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# Transitioning to a Low GHG Global Economy: the role of the electric sector

**Richard Richels***
Electric Power Research Institute

EPRI Energy and Climate Research Seminar, Washington DC
May 17th, 2012

*Originally Presented at G20 Expert Meeting in Seoul, South Korea, December 2011*

*This presentation was prepared in collaboration with James Merrick, Geoffrey Blanford, and Steven Rose of the Electric Power Research Institute and is based on a forthcoming paper.

# Outline

- Alternative futures:
  - Climate targets currently under consideration
  - Technology pathways
- Implications:
  - Gross World Product
  - Electric sector composition
- Key messages

*Note: This analysis was undertaken using the MERGE model as part of Stanford University's EMF-27 examination of alternative climate targets and technology pathways.*

# Three Scenarios for Global Climate Policy

1) G8 Proposal
   - Global $CO_2e$ emissions reduction of 50% in 2050 relative to 1990
   - Group 1 countries make 80% reduction
   - Group 2 countries make remaining reductions
   - Group 3 countries unconstrained

2) 550ppm $CO_2e$ Target
   - Cap global emissions to reach specified atmospheric concentration
   - Target based on radiative forcing functions as specified in IPCC (2007)

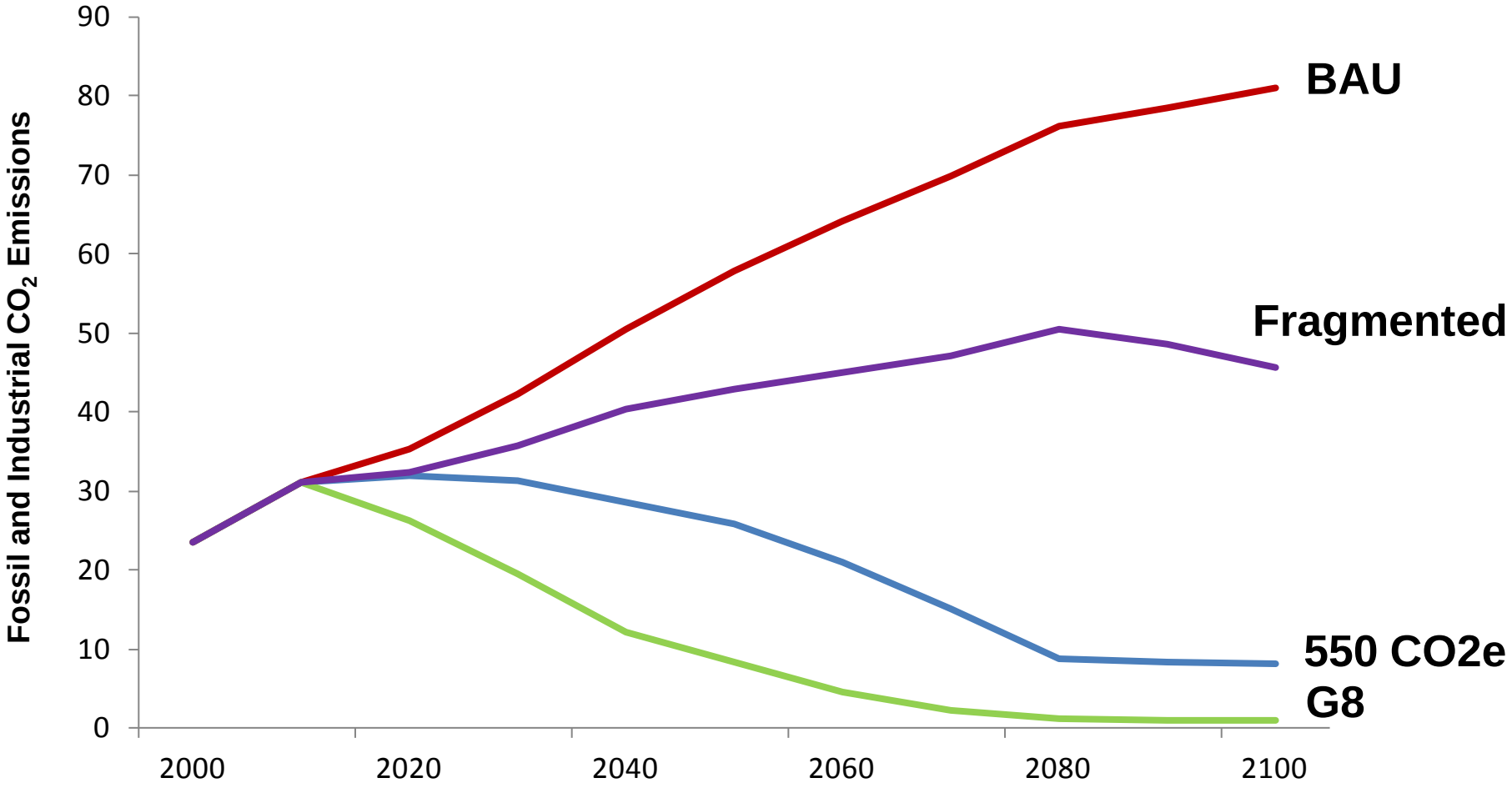
3) Fragmented Approach
   - Group 1 targets a 50% $CO_2e$ emissions reduction in 2050 relative to 1990
   - Group 2 follows a fragmented international climate policy
   - Group 3 countries unconstrained

