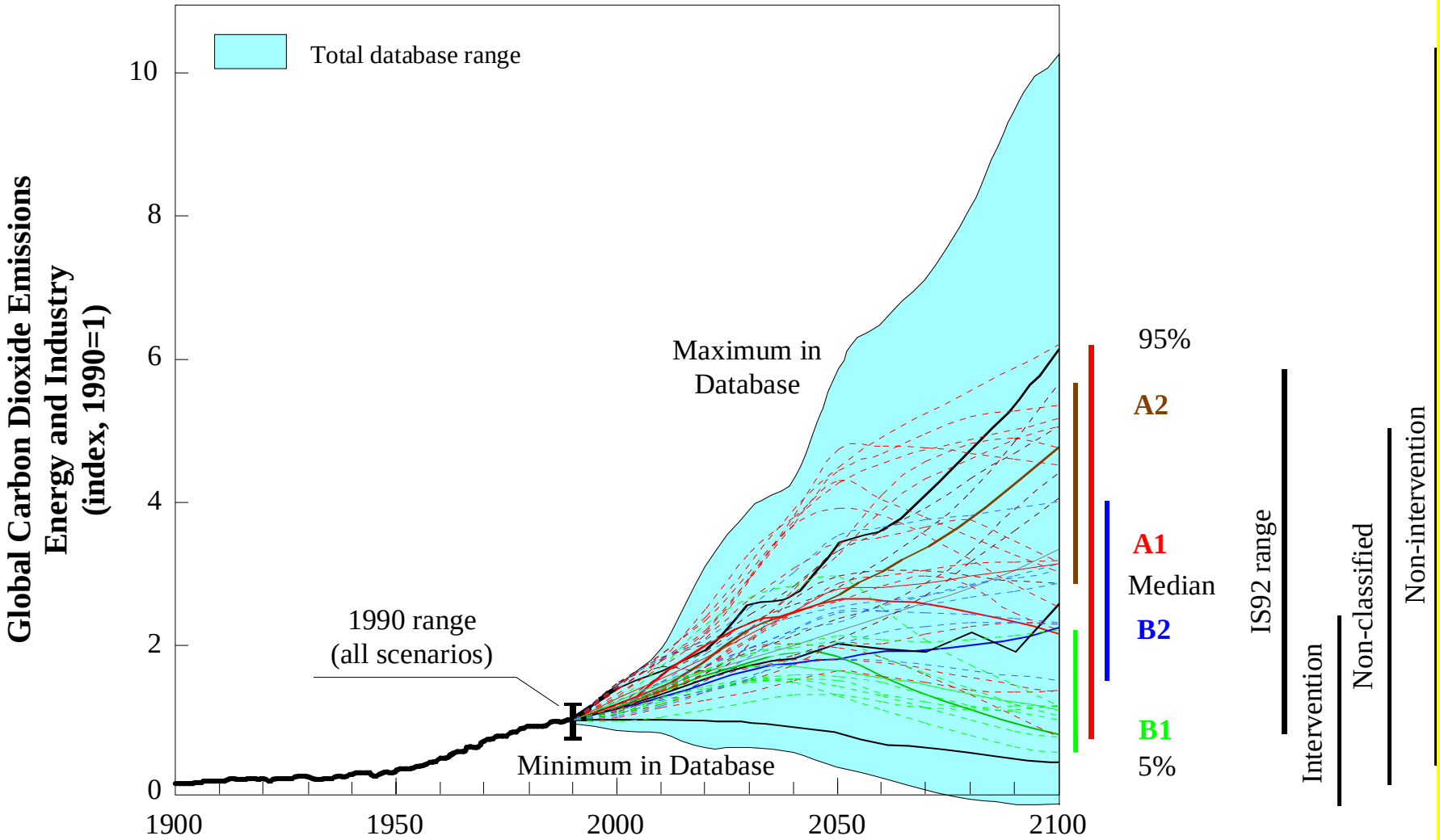



Nakicenovic

IPCC 2001

# Global Carbon Dioxide Emissions

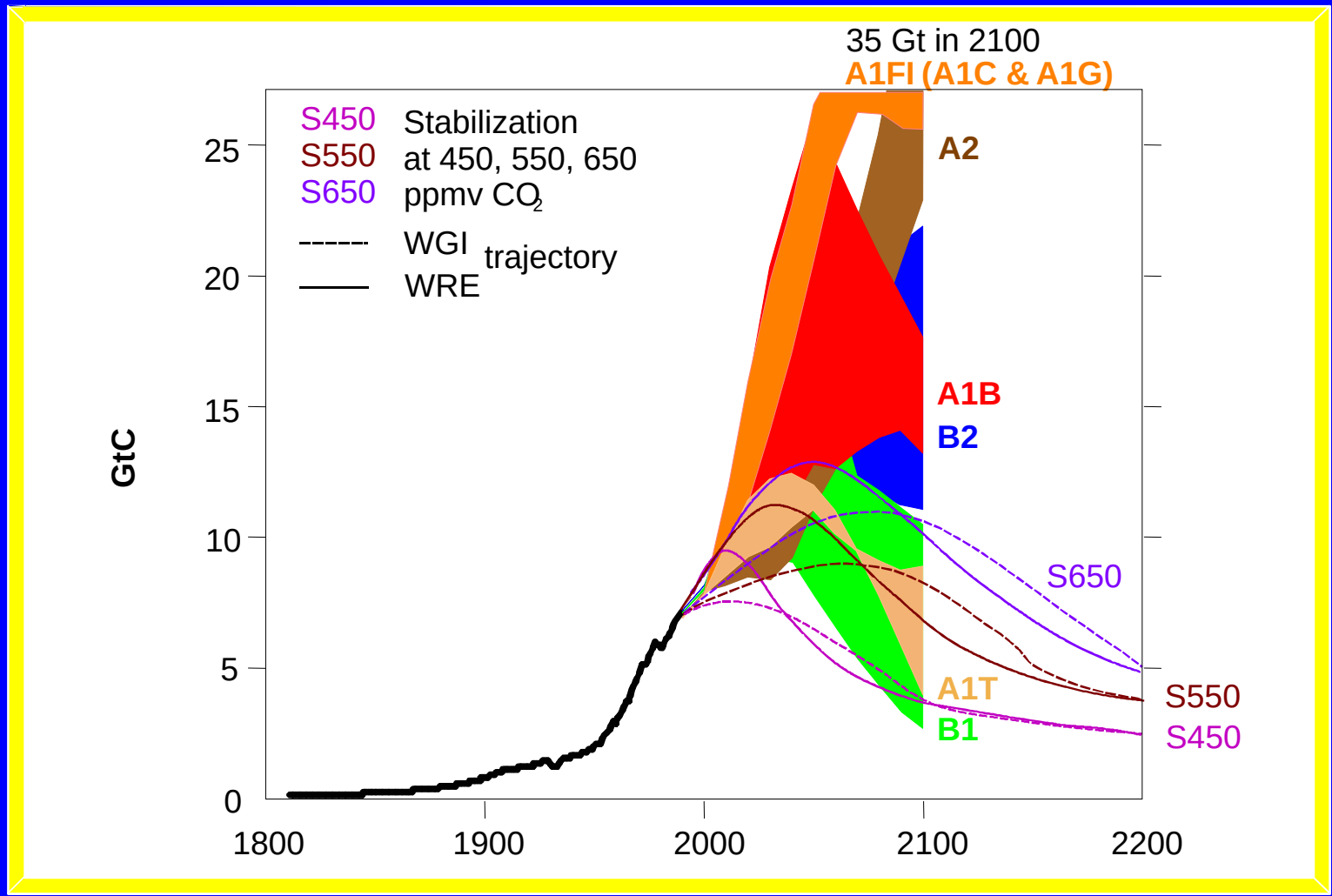
## 40 SRES Scenarios and Literature Range




Nakicenovic *et al.*

SRES 2000

# Carbon Emissions: Scenarios and Stabilization Profiles




Nakicenovic et al.

SRES 2000

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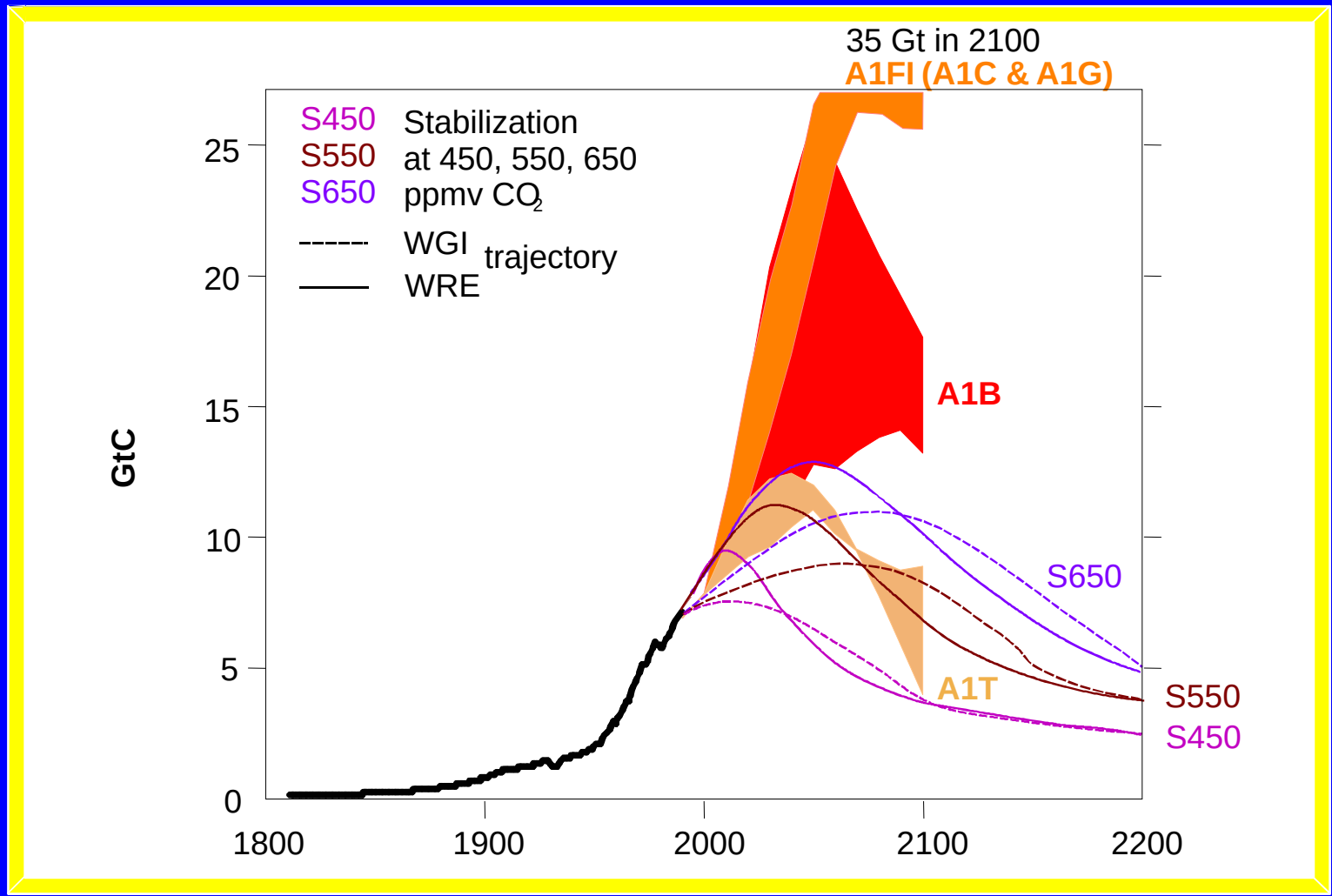


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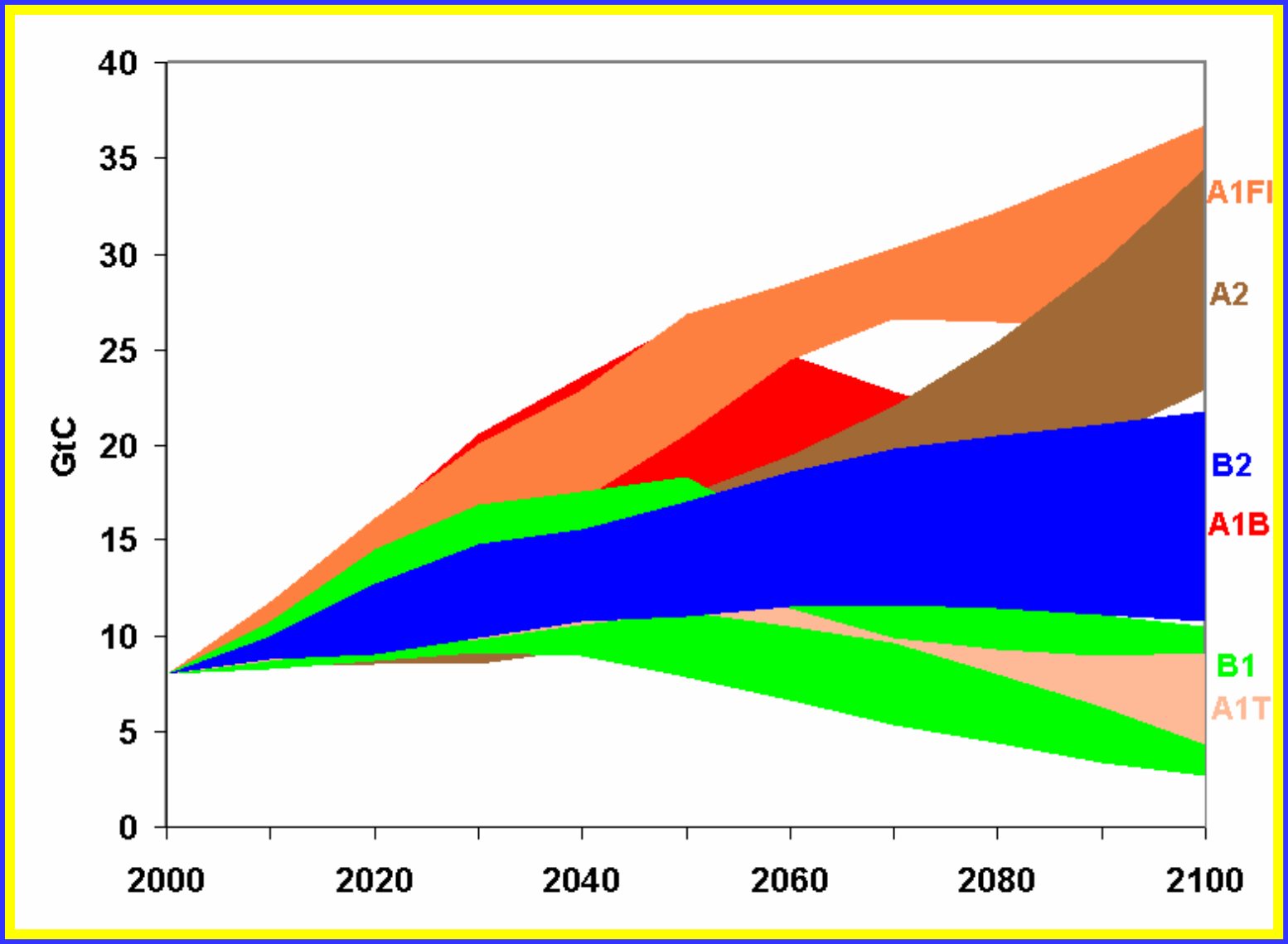


