Globale und österreichische Energieperspektiven Forschungs- und Investitionsbedarf

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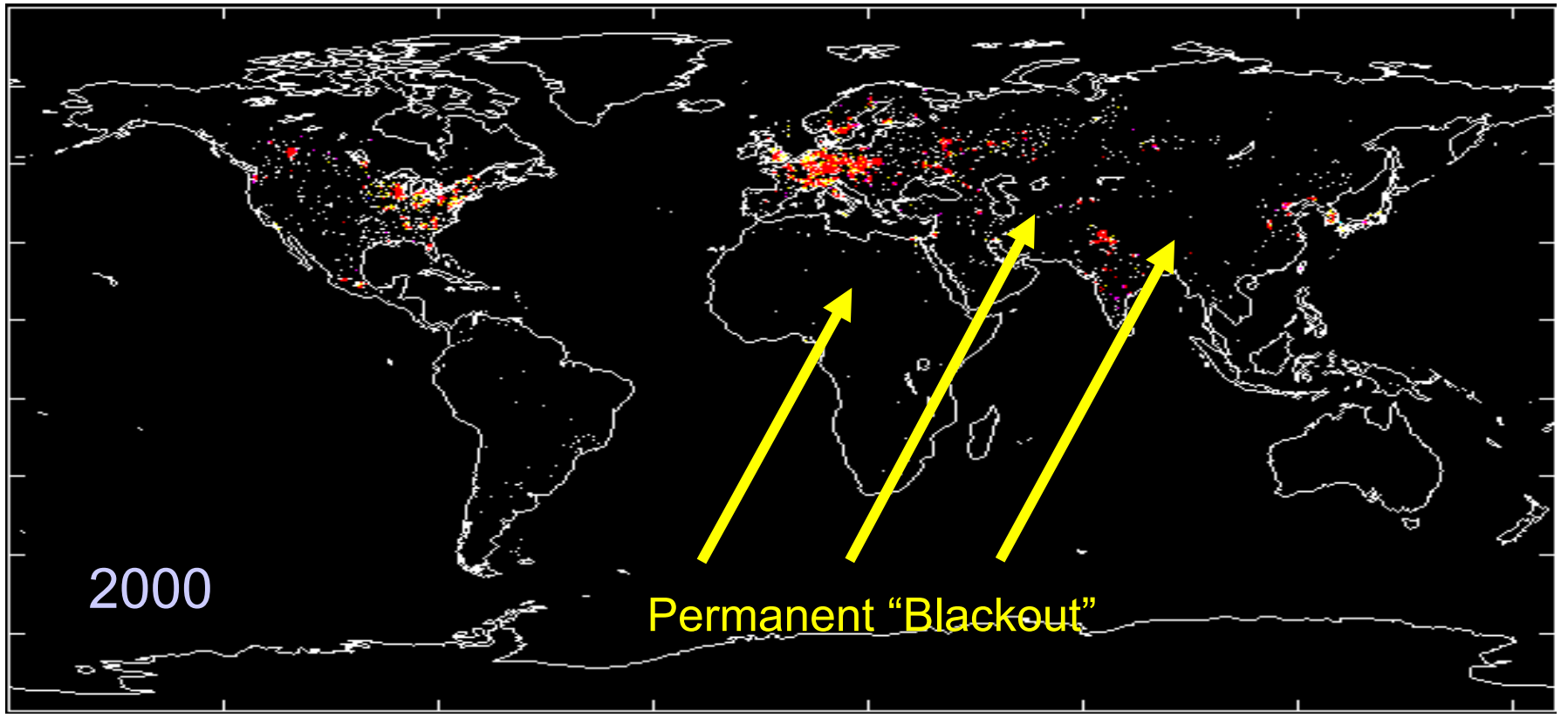
Sichere Energieversorgung, Strategien und Technologien für die Zukunft, Energie 2050, BMVIT und IEA, Millennium Event Center, Wien – 29 November 2006

Herausforderungen
Challenges

- Bereitstellung von nachhaltigen Energiedienstleistungen
  - Provisioning of energy services
- Technologiediffusionsdauer 20 bis 70 Jahre
  - Technology diffusion takes 20 to 70 years
- Finanzierung des Strukturwandels
  - Financing energy transformations
- Energieeffizienz und Entkarbonisierung
  - Efficiency improvements and decarbonization
- Energiesicherheit und Zuverlässigkeit
  - Safety and security

Night Lights



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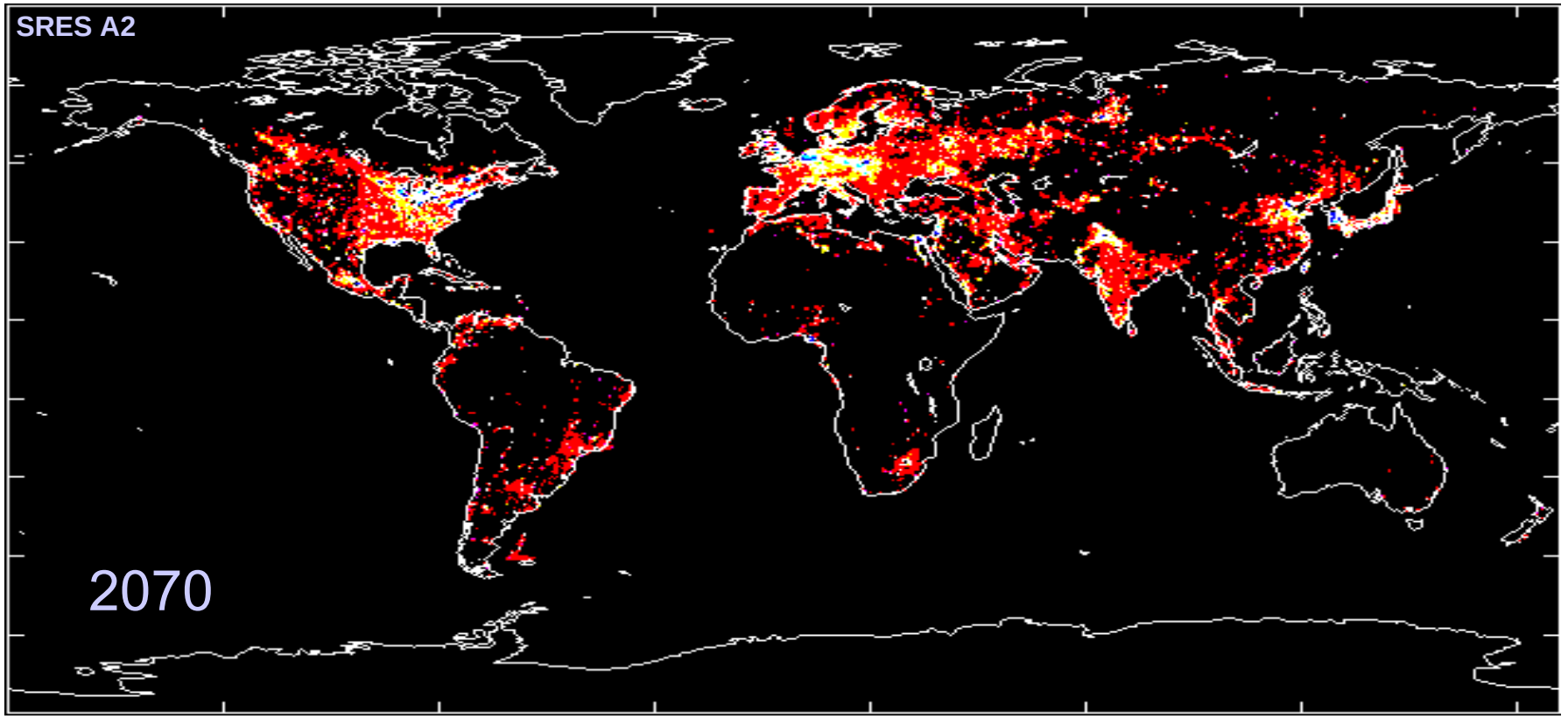
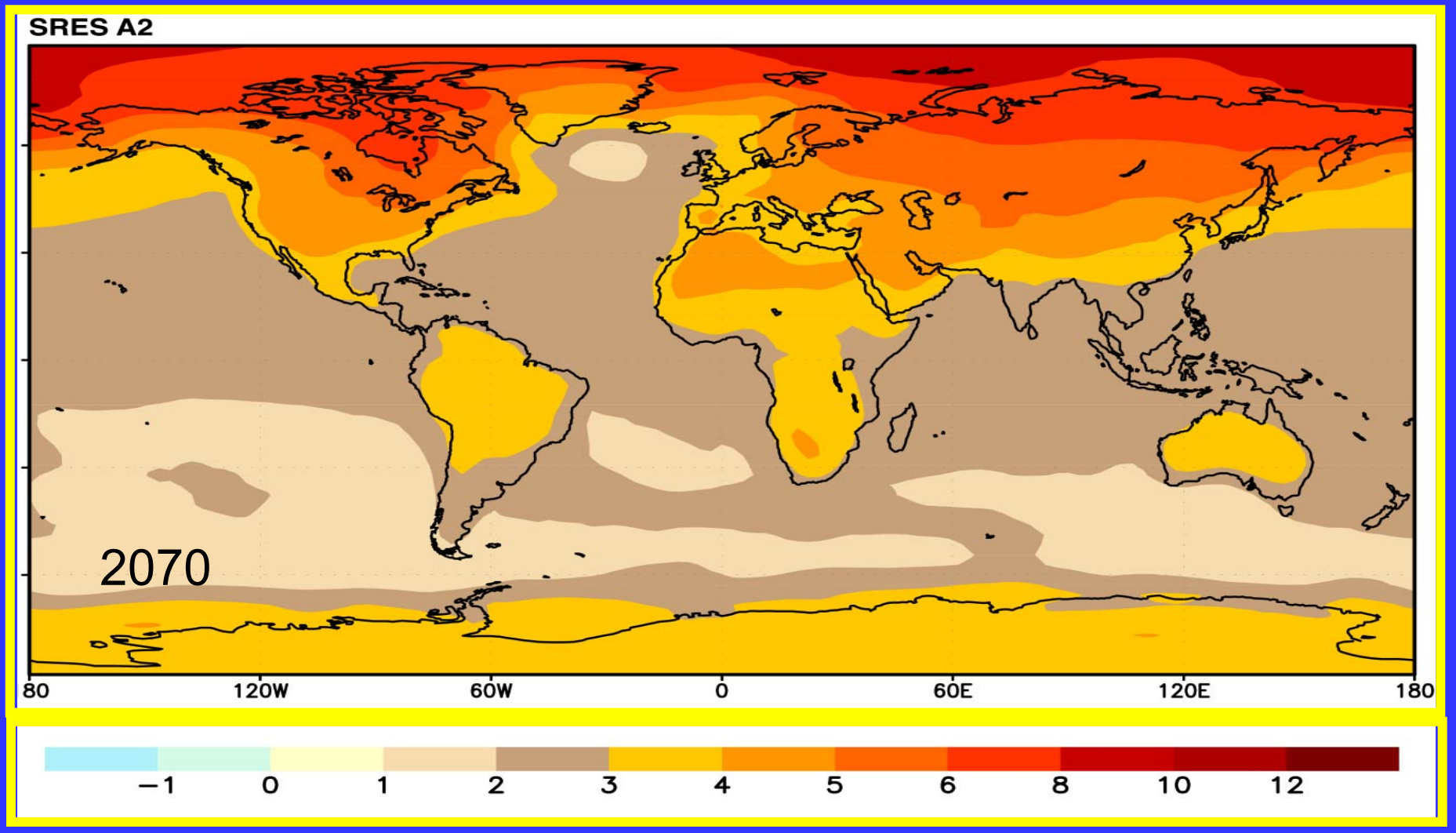


Δ Temperature



Scenario Overview (World by 2100)

	2000	A2r	B2	B1
Population, 10^9	6	12	10	7
GDP, $10^{12}$$	36	190	240	330
PE, EJ	440	1750	1300	1050
PE intensity, %/yr	-0.9	-0.6	-1.2	-1.7
Zero-C, % share	15	36	47	61
GtC energy	7	27	16	6
GtC forests	1	<1	-2	-1
GtC-e all others	3	10	5	4
GtC-e total	11	38	19	9
ppmv (CO_2-equiv)	470	1390	980	690
Stabilization (ppmv-equiv)		670-1090	520-670	480-670