# Four Pathways for Technology

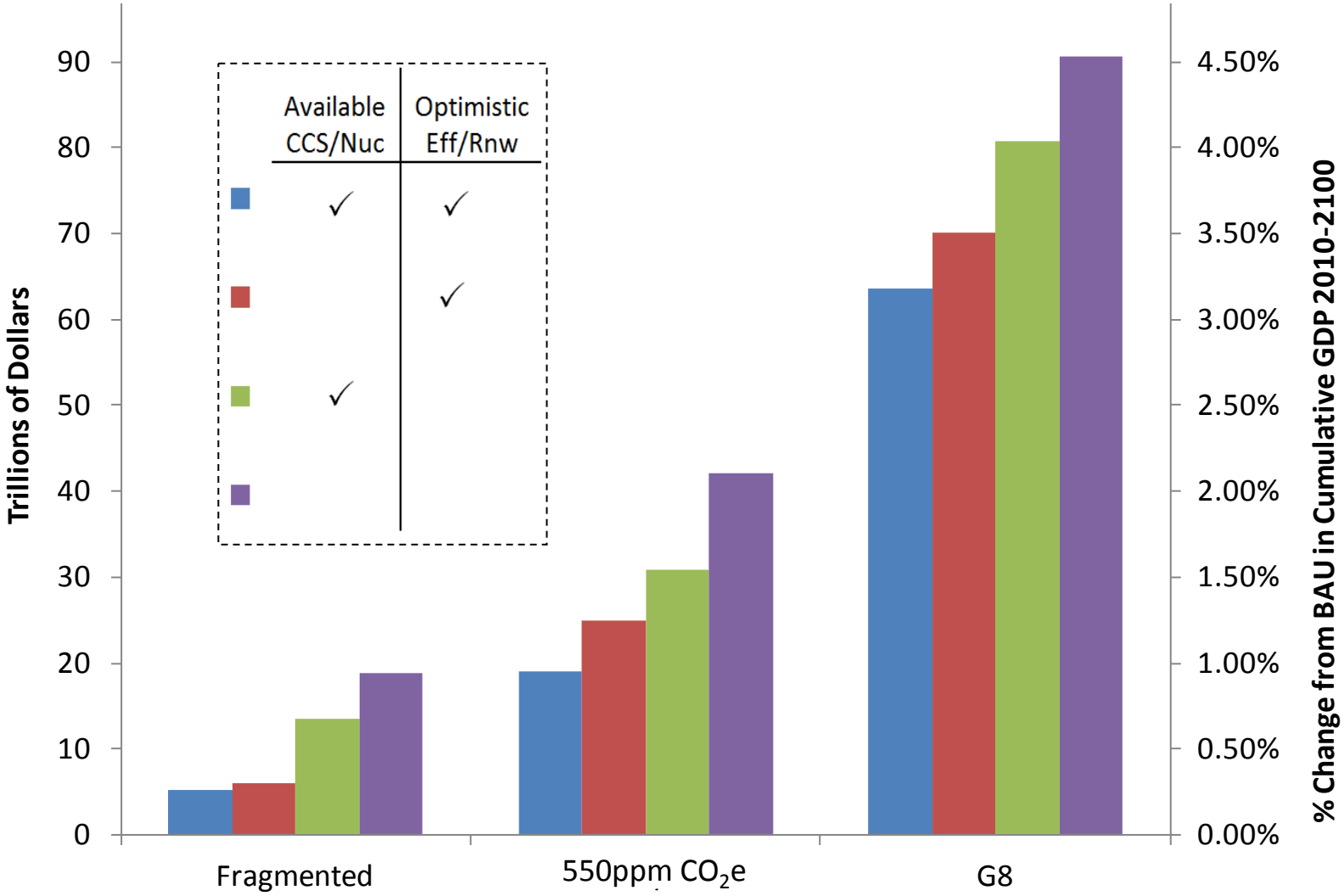
1) Full Set of Technology Options
   - Optimistic efficiency, renewables | new nuclear & CCS available
2) Full Set without CCS/Nuclear
   - Optimistic efficiency, renewables | new nuclear & CCS not available
3) Full Set without Optimistic Efficiency/Renewables
   - Reference efficiency, renewables | new nuclear & CCS available
4) Limited Set of Technology Options
   - Reference efficiency, renewables | new nuclear & CCS not available

- *Optimistic efficiency = 60% faster annual rate of improvement relative to reference*
- *Optimistic renewables refer to reduced integration costs and greater decreases in electricity generation costs. In addition, a greater supply of bioenergy is assumed*

# Implications for $CO_2$ Emissions



# Implications for Gross World Product:
## cumulative present value 2010-2100





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# What do emissions mean for temperature?