Nakicenovic et. al

IPCC 2001

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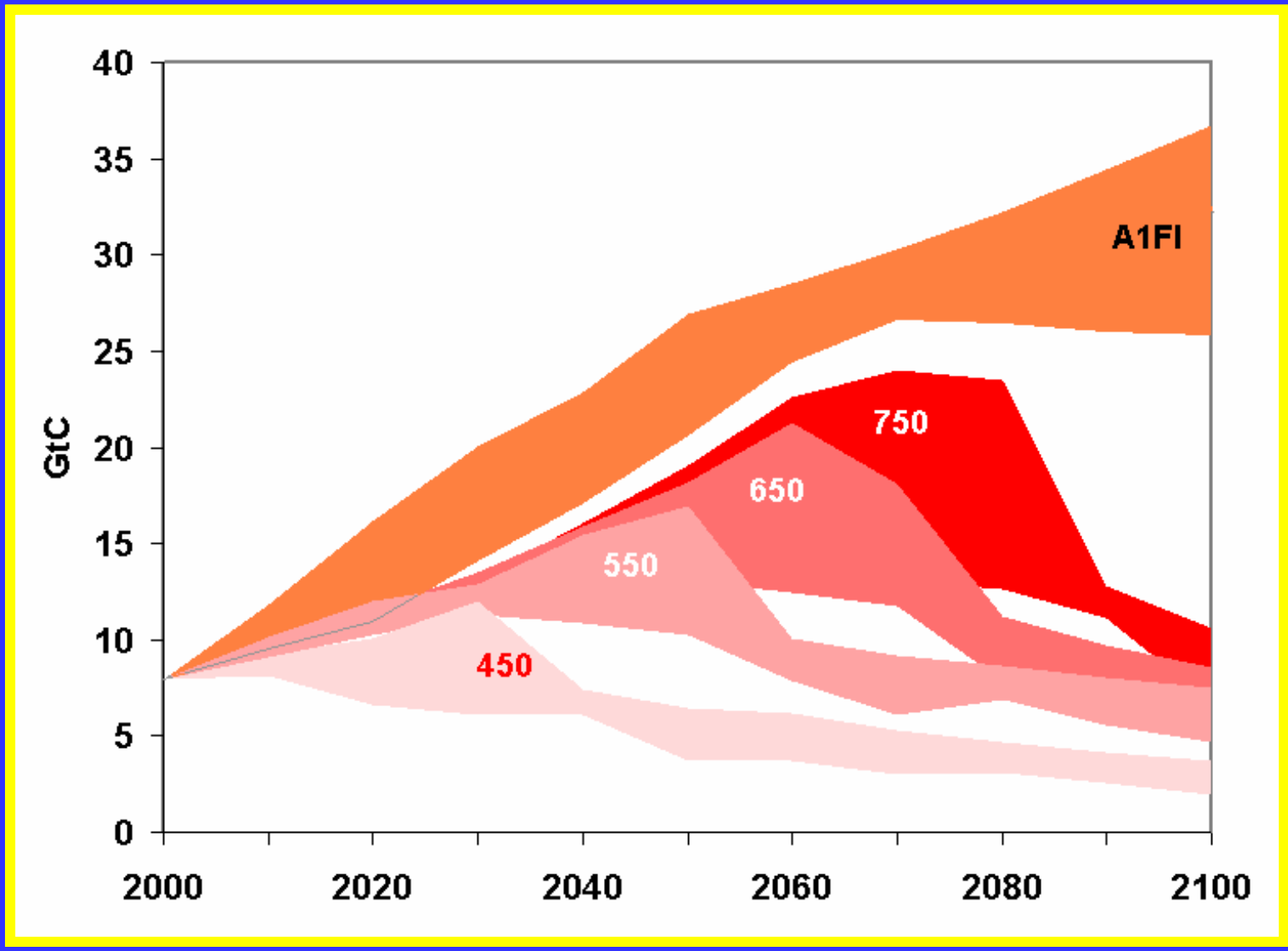


Nakicenovic et. al

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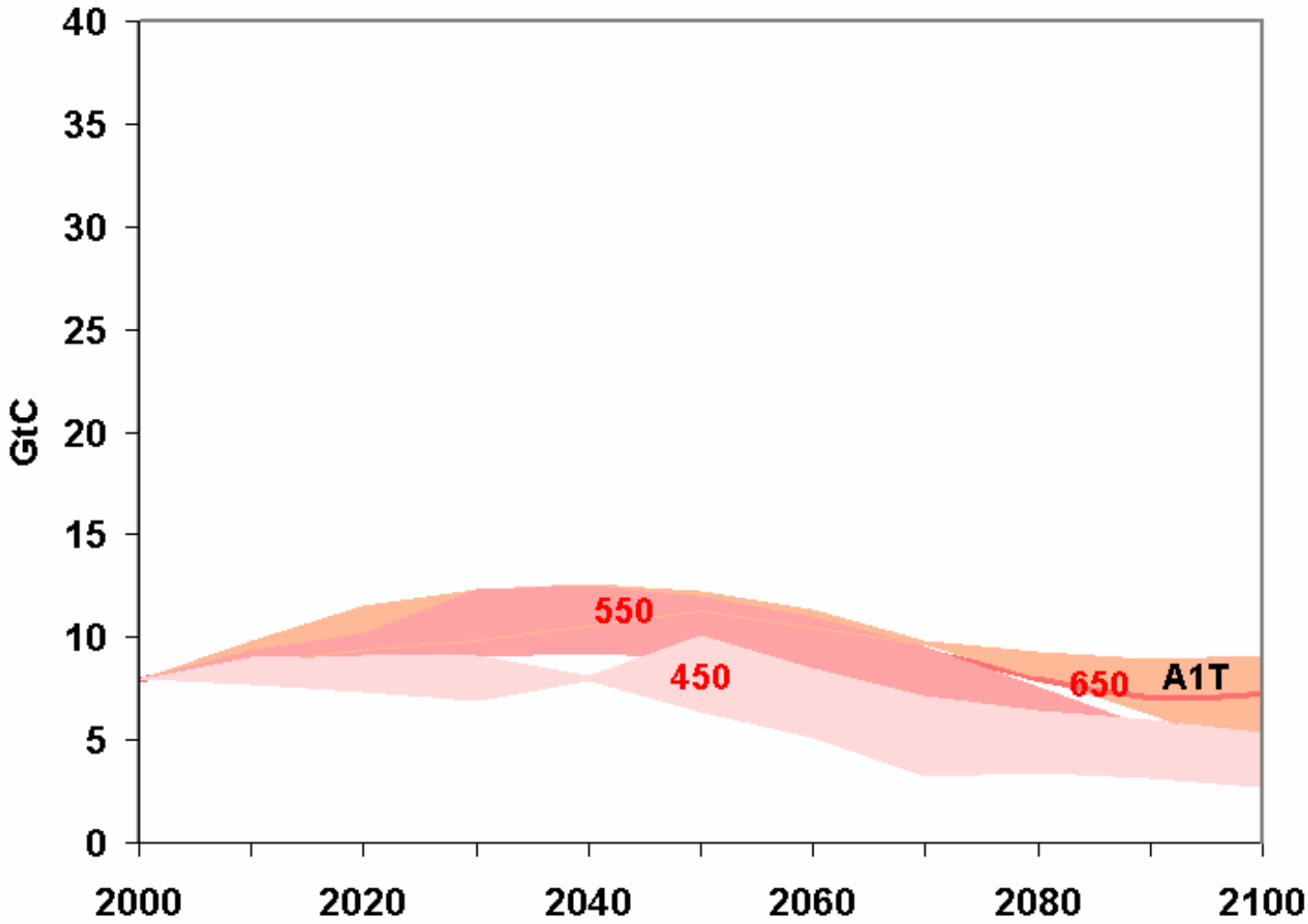


Nakicenovic et. al

IPCC 2001

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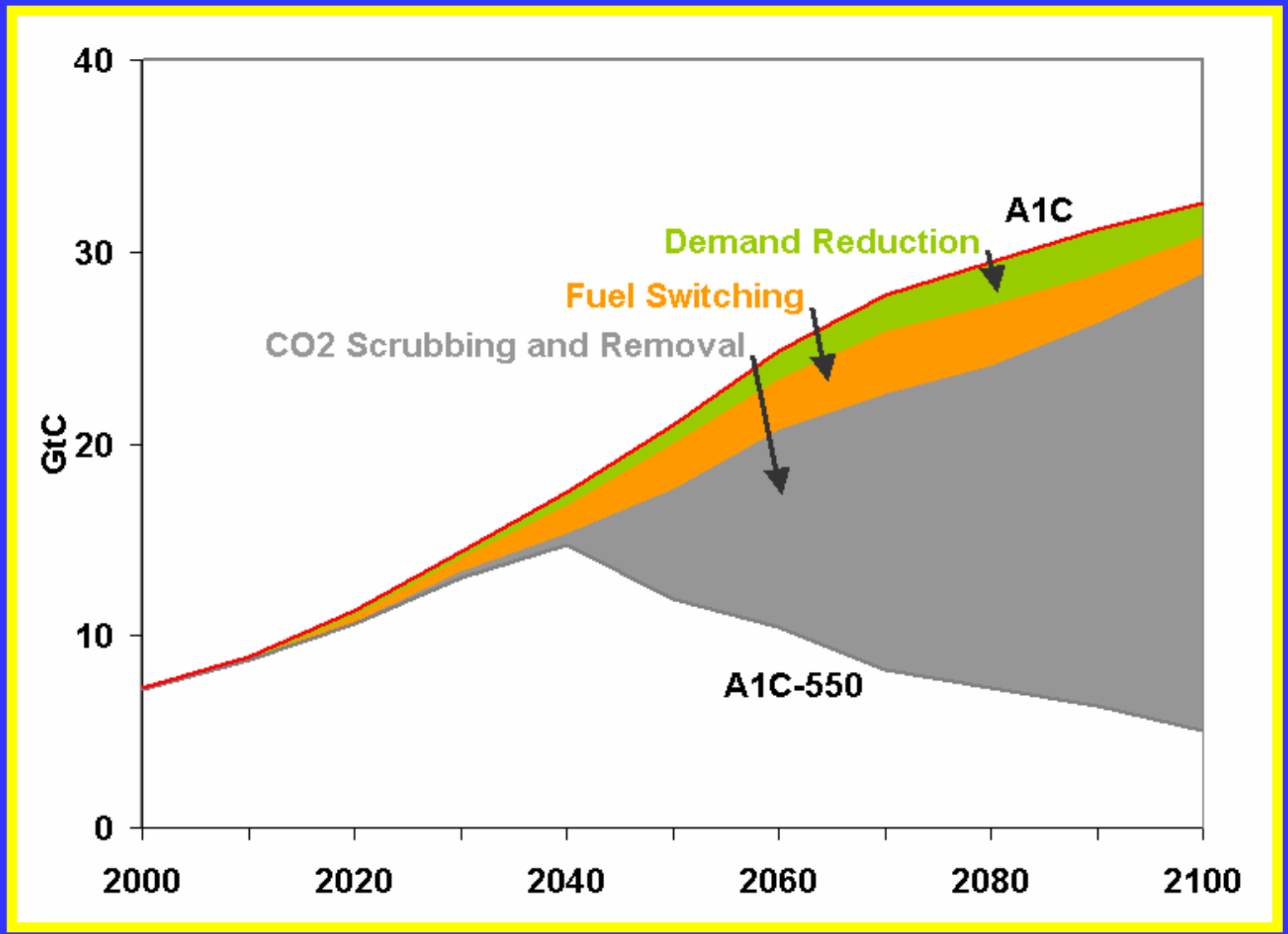


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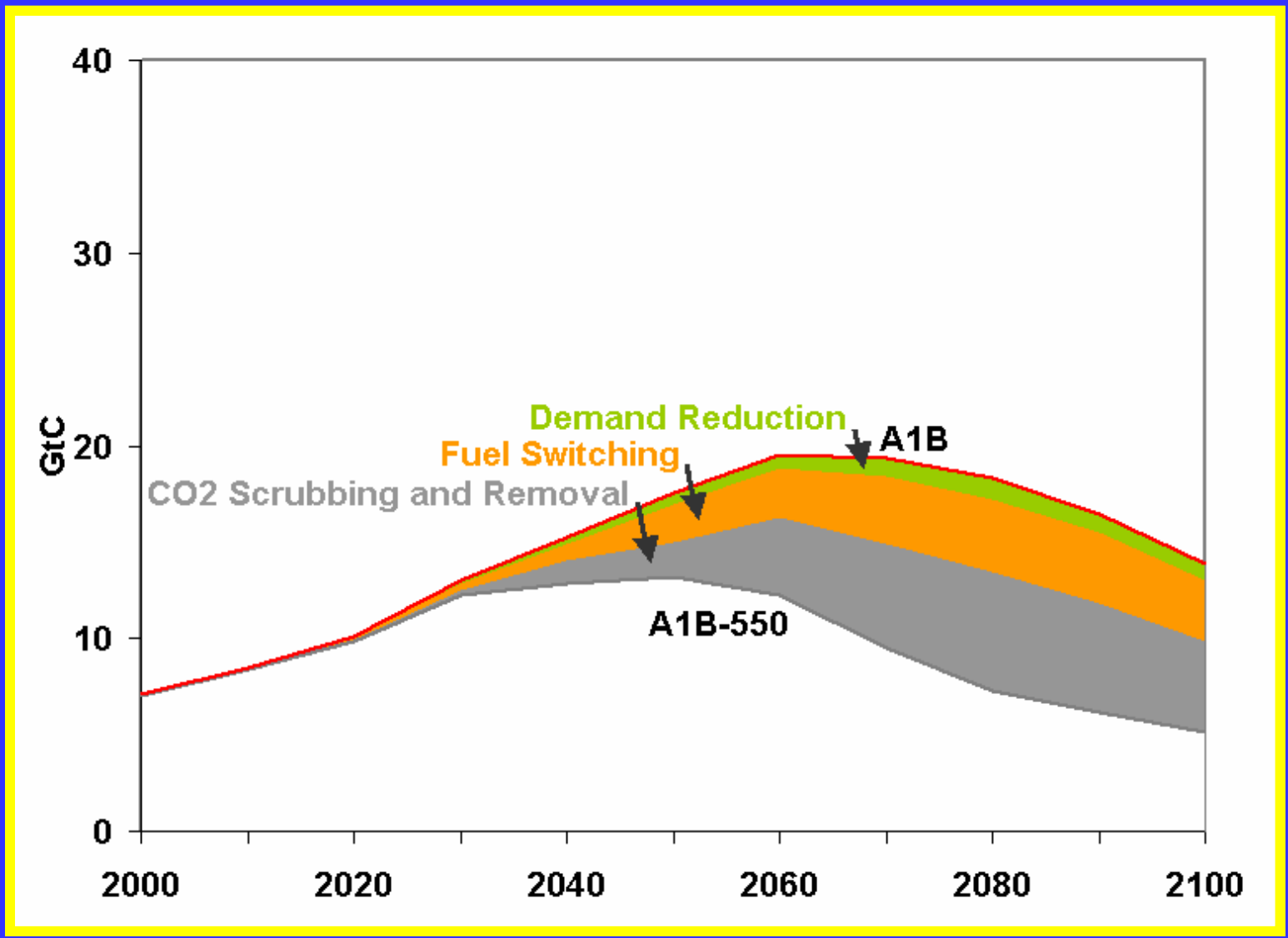
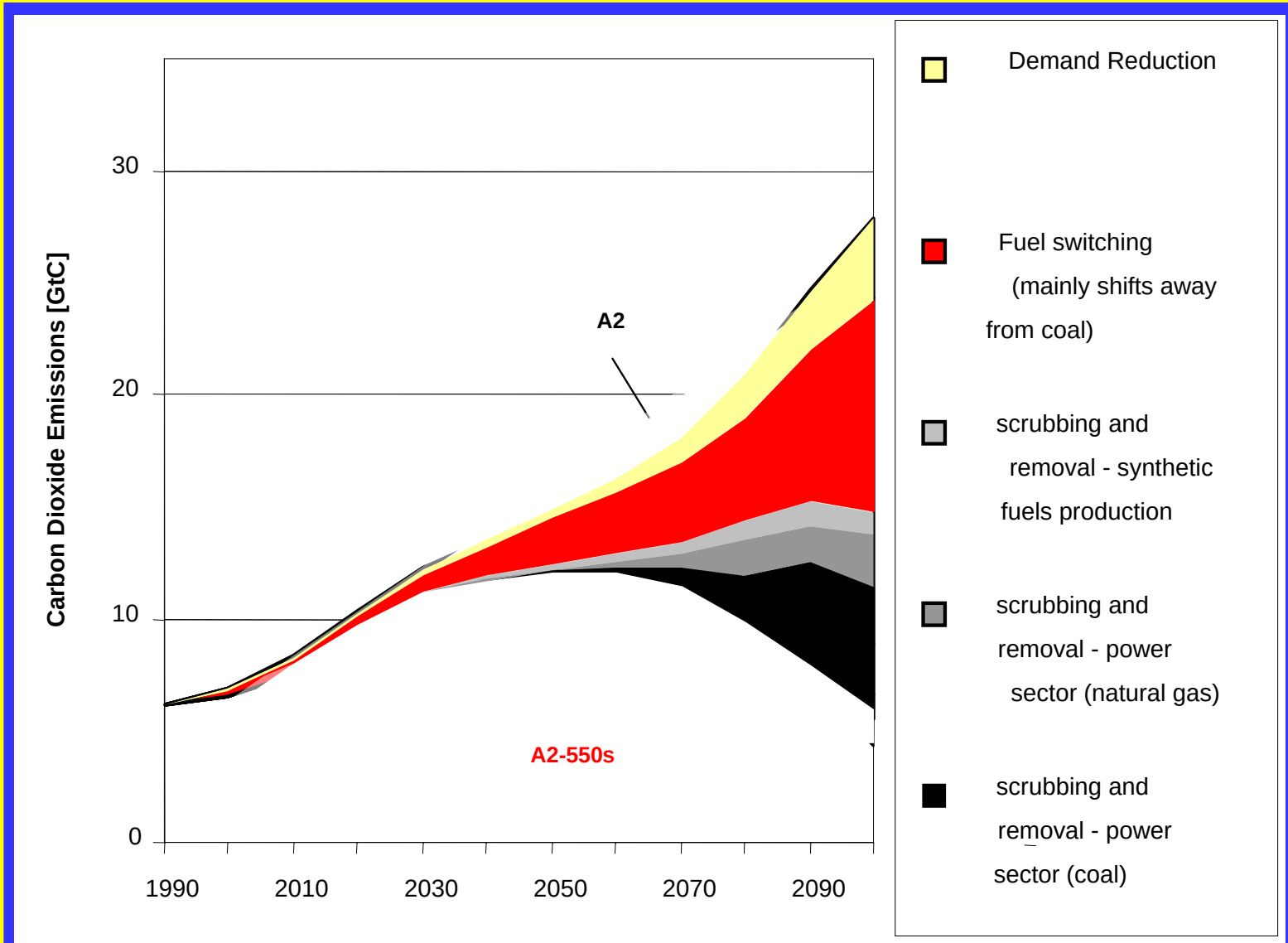


