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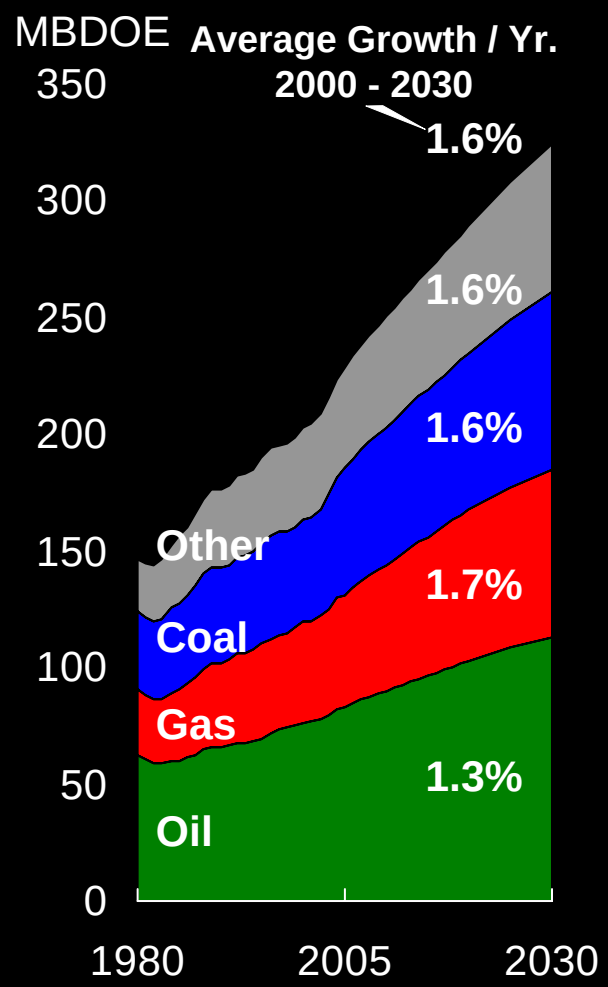
Energy Outlook and Climate Policy Framework

Sherri K. Stuewer
Vice President SH&E

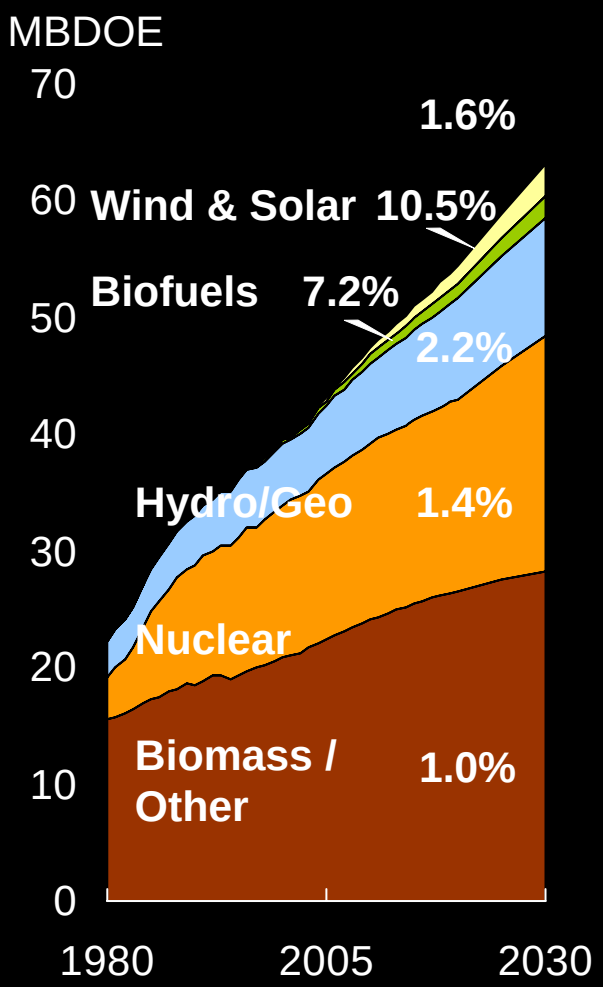
August 2007

Global Energy Demand by Fuel

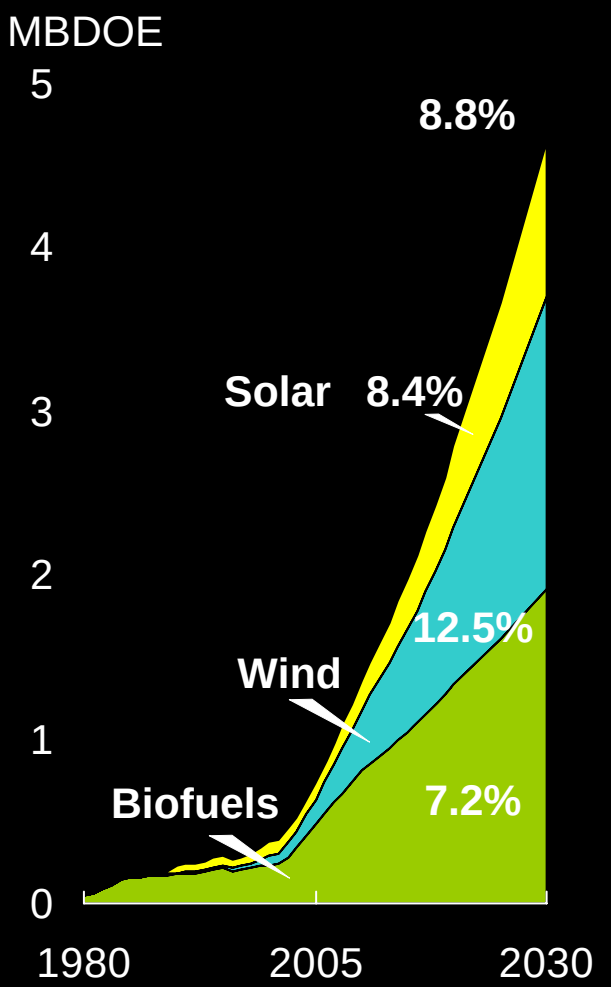
Primary Energy



Other Energy



Wind, Solar & Biofuels



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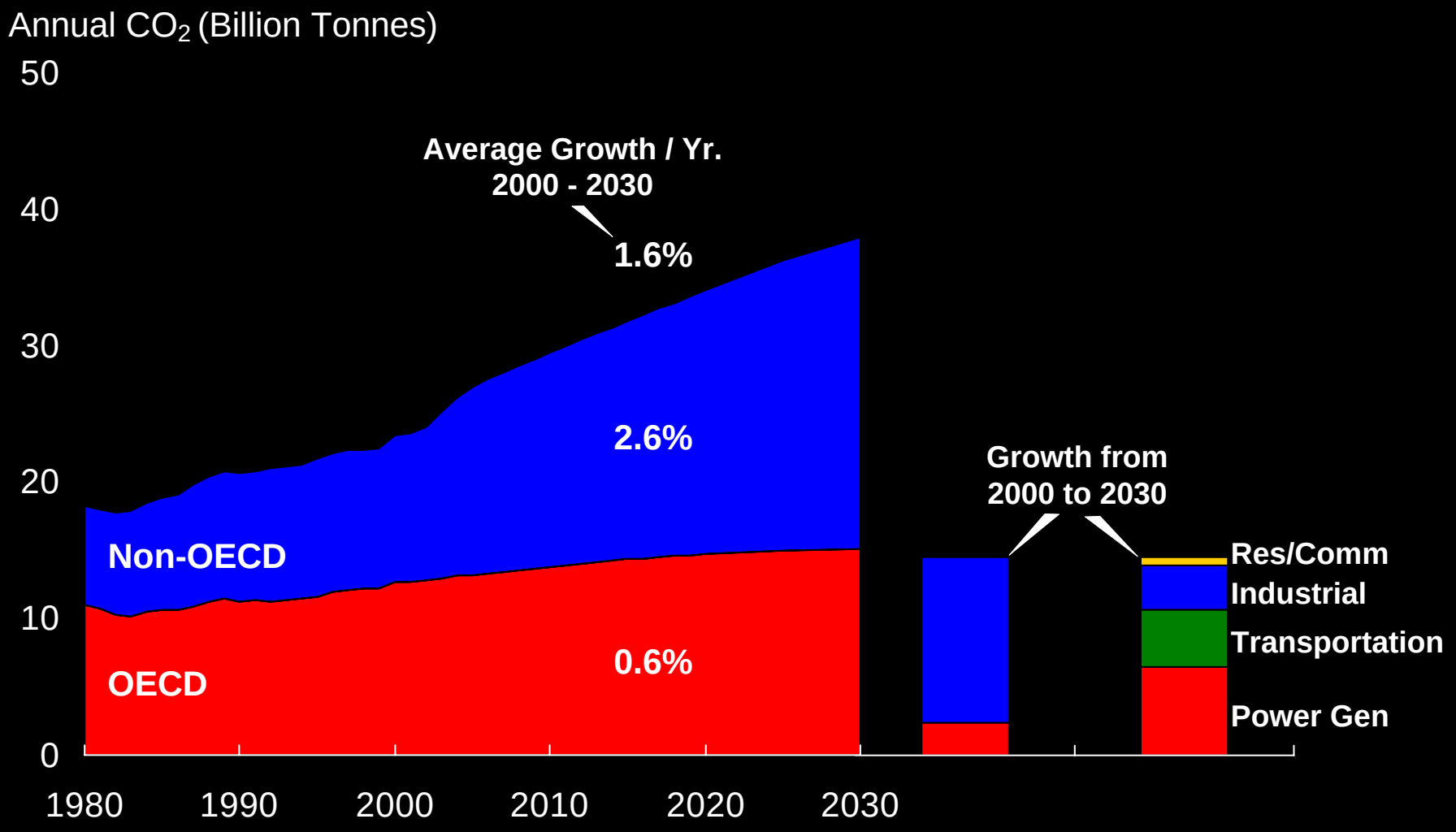
Global CO_2 Emissions from Energy Use



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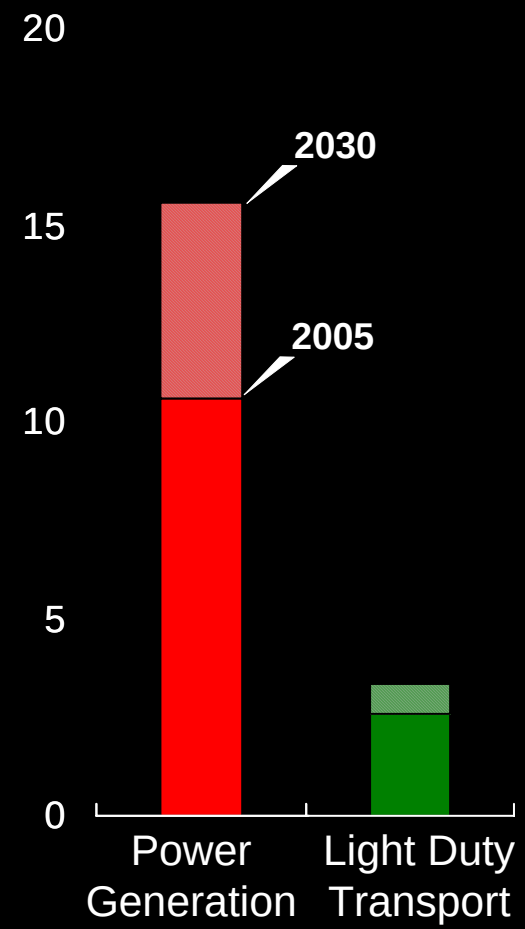
CO_2 Mitigation Options