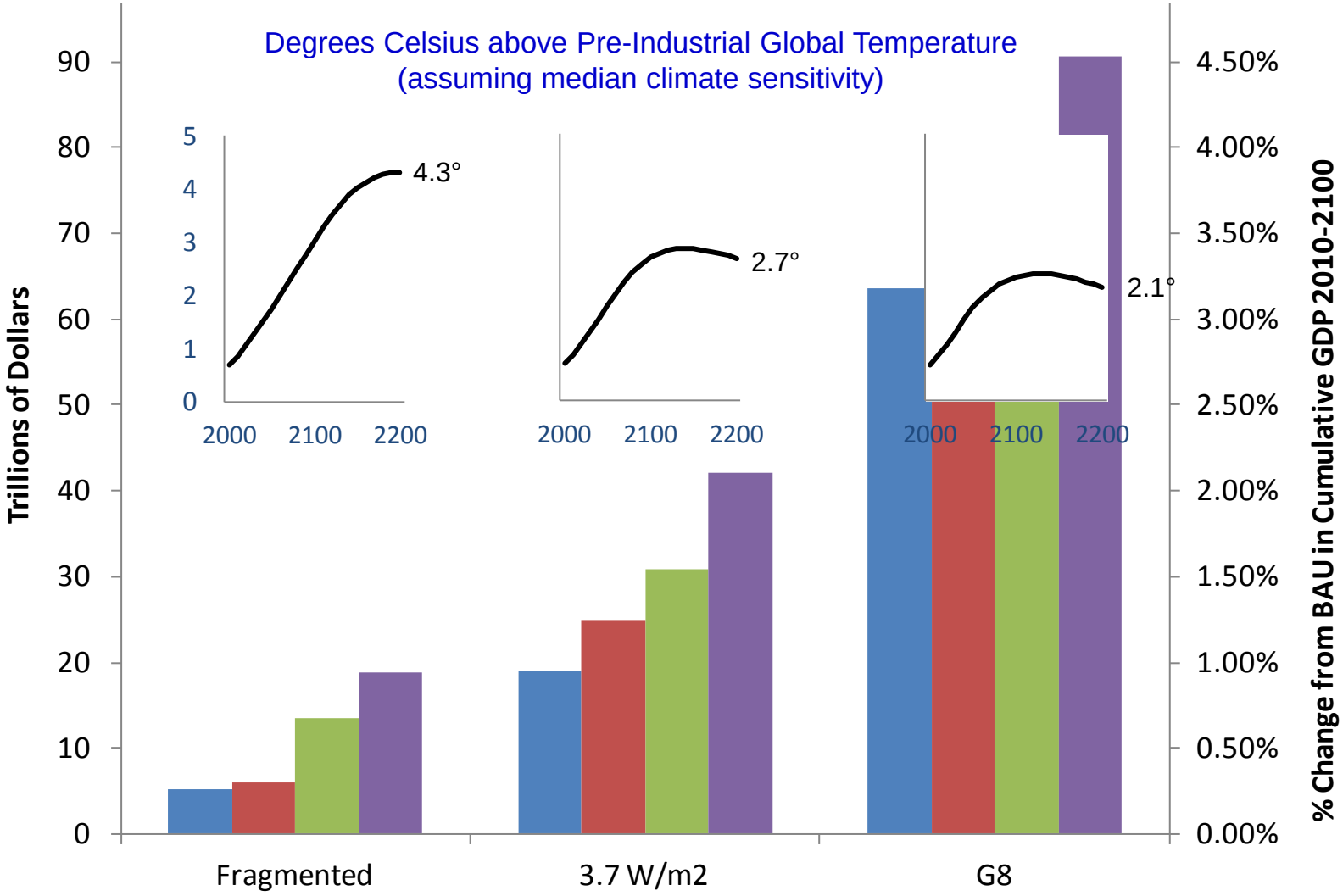
- Depends on several factors, e.g. climate sensitivity and thermal lags → Both are ***very uncertain***

- Climate sensitivity is defined as the equilibrium temperature increase in response to ***sustained forcing*** equivalent to a doubling of atmospheric $CO_2$ (i.e. 550 $CO_2$e or 3.7 W/m$^2$)

- Median value for climate sensitivity from IPCC is 3°C, scales linearly with forcing

- MERGE uses a reduced-form representation of more complex climate models

# Economic Costs vs. Potential Climate Outcomes





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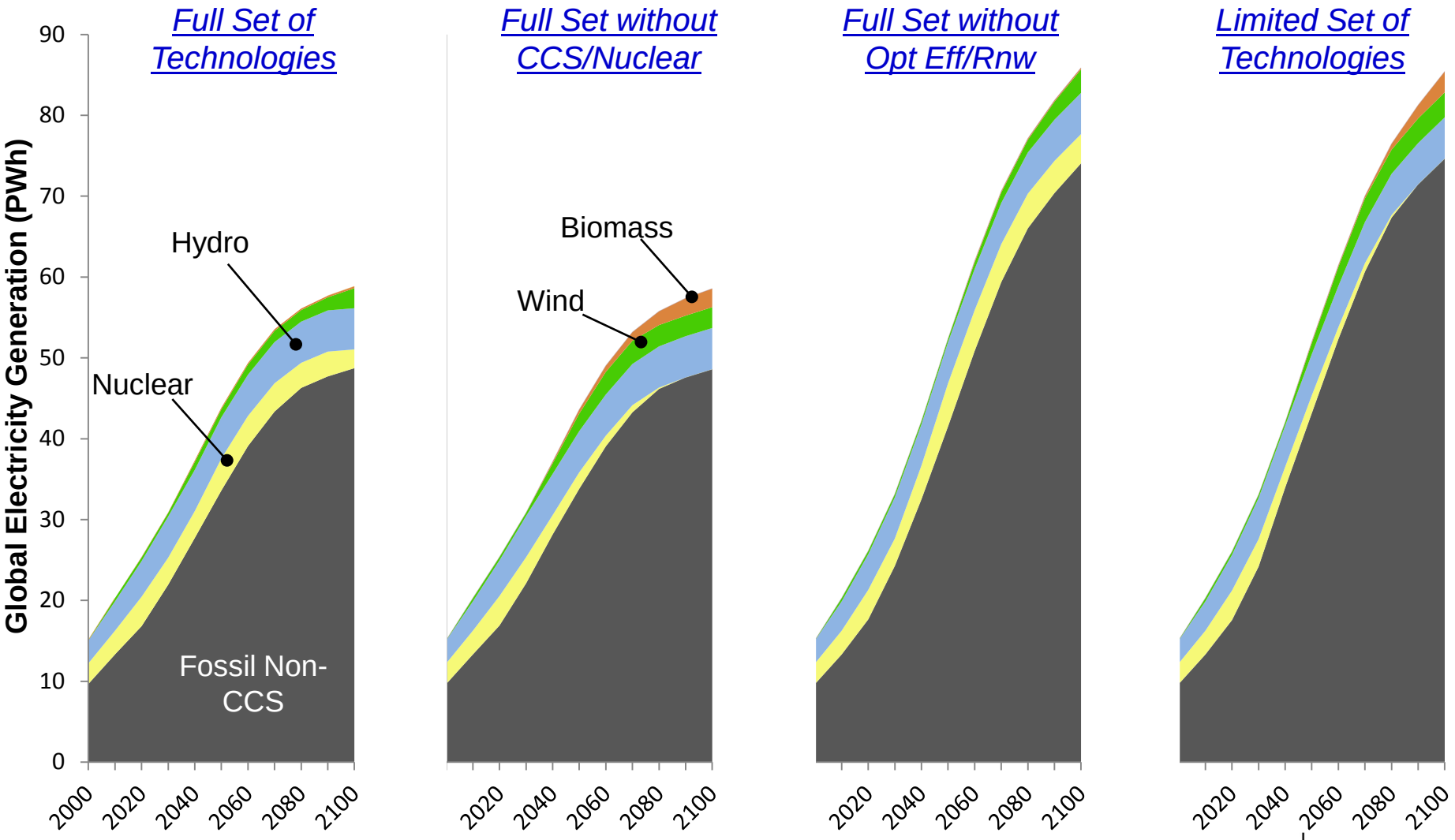
# Electric Sector Composition: Business-as-usual (BAU)