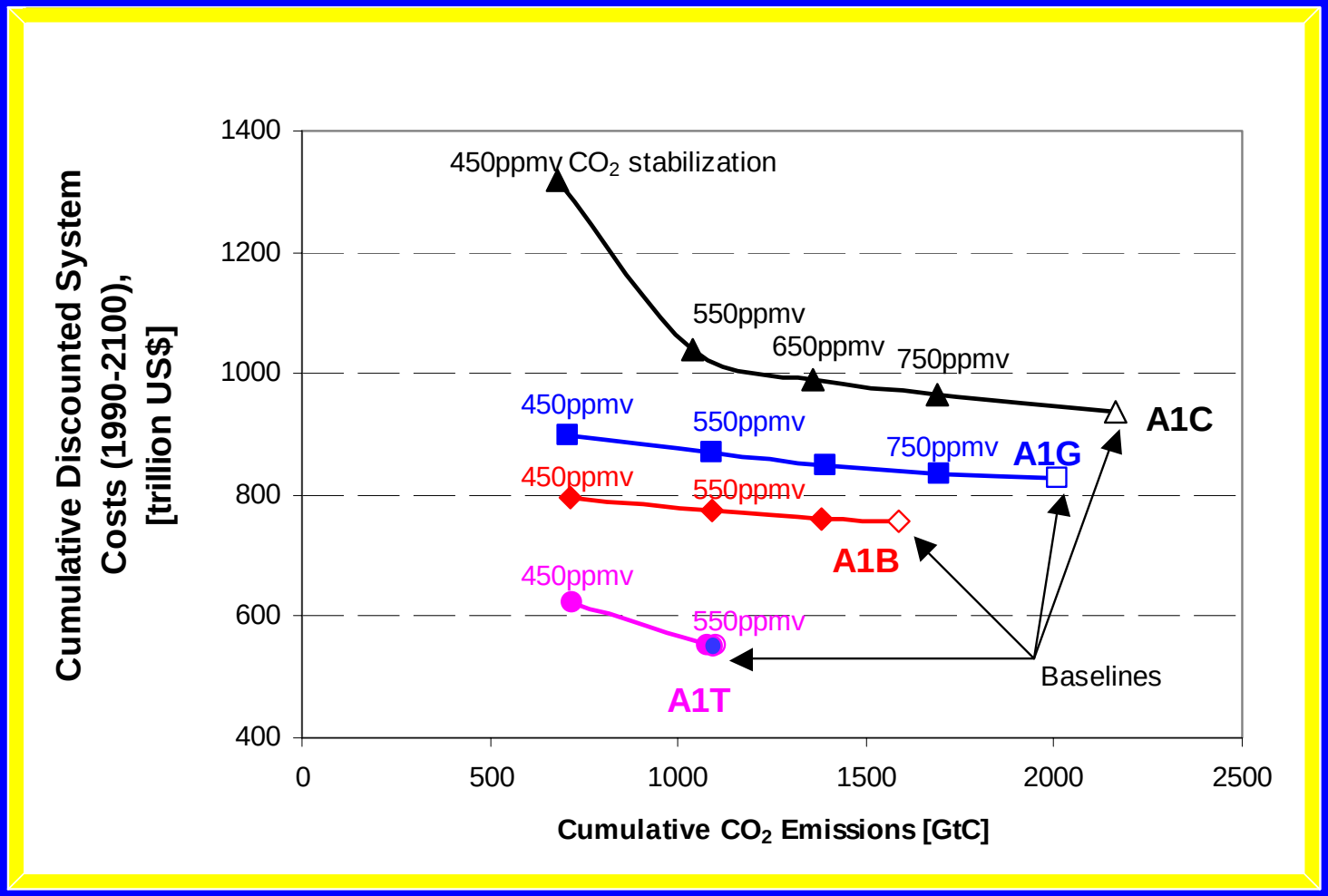
# Emissions Mitigation Technologies




Nakicenovic

Source: K. Riahi

# ENERGY SYSTEMS COSTS OF ALTERNATIVE BASELINES AND STABILIZATION SCENARIOS



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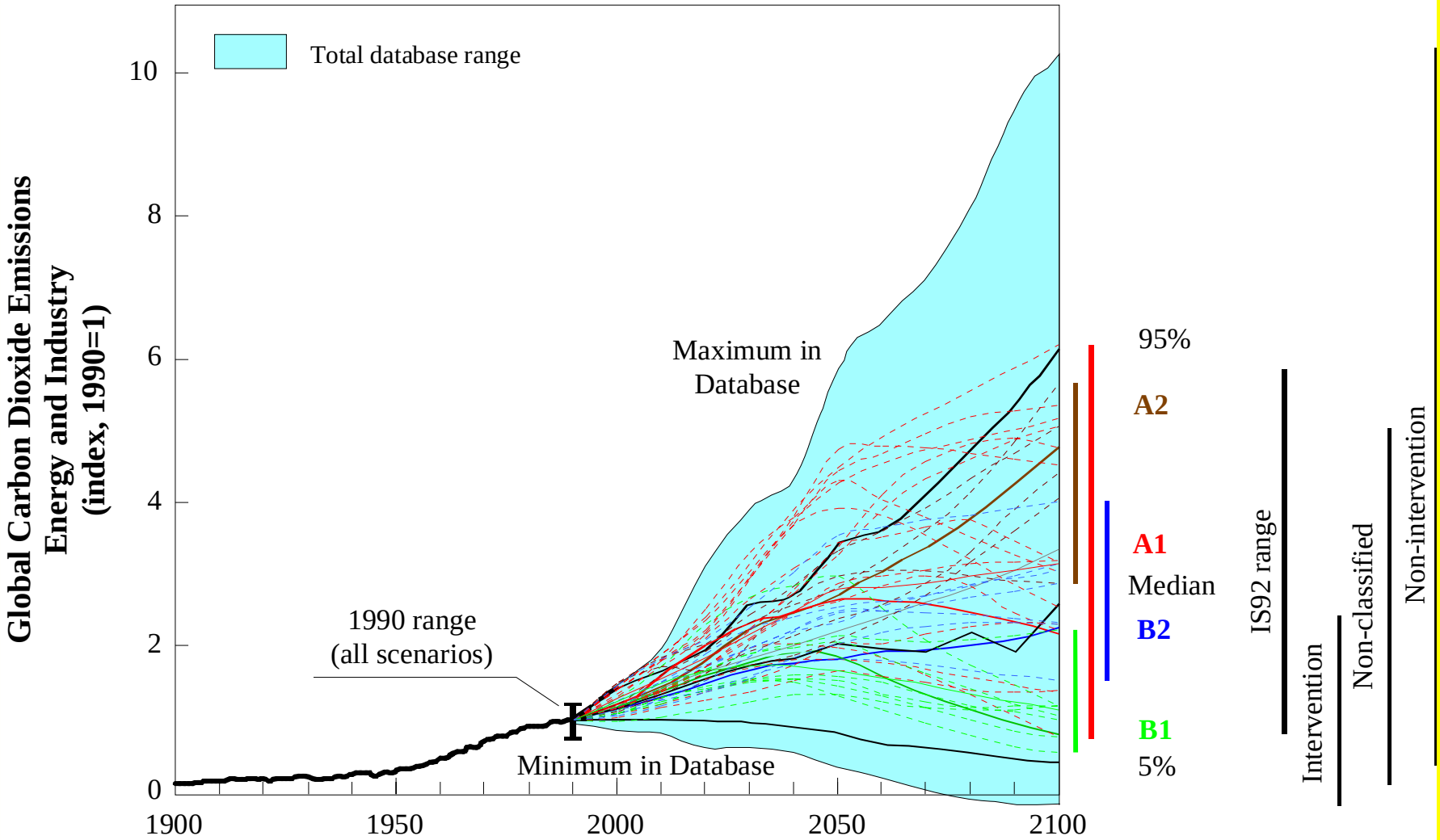
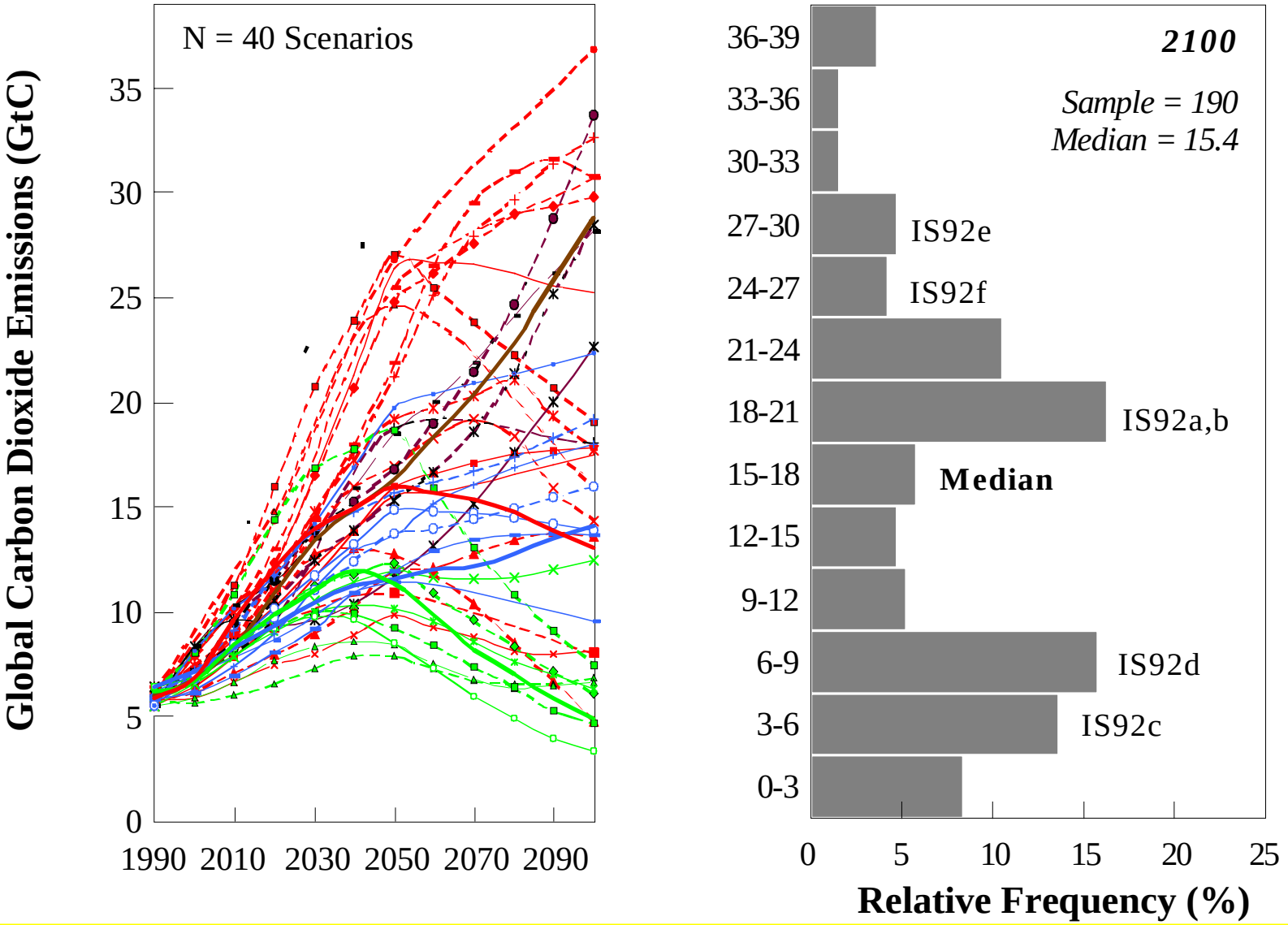