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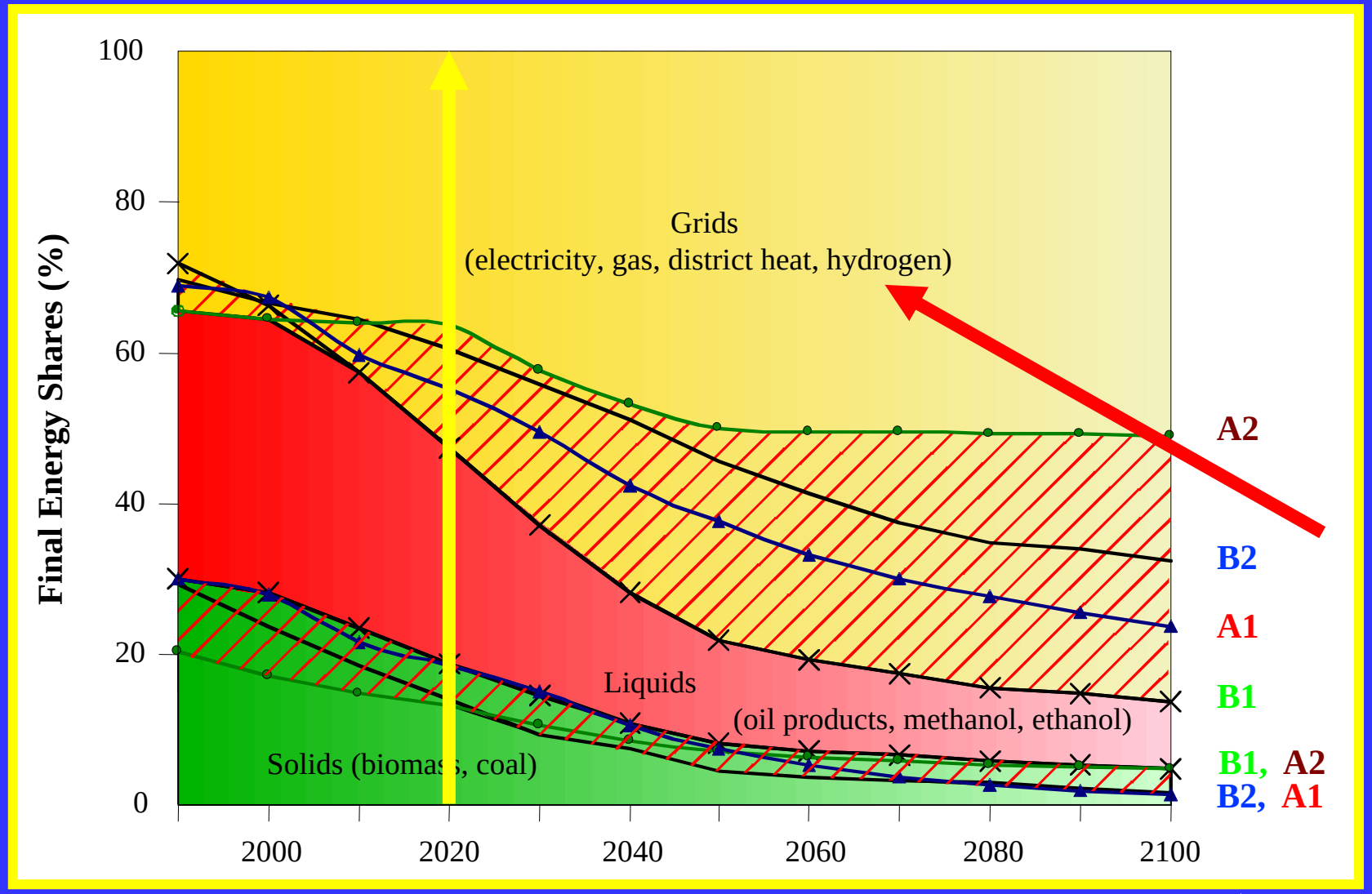
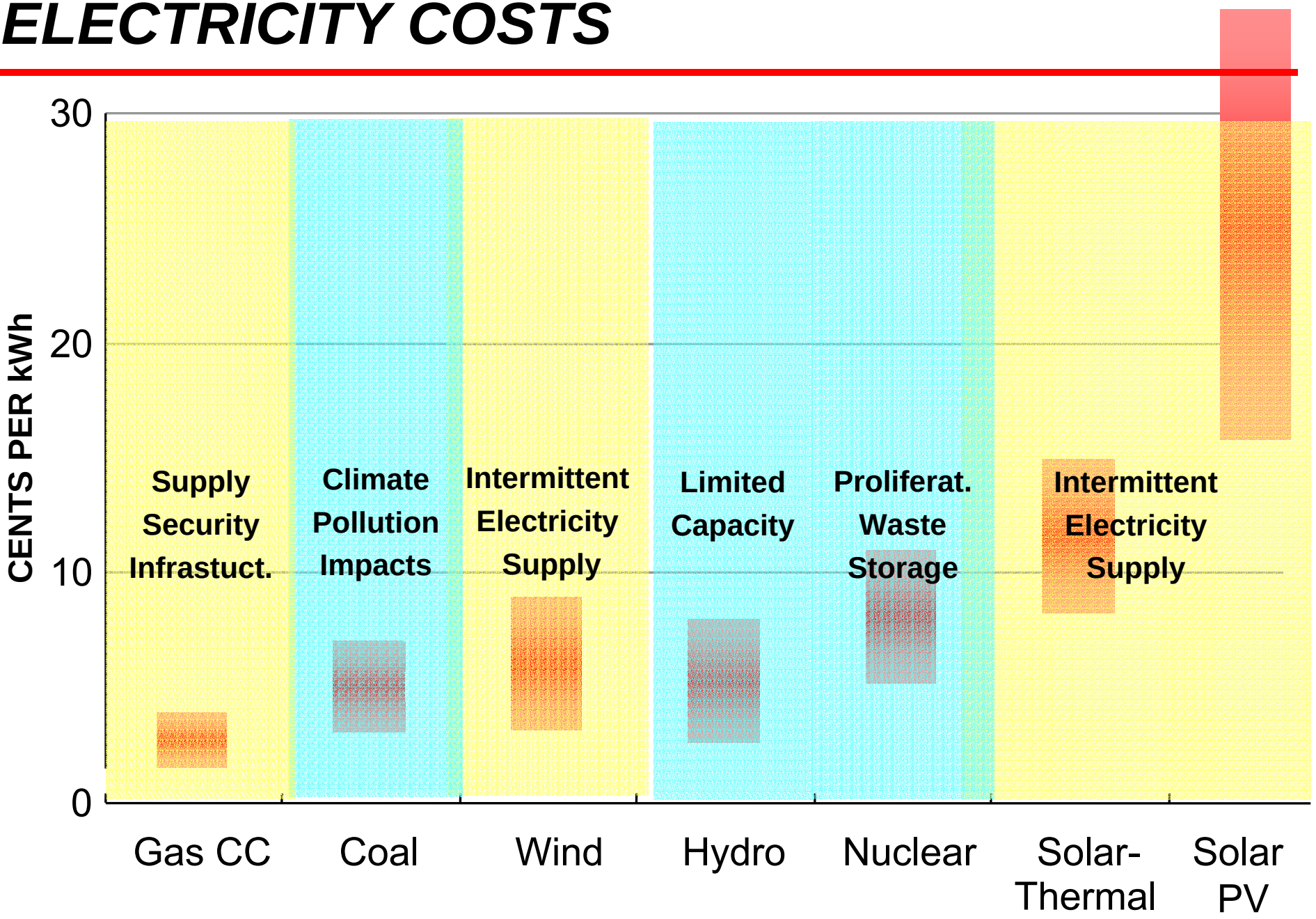
Global Final Energy by Form
IIASA IPCC SRES Scenarios

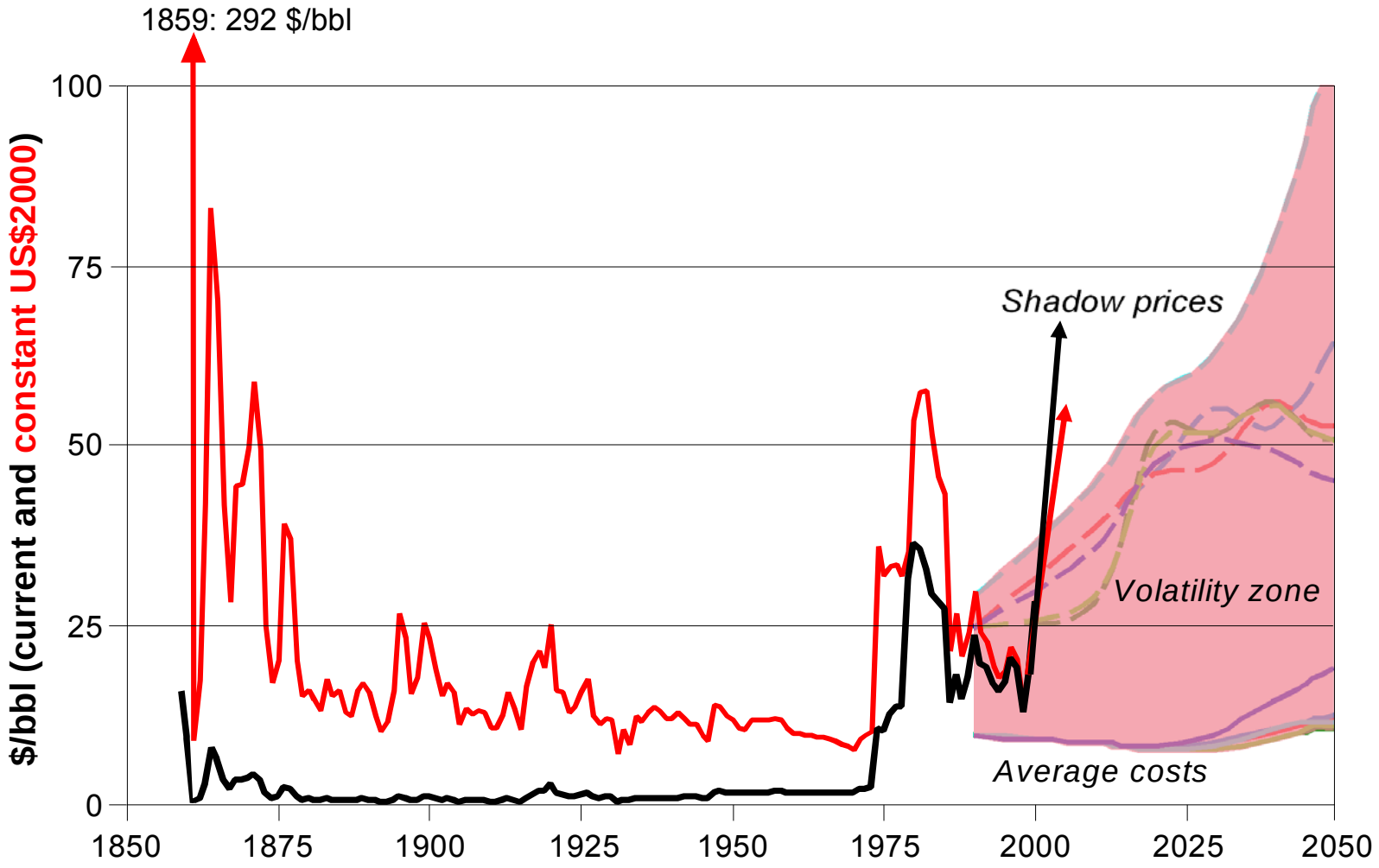


ELECTRICITY COSTS

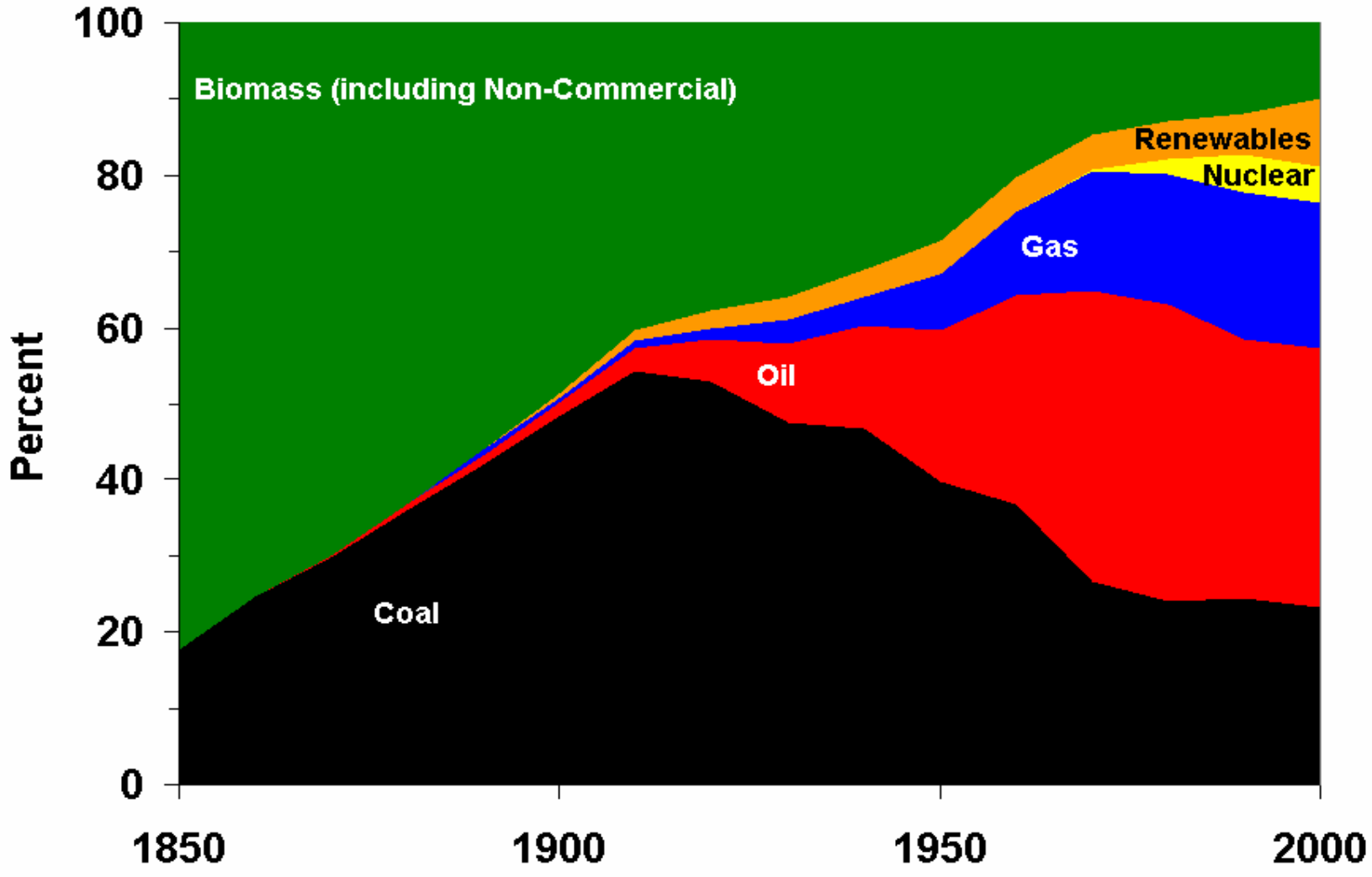


Source: Kheshgi, Exxon Mobil (2002)

Historical Oil Prices and in Scenarios



Evolution of Global Primary Energy



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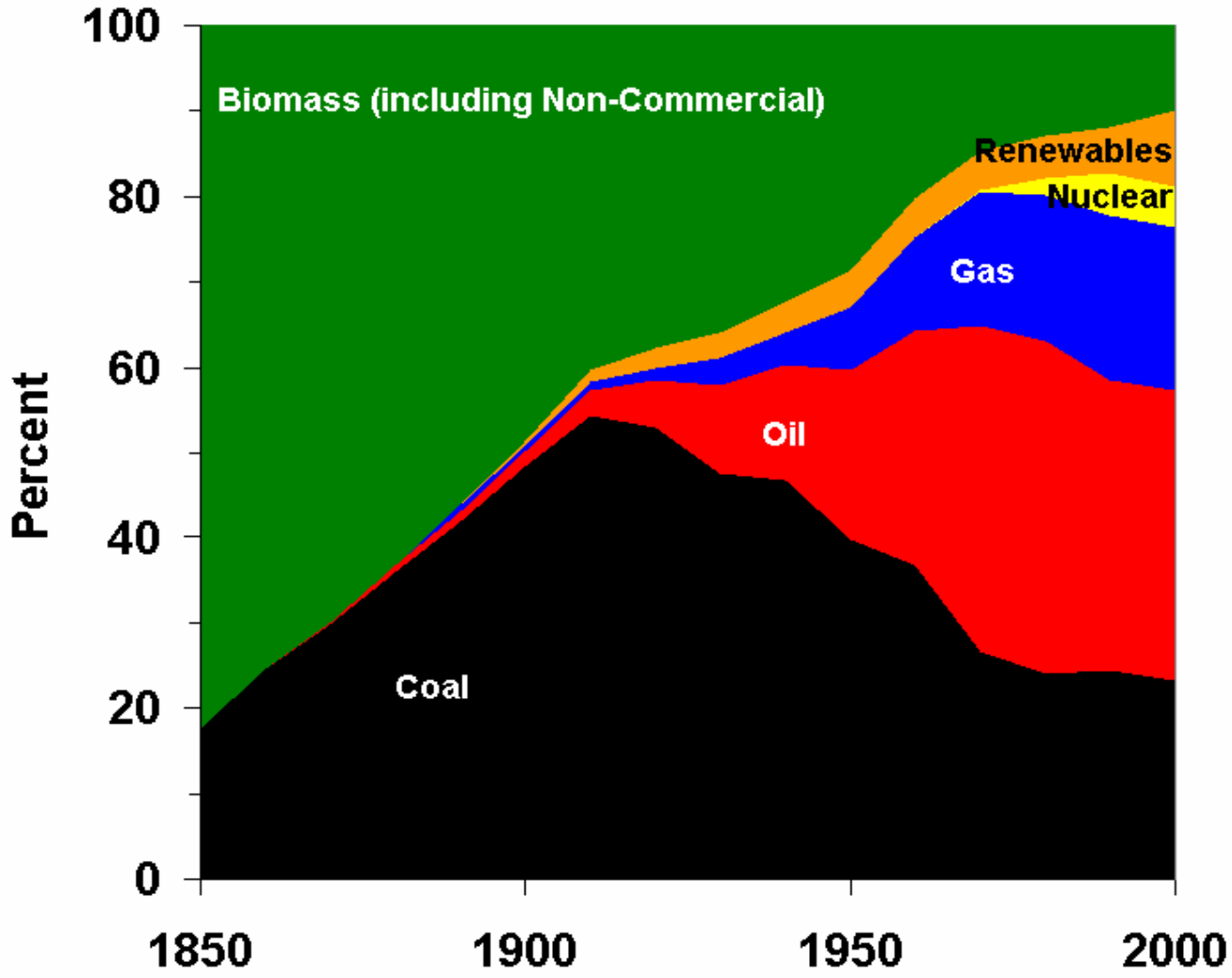