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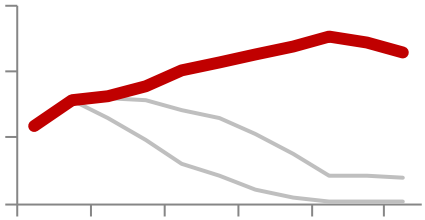
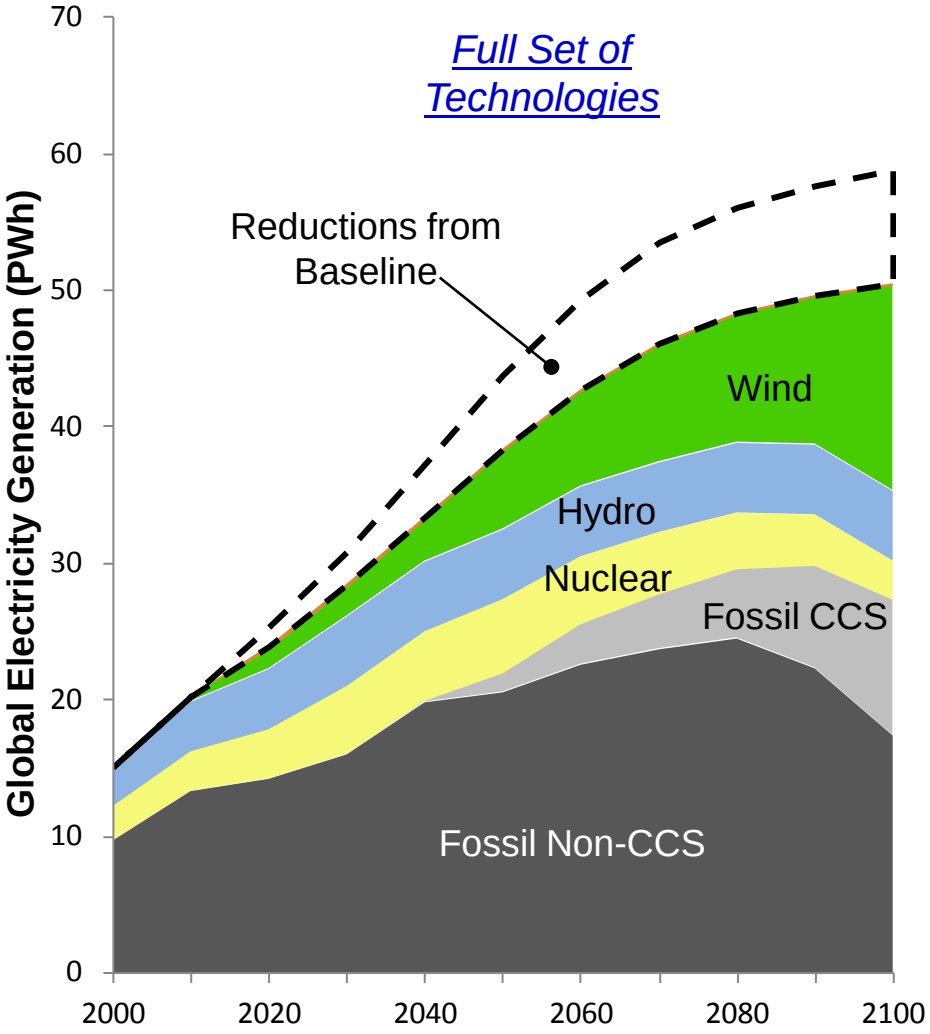
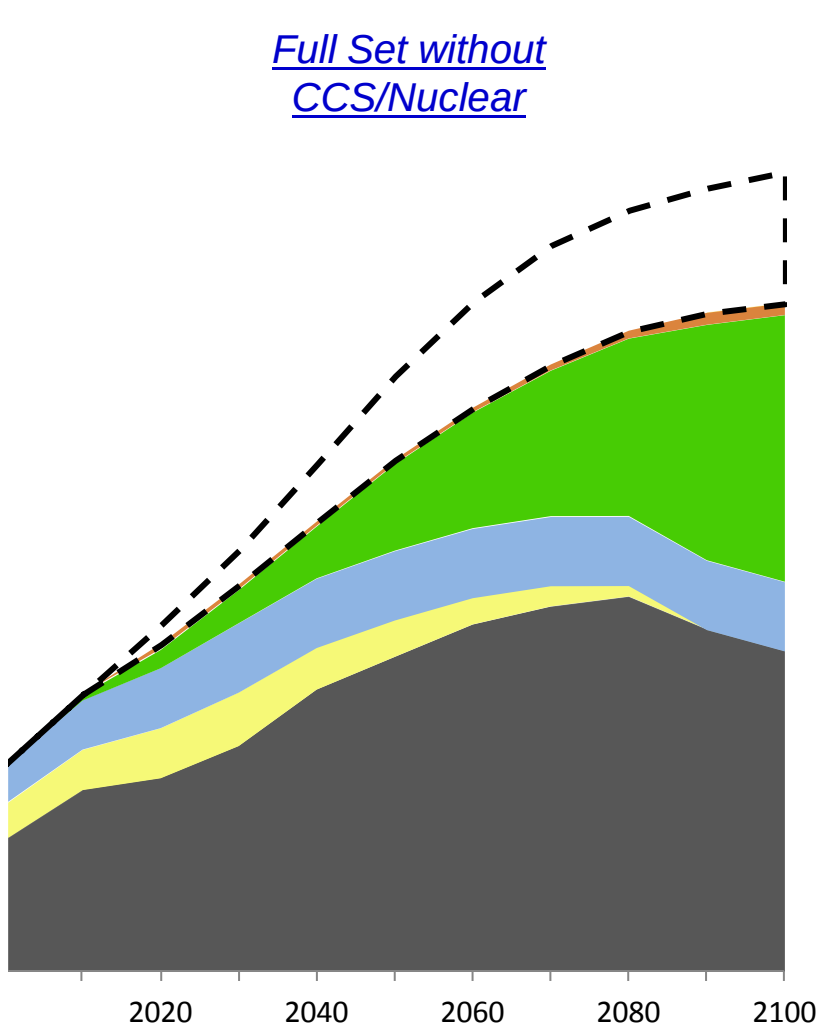
# Electric Sector Composition: Fragmented Approach