Nakicenovic *et al.*

SRES 2000

# Energy-Related Carbon Dioxide Emissions

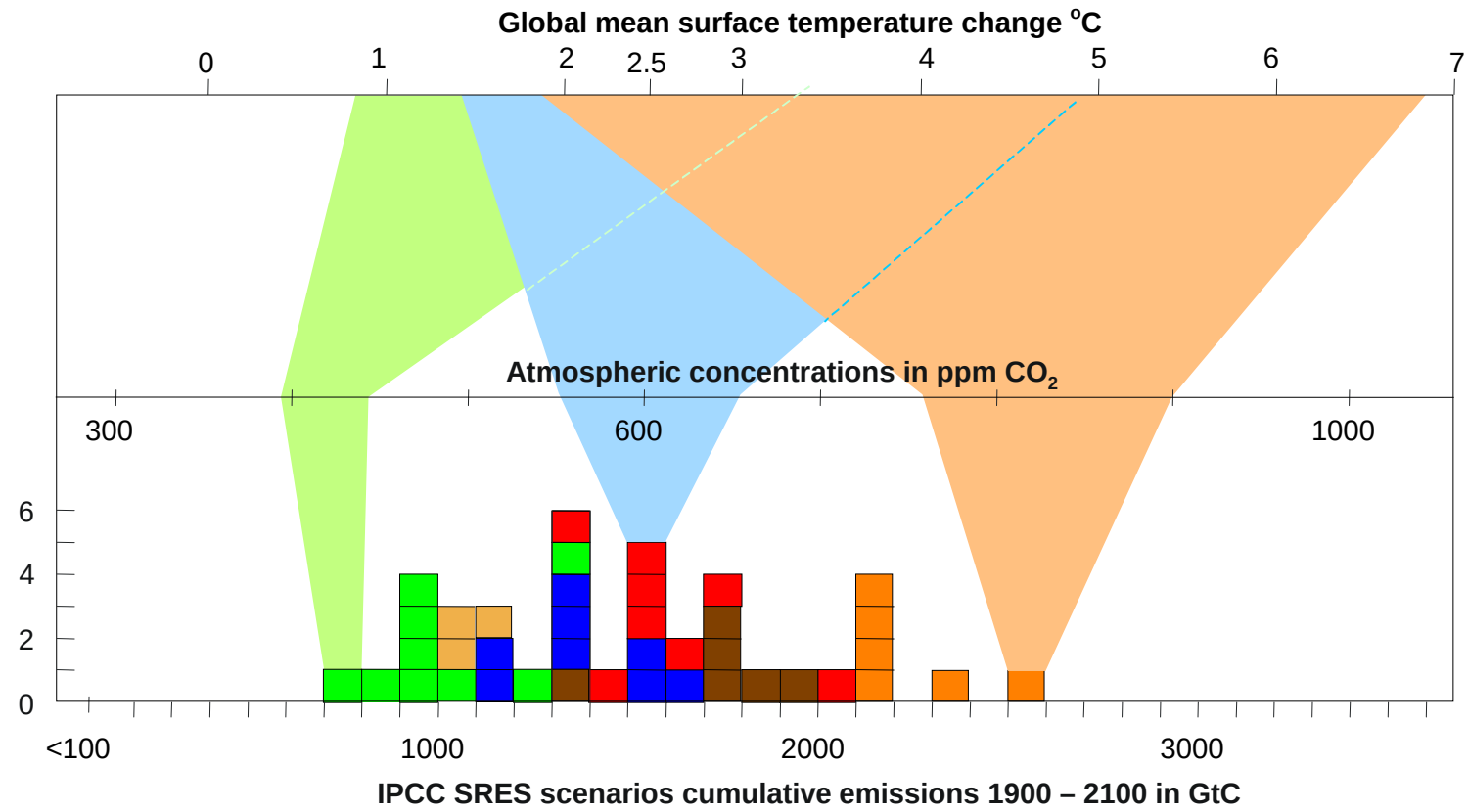



Nakicenovic *et al.*

SRES 2000

# MAJOR CLIMATE CHANGE UNCERTAINTIES

Cumulative $CO_2$ of IPCC SRES scenarios and resulting $CO_2$ concentrations and climate sensitivity in $^oC$ temperature change based on MAGICC model

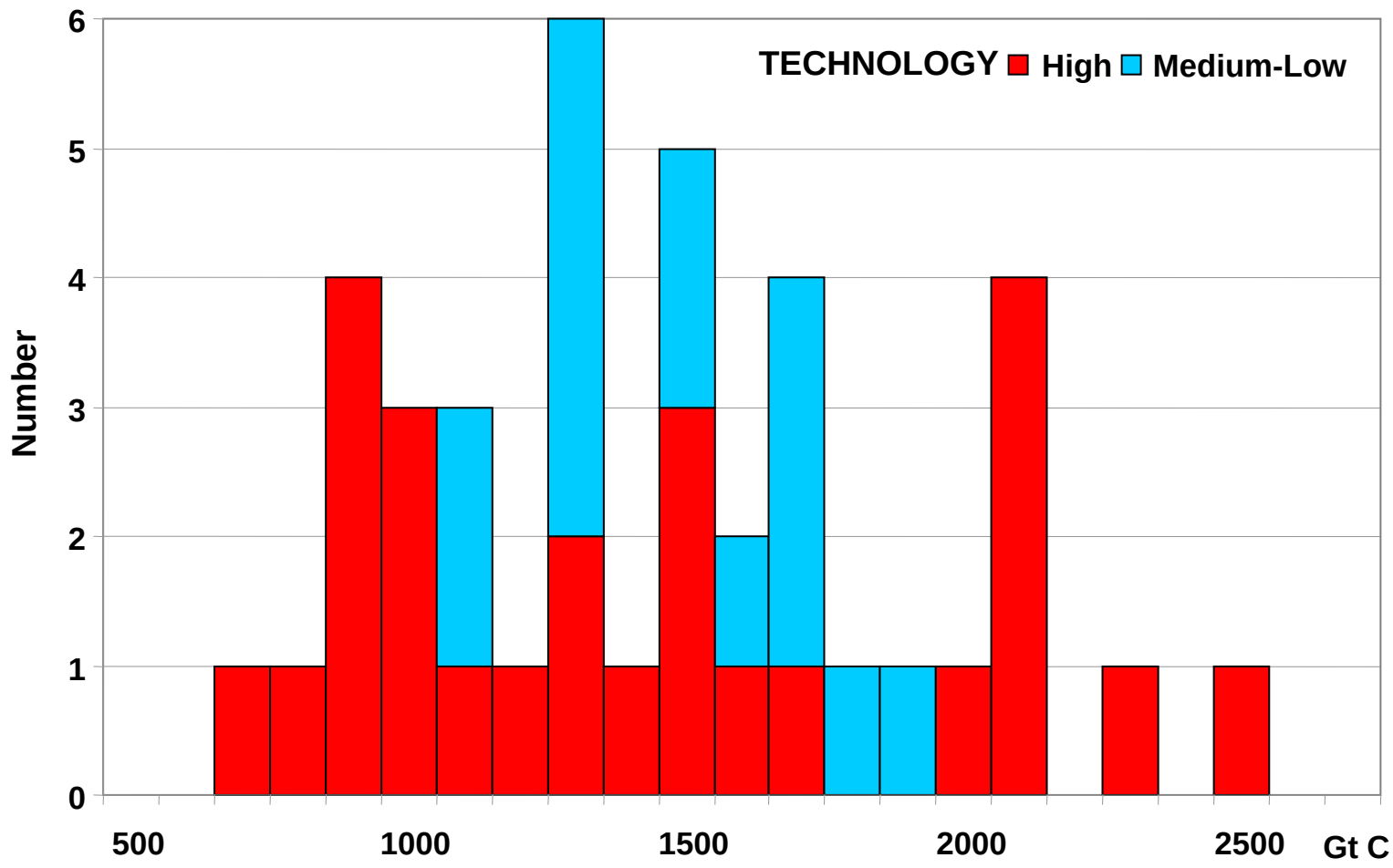



Grübler

IIASA 2002

# Distribution of Cumulative Carbon Emissions

## Across the Range of SRES Scenarios

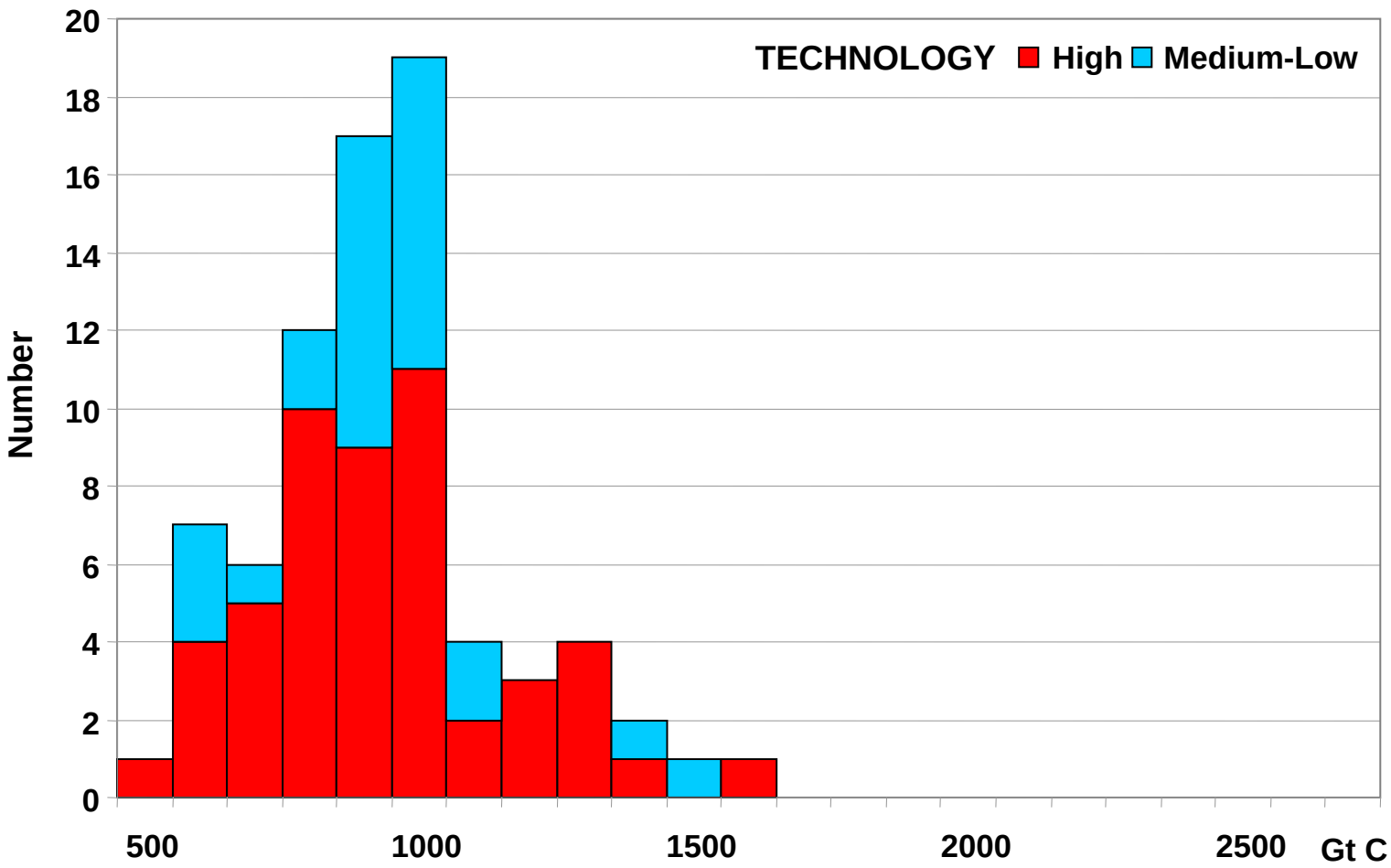



Nakicenovic & Slentoe

IIASA 2003

# Distribution of Cumulative Carbon Emissions

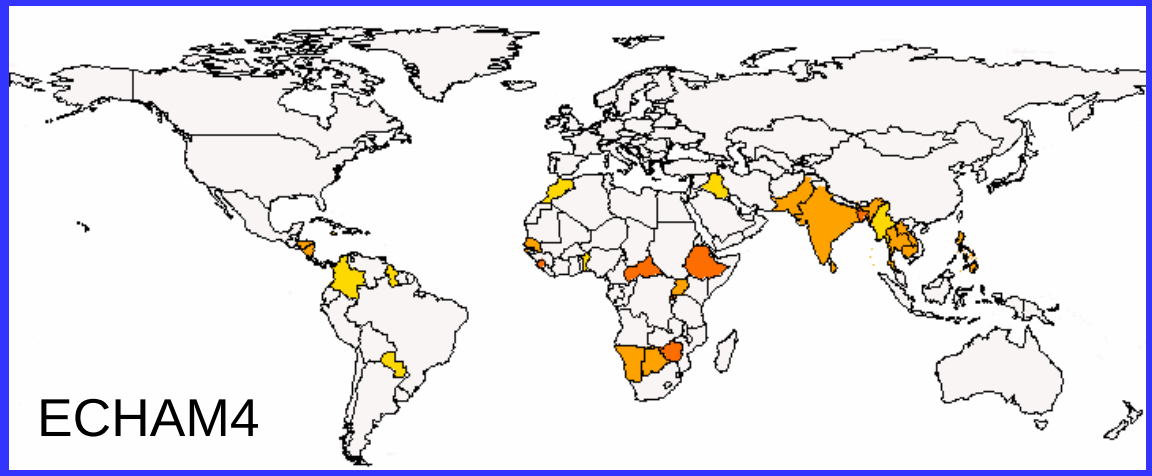
## Across the Range of Post – SRES Scenarios

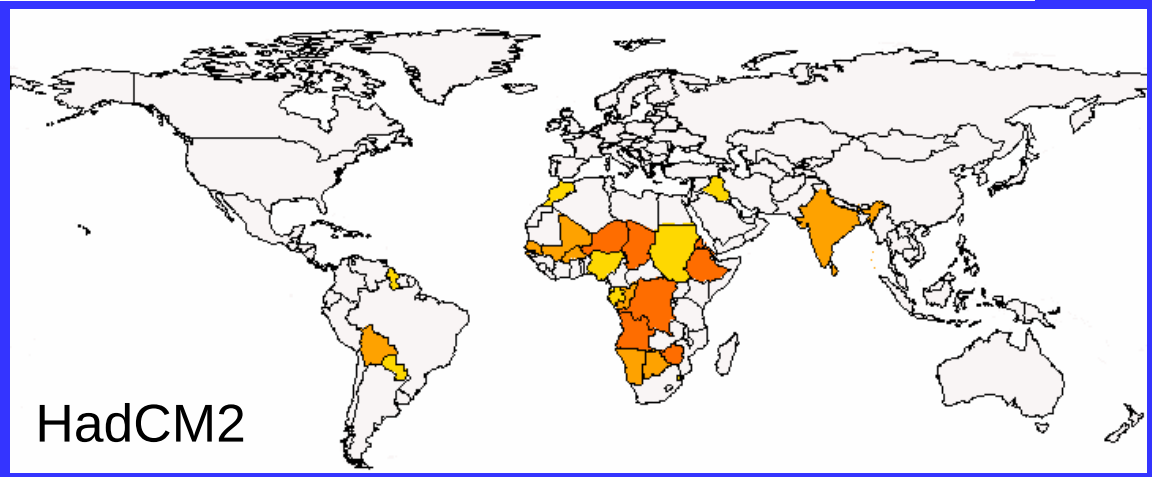


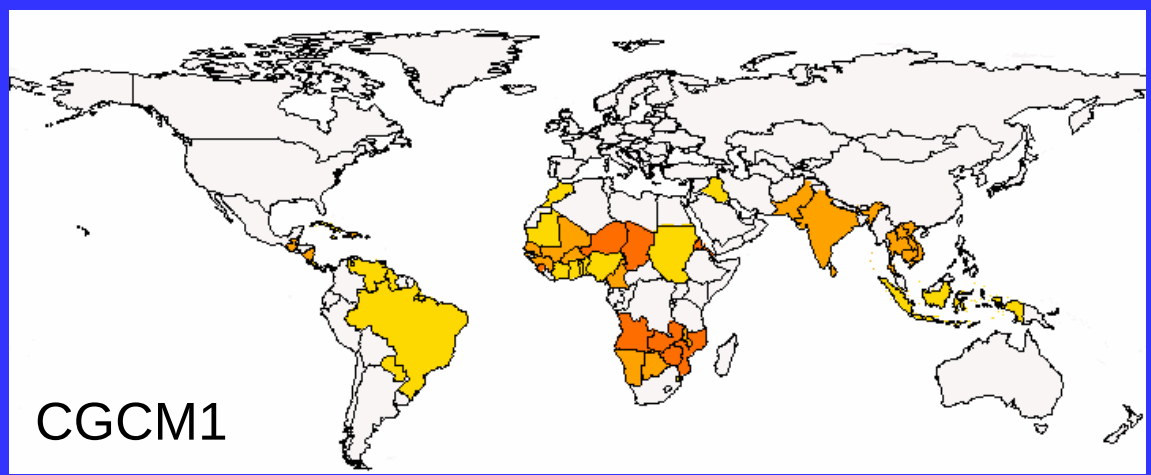

Nakicenovic & Slentoe

IIASA 2003

# Climate Change Impacts on Cereal Production Potential of Food Insecure Countries 2080s




- Undefined
- Group 1 losers
- Group 2 losers
- Group 3 losers
- No impact
- Group 1 winners
- Group 2 winners
- Group 3 winners
- Not assessed