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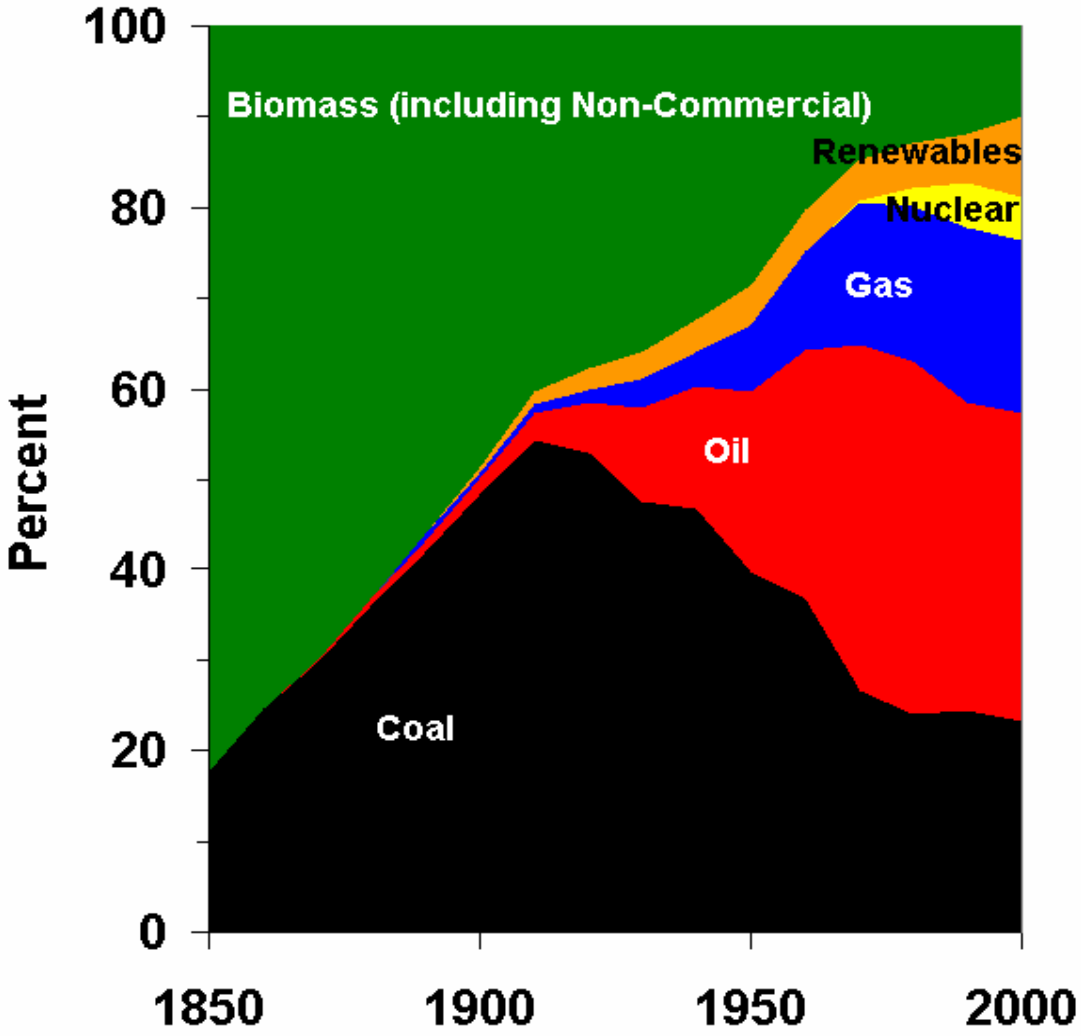

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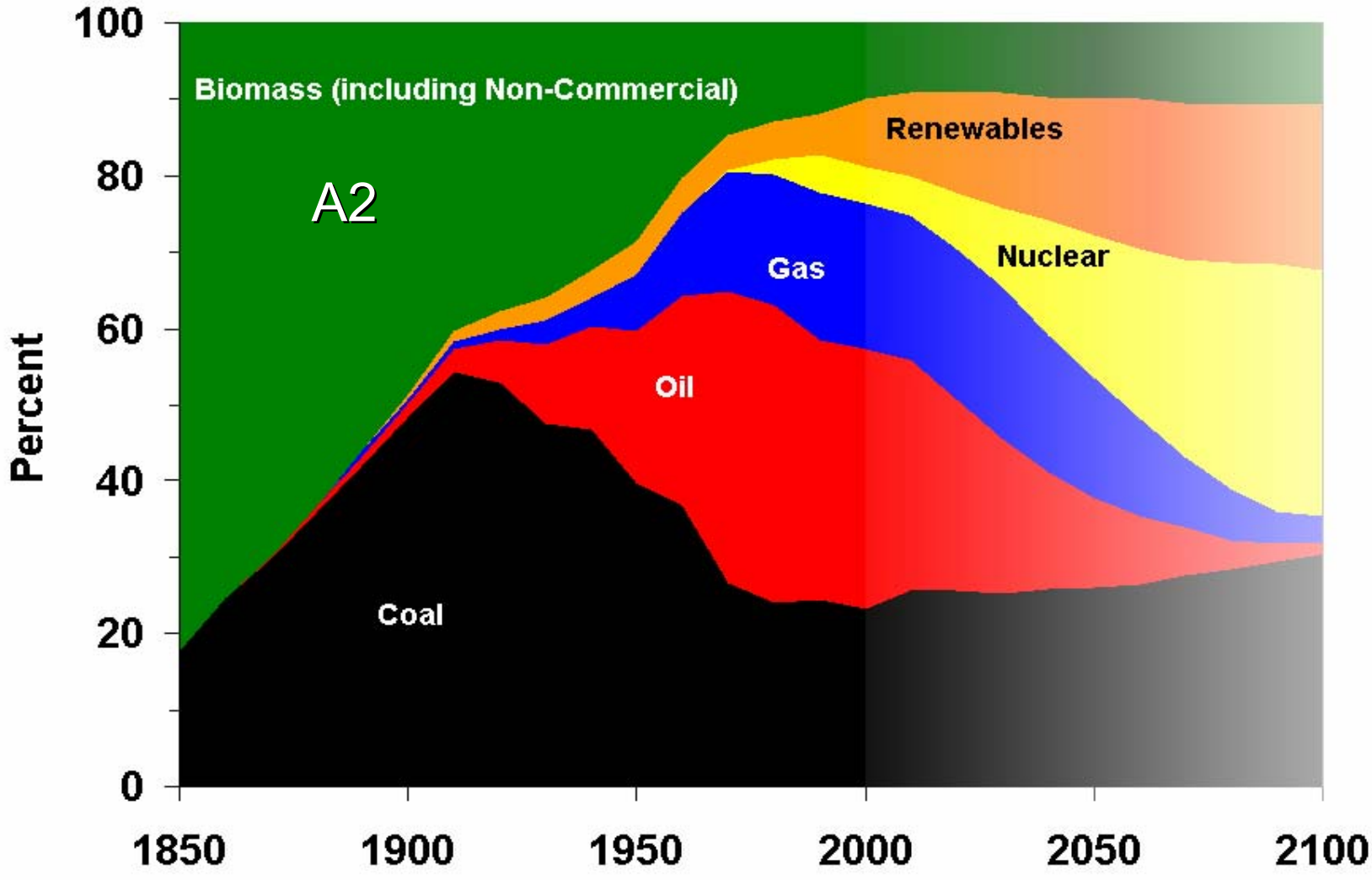

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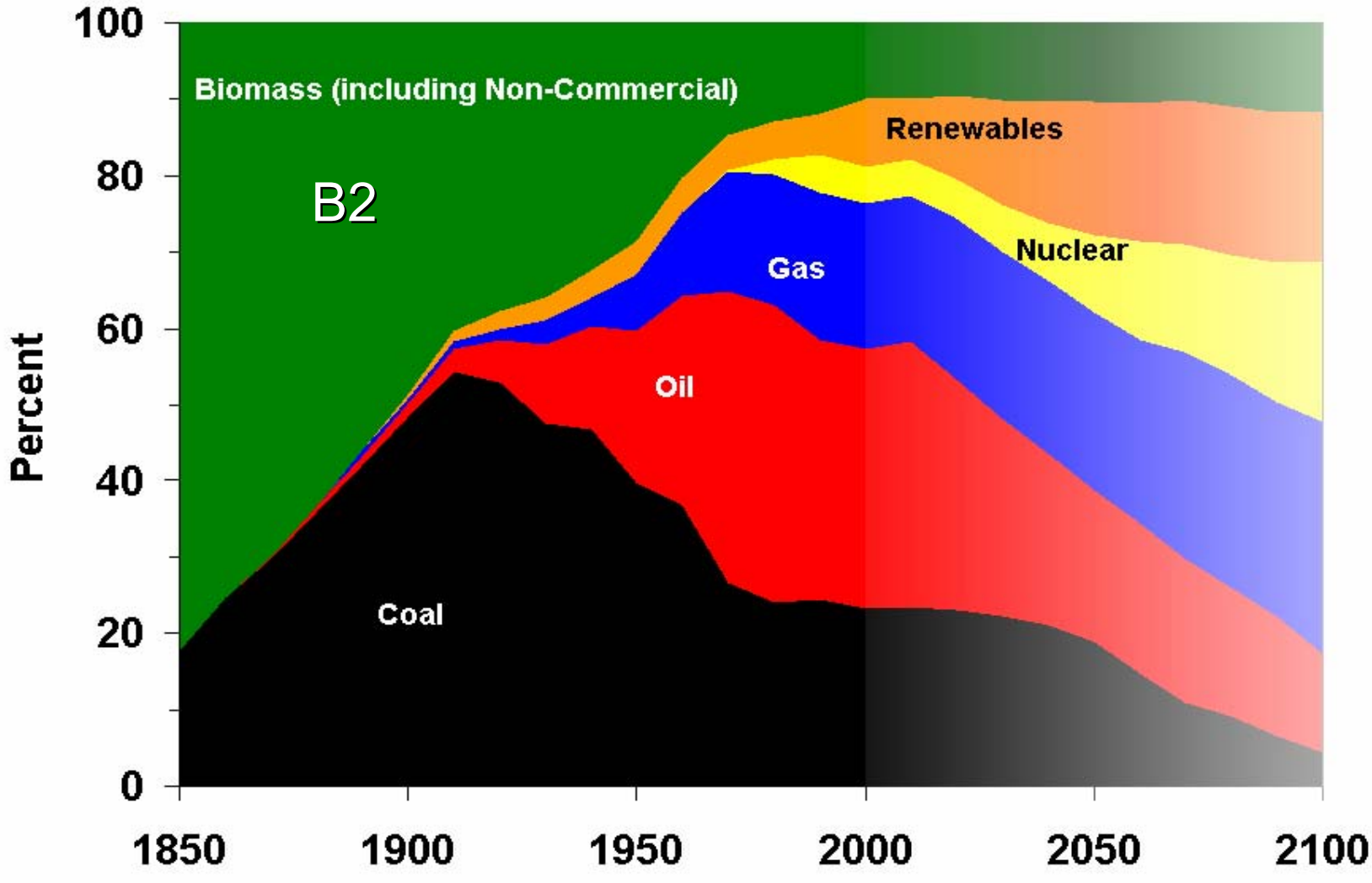

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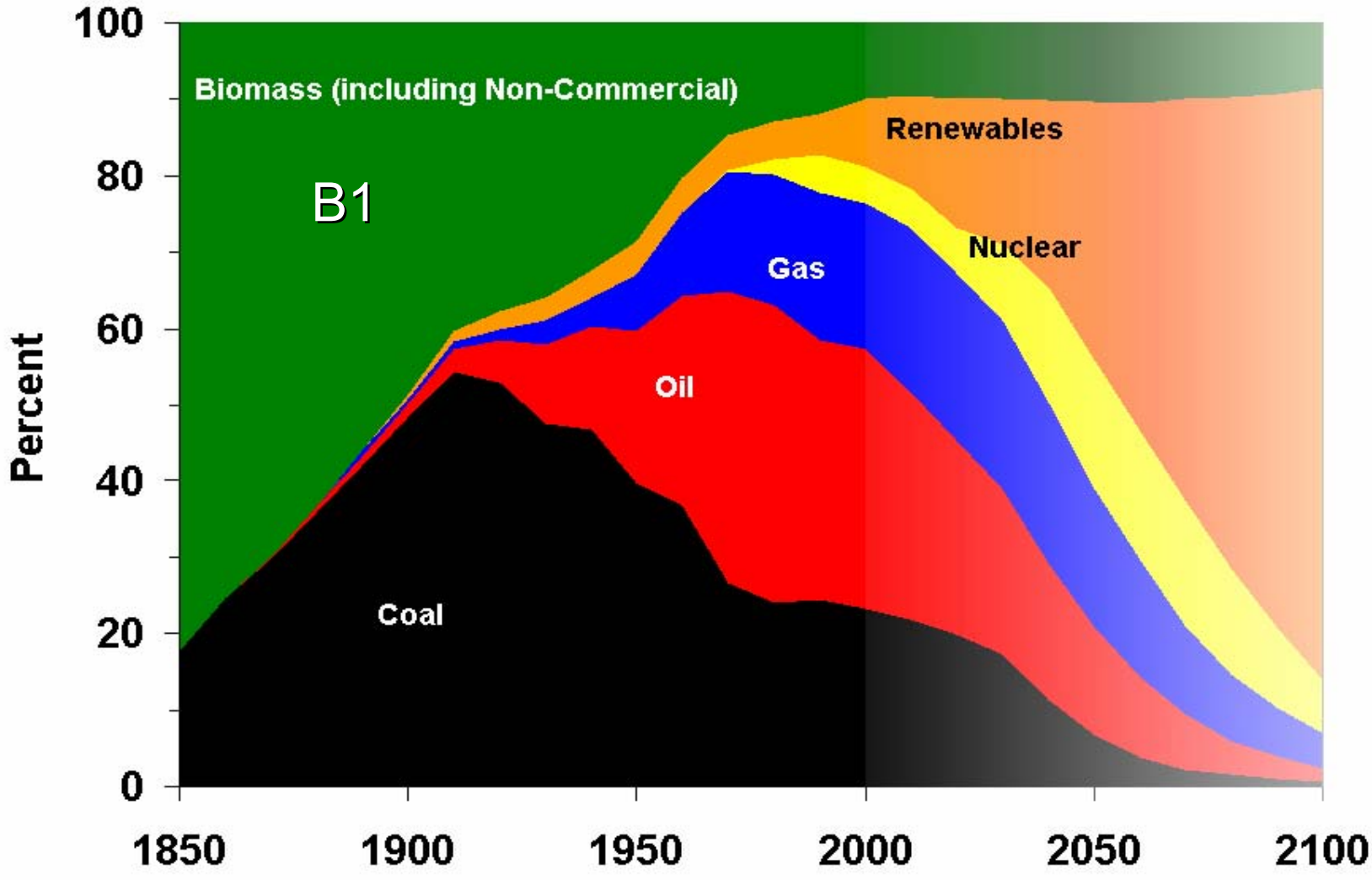
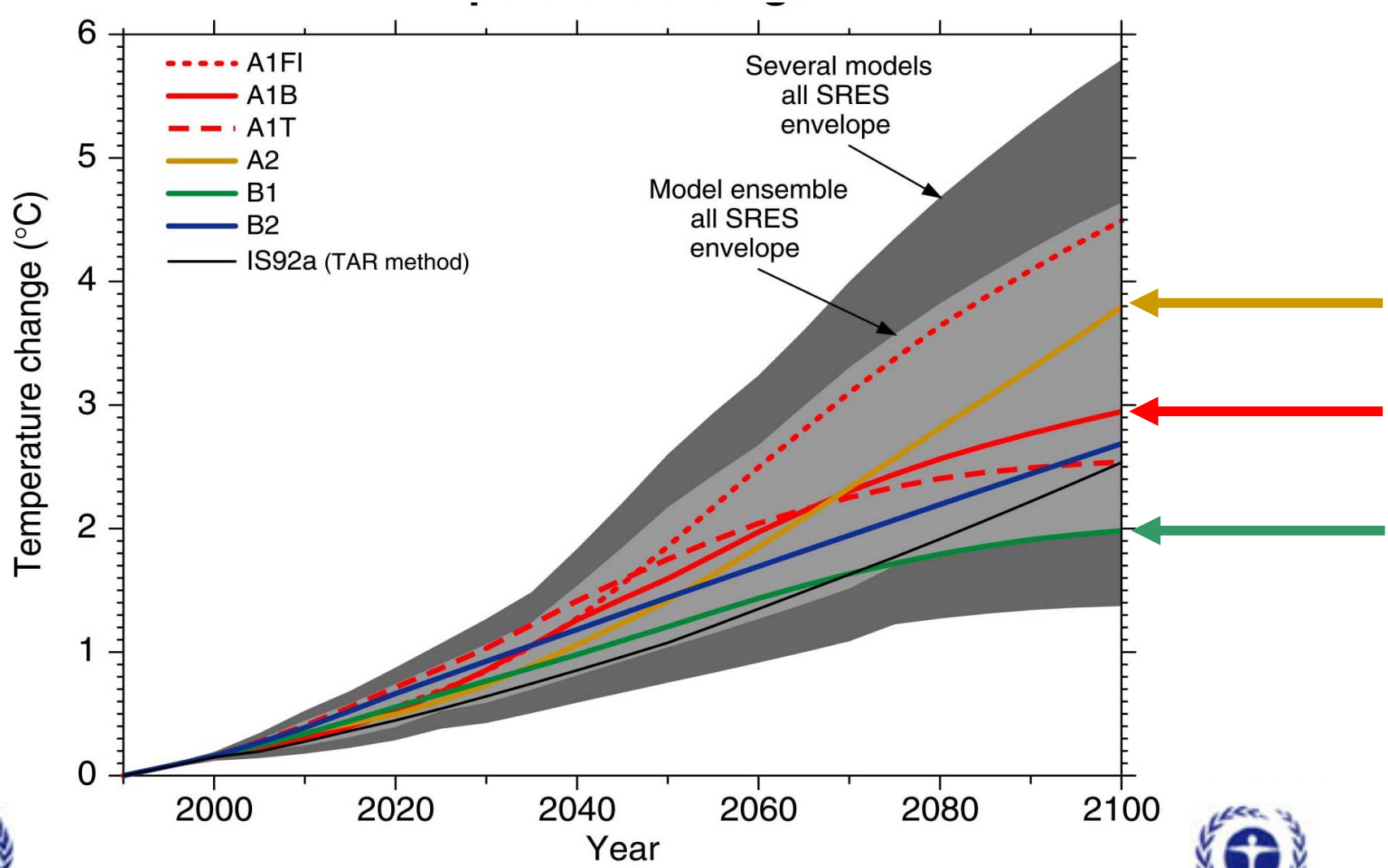