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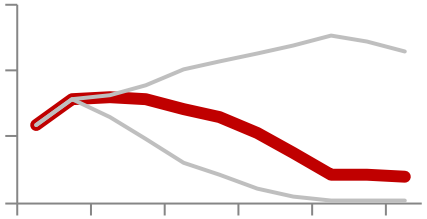
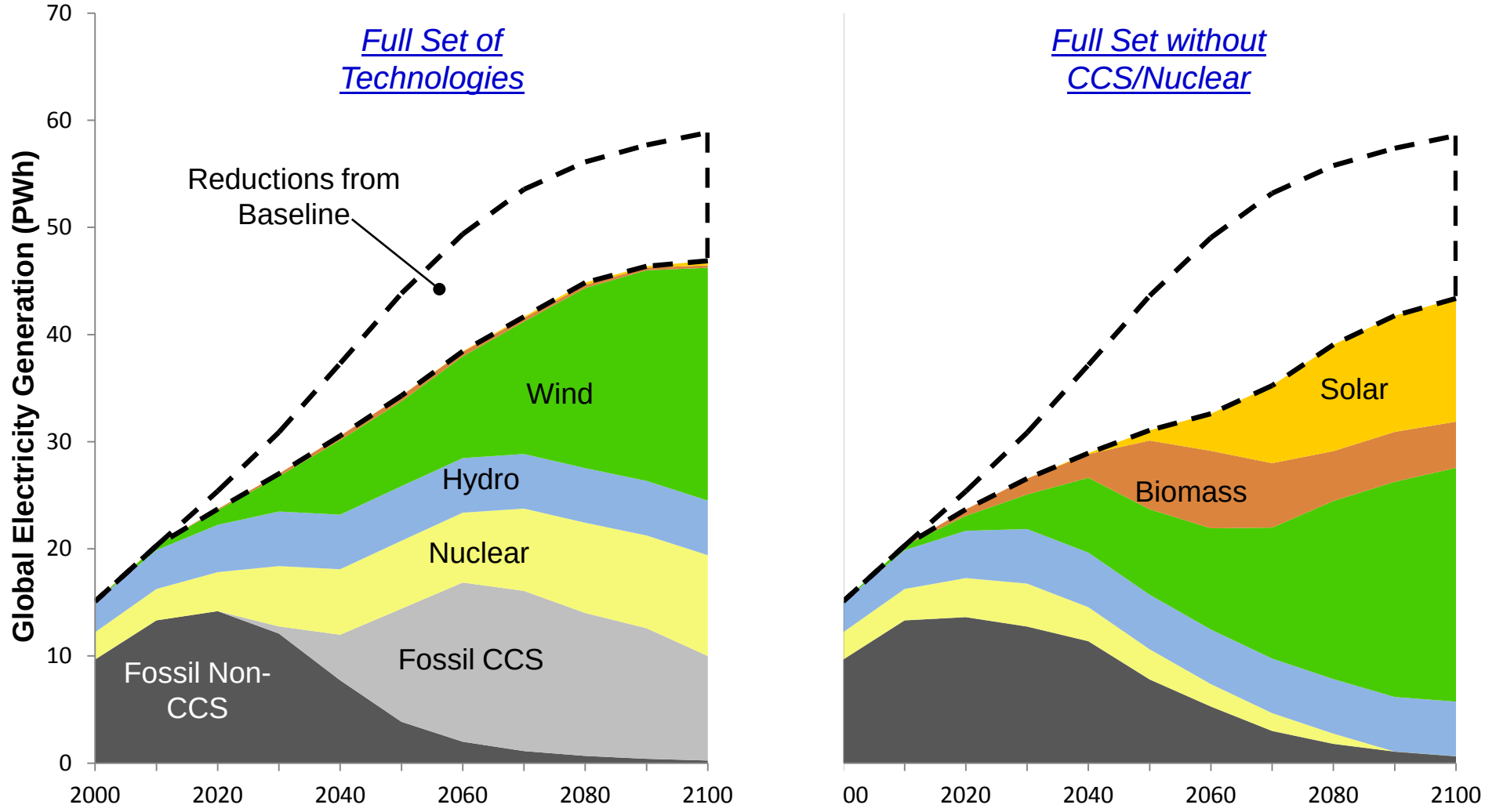
# Electric Sector Composition: 550ppm $CO_2e$ Target