Fischer *et al.*, IIASA, 2001

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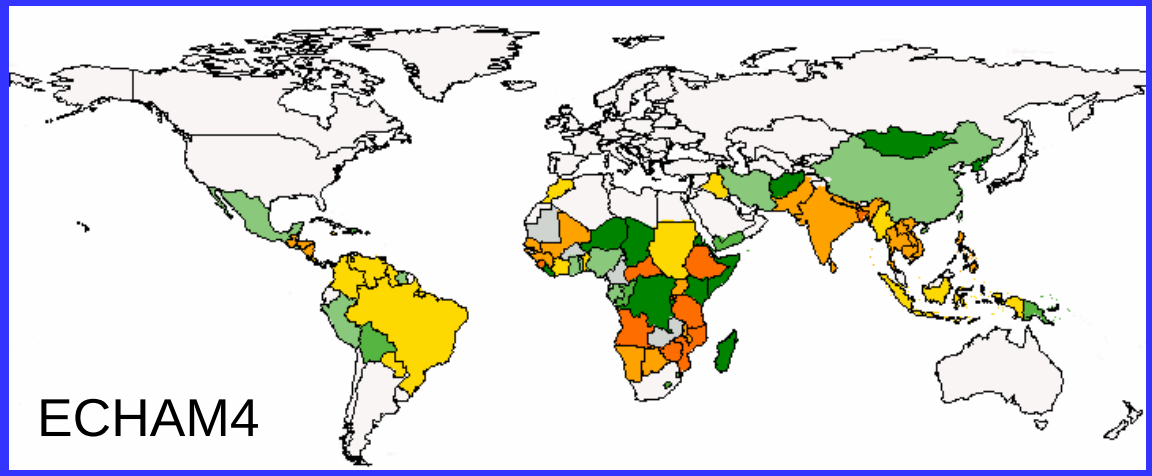


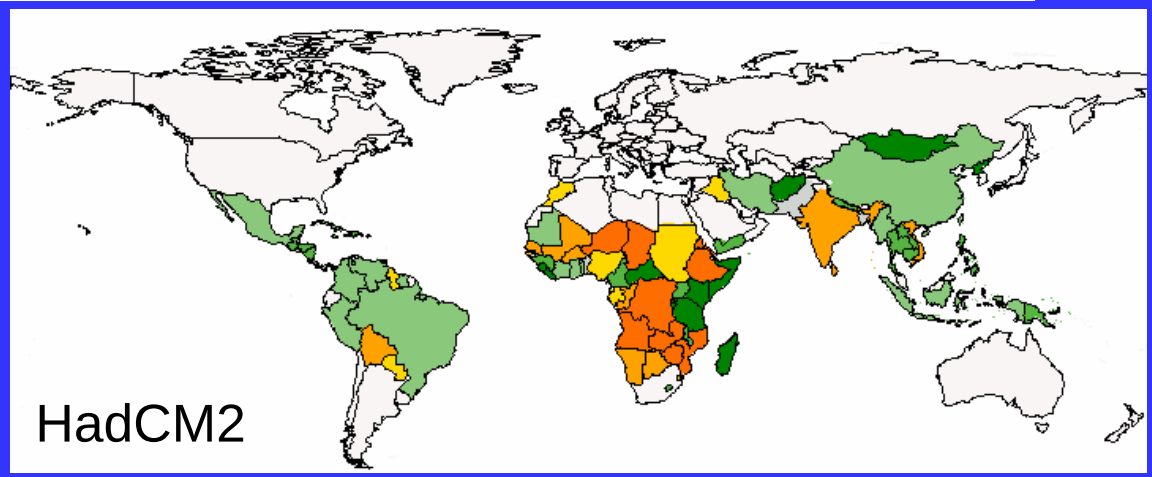


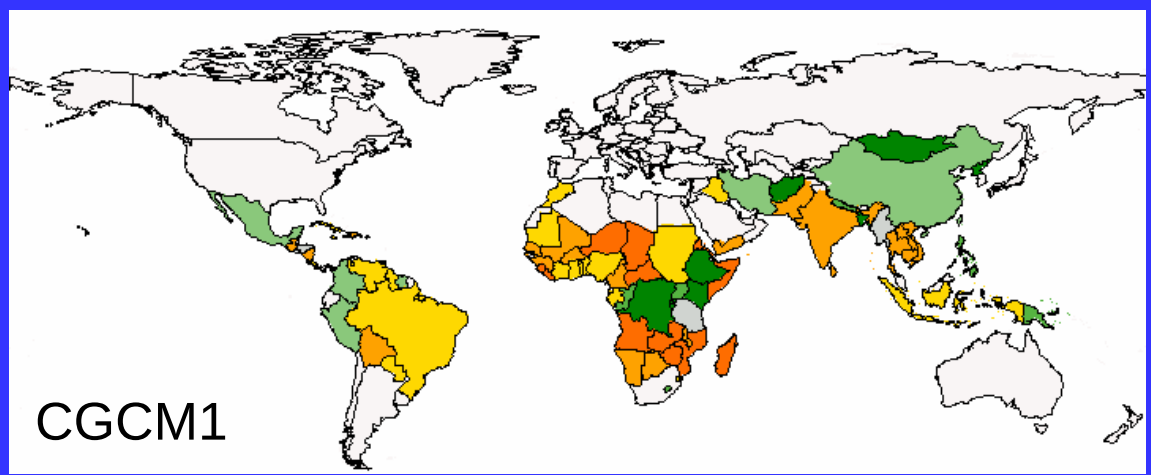


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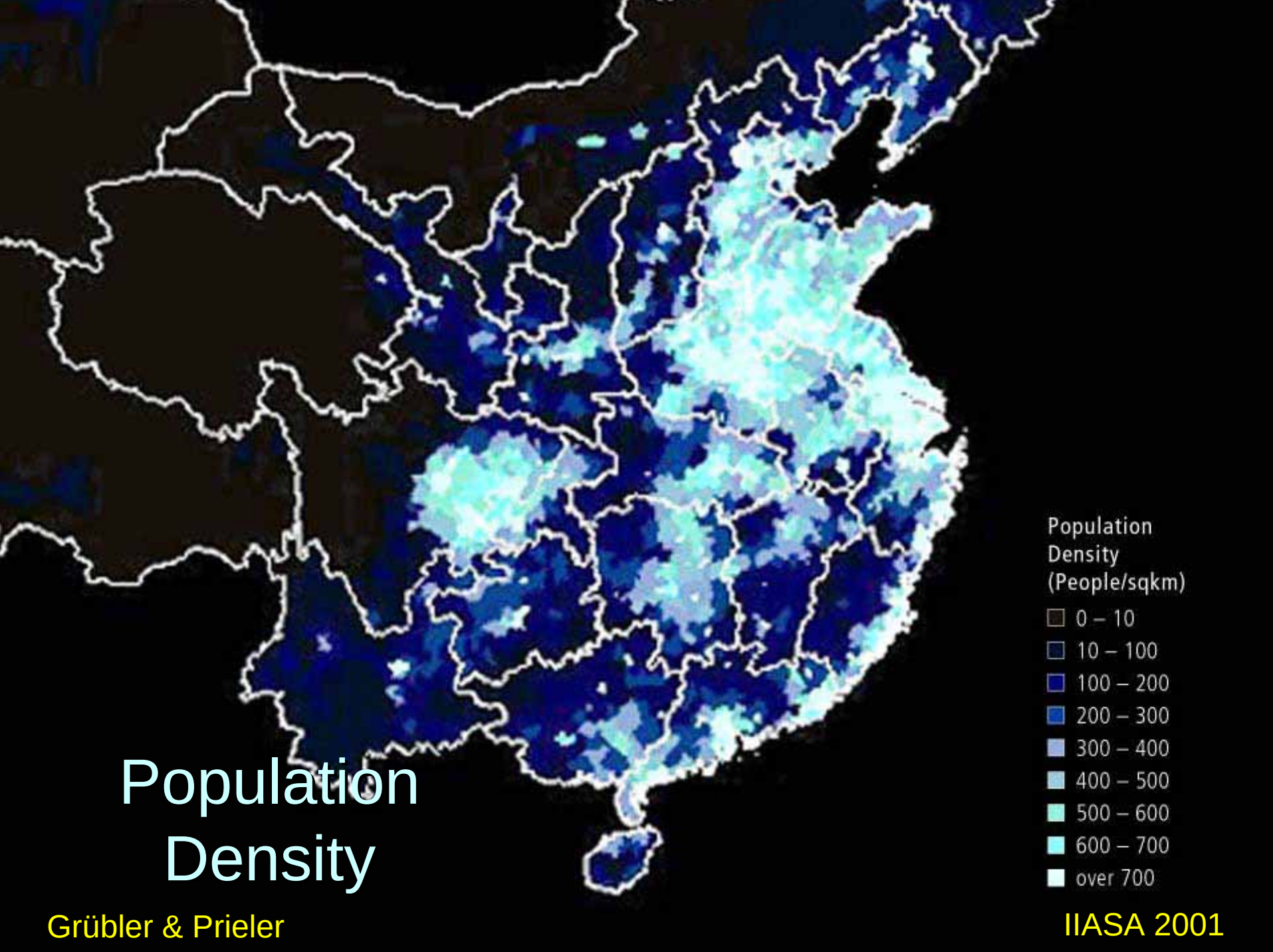
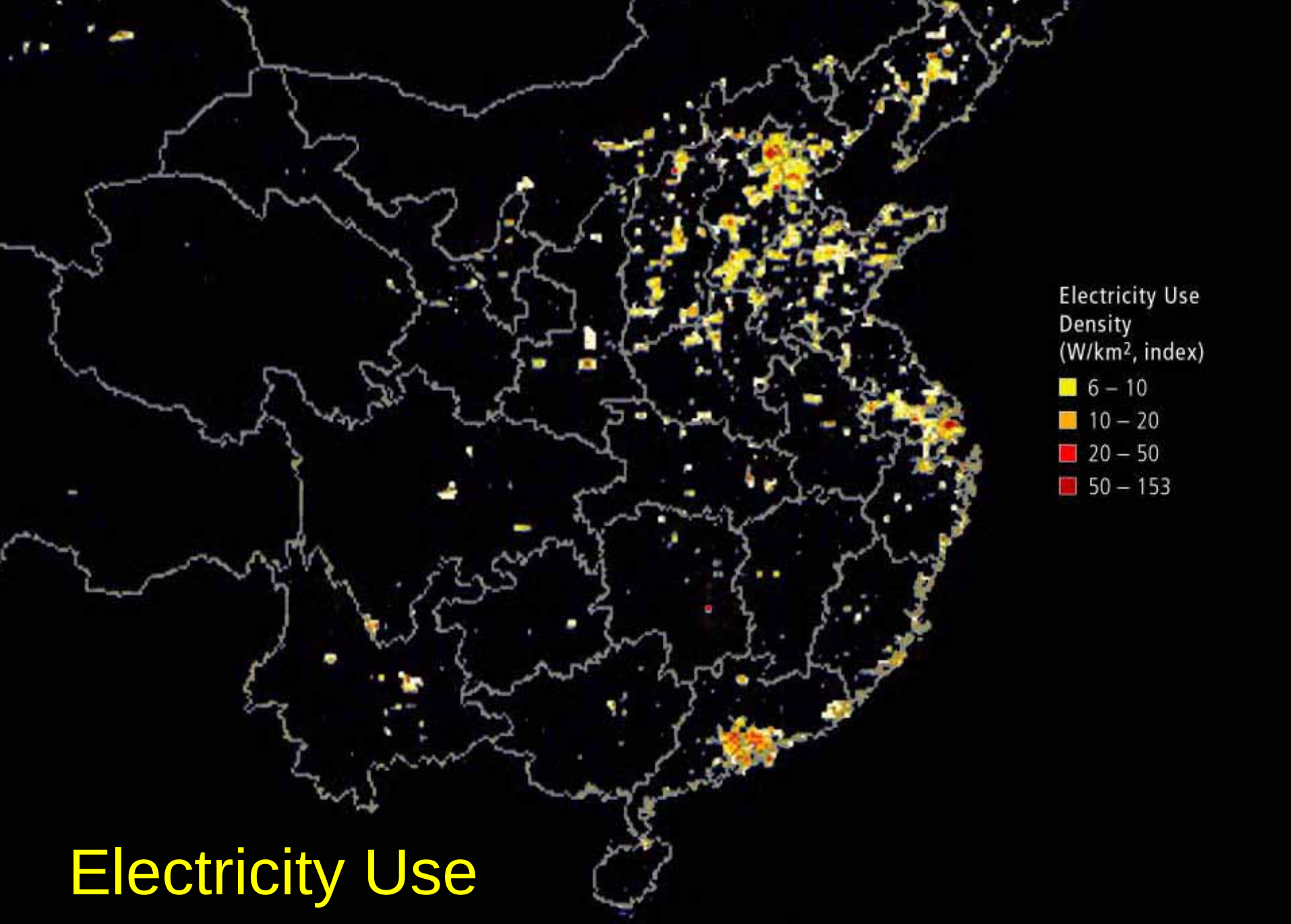