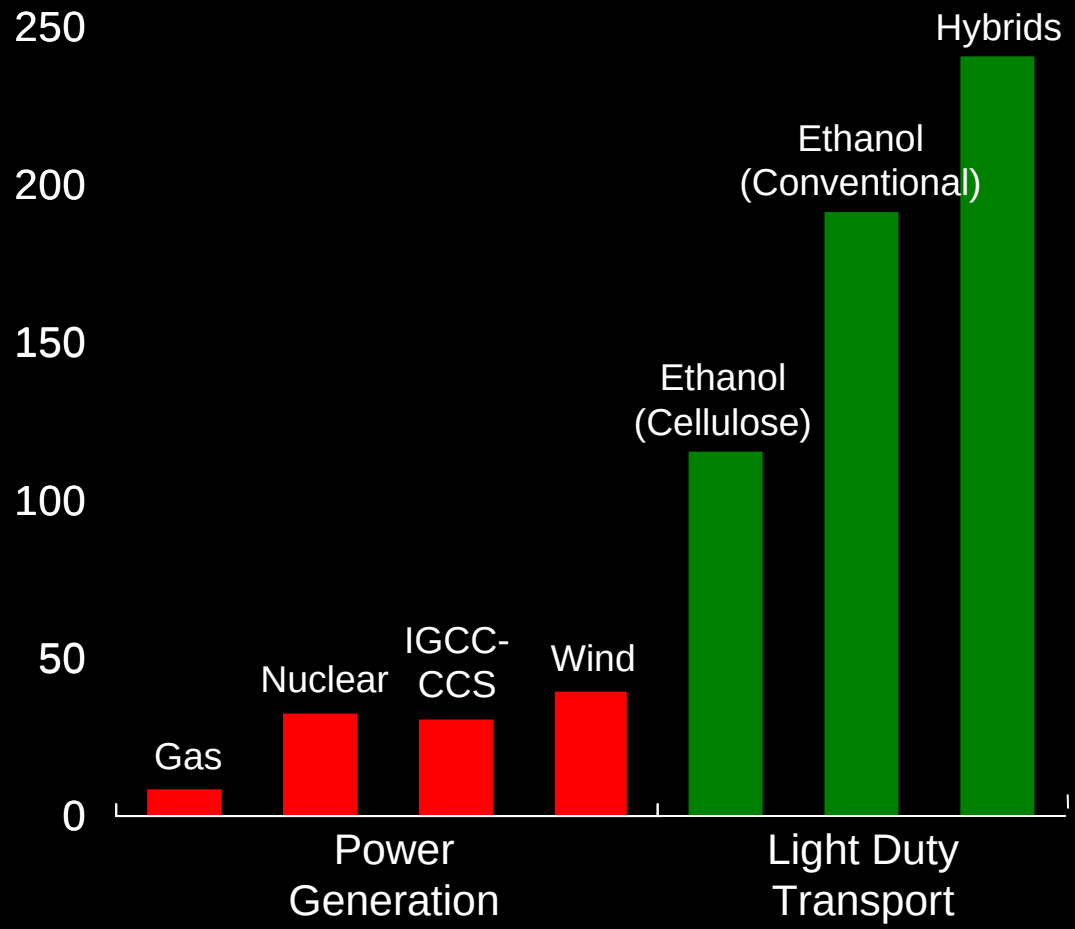
Scale

Annual CO_2 (Billion Tonnes)



Cost

$ per Tonne CO_2 Avoided



Source: SFA Pacific; JEC WTW Study (Dec. 2005)

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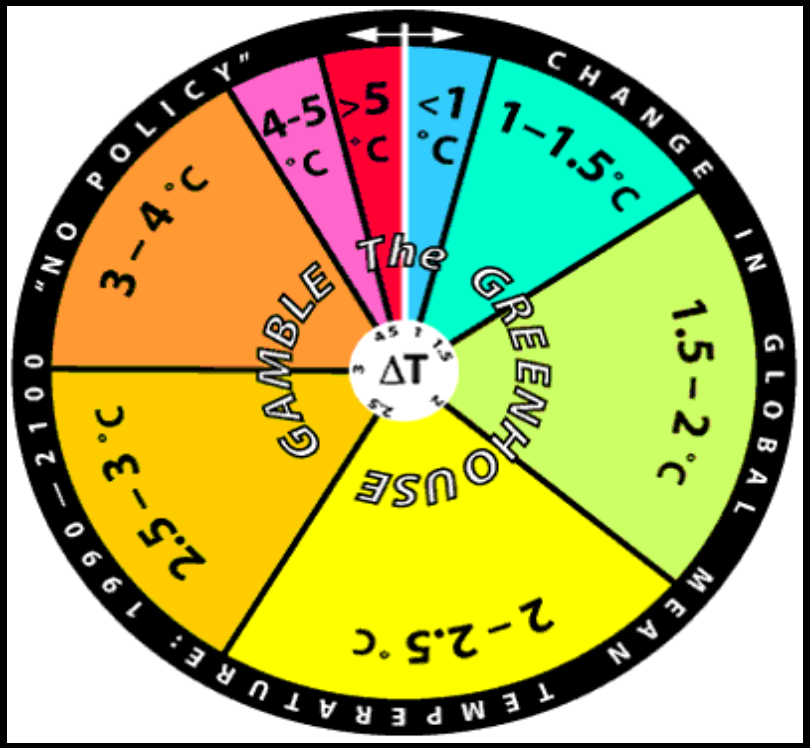
Climate Change Risk Management

MIT Joint Program



Temperature increase by 2100
with no new GHG policy

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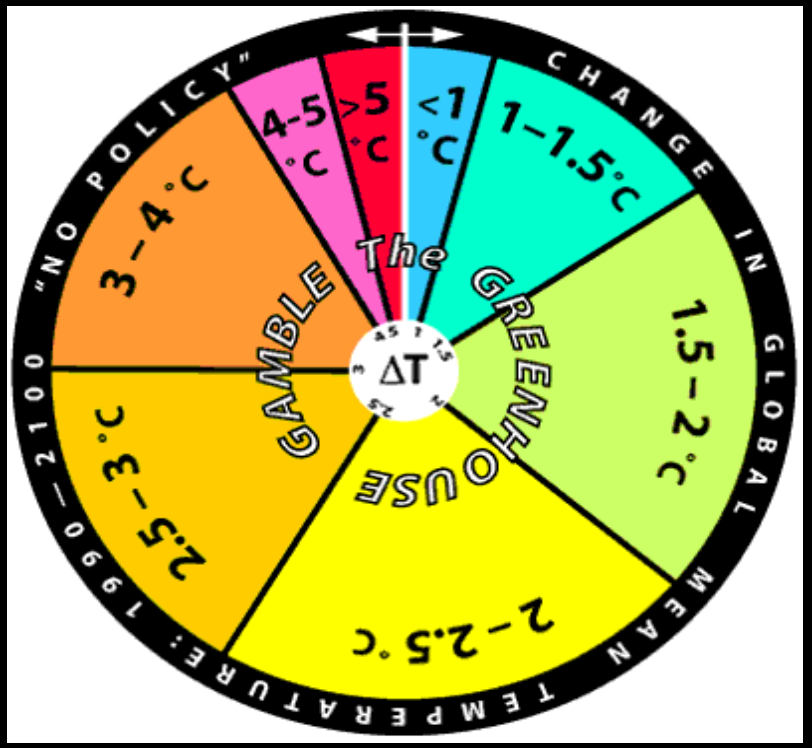
Climate Change Risk Management

MIT Joint Program



Temperature increase by 2100
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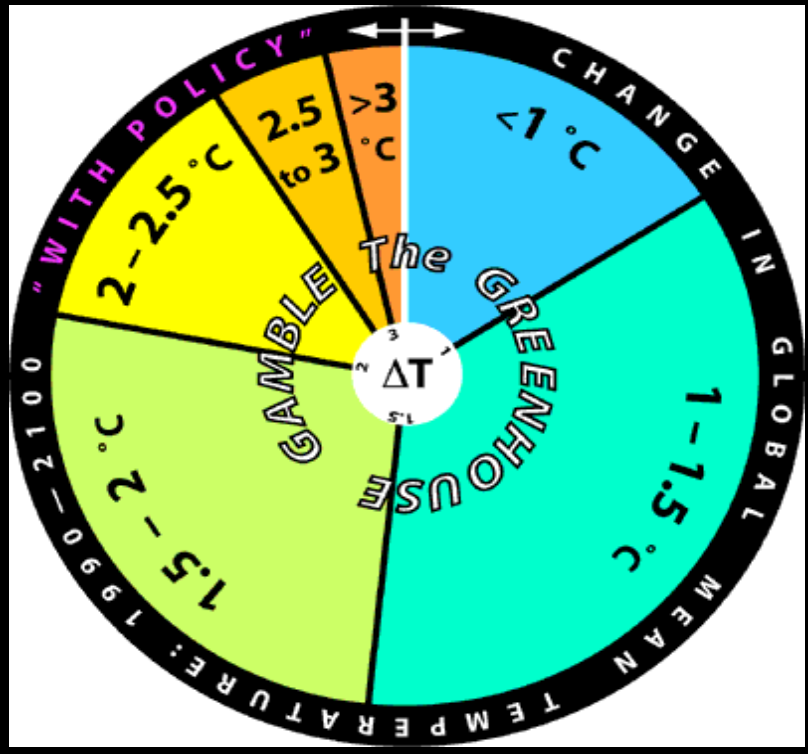

Temperature increase by 2100
at 550 CO_{2e} stabilization

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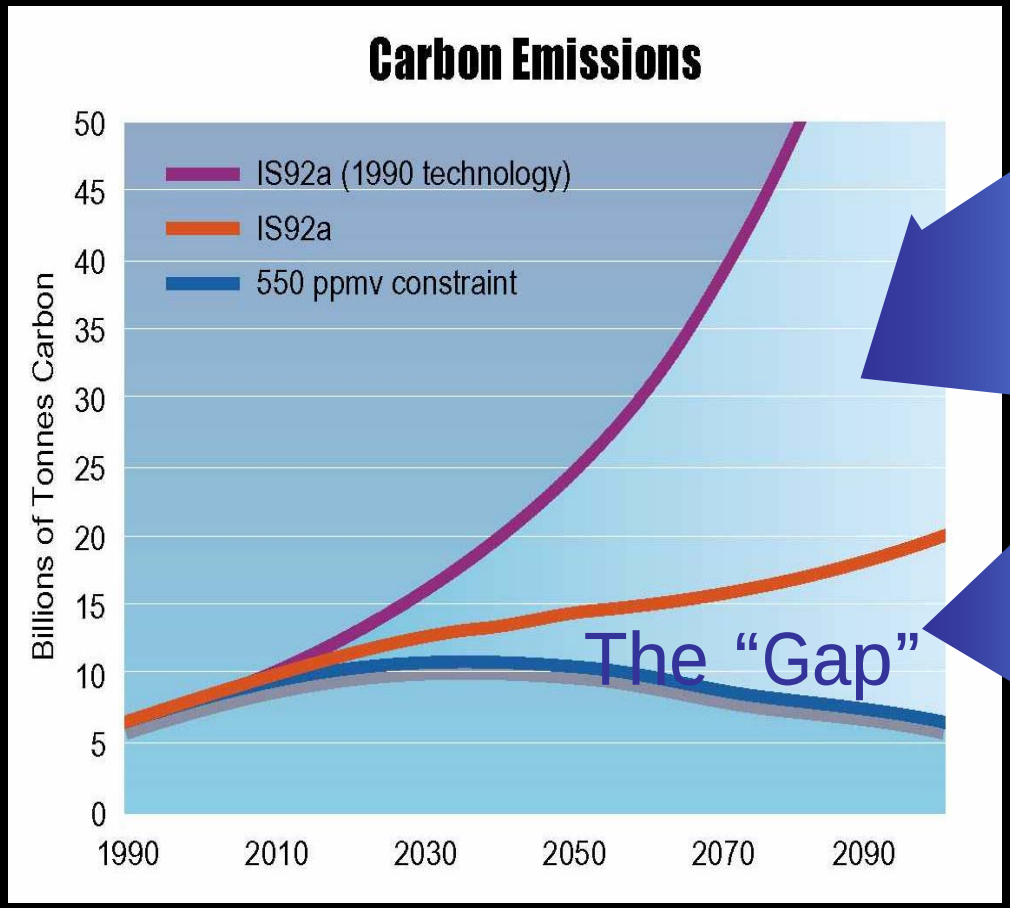
Efficiency Improvements and New Technology Needed



Assumes Significant Advances:

- Energy intensity
- Nuclear
- Renewables

Gap Technologies:

- Carbon capture and storage
- H_2 and advanced transportation
- Bio-technologies
- Solar

Source: J. Edmonds, PNNL

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Policy Framework for Managing Risks of Climate Change

- Long-term objective:
  - Reduce risk of serious impacts at reasonable cost to society

- Near-term objectives:
  - Promote energy efficiency
  - Promote deployment of existing technologies that reduce GHG emissions
  - Support research and development of low-GHG technologies
  - Support climate research to reduce uncertainties and pace response