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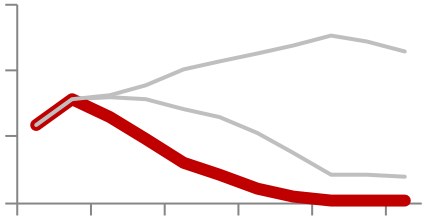
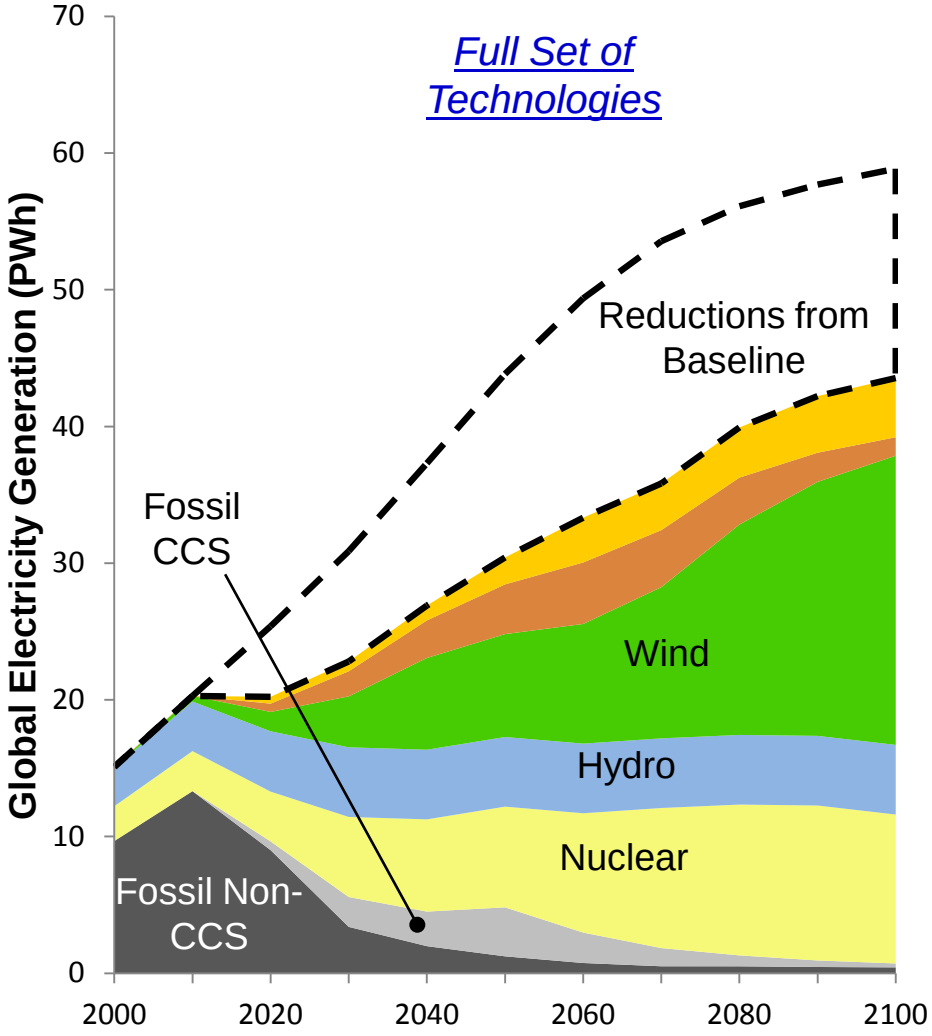
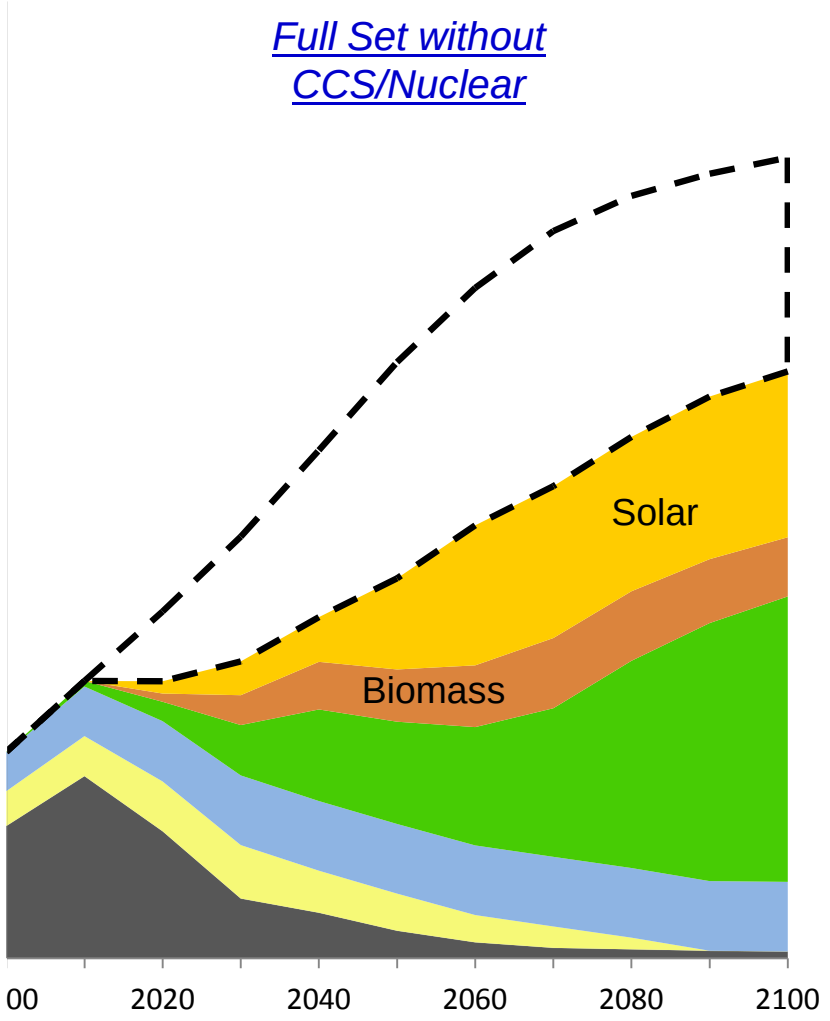
# Electric Sector Composition: G8 Proposal