Global Mean Temperature Change

Six illustrative SRES scenarios, full range

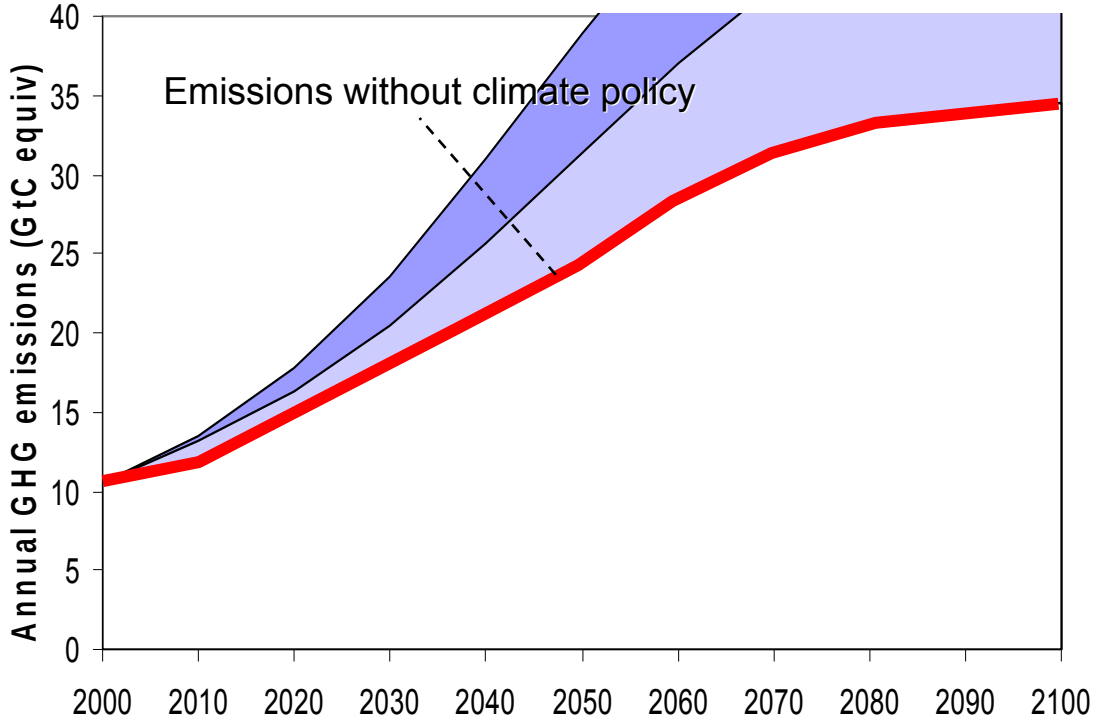


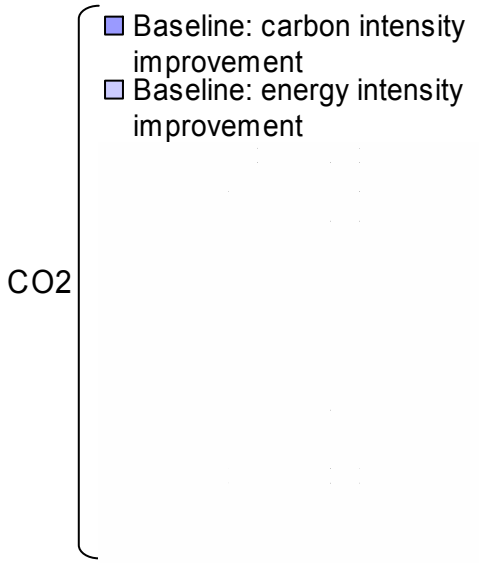
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

WMO

UNEP

World GHG Emissions
IIASA A2r Scenario





World GHG Emissions
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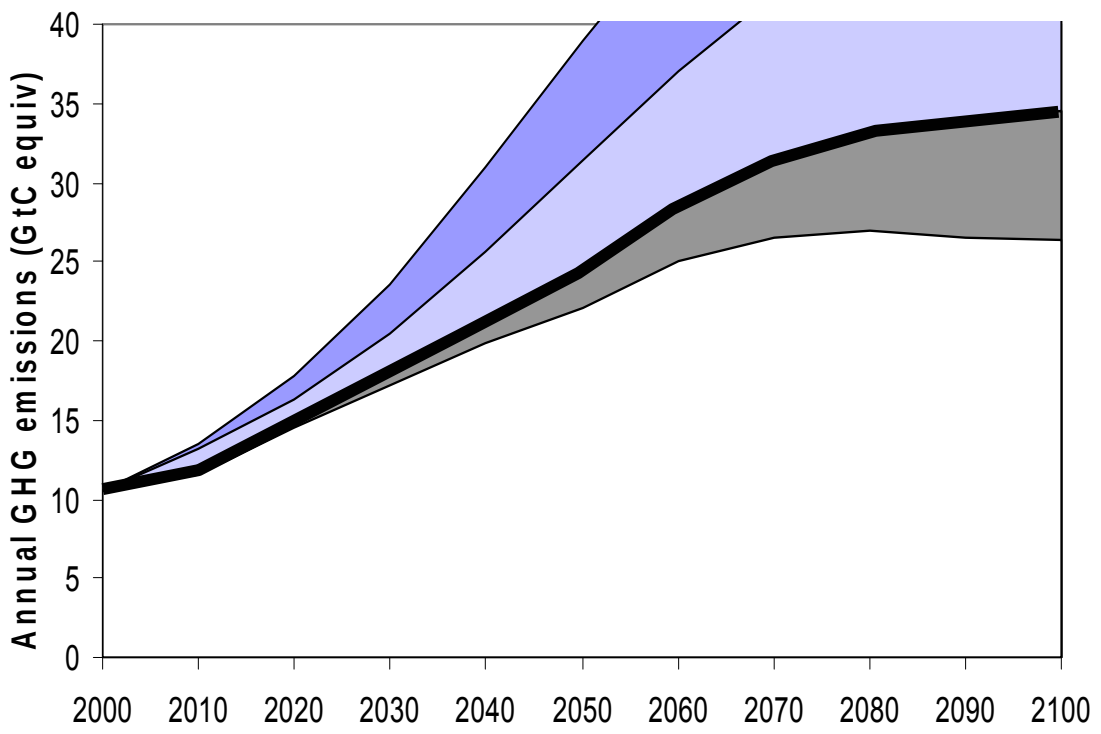

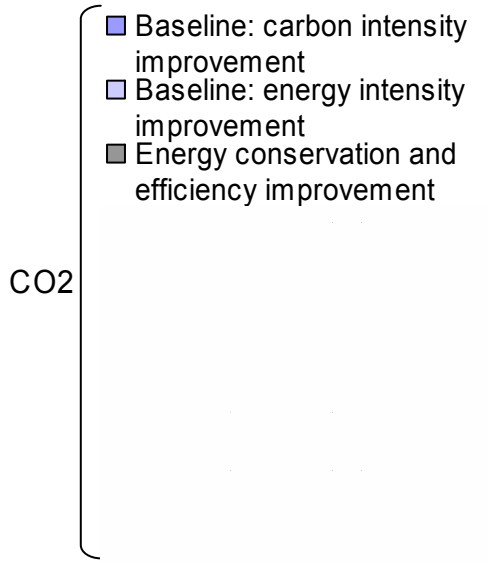

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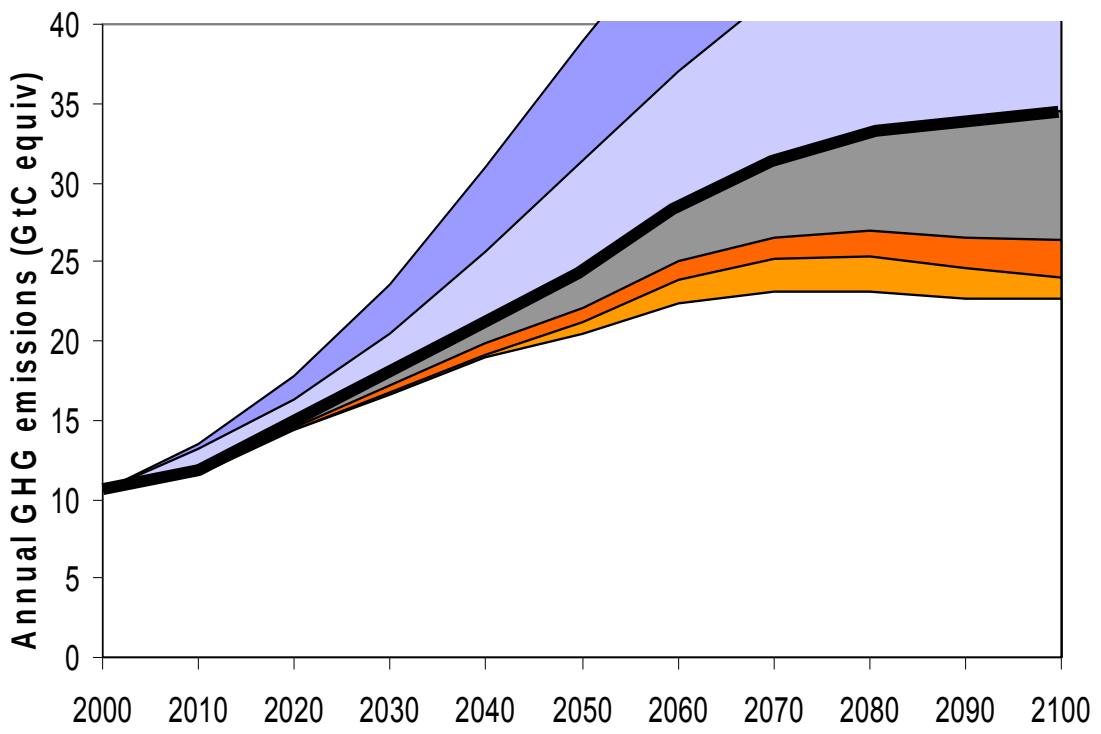