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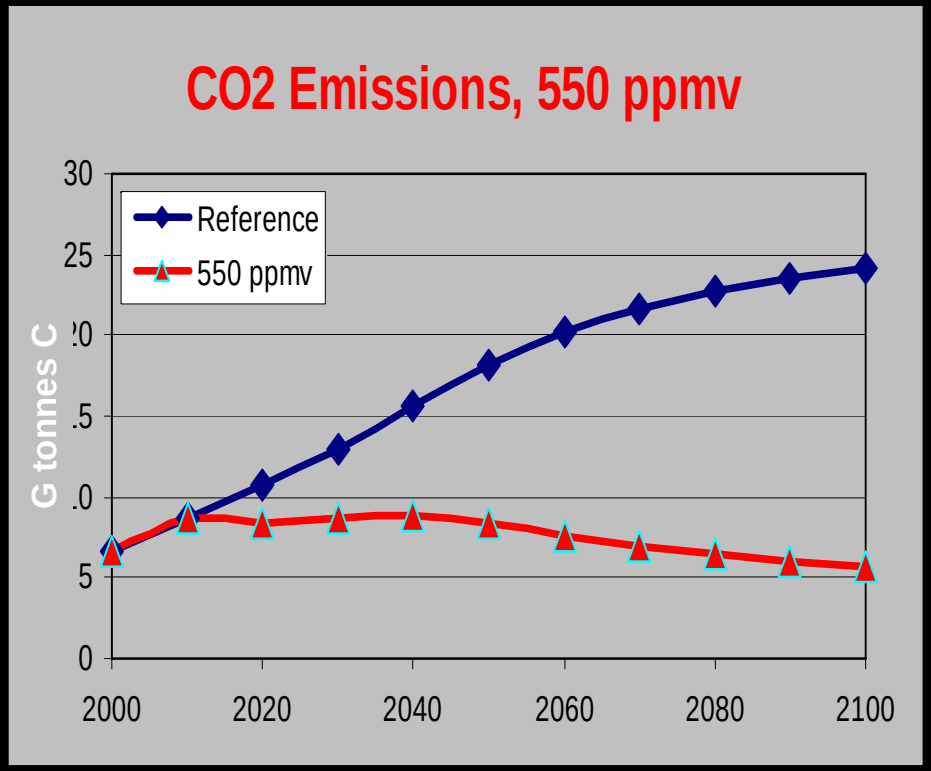
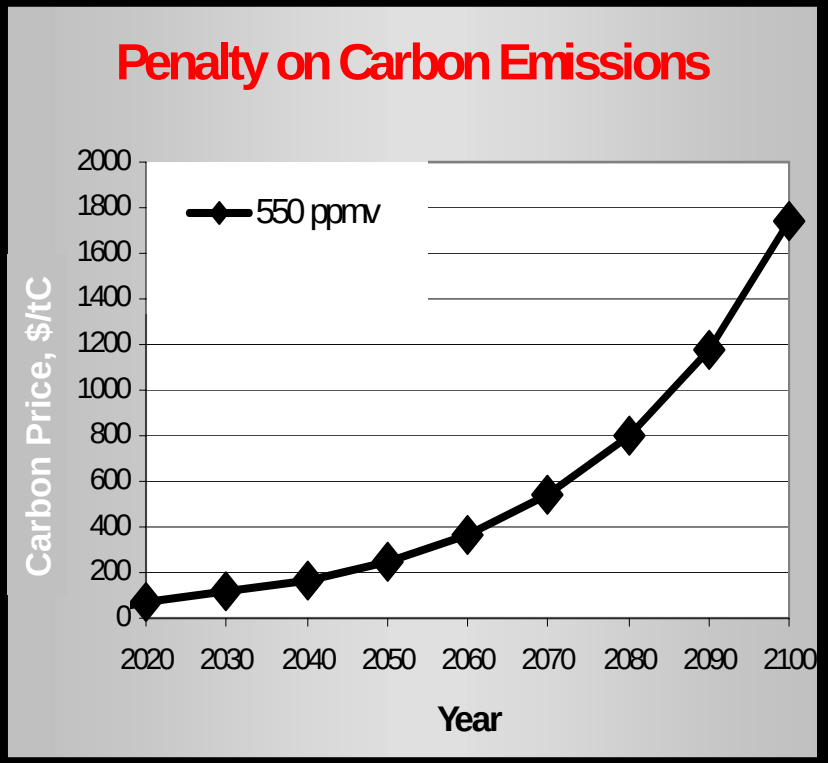
Emerging Focus on CO_2 Stabilization Scenarios





Stabilization scenarios developed for US Climate Change Science Program (Draft 2006) by MIT Joint Program on Science and Policy of Global Change

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Costs to Stabilize Vary Significantly Among Models

Price $/tonne Carbon

450

Year	Battelle	EPRI	MIT
2020	94	112	259
2050	435	589	842
2100	676	1000	6053

550

Year	Battelle	EPRI	MIT
2020	17	8	75
2050	99	37	245
2100	330	440	1743

650

Year	Battelle	EPRI	MIT
2020	4	3	30
2050	18	14	97
2100	217	160	686

$100/tonne Carbon in US implies:

Crude oil	$60/bbl	+20%
Gasoline	$2.40/gal	+11%
Utility Coal	$33/ton	+170%
Electricity	9.6¢/kWh	+18%

DRAFT Stabilization scenarios US Climate Change Science Program (2006)

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Policy Design - First Principles

- Ensure a uniform and predictable cost of carbon across the economy
- Maximize use of markets
- Promote global participation
  - Consider priorities of developing world
  - Recognize impacts of imbalances among national policies
- Minimize complexity to reduce administrative costs
- Maximize transparency to companies and consumers
- Adjust in the future to developments in climate science and the economic impacts of climate policies

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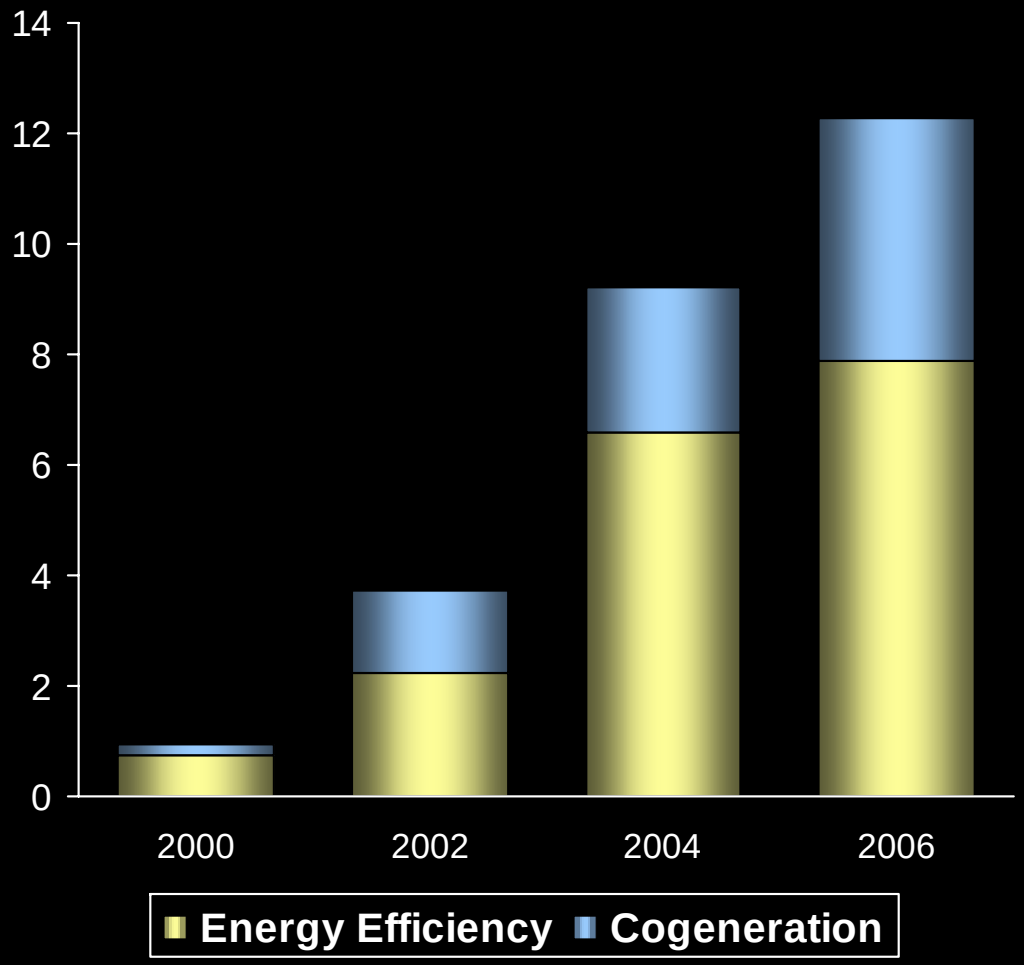
ExxonMobil Actions to Reduce GHG Emissions

Avoided GHG emissions in 2006 equivalent to taking more than 2 million cars off the road in the United States.

Avoided GHG Emissions from ExxonMobil Actions Since 1999,

CO_2-equivalent emissions (million metric tons)



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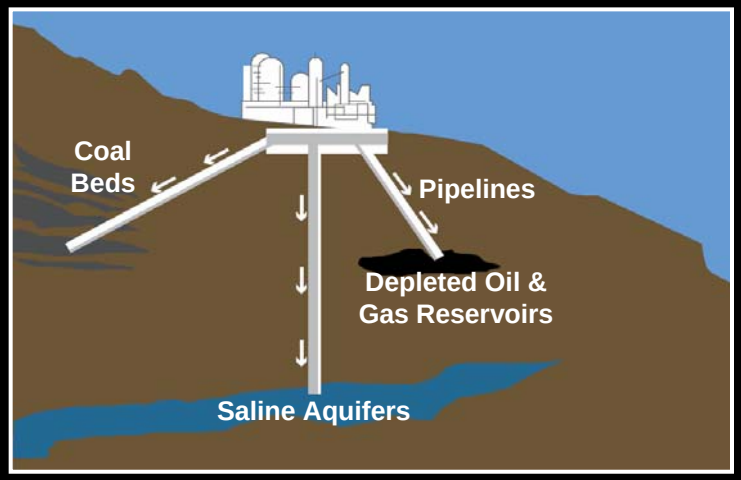
ExxonMobil Technology Actions to Reduce GHG Emissions

Carbon Capture & Sequestration



Advanced Vehicle & Fuels

Breakthroughs

GCEP
Global Climate & Energy Project
STANFORD UNIVERSITY

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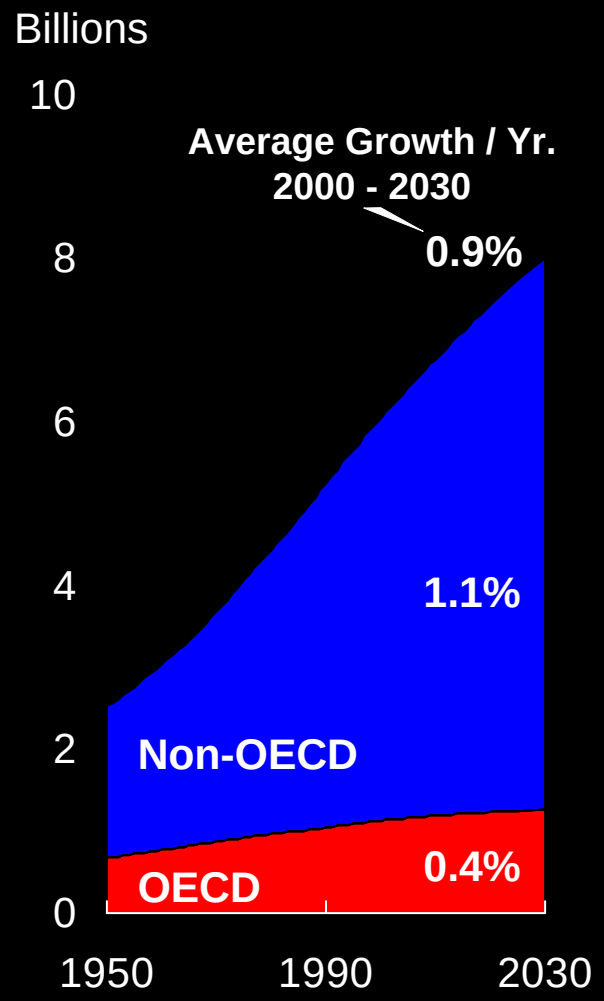
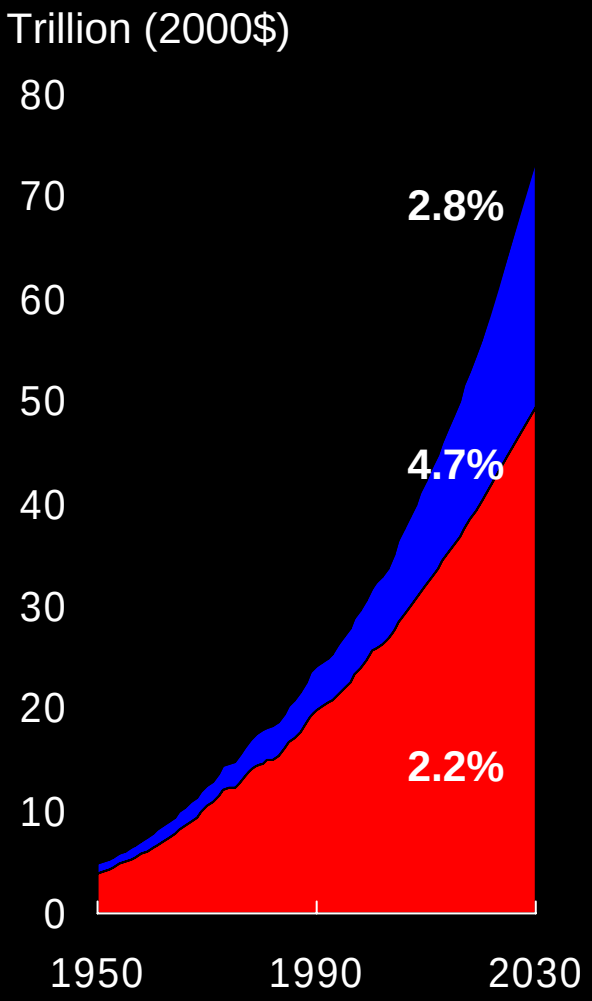
BACKUP