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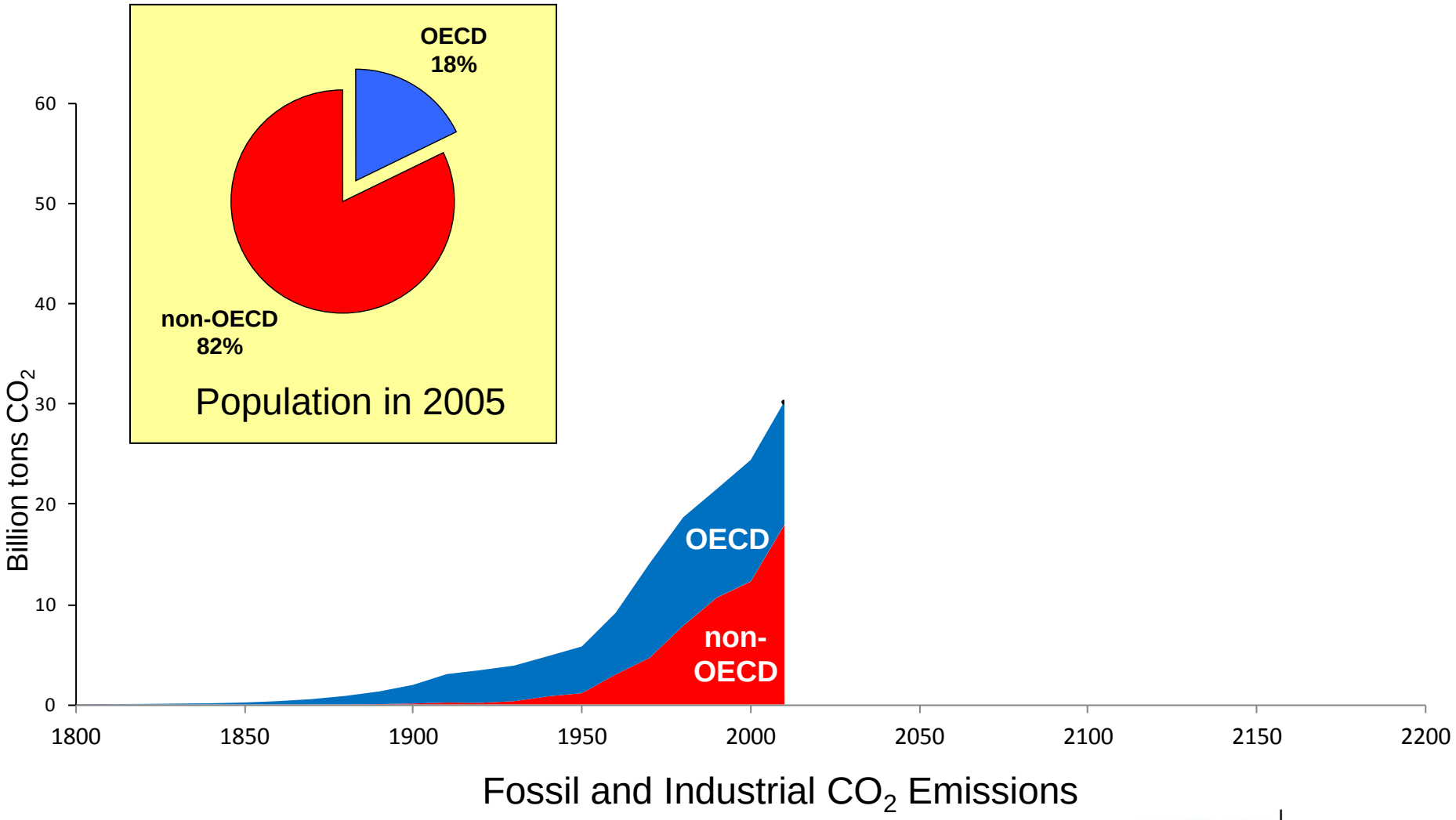
# A Regional Perspective