# Population Density

Grübler & Prieler

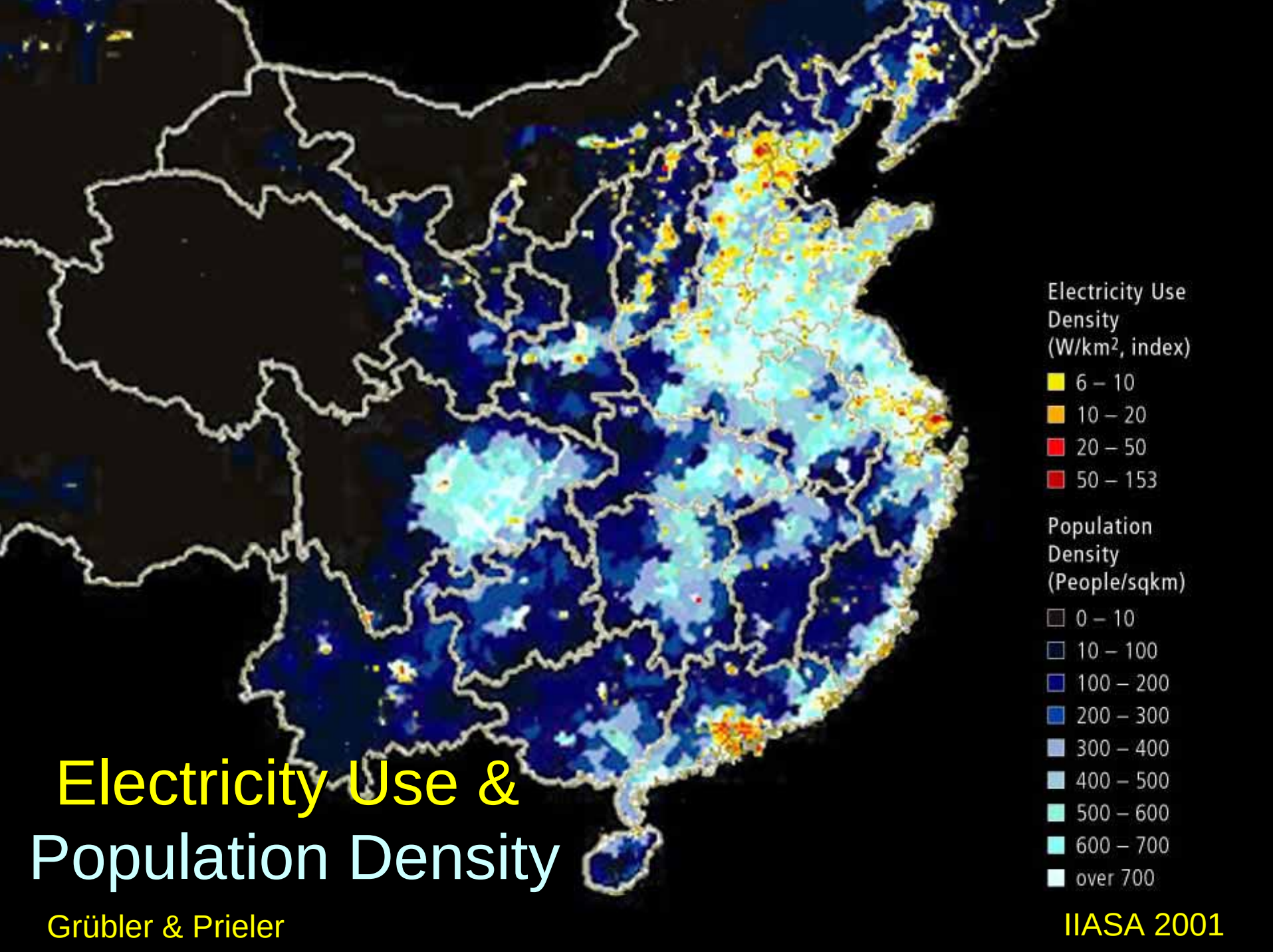
IIASA 2001




# Electricity Use

Grübler & Prieler

IIASA 2001



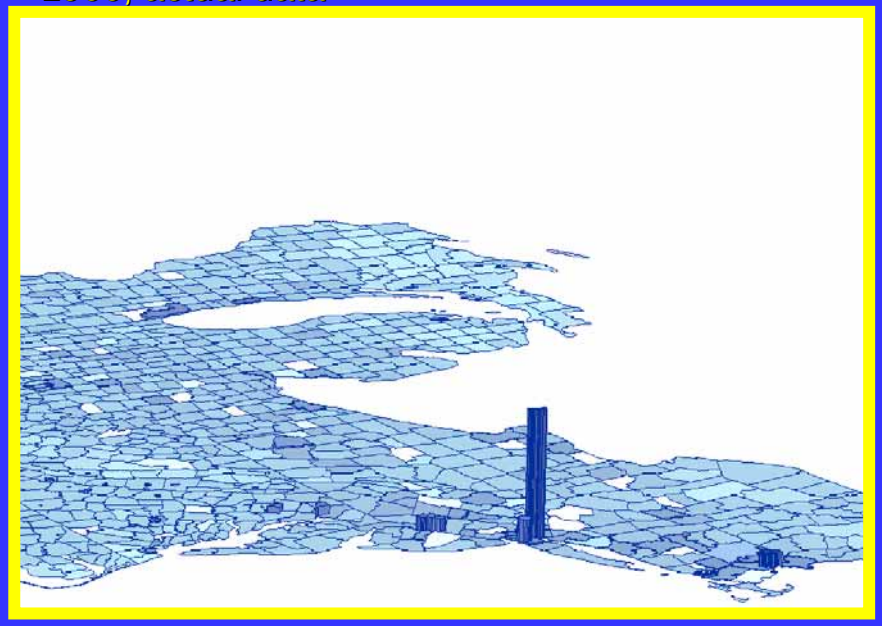

# Electricity Use & Population Density

Grübler & Prieler

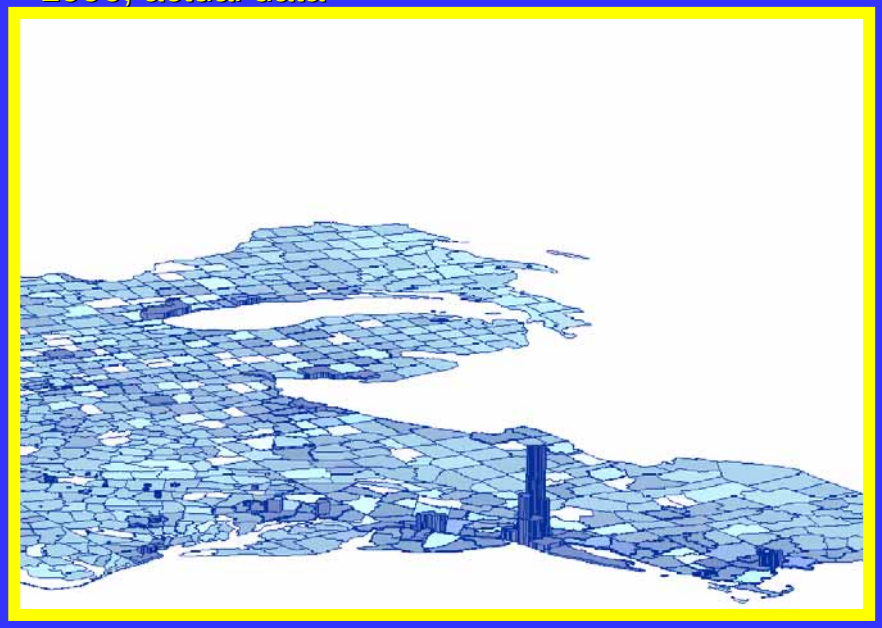
IIASA 2001

# North-East of the USA

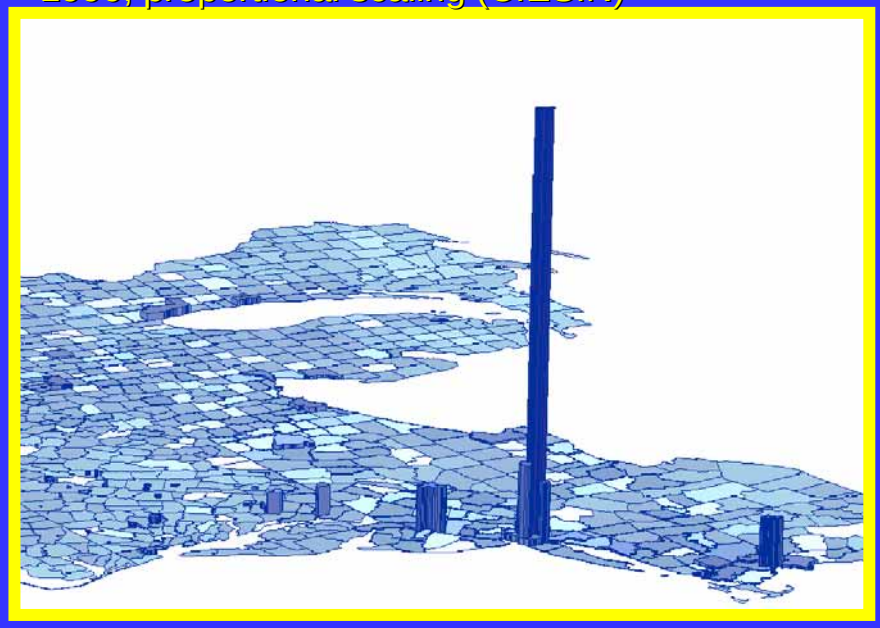
1900, actual data



1990, actual data



1990, proportional scaling (CIESIN)



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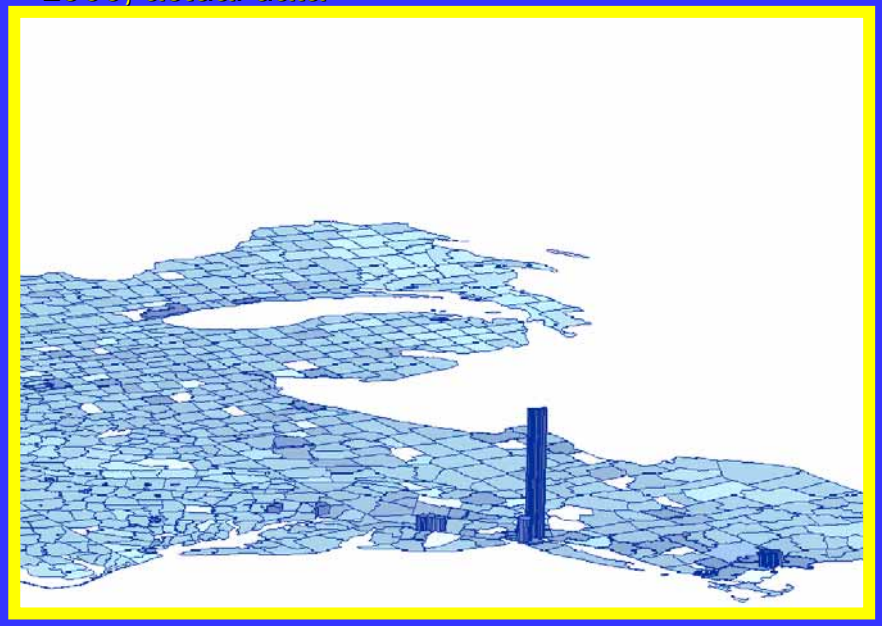
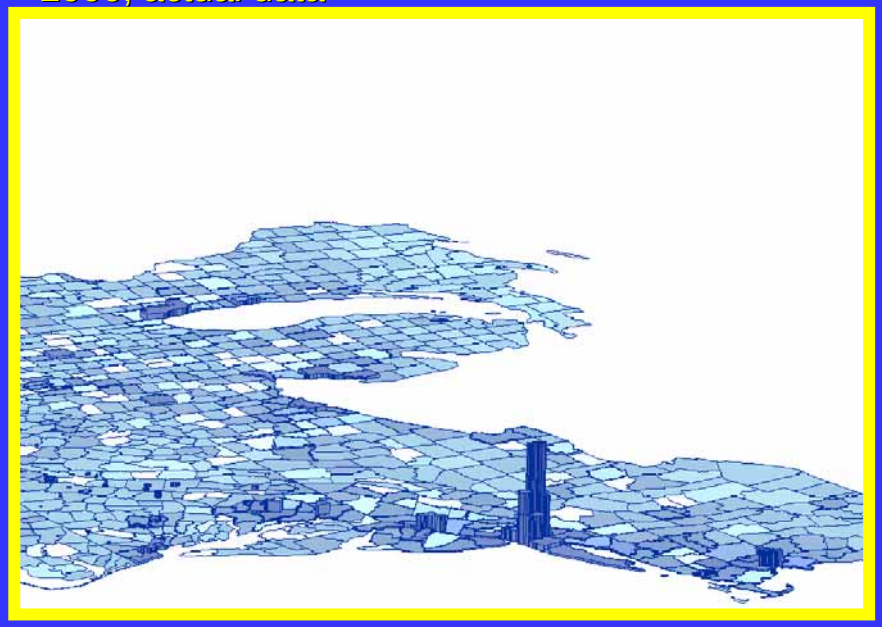


2000, actual data



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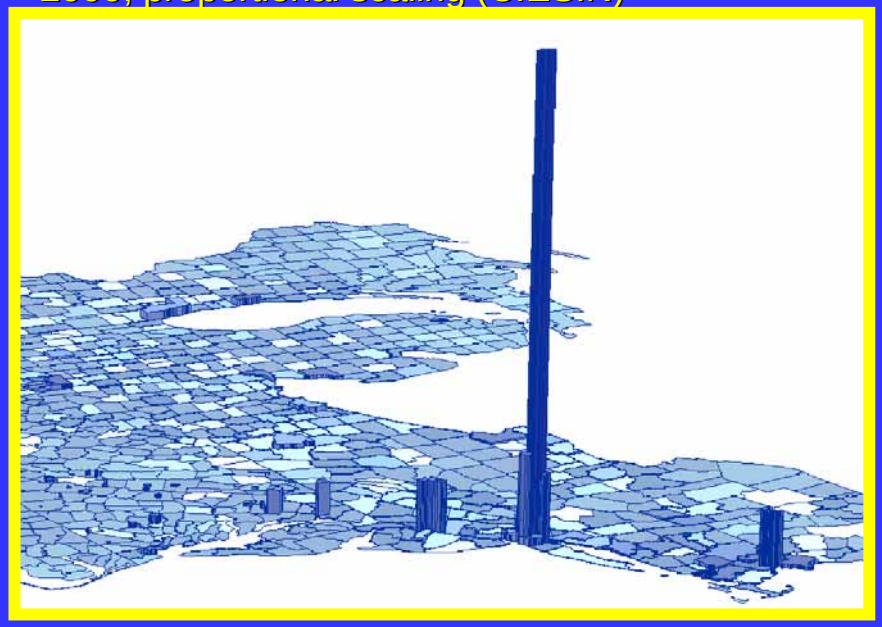
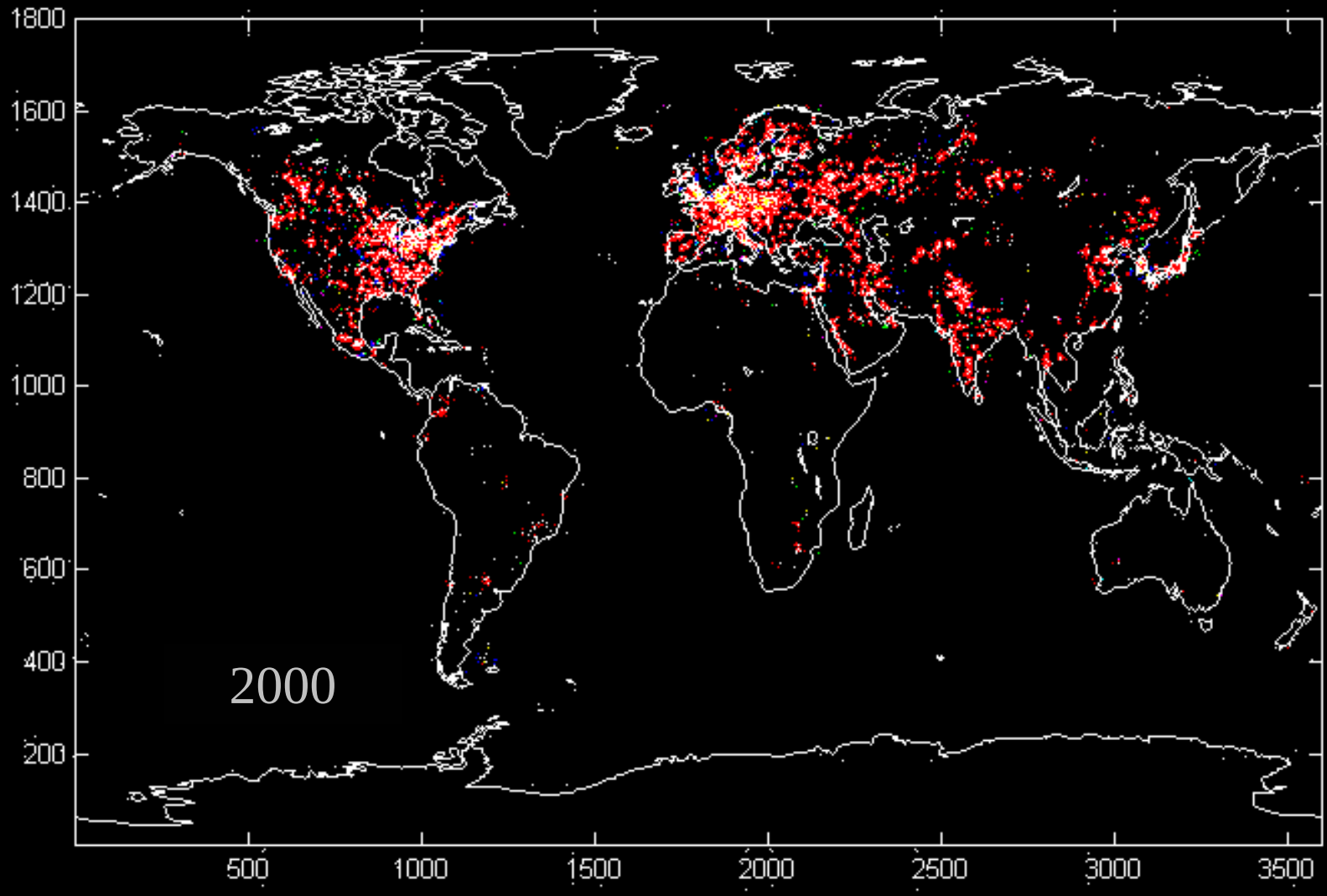
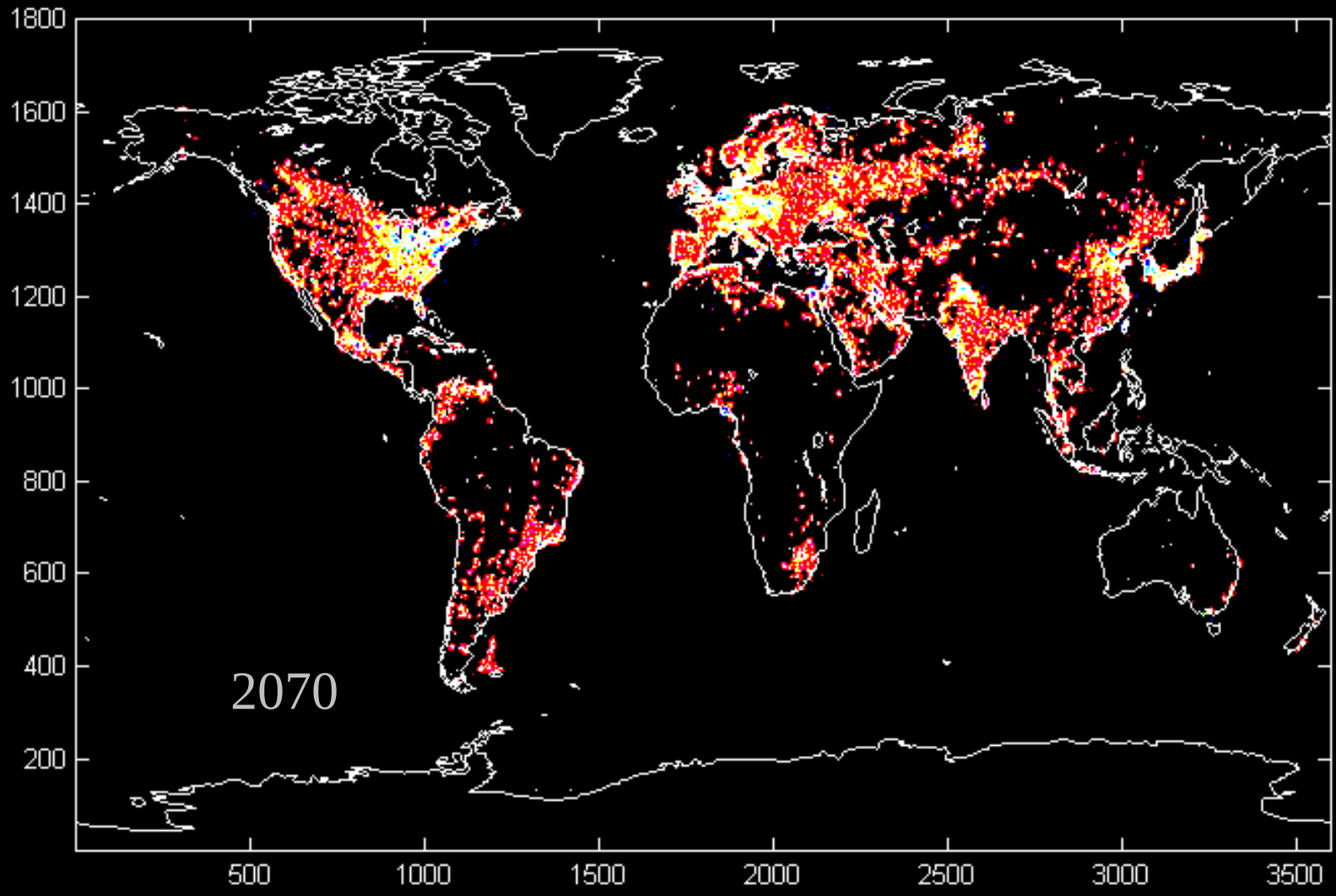