Global Economics and Energy

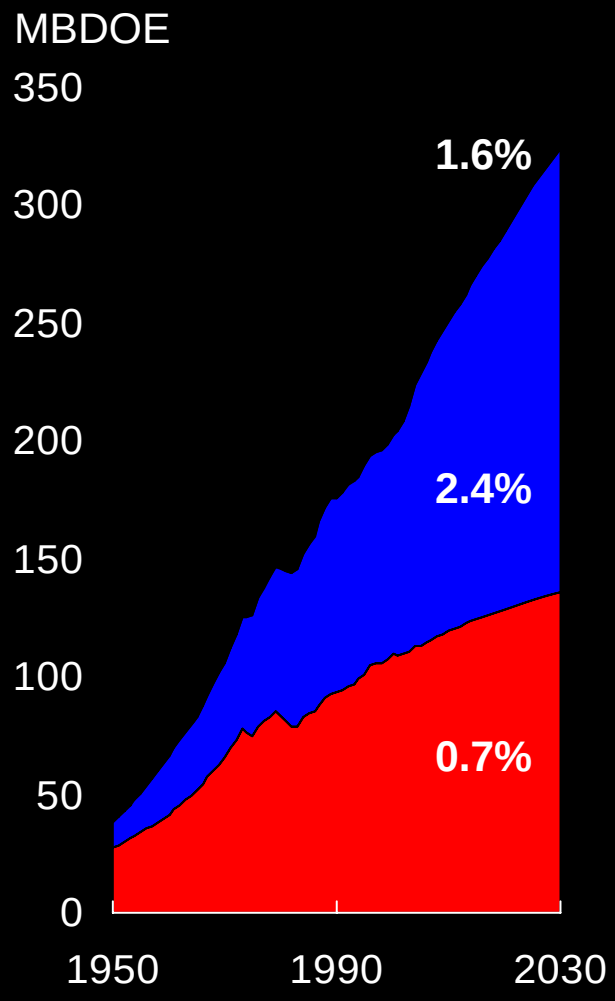
Population



GDP



Energy Demand



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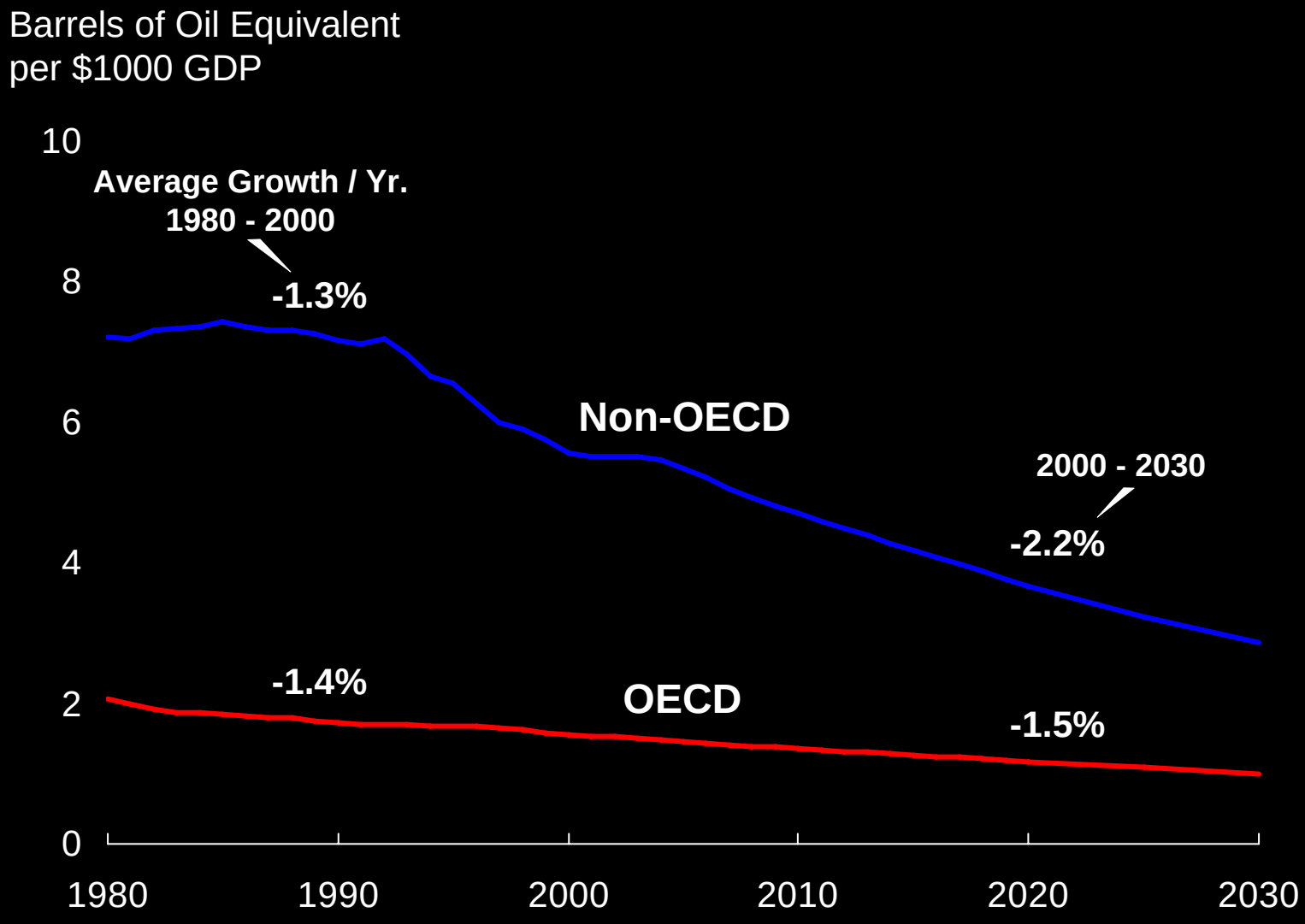
Energy Intensity



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Energy Outlook: Implications for Carbon

- Global issue
- Wide variety of mitigation options
  - Different scales
  - Different costs
- Significant uncertainties
- But risks warrant action now

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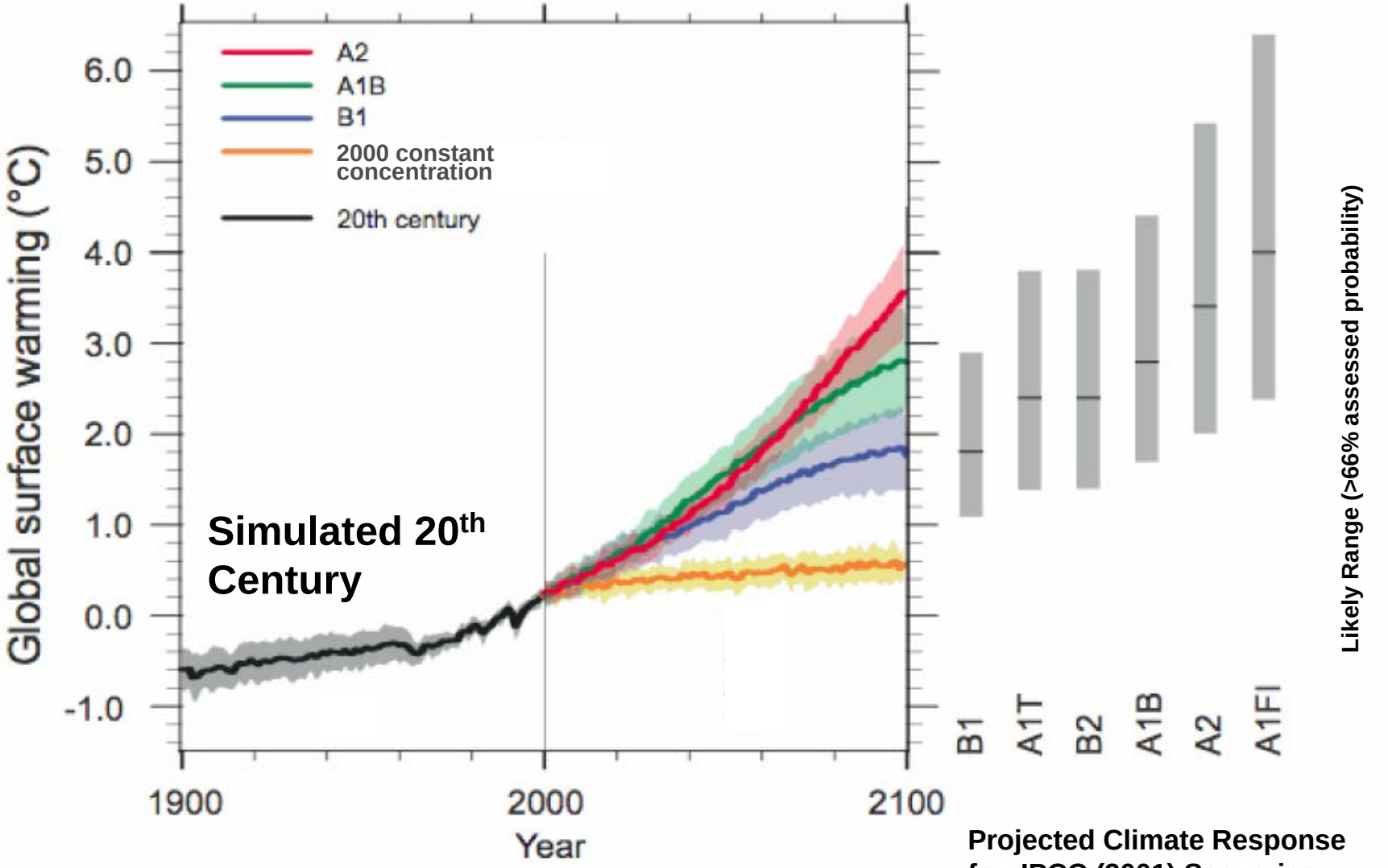
Uncertain Risks of Future Climate Change

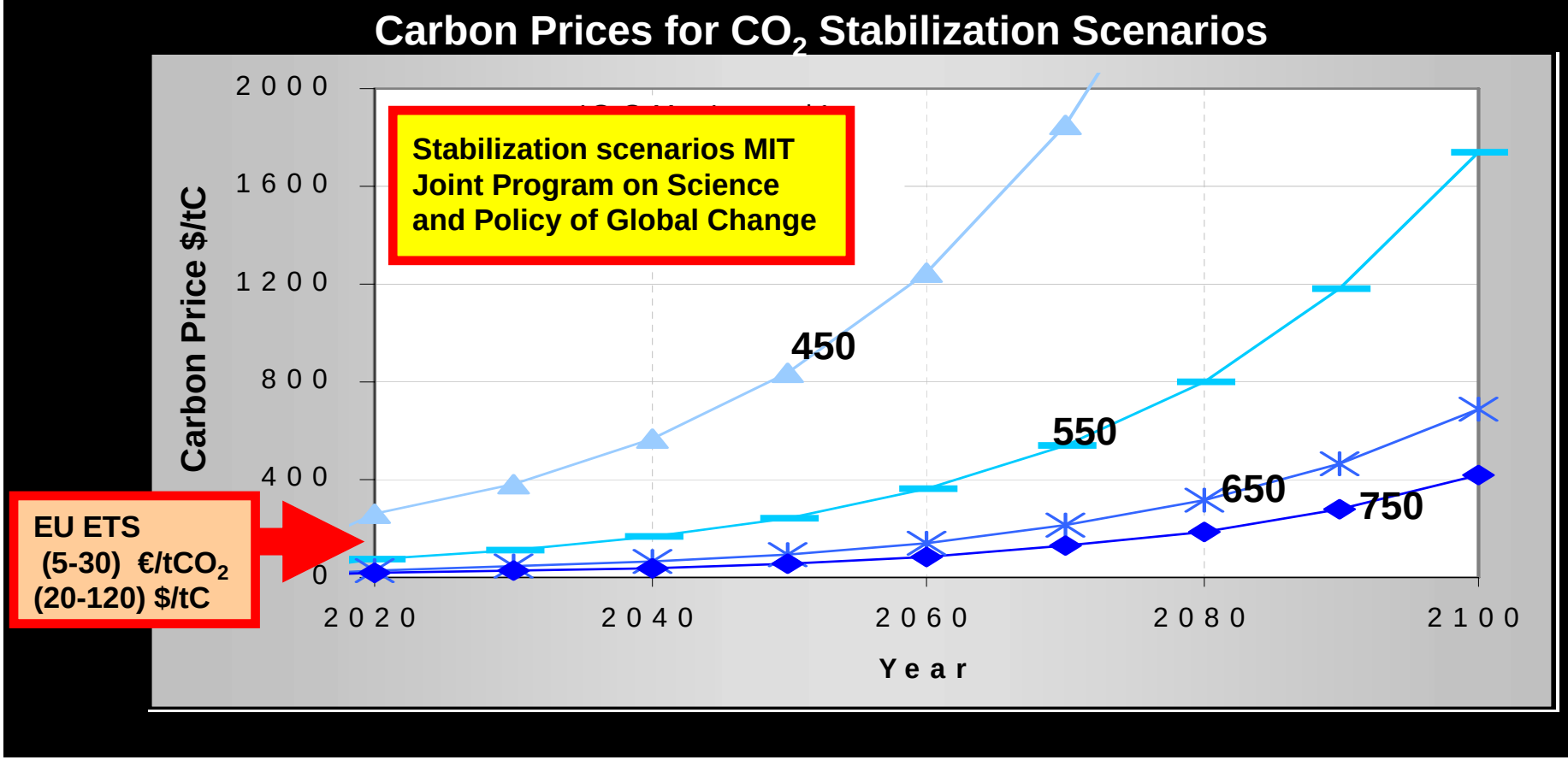


IPCC Fourth Assessment Report

Projected Climate Response for IPCC (2001) Scenarios (all assume no GHG mitigation)