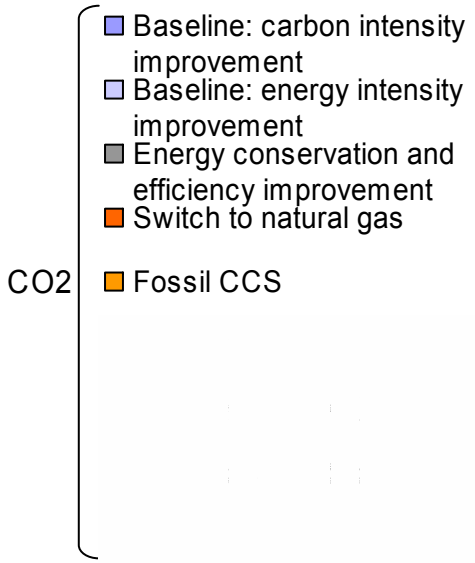

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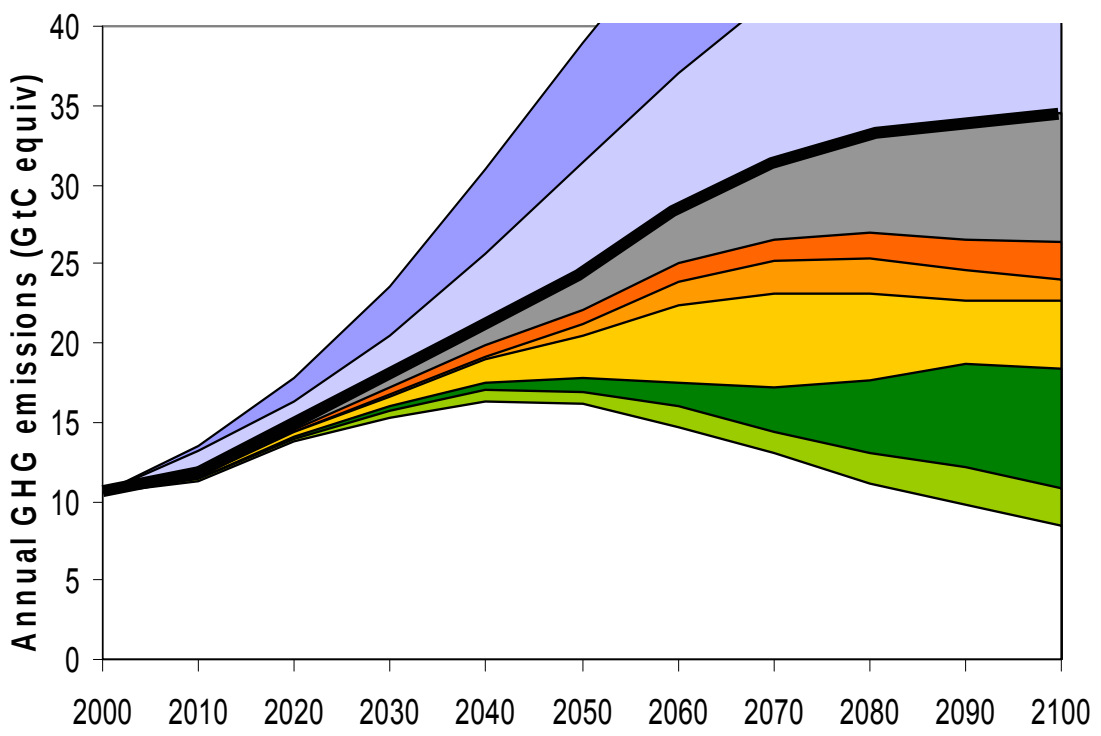
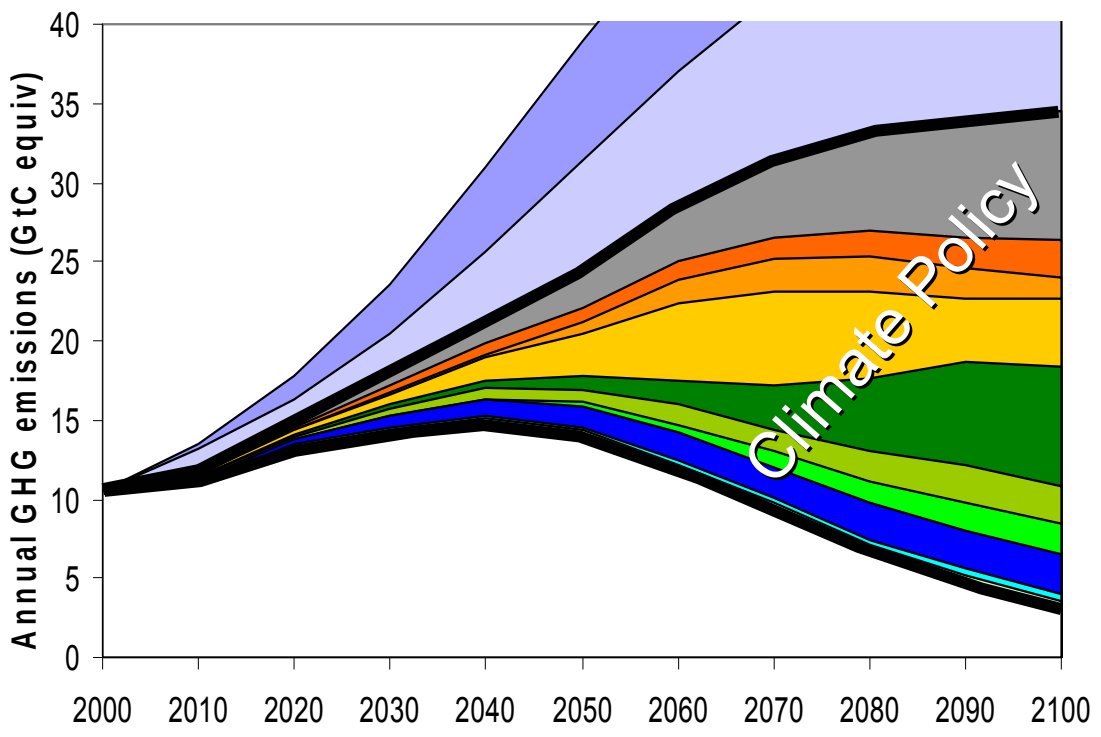
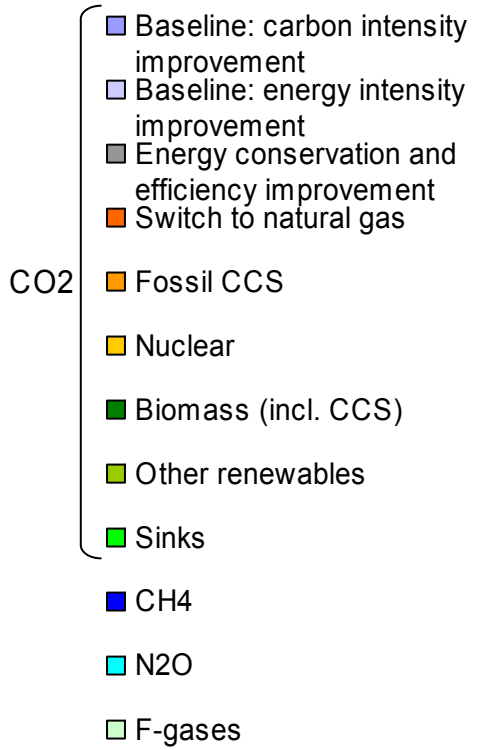


CO2

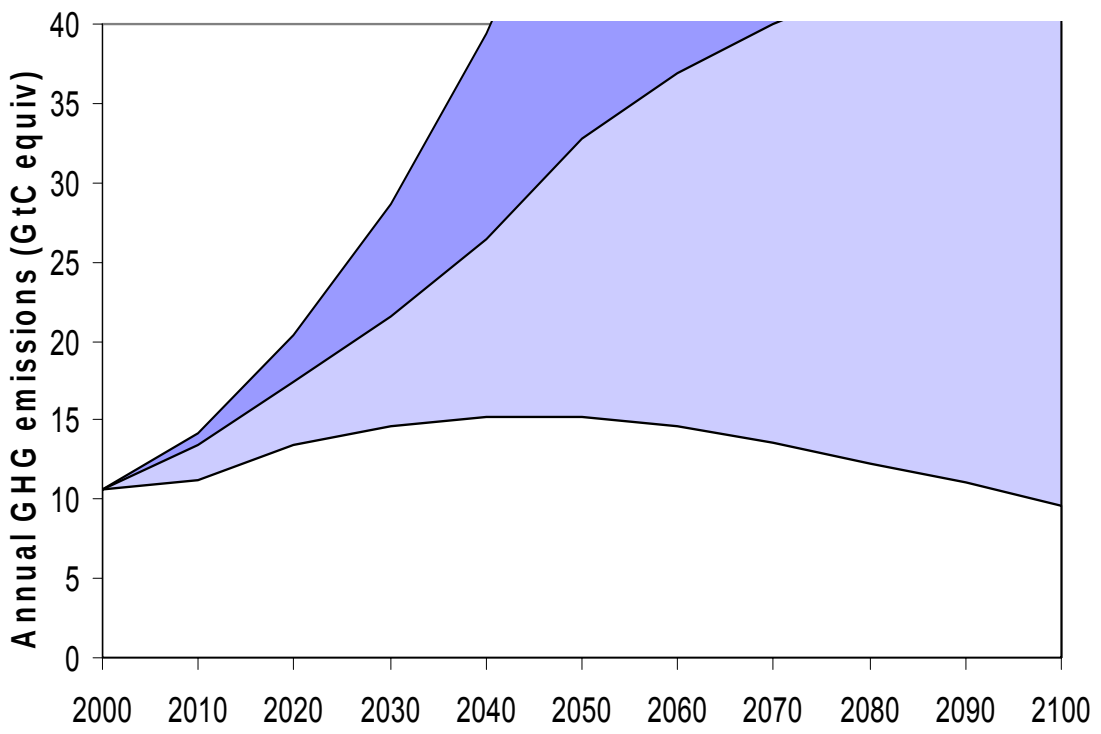
- Baseline: carbon intensity improvement
- Baseline: energy intensity improvement
- Energy conservation and efficiency improvement
- Switch to natural gas
- Fossil CCS
- Nuclear
- Biomass (incl. CCS)
- Other renewables

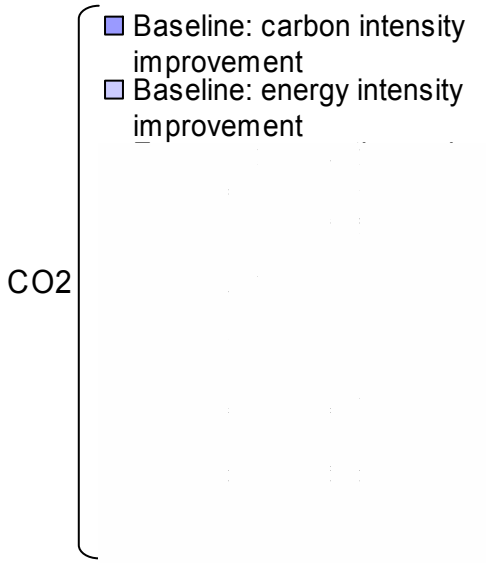
World GHG Emissions
IIASA A2r Scenario





World GHG Emissions
IIASA B1 Scenario





World GHG Emissions
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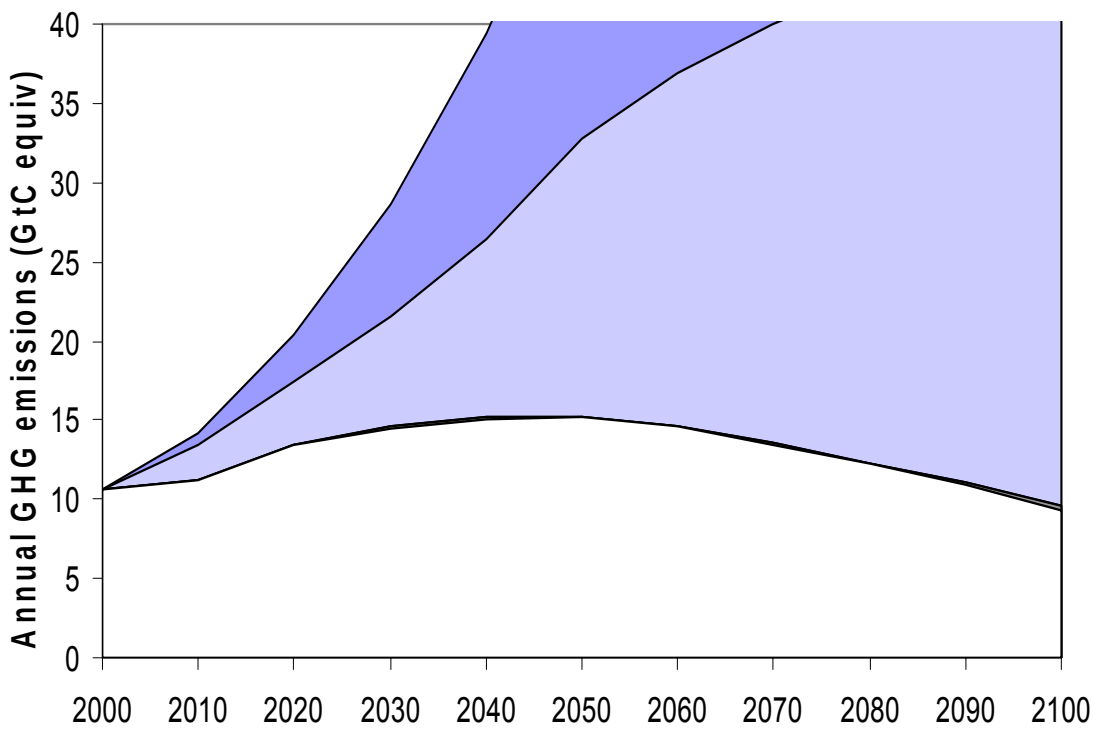

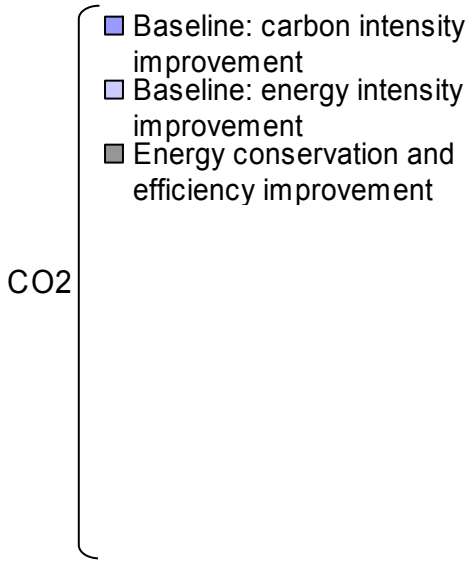

World GHG Emissions
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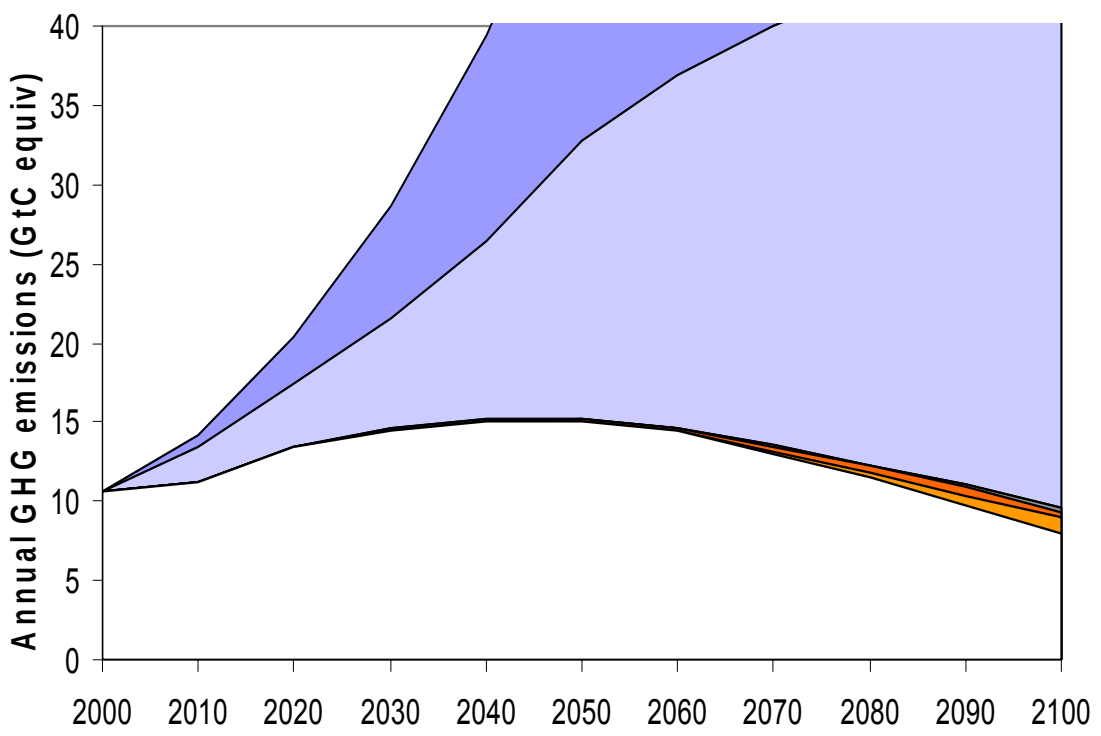