Nakicenovic #31

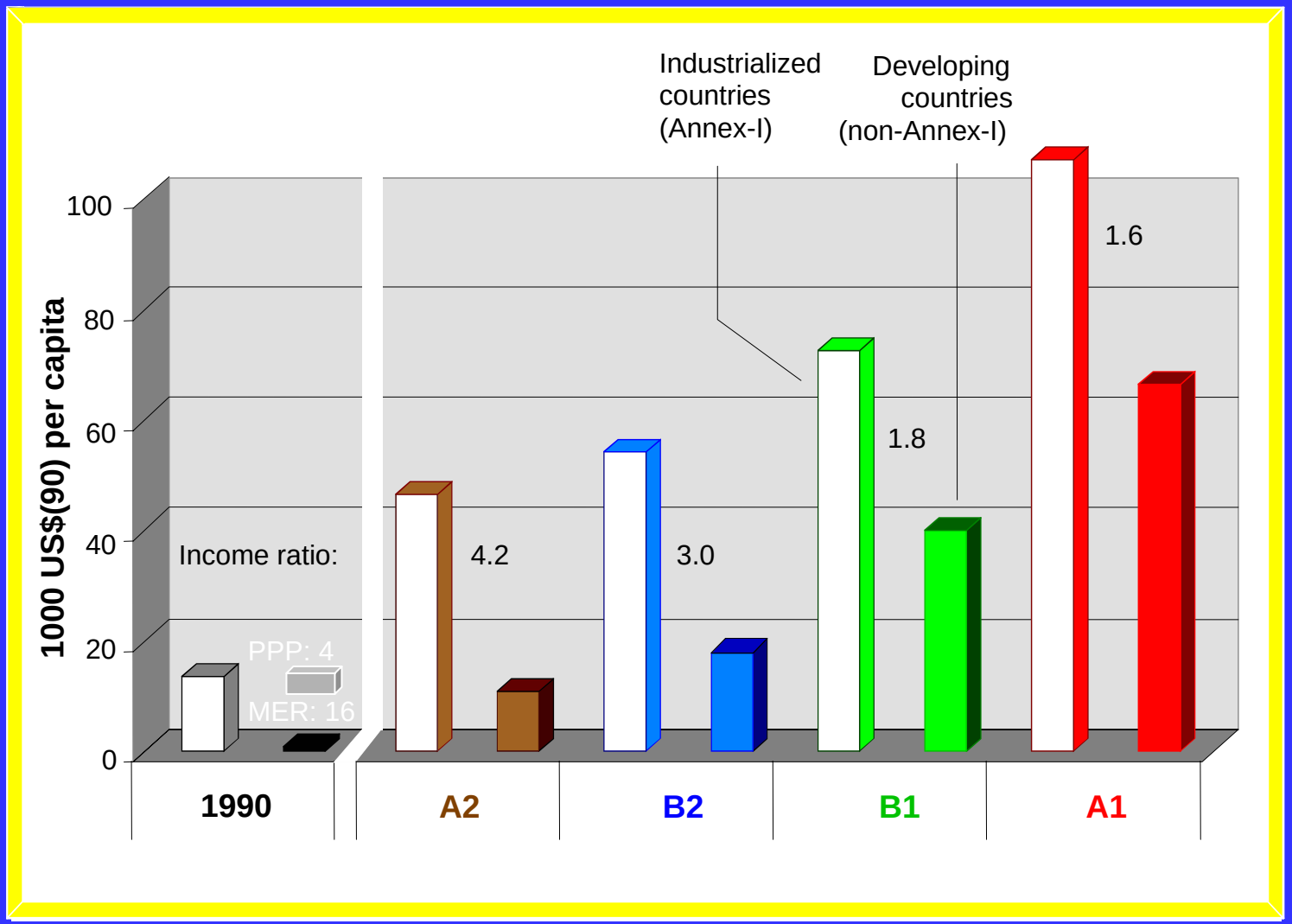
IIASA&TUW 2004




Nakicenovic #32

IIASA&TUW 2004

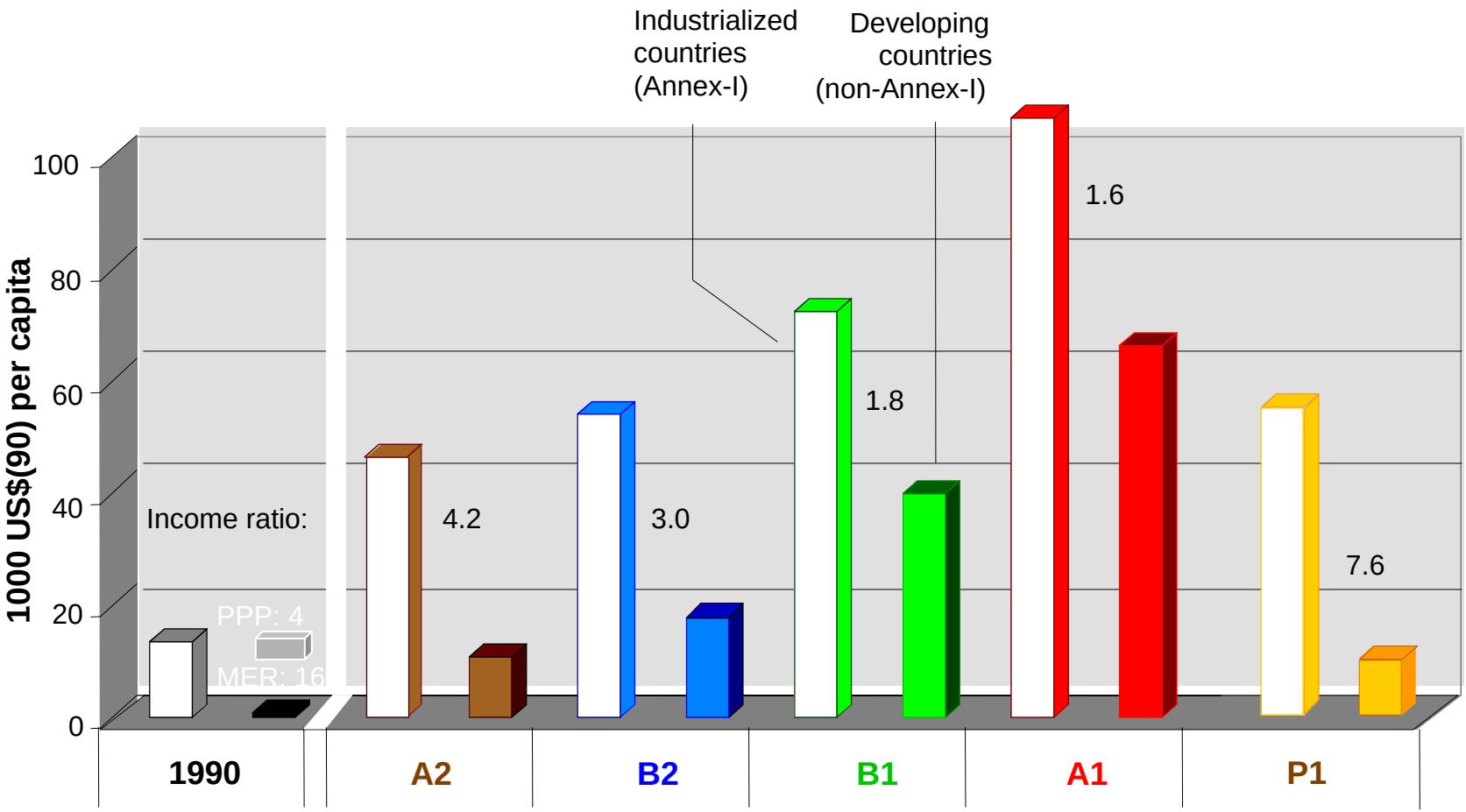
# Per Capita Income Across SRES Scenarios




Nakicenovic *et al.*

IIASA 2000

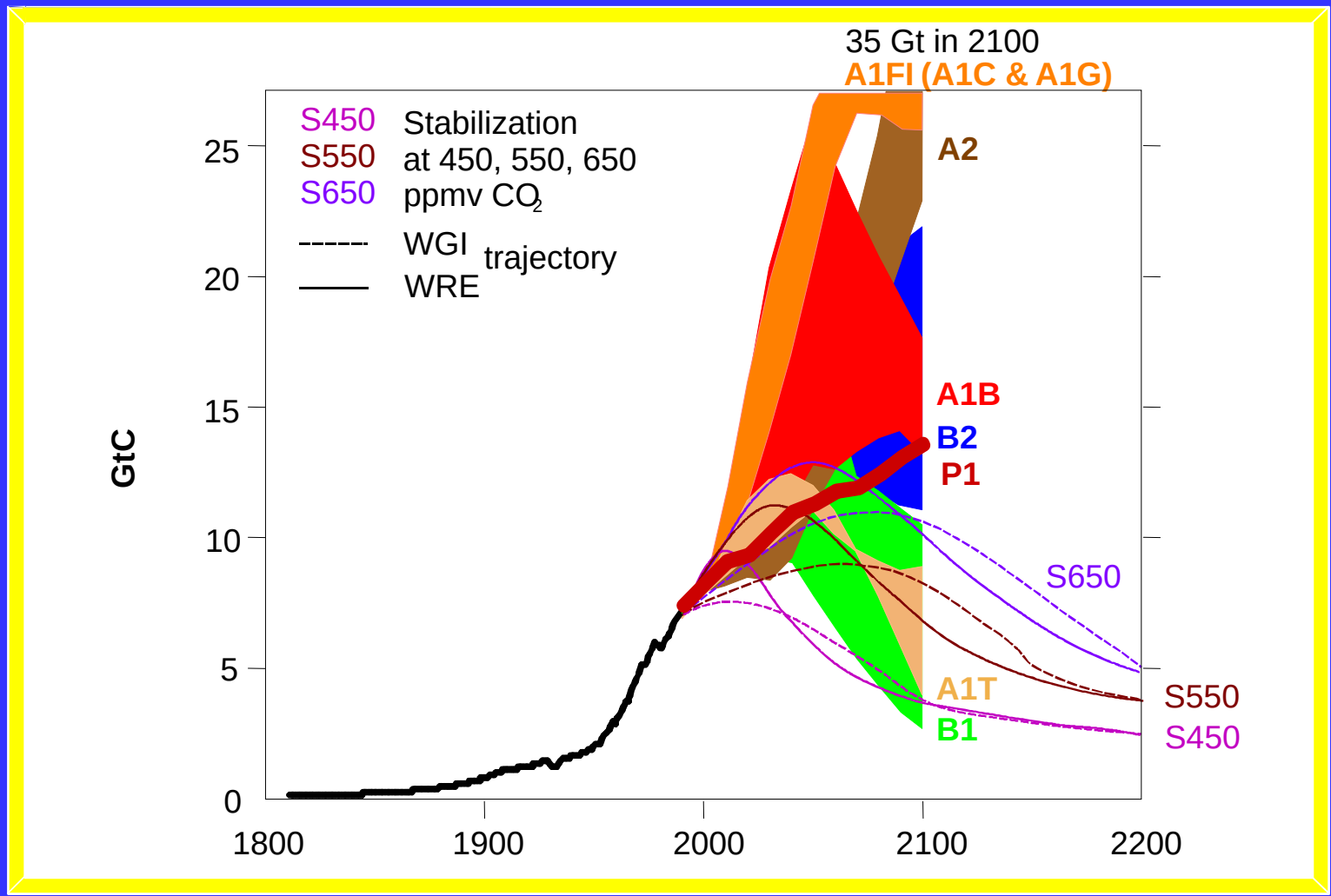
# Per Capita Income Across SRES Scenarios