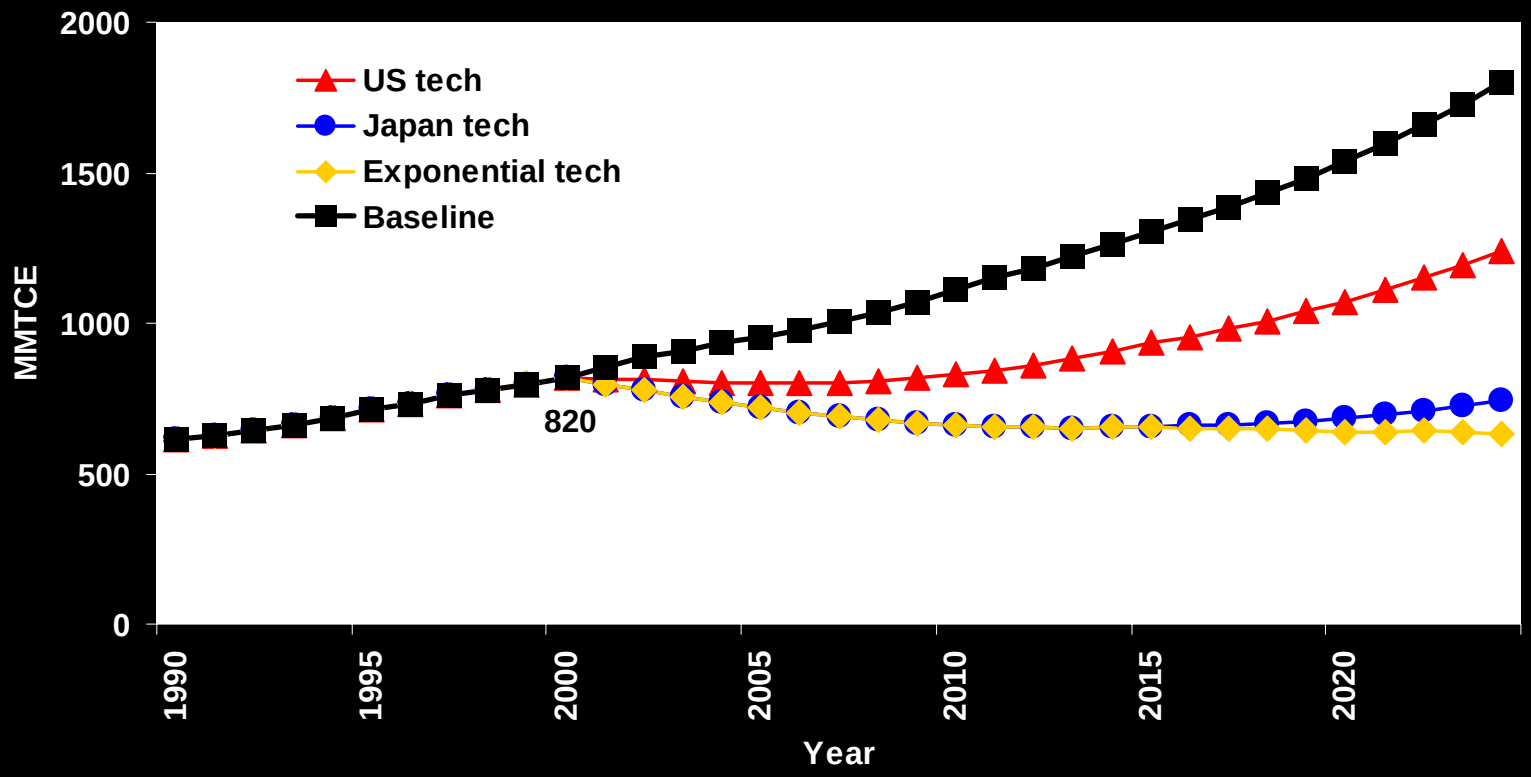
Economic Insights from Stabilization Scenarios

- Carbon price depends on cost and availability of mitigation technologies
- Price rises with higher reference case emissions, with time, and with more stringent stabilization targets



Existing Technologies Offer Significant Potential

Projected Chinese Emissions with Enhanced Technology



Source: P. Bernstein, S. Tuladhar, and W. D. Montgomery, "Potential For Reducing Carbon Emissions from Non-Annex B Countries through Changes in Technology"

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Near-term Policy Options Under Consideration

- Cap and trade system (known emissions quantity, cost uncertain)
  - "Downstream" (permit/allowance to emit GHG gasses)
  - "Upstream" (permit/allowance to sell carbon fuels)
  - Key design issues – allocation methodology, safety valve on allowance costs
- Carbon taxes (known cost, emissions quantity uncertain)
  - Key design issues – use for revenue
- Standards
  - Buildings
  - Vehicles
  - Major equipment/appliances

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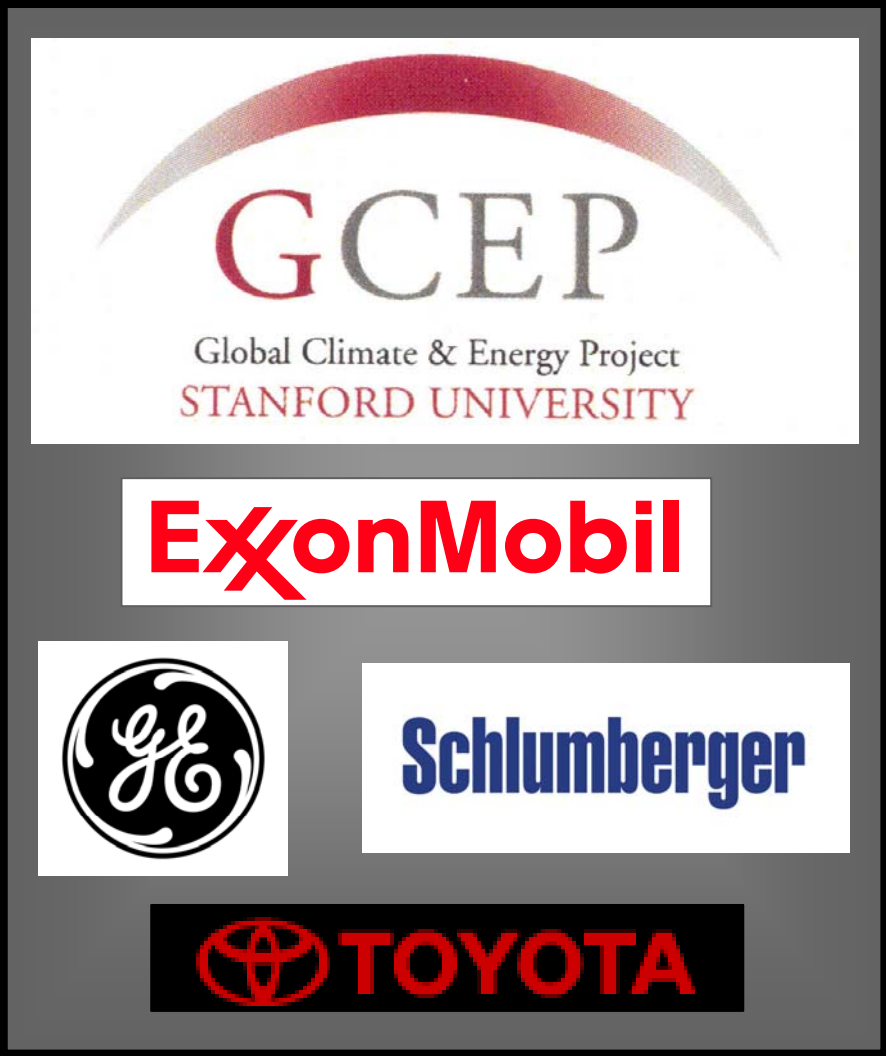
Global Climate and Energy Project



- Long-term commitment – 10 years
- Focused on creating innovative, commercially viable technologies with low GHG emissions
- Unprecedented alliance of scientific researchers and leading companies
- Current project slate:
  - >35 projects at Stanford and in Europe, USA, Japan, Australia
  - Involving over 100 students and post-docs
  - Programs in renewables, carbon capture and storage, advanced combustion, hydrogen

gcep.stanford.edu

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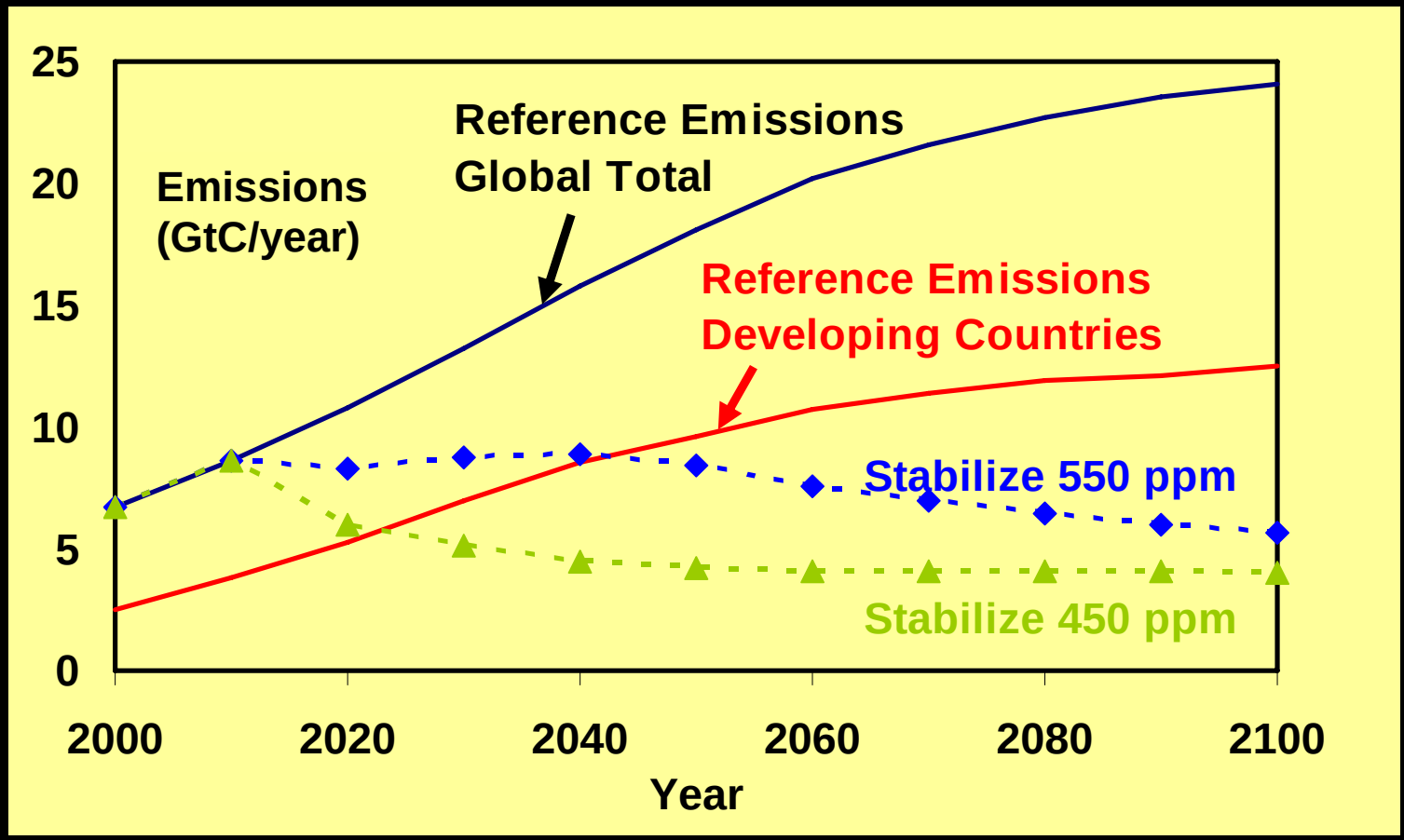
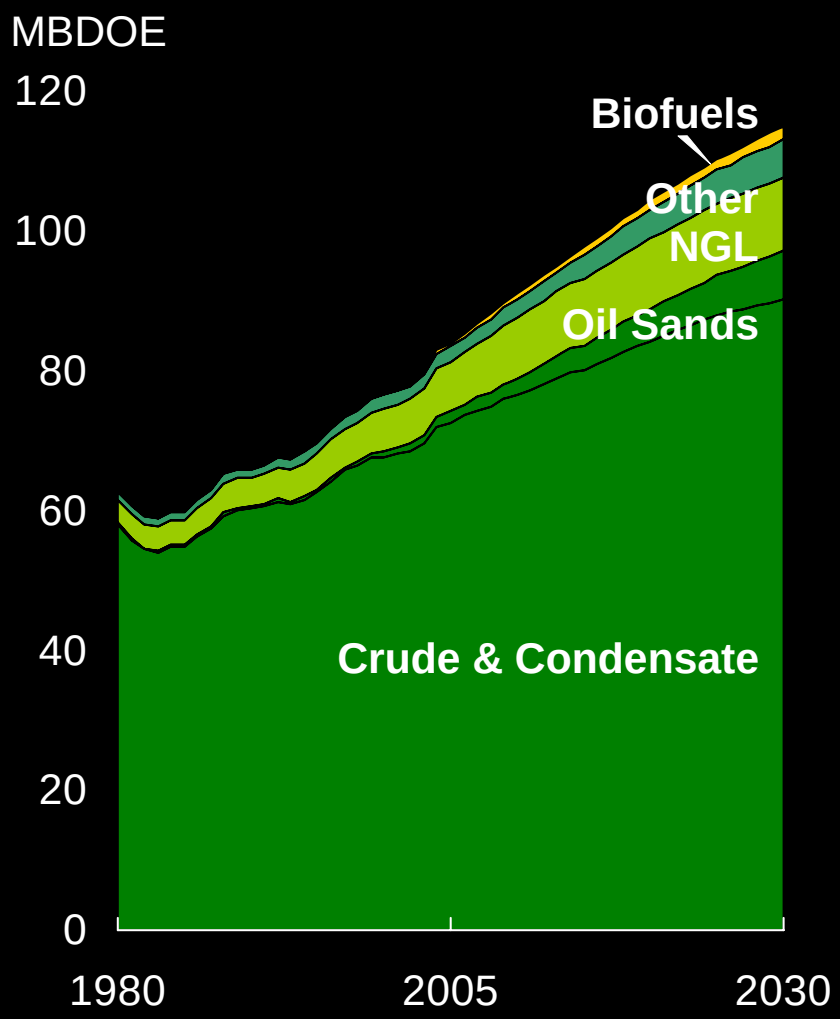
Stabilization Requires Global Participation