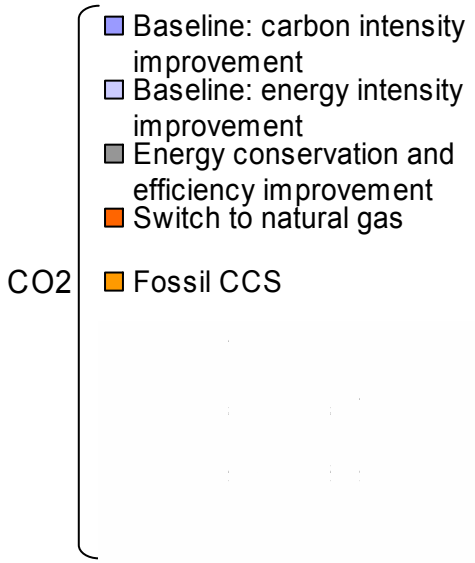

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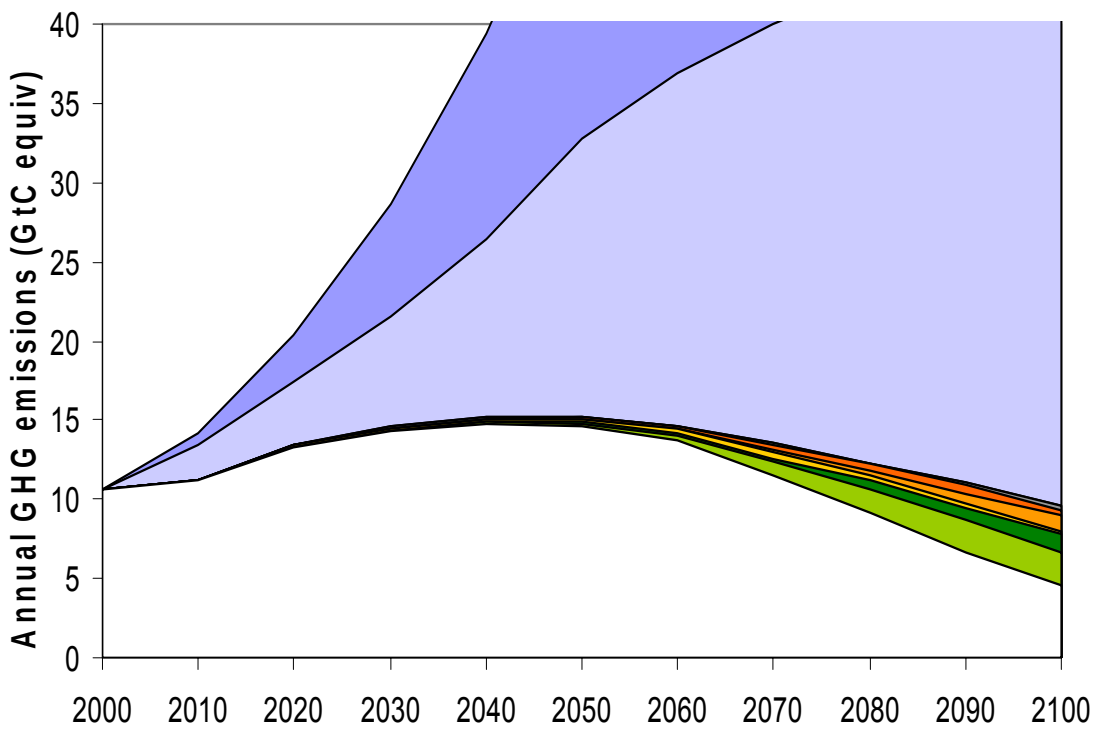

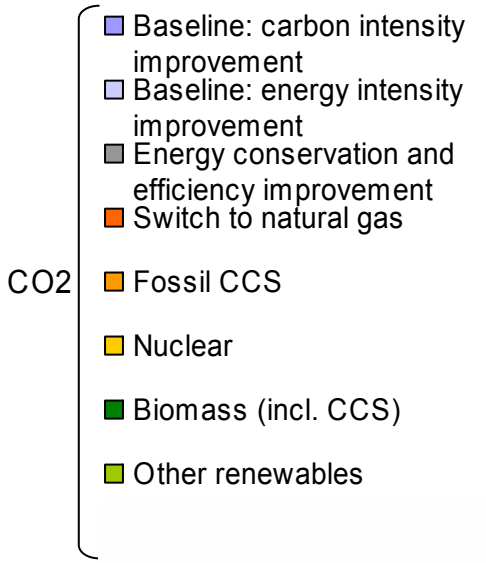

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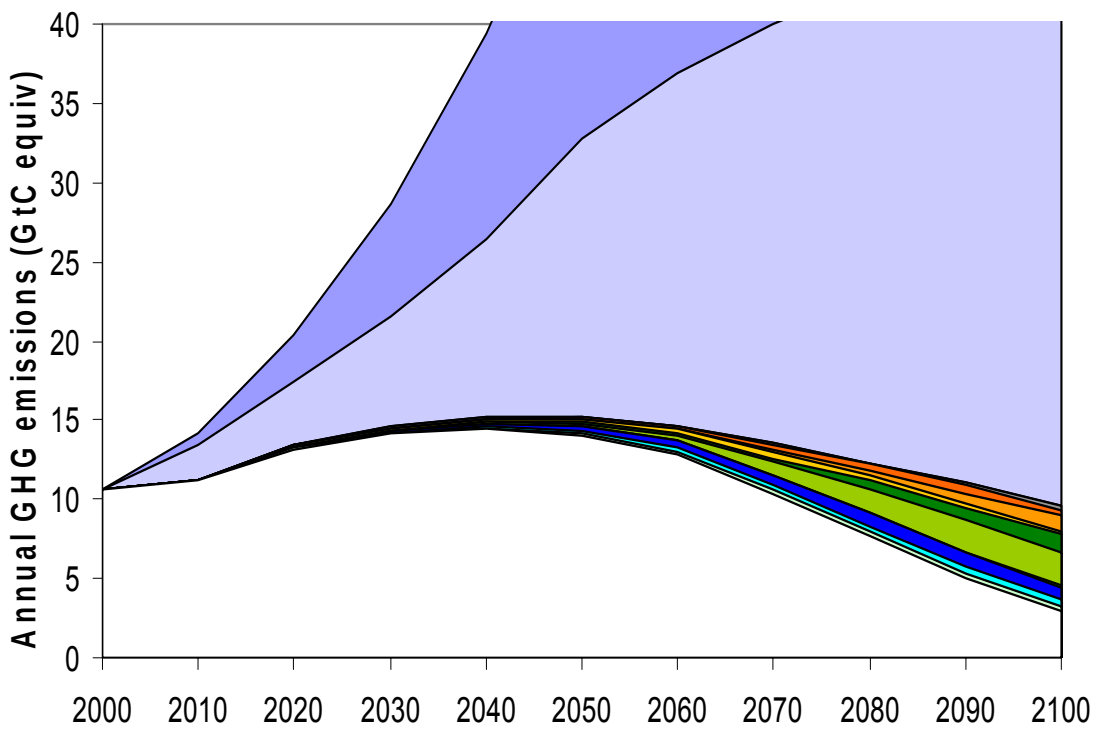
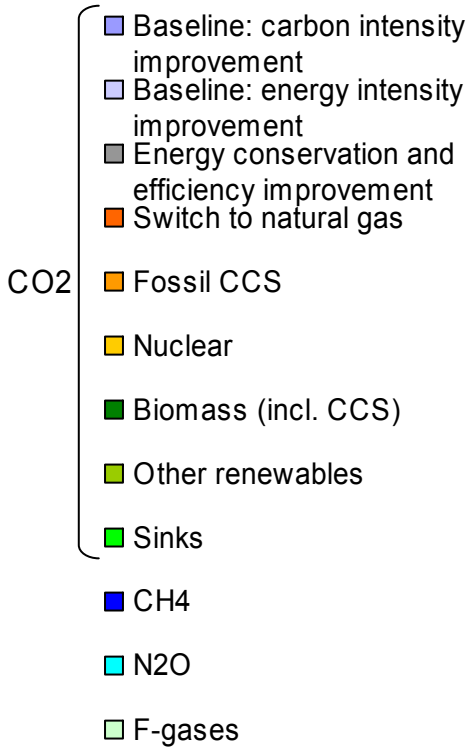




Methode

Baseline Szenario 2050

- **Top-Down Ansatz**

  IPAT Analyse

  (Impact = Population x Affluence x Technology)

  Erlich, Holdren (1972)

Basierend auf folgender Literatur

- **(1) Wifo-Szenario (2005)**
- **(2) European Energy and Transport Trends to 2030 (2004 DG TREN PRIMES-Modell)**
- **(3) IPCC Special Report on Emissions (2001)**

$$Emissionen\ in\ CO_2Equiv = B \cdot \frac{BIP(VA)}{B} \cdot \frac{E}{BIP(VA)} \cdot \frac{CO_2Equiv}{E}$$

B ... Bevölkerung

BIP ... Bruttoinlandsprodukt

VA ... Sektorielle Wertschöpfung

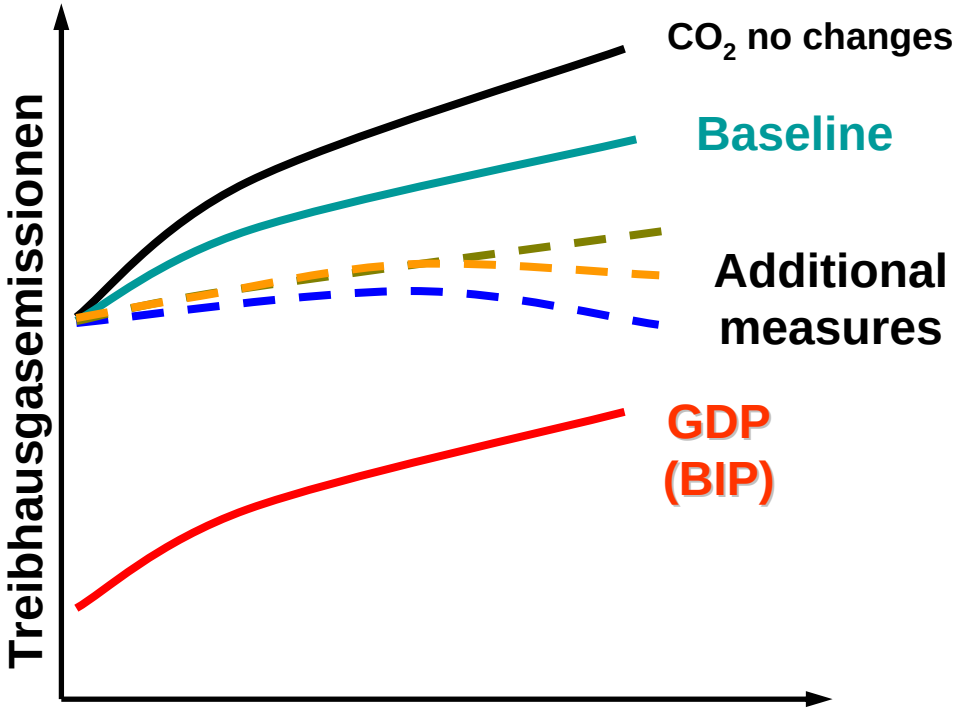
E ... Energiebedarf

- **Baselineszenario 2020-2050**
  - **Intensitäten von (2) und (3) MESSAGE A1-B2 Szenarien**
  - **Übernommen und an (1) angepasst**
- **Baseline Szenario ist energieintensives Szenario**

Emissionen:

Vermeidungsmaßnahmen

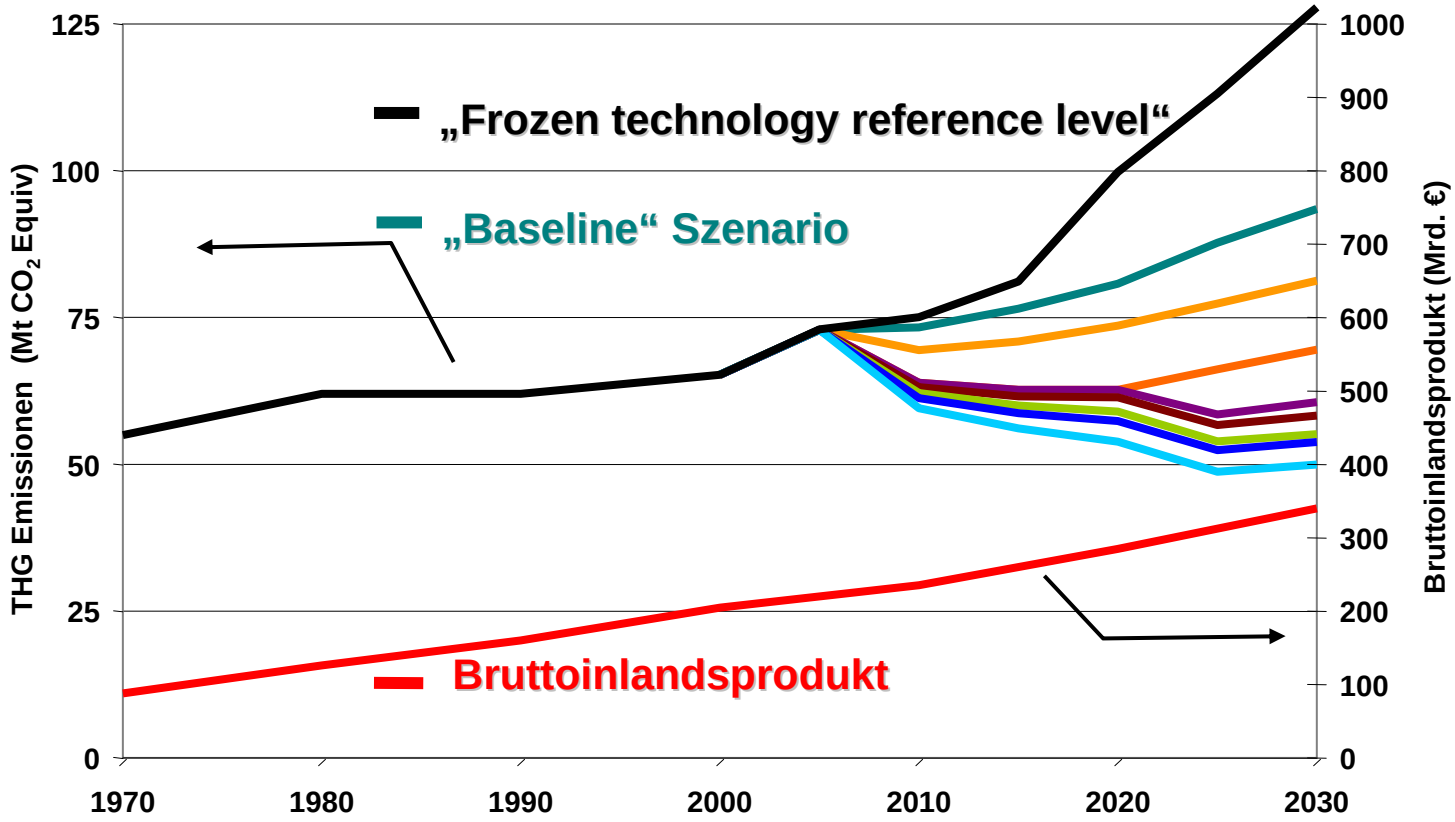
- **Analysen werden bei konstanter Energiedienstleistungsnachfrage und Nachfragestruktur durchgeführt**



- **Durch effizientere Bereitstellung der Energiedienstleistung**
  - **Technologien mit höherem Jahresnutzungsgrad**
  - **Gebäudedämmung / -struktur**
  - **Reduktion des Flottenverbrauchs**
- **Durch Substitution von emissionsintensiven Technologien**
  - **Änderung der Energieträger**
  - **Verstärkte Nutzung von öffentlichen Verkehrsmittel**
  - **CO2-Abtrennung**

Research for Climate Protection

Technological Options for Mitigation (Reclip:tom)