Nakicenovic *et al.*

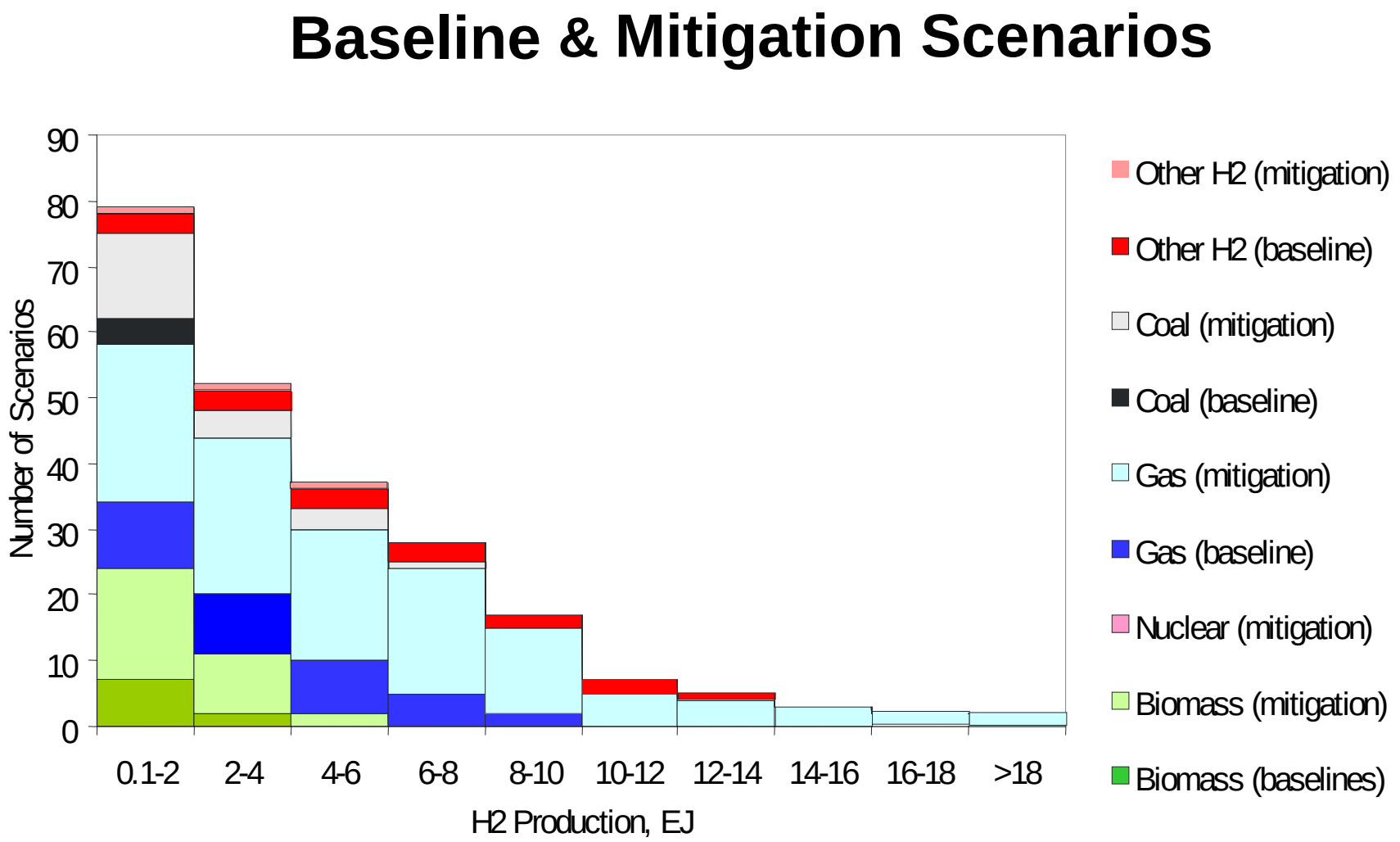
IIASA 2000

# Carbon Emissions: Scenarios and Stabilization Profiles



# Potential Hydrogen Market by 2020

## 34 IIASA-WEC and IIASA-IPCC Scenarios



# DYNAMICS OF TECHNOLOGY

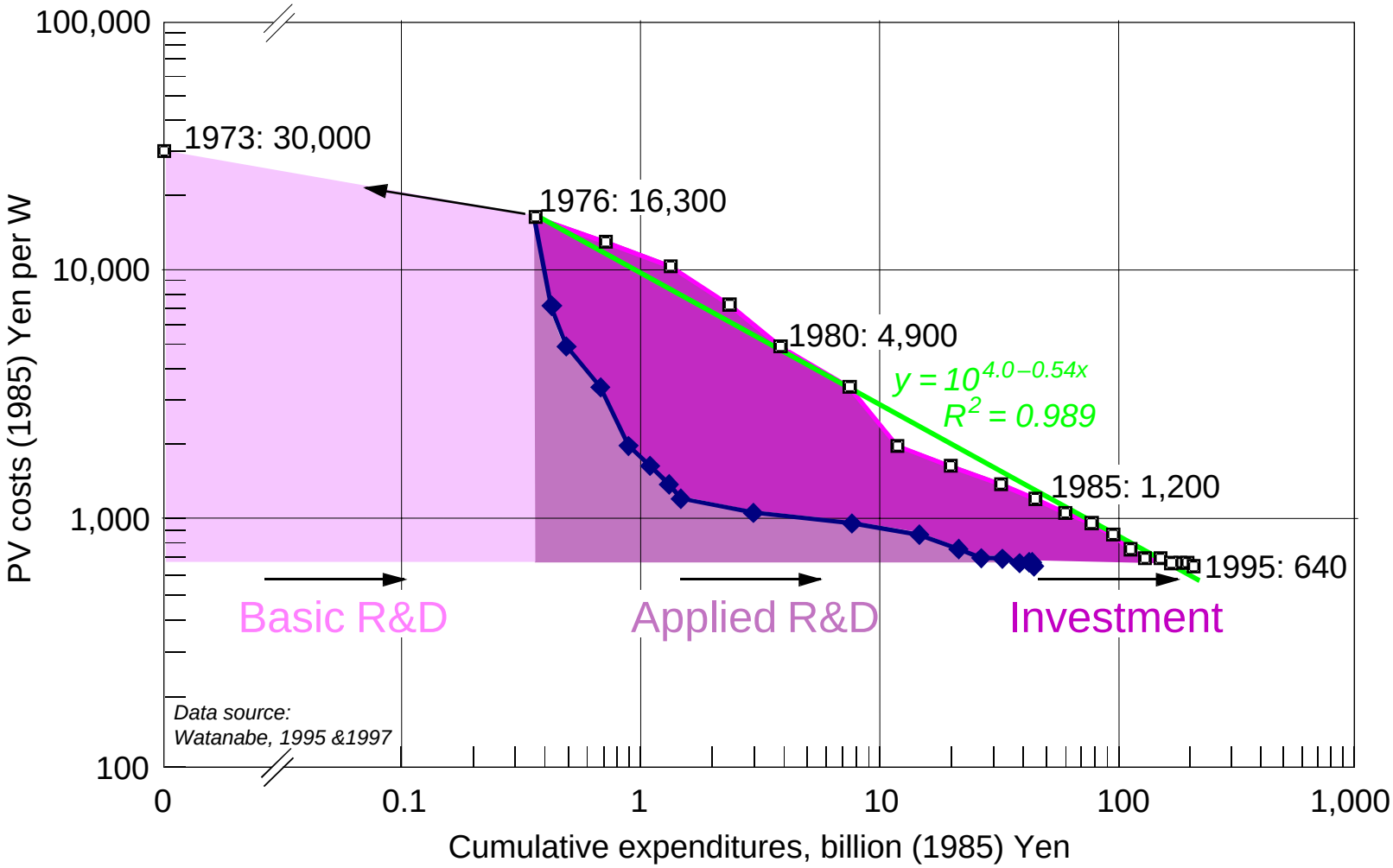
- **Deep Uncertainty:**

  Limited knowledge on feasibility and costs of future technologies

- **Technological Learning:**

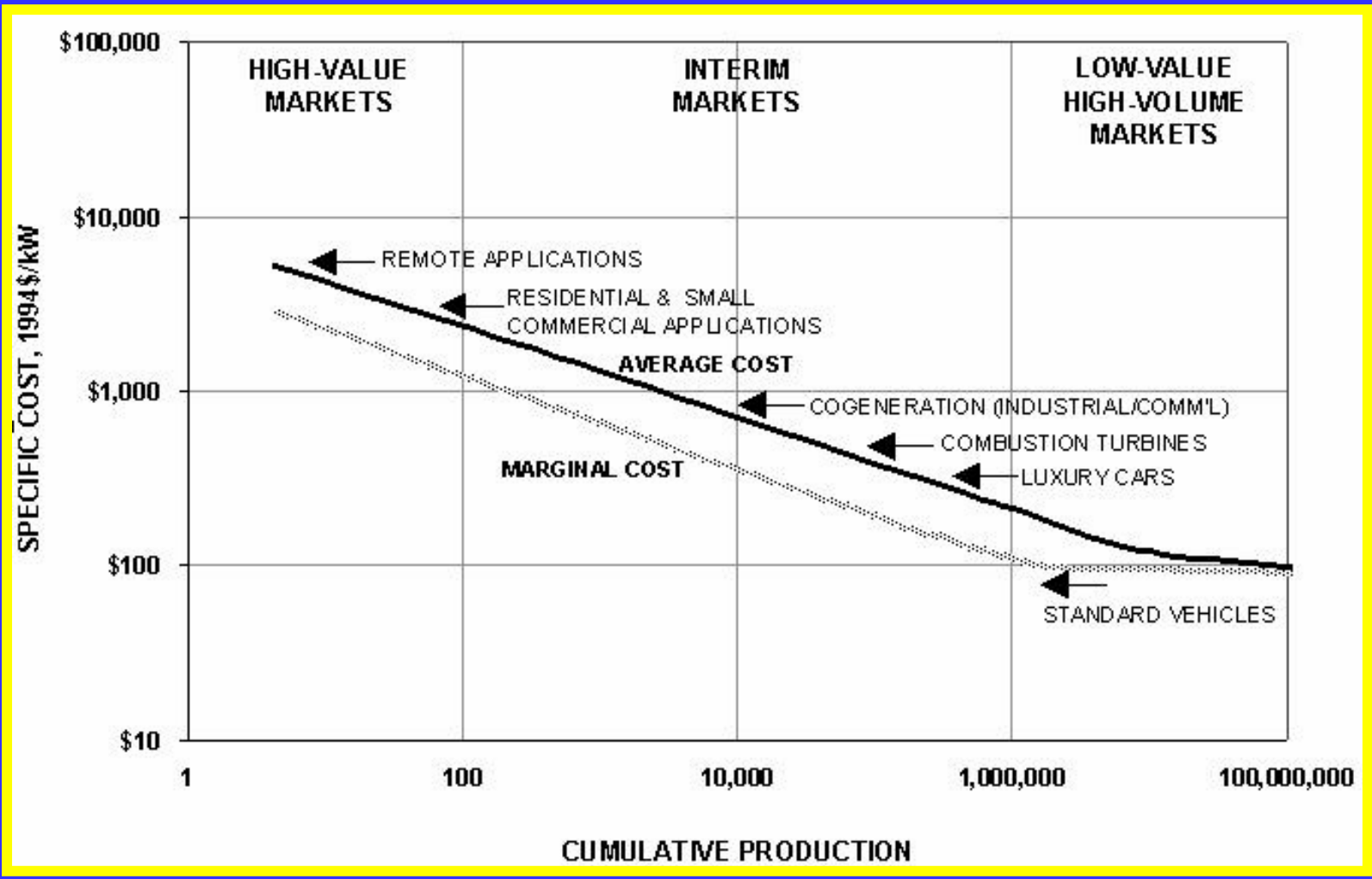
  Improvements are a function of accumulated experience (learning curve)

# Japan - PV Costs vs. Expenditures



# Fuel Cell Marketing Strategy

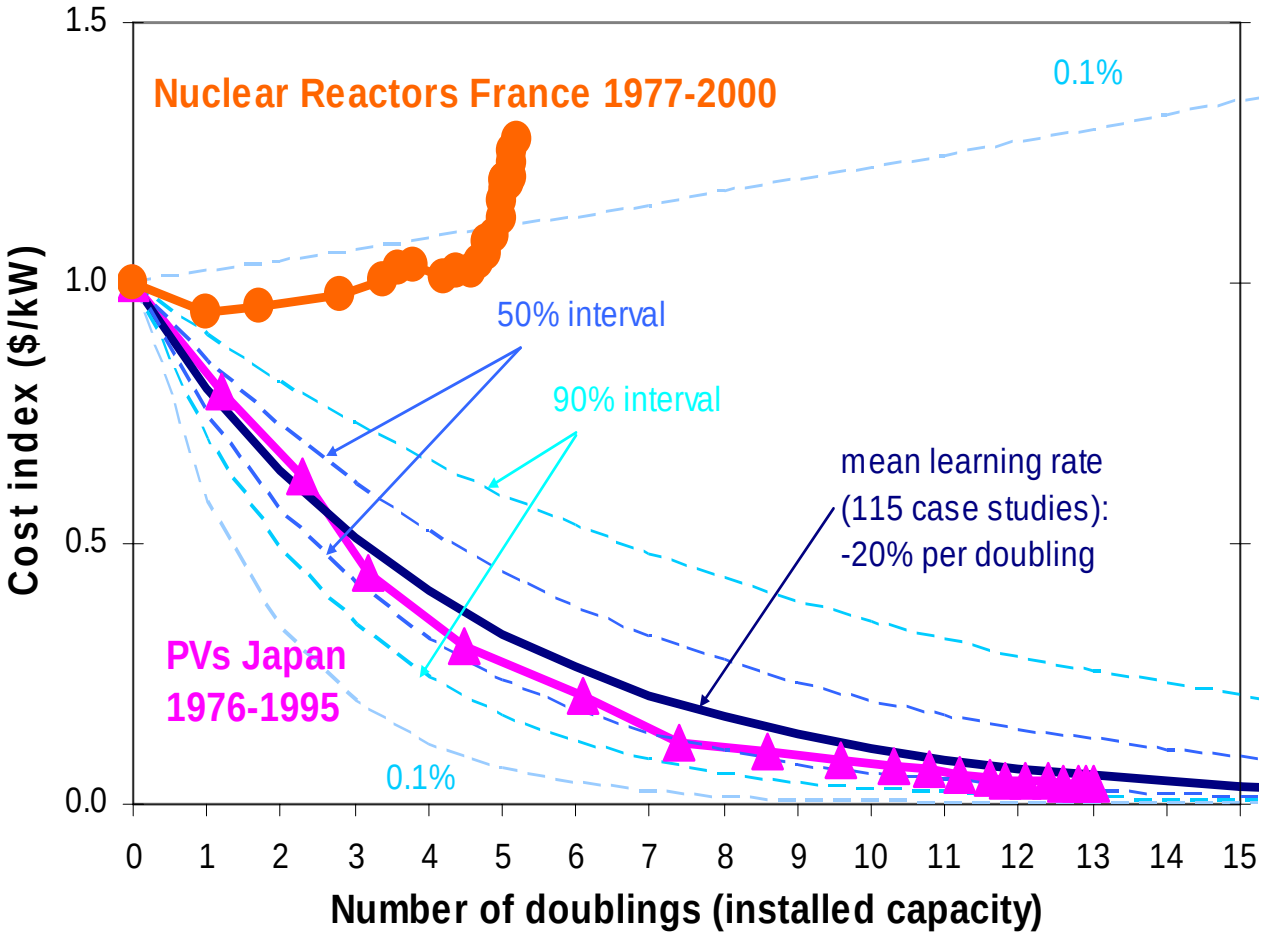
## Successive Market Niches via Cost Reductions




Source: P. B. Bos, *Commercializing Fuel Cells – Managing Risks*,
Fourth Grove Fuel Cell Symposium, Commonwealth Institute London, September 19-22, 1995

# Technological Uncertainties

## Learning rates (push) and market growth (pull)



# Learning Potentials
## Number of Units Sold to Date

| | | | |
|---|---|---|---|
| **Automobiles** | **>1** | **$10^9$** | Δ=x100,000 |
| **Electric cars** | **<1** | **$10^4$** | Fuel Cells |
| **Intel chips** | **>1** | **$10^8$** | Factor 1,000 |
| **PV cells** | **<1** | **$10^5$** | Difference! |
| **Gas turbines** | **<1** | **$10^6$** | Factor 100 |
| **Wind turbines** | **>1** | **$10^4$** | Difference! |
| **Nuclear reactors** | **<1** | **$10^3$** | Negative Learning Possibility |

# Why Are Increasing Returns, Uncertainty and Risk Important?

- Very long-term processes
- Substantial effect on economic development
- Path dependency and technological “lock in”
- Highly uncertain characteristics and economic performance of future technologies
- Potentially high impact on global, regional and local environment

# Stabilization Scenarios "Stylized Facts"

- Path-dependence of stabilization vs baseline
- Baseline more important than stabilization
- Uncertainty – probabilistic or distributions
- Stabilization reduces emissions uncertainties
- Consequences of lower economic growth
- Ancillary and avoided adaptation benefits
- Spatially explicit drivers, mitigation & impacts

# Next Steps on Urgent Issues

- Limitations of downscaling need to be considered (need for scaling methods; other to proportional)
- Emissions modeling community could be asked to include all GHGs and particulates in multigases baseline scenarios
- Role of additional GHGs and particulates to be considered in stabilization scenarios (e.g. burden-sharing; uncertainties)

http://www.iiasa.ac.at/Research/TNT/index.html

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