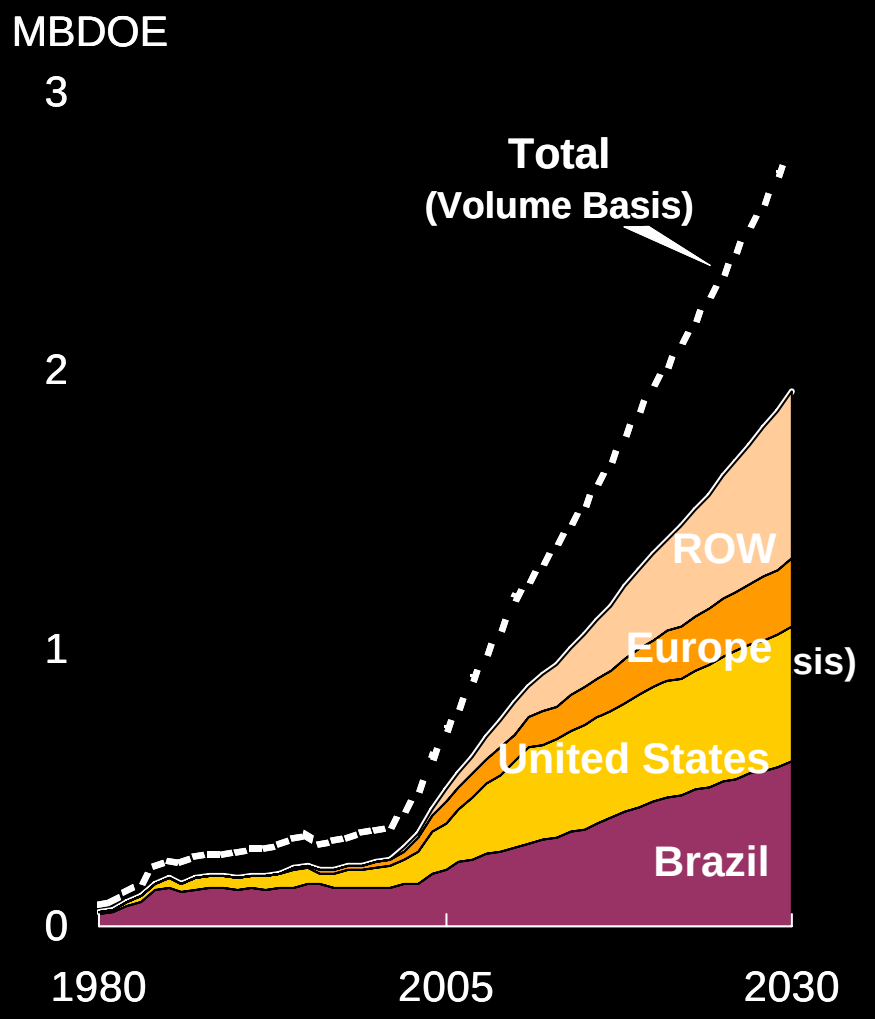
Stabilization scenarios MIT Joint Program on Science and Policy of Global Change

Global Biofuels Production

Liquids Supply



Biofuels



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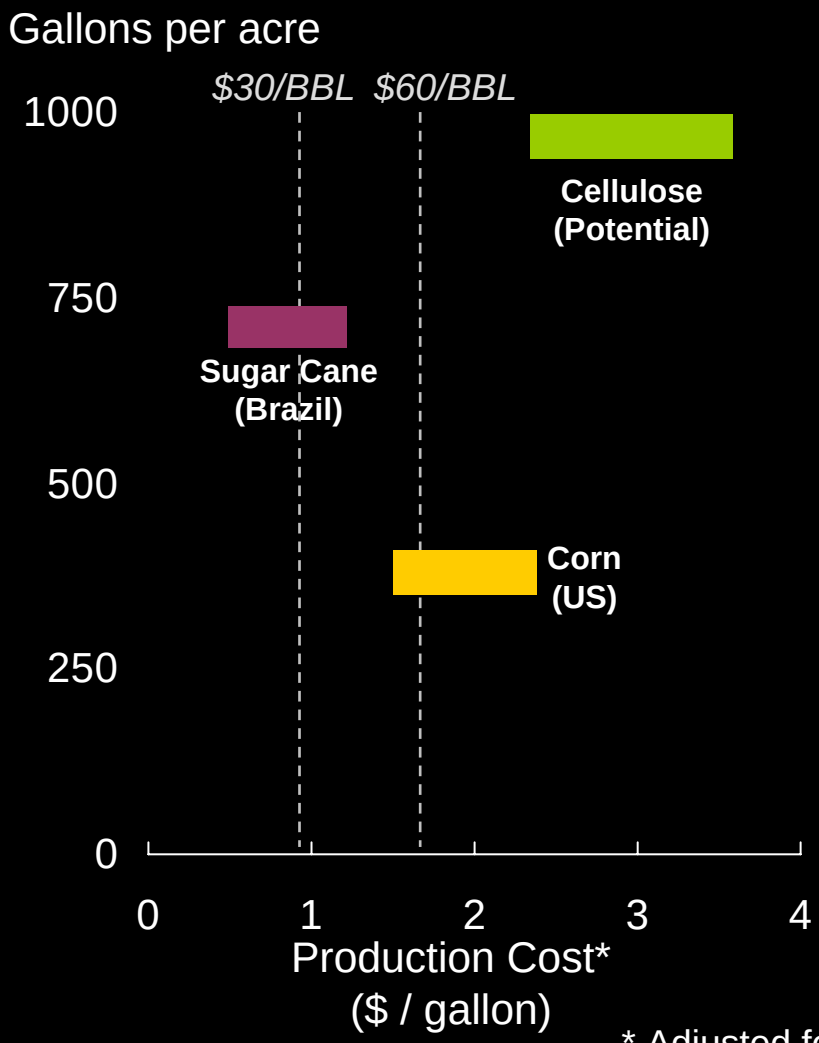
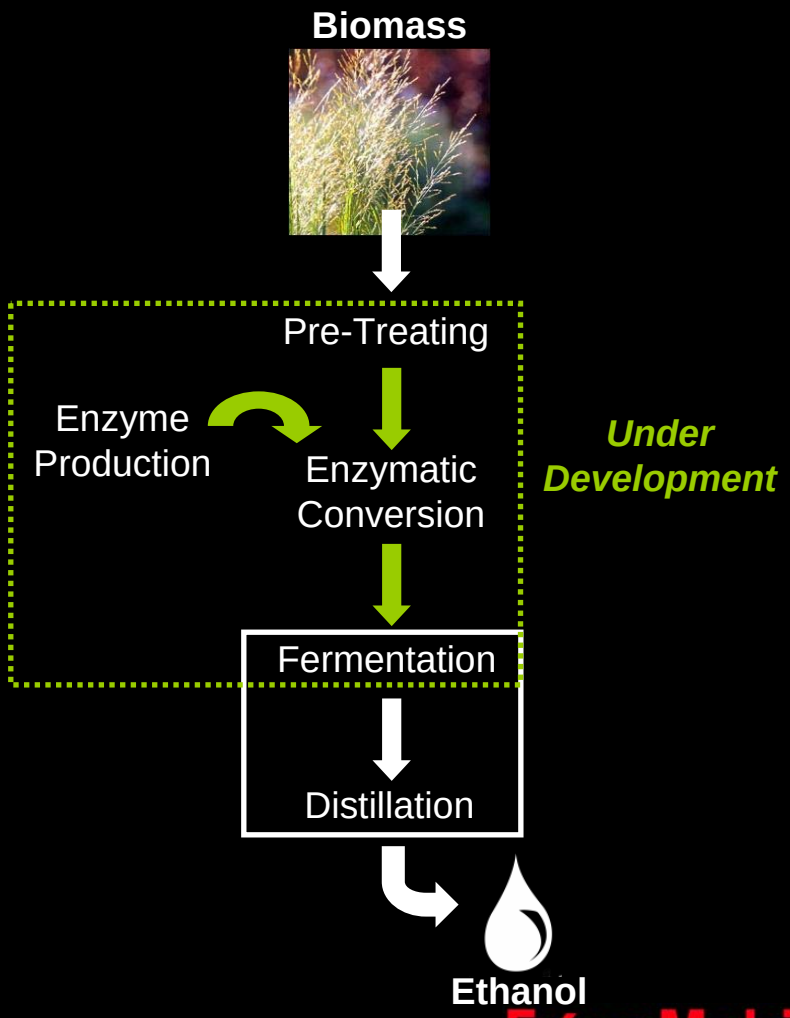
Cellulosic Ethanol - Potential