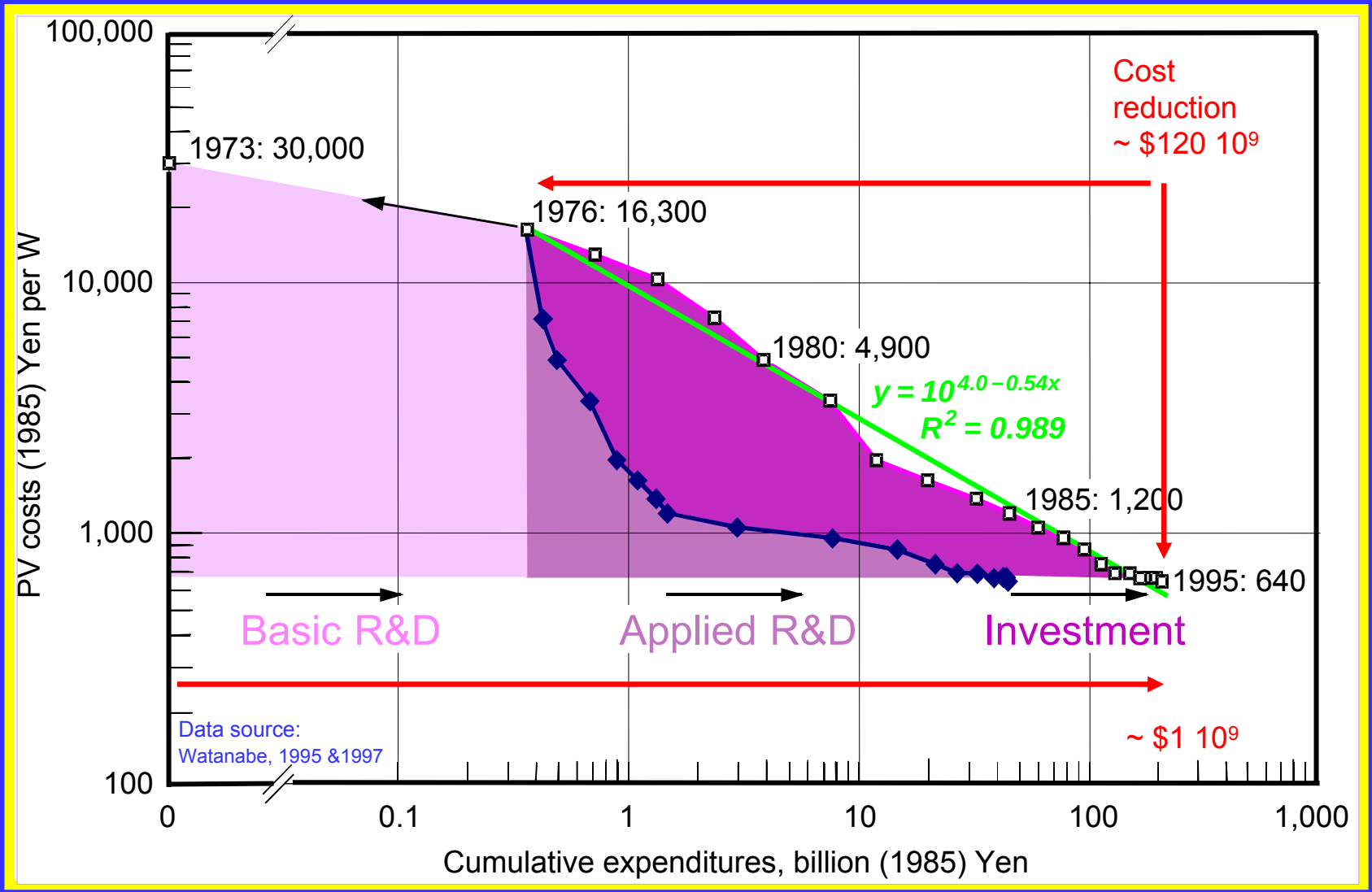
Energieeffizienz: Raumwärme, Licht, EDV, elektr. Motoren
Energieeffizienz Transport
Kein Neubau von Kohlekraftwerken
Ergasfahrzeuge und forcierter Einsatz von Biofuels
Zusätzlicher Ausbau von erneuerbaren Stromerzeugung
Haushalte, Tertiärer Sektor: Vollständiger Ersatz von Kohle u. Öl durch Gas
Industrie: Vollständiger Ersatz von Kohle u. Öl durch Gas

Müller, 2006

TECHNOLOGIE-ENTWICKLUNG
Technology Dynamics

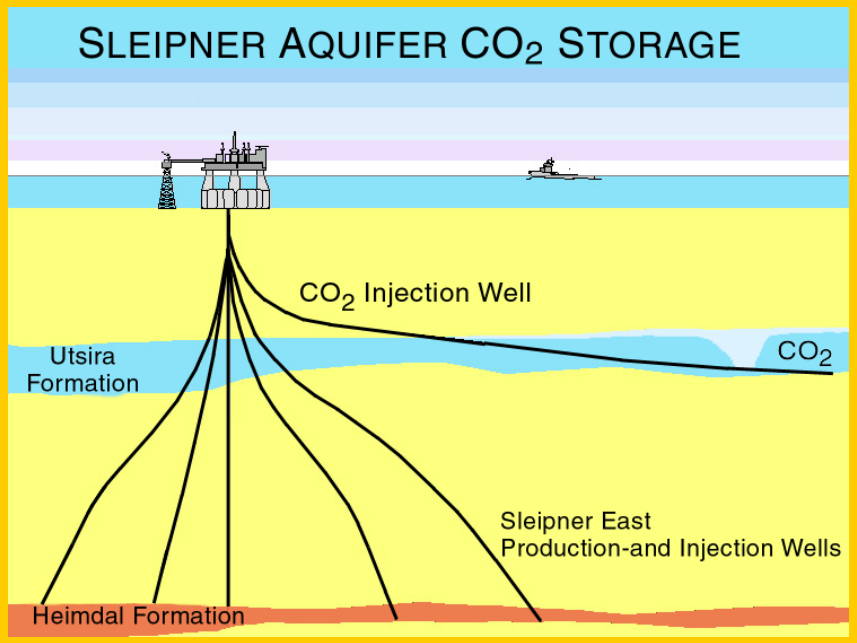
- Technologische Unsicherheit: Beschränktes Wissen über zukünftige Technologien
  - Deep Uncertainty: Limited knowledge on feasibility and costs of future technologies
- Endogene Technologiedynamik: Kostensenkungen von Technologien sind Folgen der gesammelten Erfahrung
  - Technological Learning: Improvements are a function of accumulated experience (learning curve)

Japan - PV Costs vs. Expenditures



Existing and Planned Projects

- Sleipner Project, saline formation, North Sea
- Weyburn, EOR, Saskatchewan, Canada
- In Salah, gas reservoir, Algeria (development)
- Snohvit, off-shore saline formation, North Sea
- Gorgon, saline formation, Australia (planning)

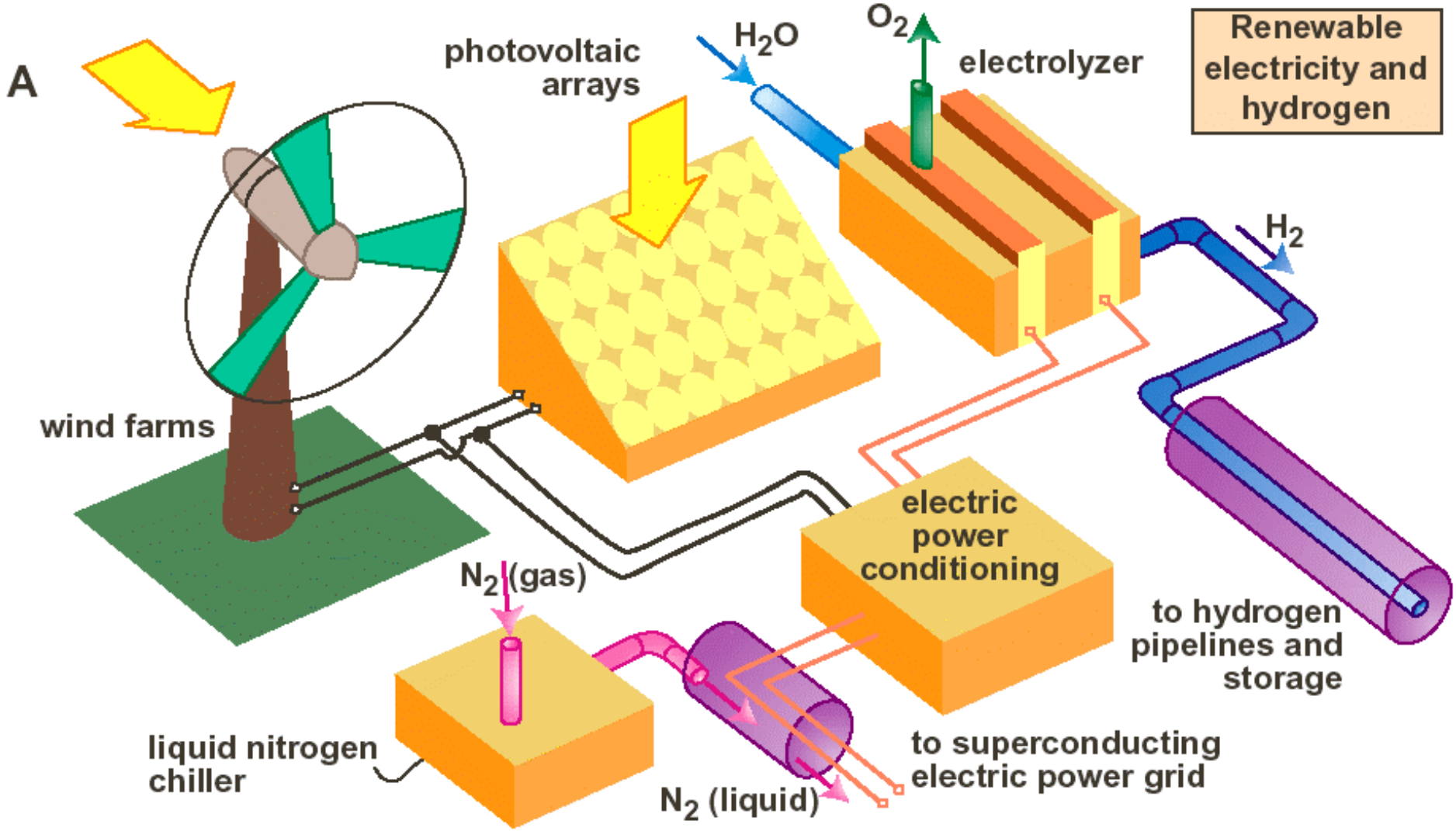


Nakicenovic #36

Source: Sally Benson, 2003

RENEWABLES

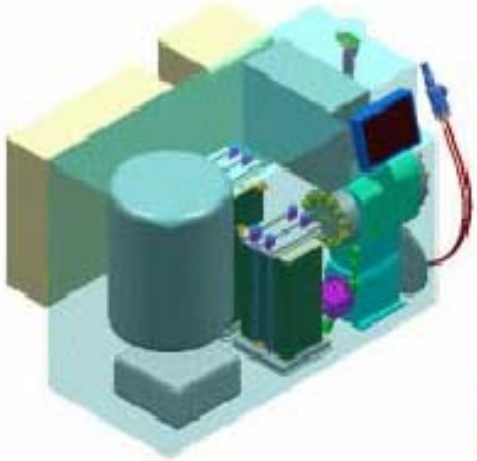
Hoffert et al., Science, 2002



Home Refueling System Concept

HONDA
The Power of Dreams

- *Home-size combined system, which provides Hydrogen to FCV as well as Electricity and Heat to household.*



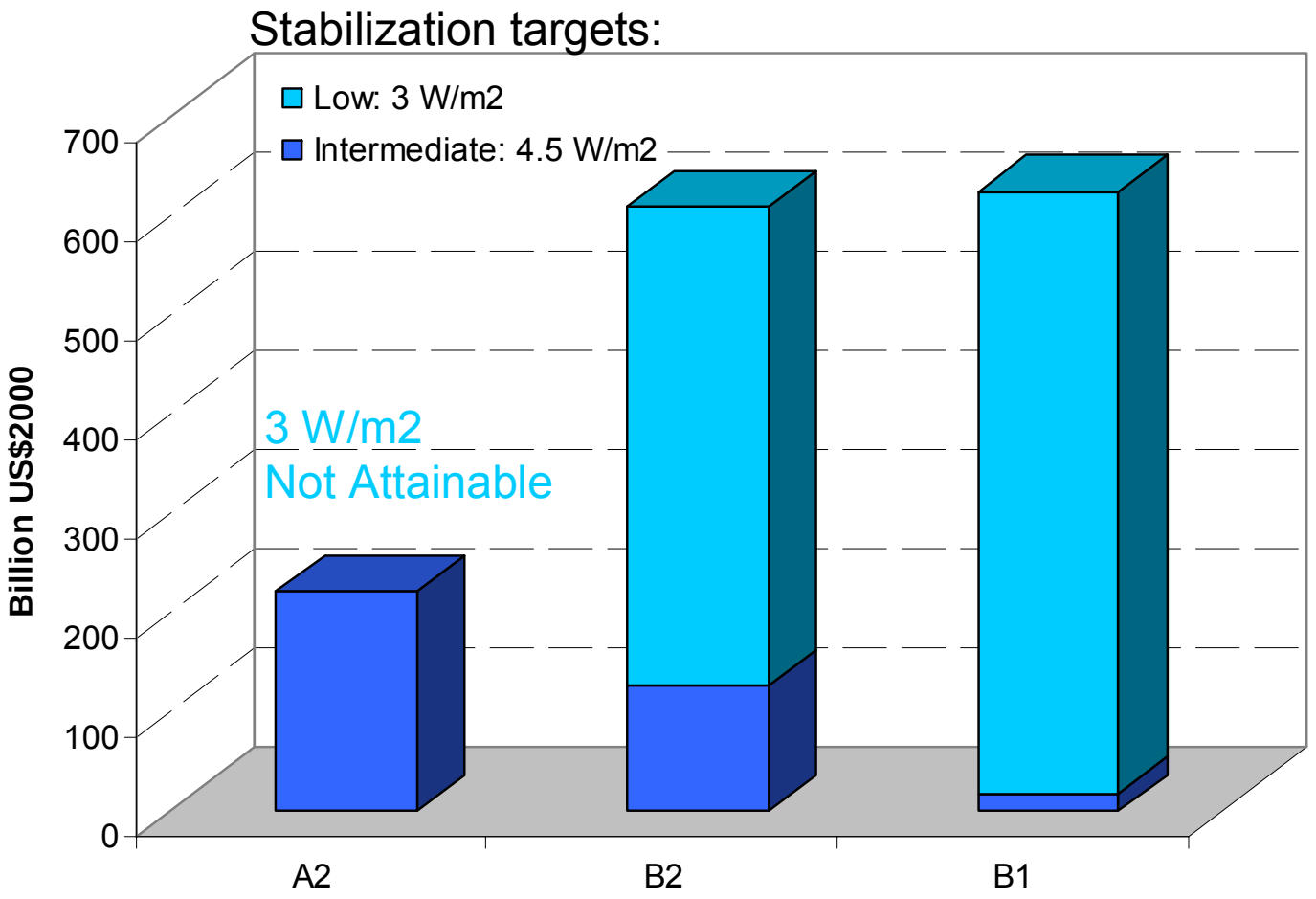
H2 for FCX

Heat & Power
for residence

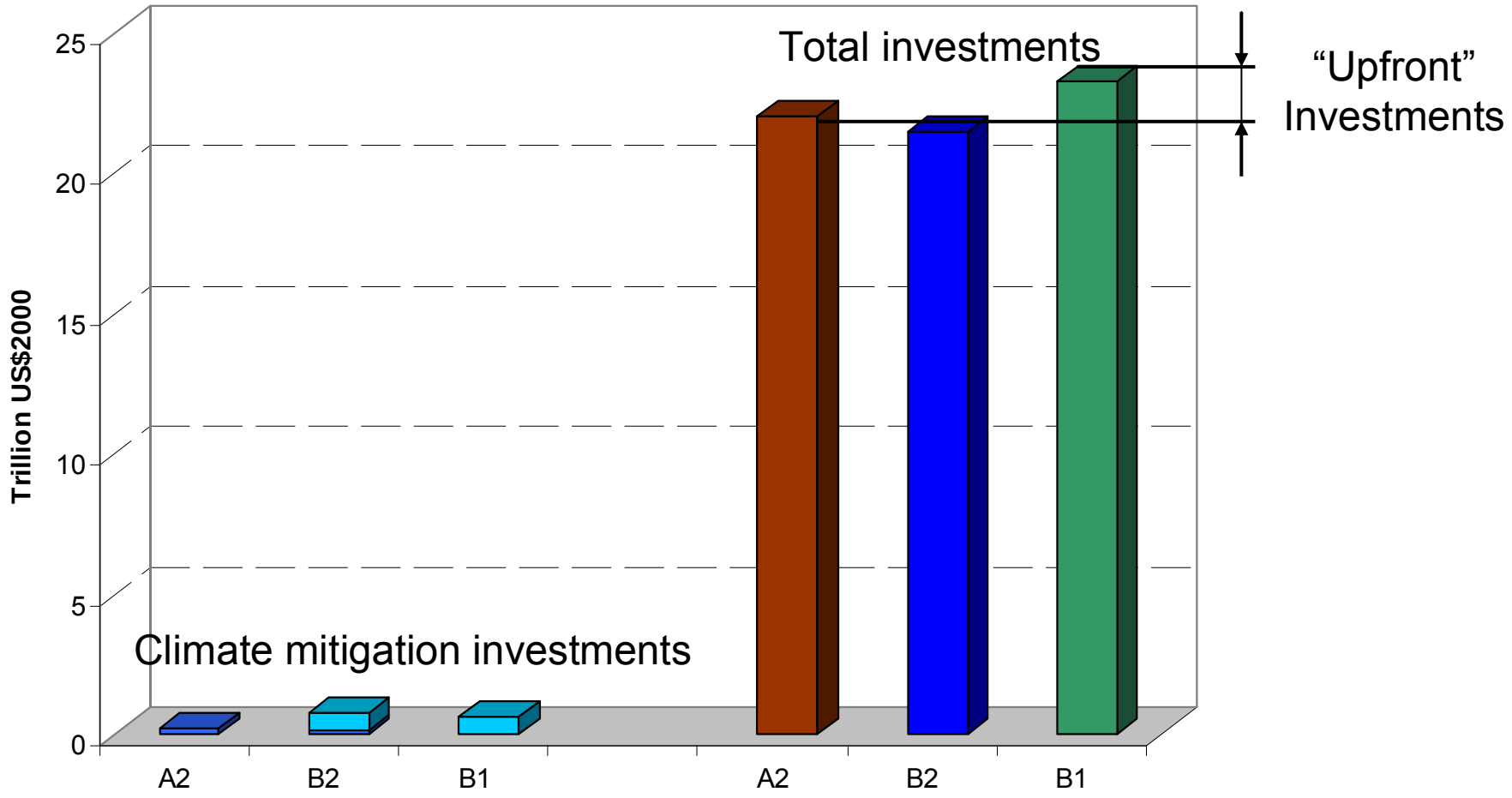
Natural gas

Hydrogen Airplane Design

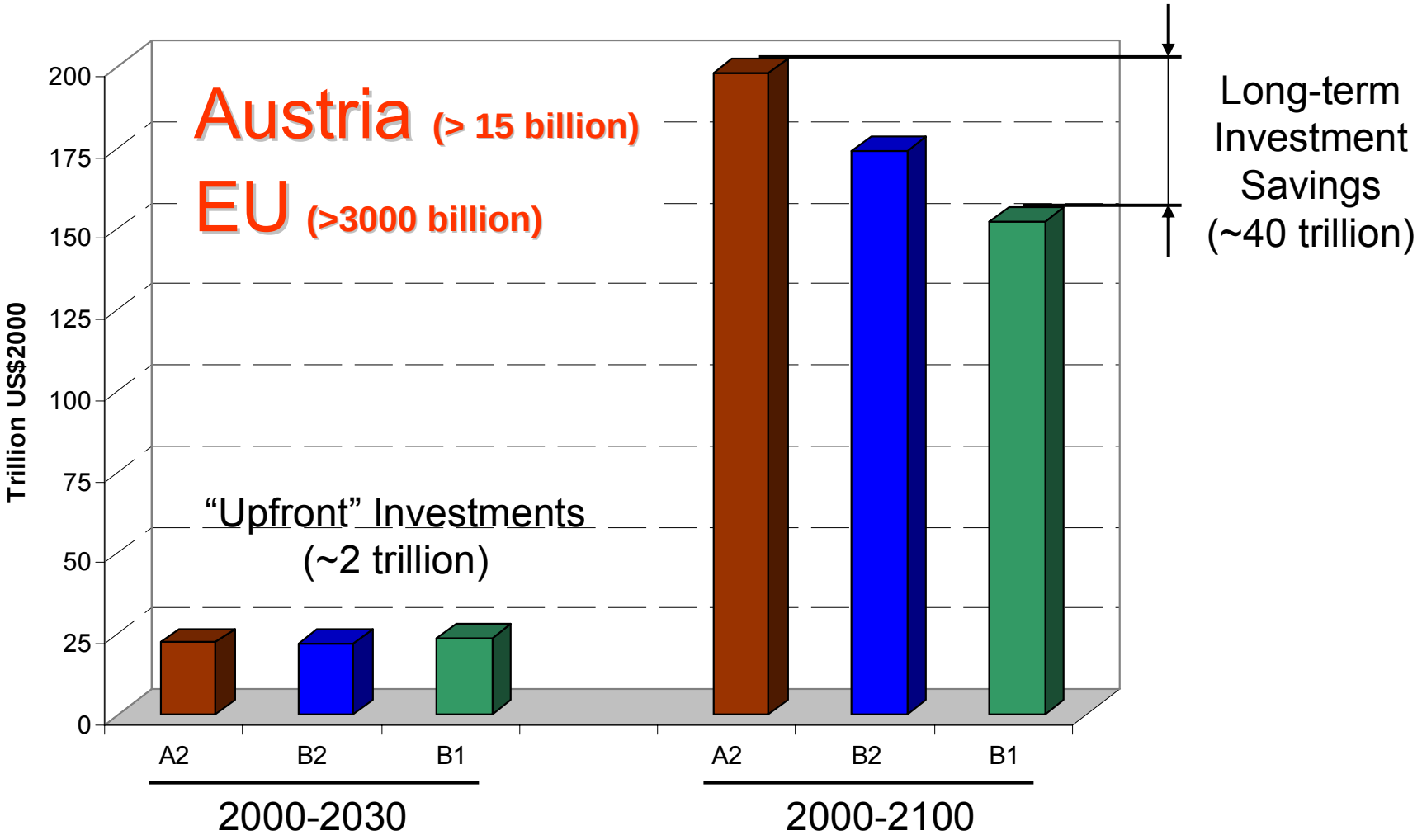
Climate-related Investments (2000-2030) (mitigation in the energy sector)



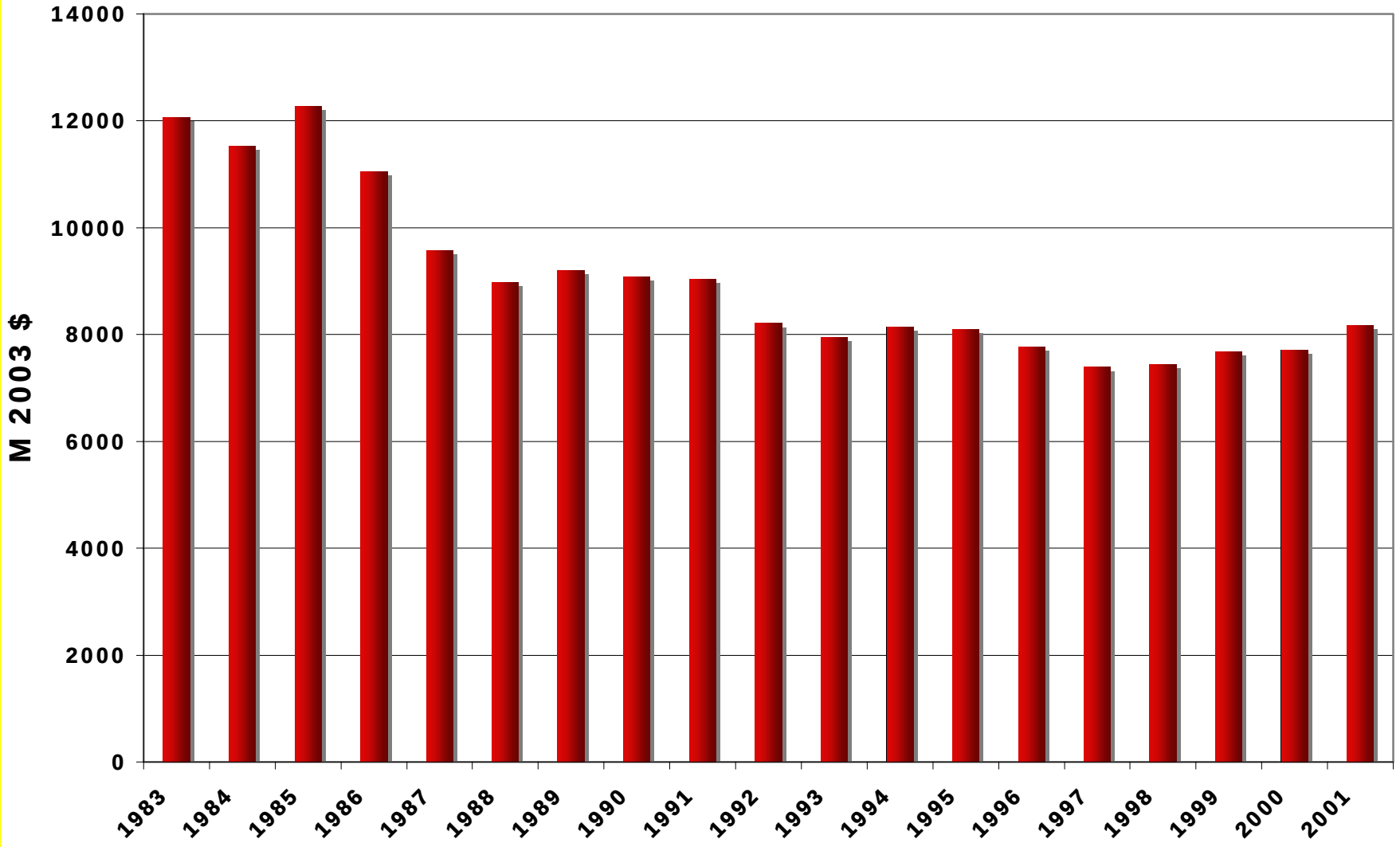
Climate Mitigation vs Total Energy Investments (World, 2000-2030)



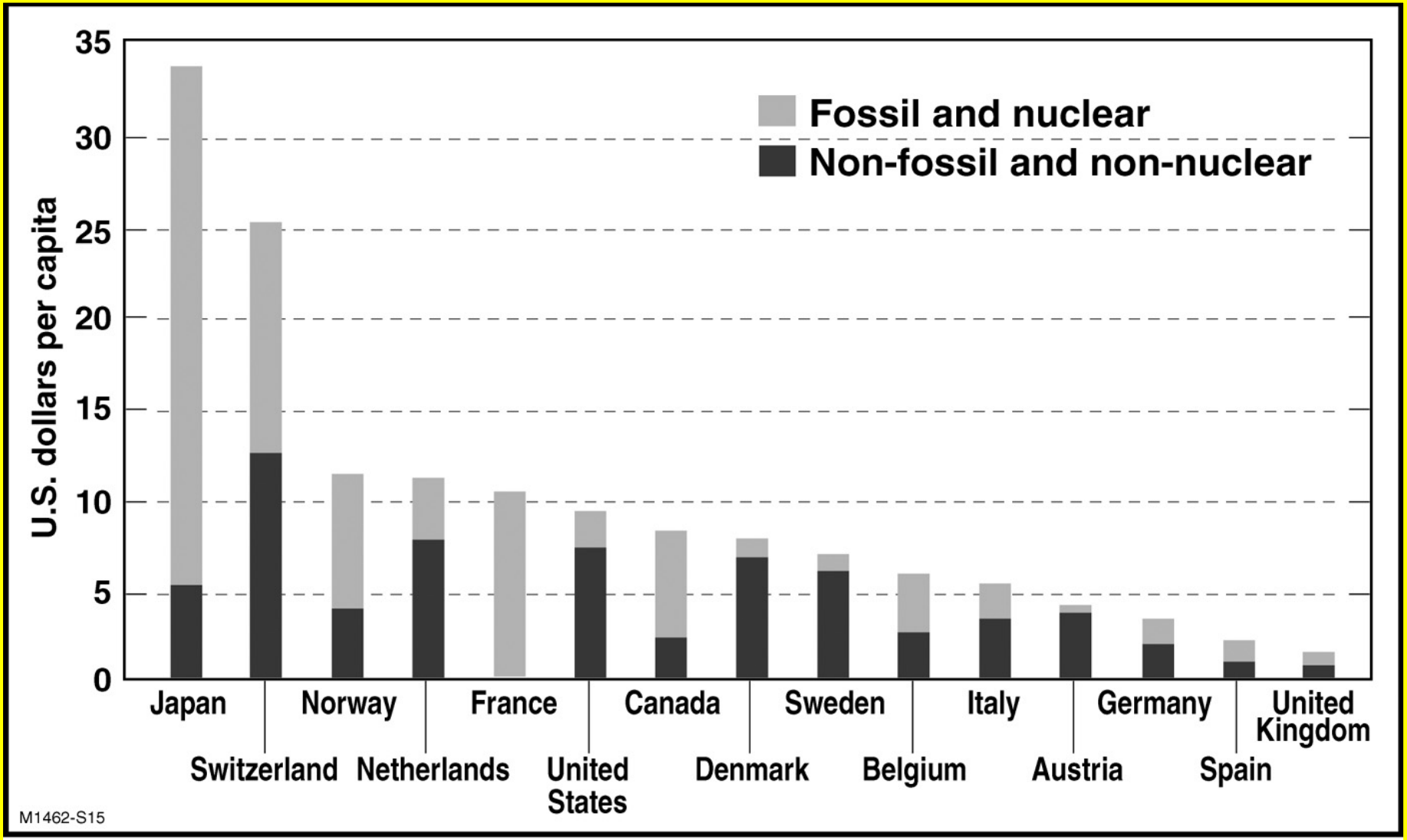
Total Energy-related Investments (World, short & long-term)



OECD E-R&D Budgets



Public Expenditure on E-R&D



World Energy Assessment, 2000

Global Energy Assessment:
Towards a more Sustainable Future

- The *magnitude* of the change required is *huge*
- The challenge is to find a way forward that addresses all the issues *simultaneously*
- A paradigm shift is needed: energy end-use efficiency, renewables, and carbon capture and storage.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