Yield and Cost



Process Complexity



* Adjusted for energy content

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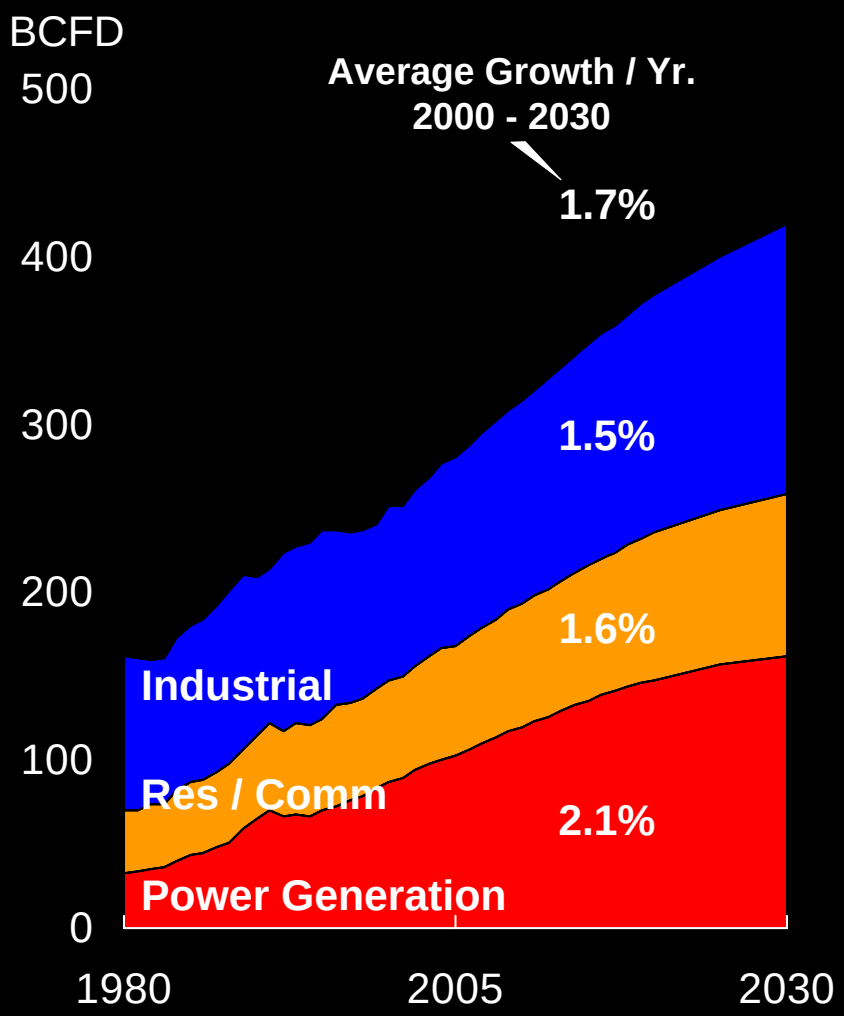
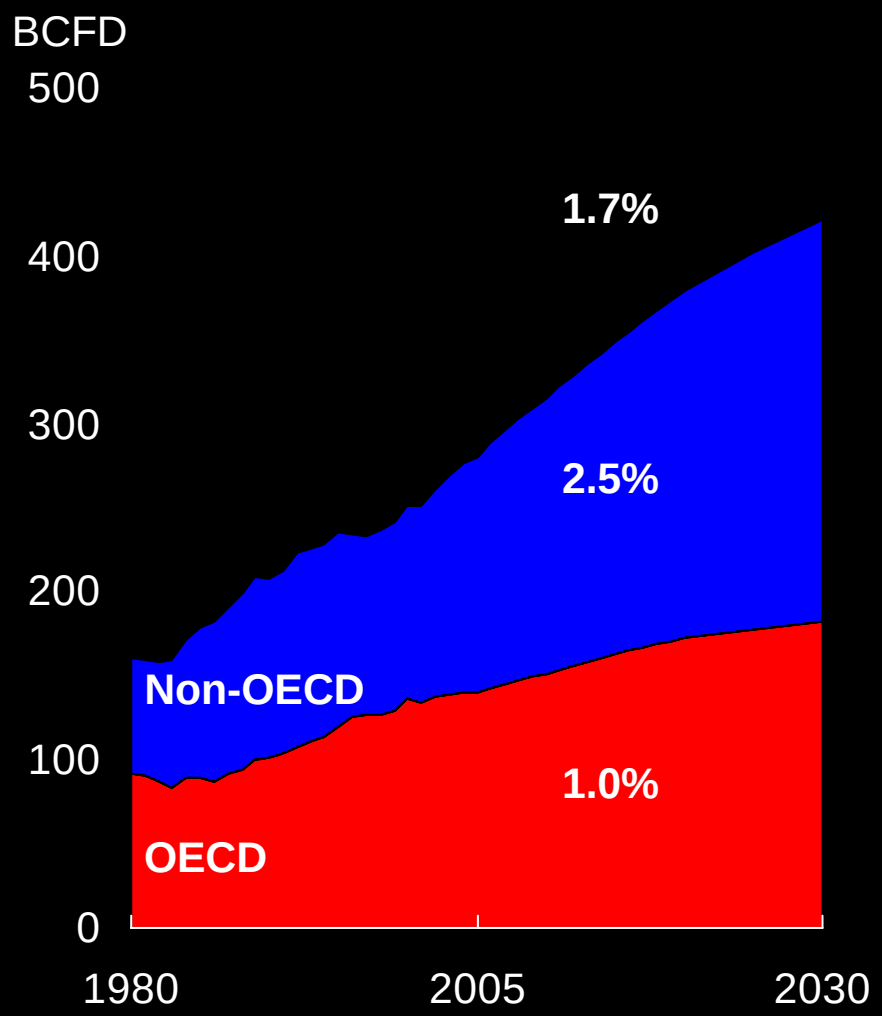
Natural Gas Demand

By Sector



By Region



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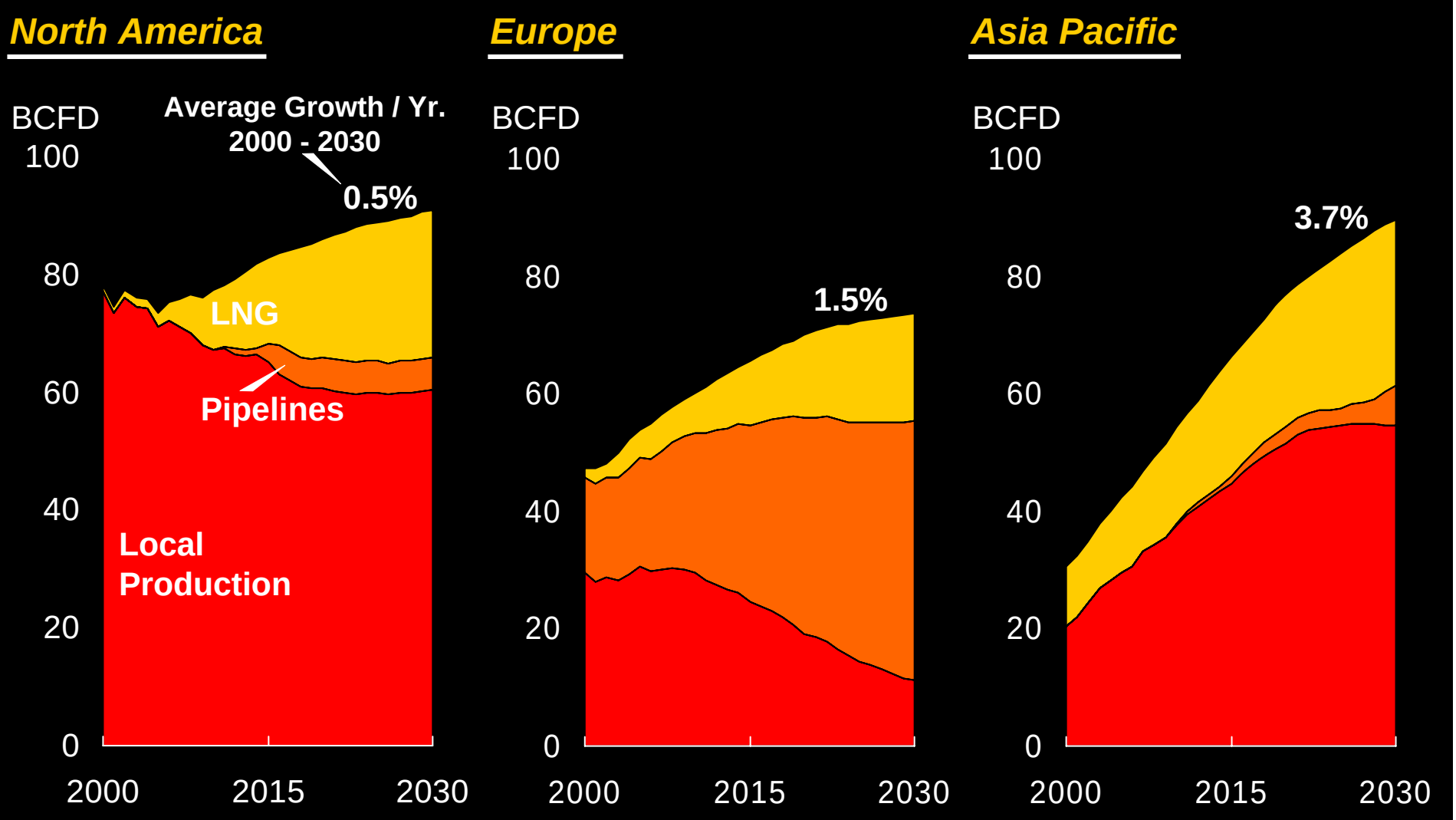
Natural Gas Supply and Demand



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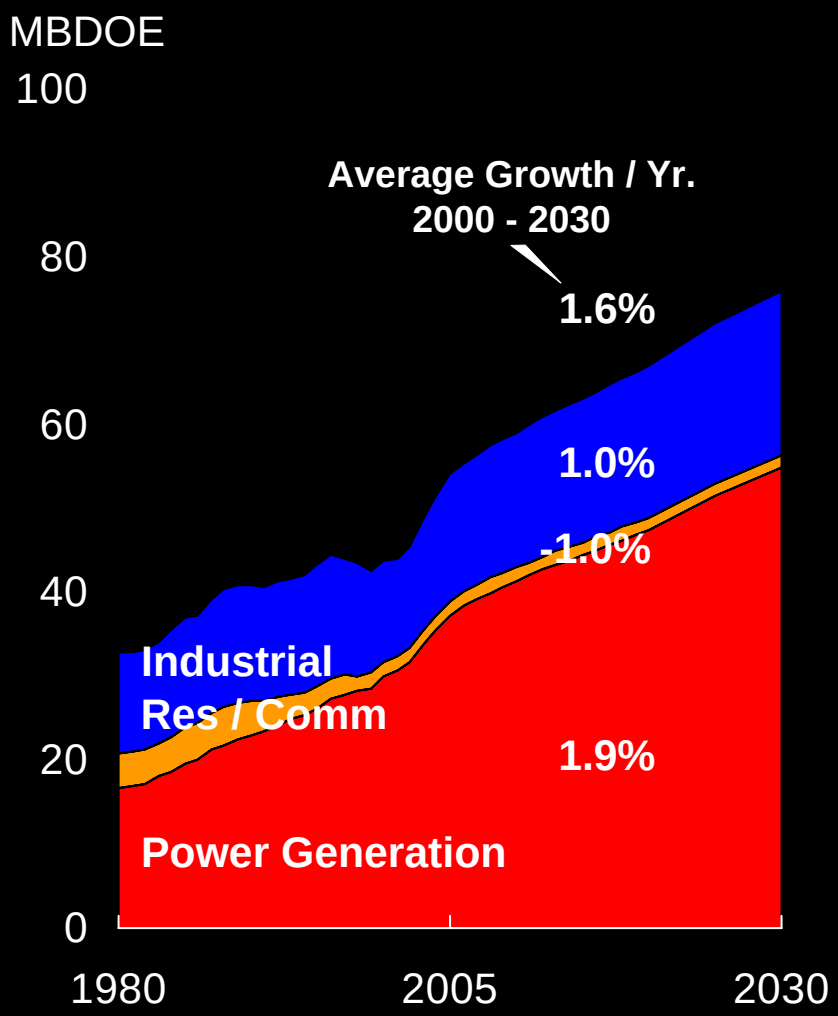
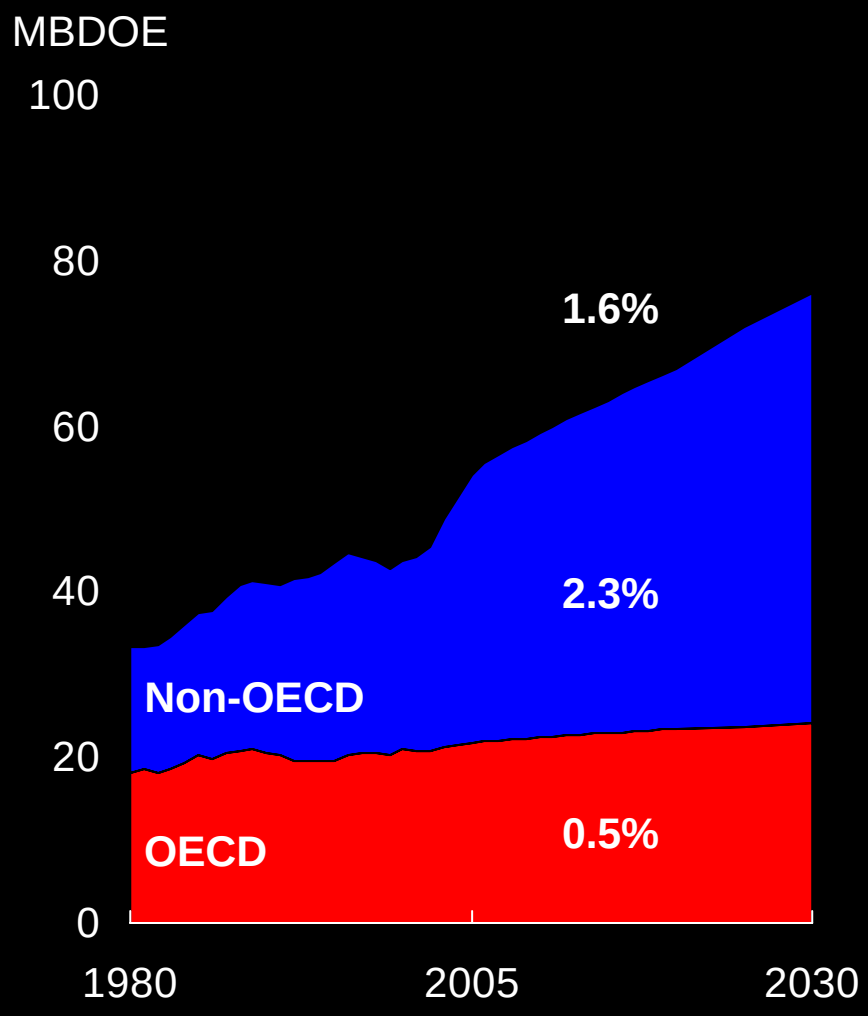
Coal Demand

By Sector



By Region



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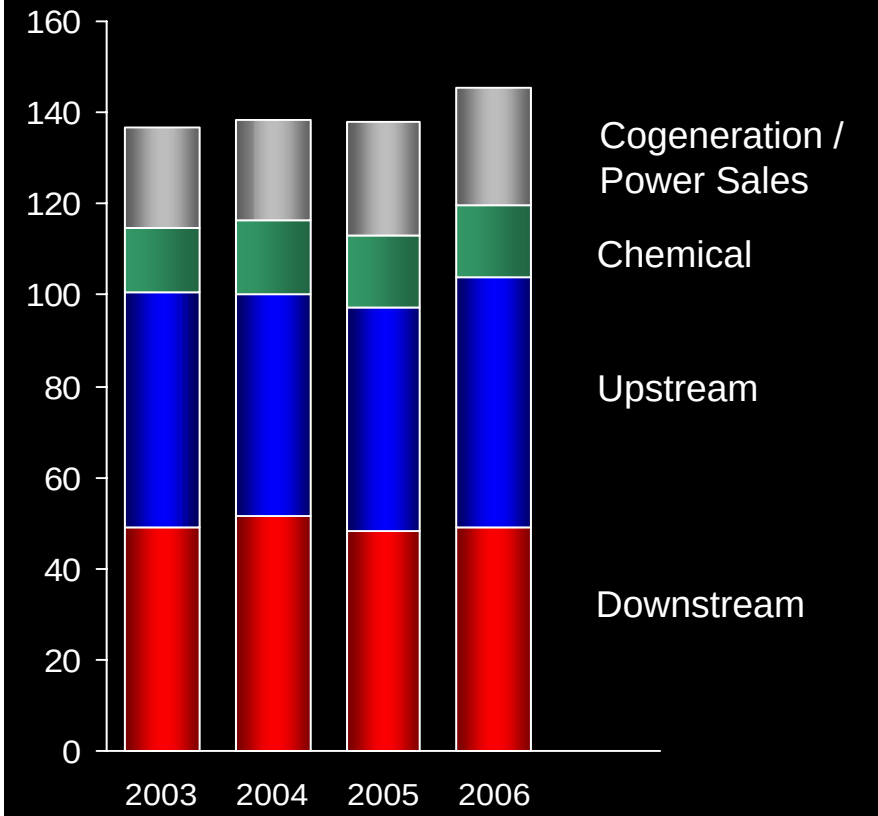
ExxonMobil Greenhouse Gas Emissions

Protect Tomorrow. Today.

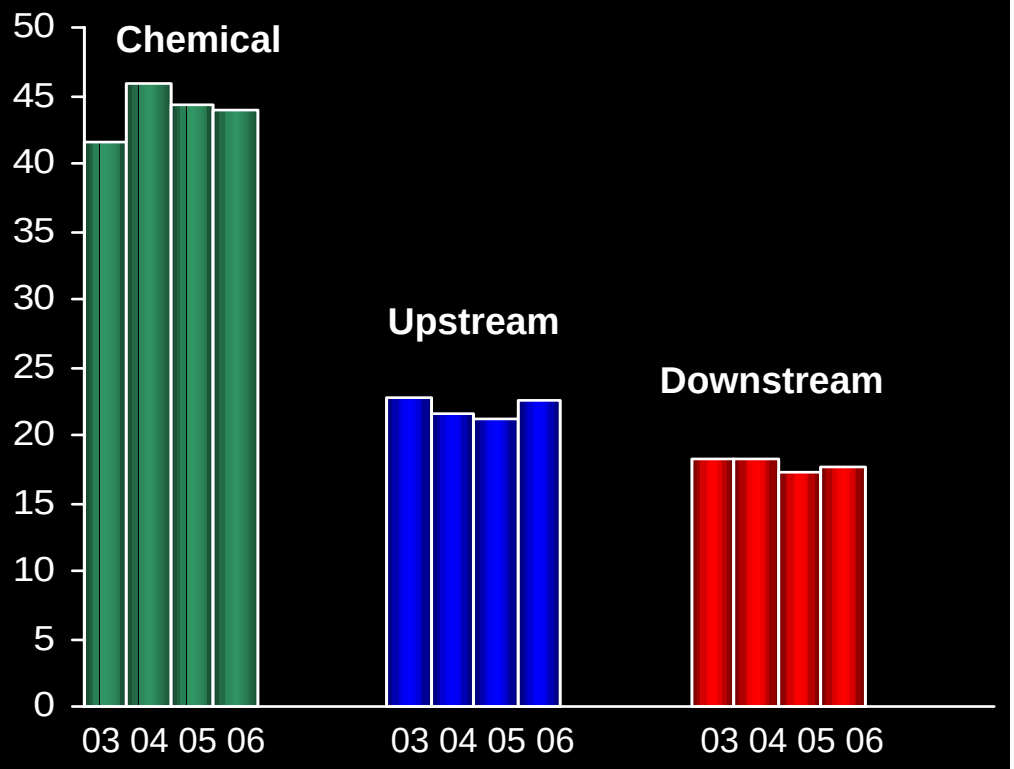
Direct Equity GHG

(M Tonnes)



Direct Equity GHG Intensity

(Tonnes /100 Tonnes Production or Throughput)



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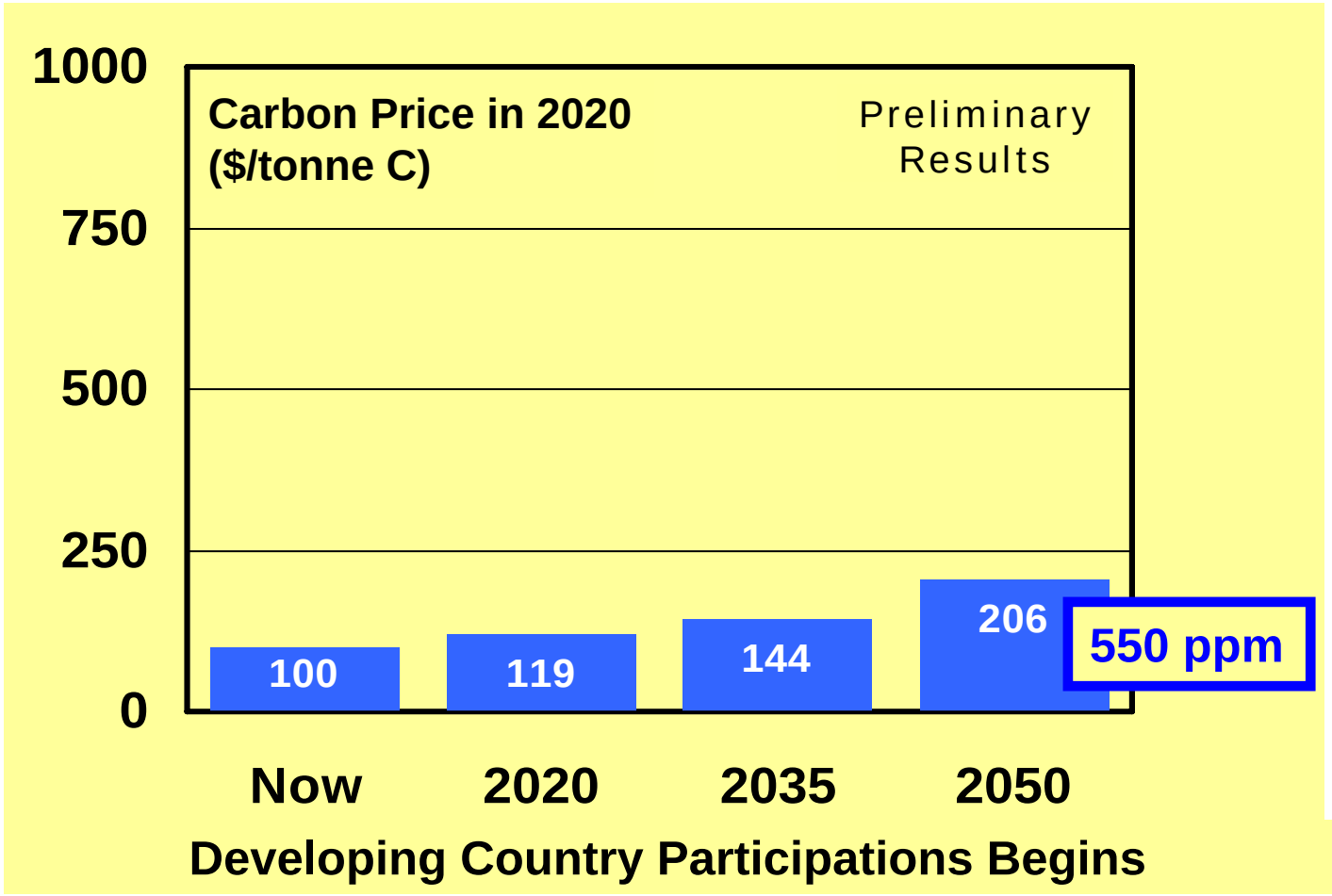
Prices Rise Sharply without Global Participation

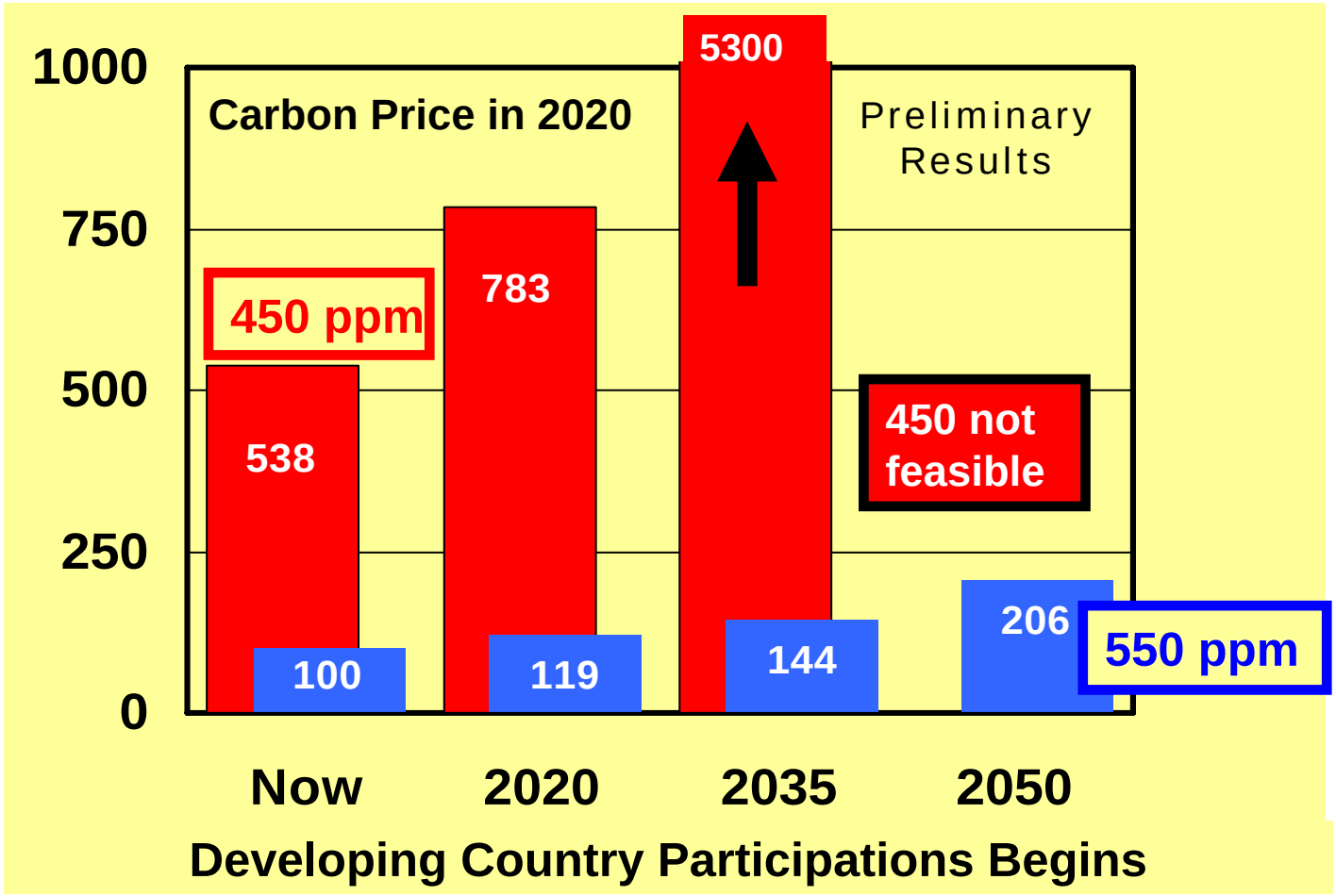
(Year 2020 Price for Idealized 550 ppm) Index = 100



Battelle
The Business of Innovation

Prices Rise Sharply without Global Participation

(Year 2020 Price for Idealized 550 ppm) Index = 100



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