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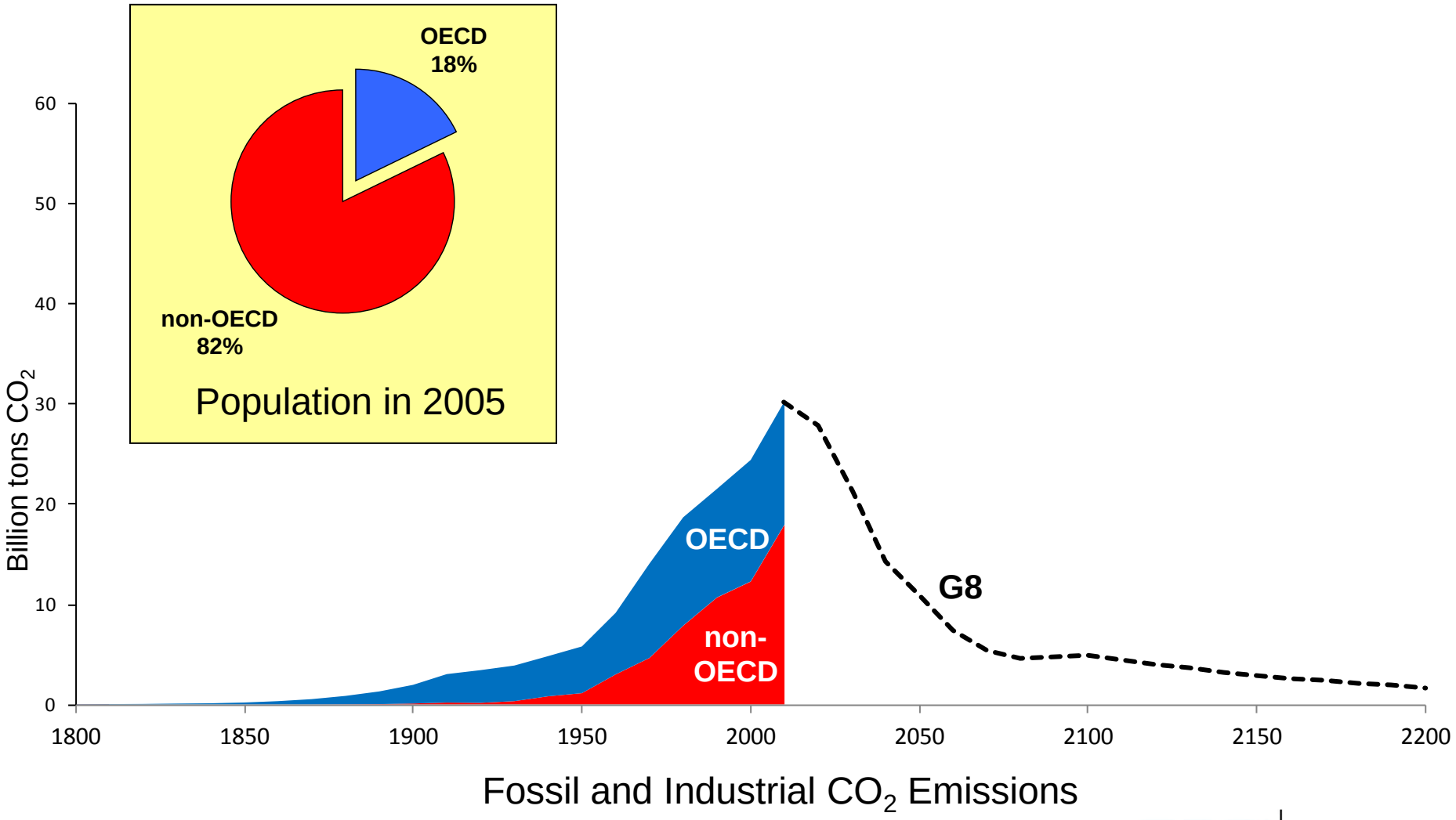

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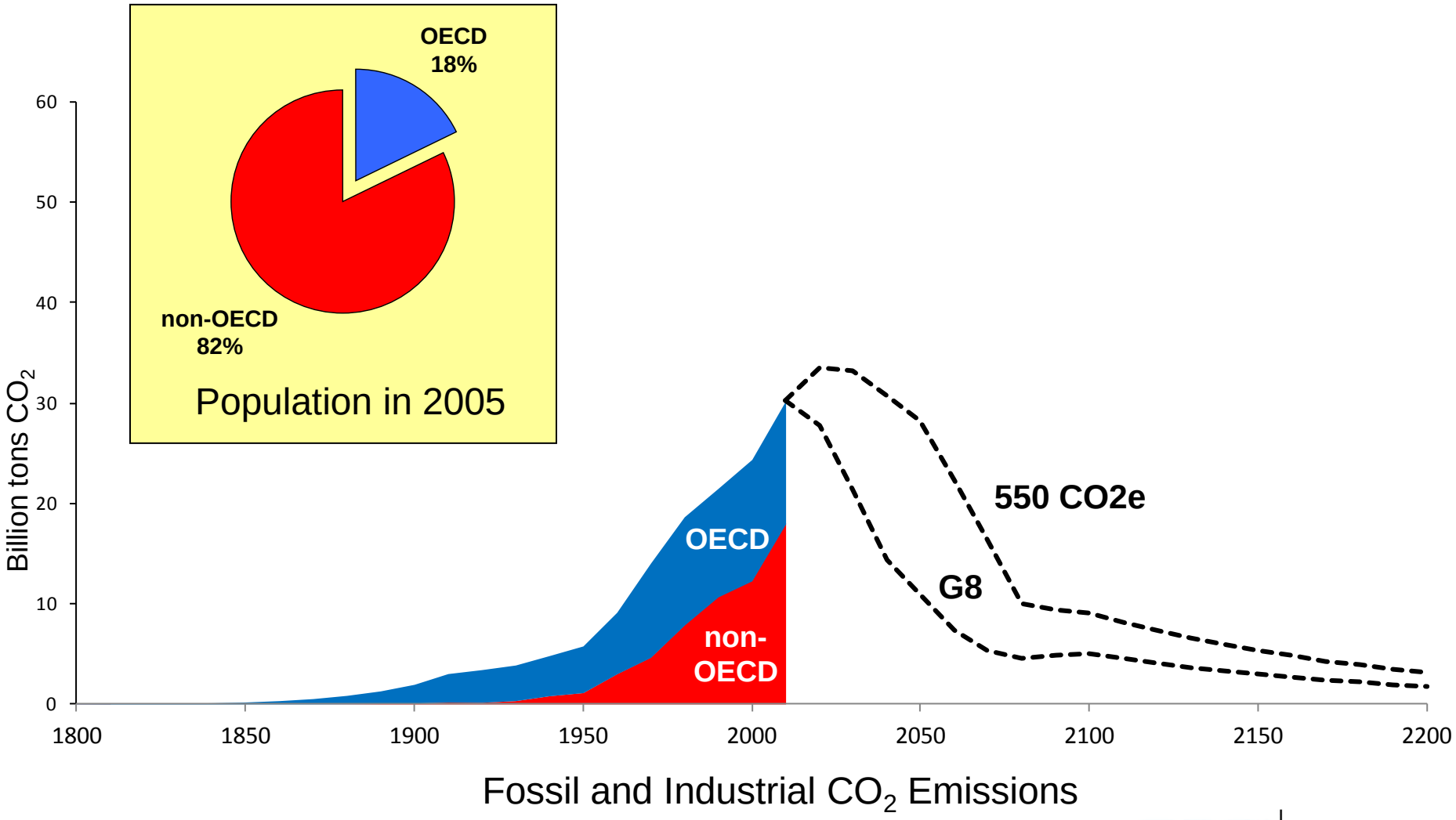

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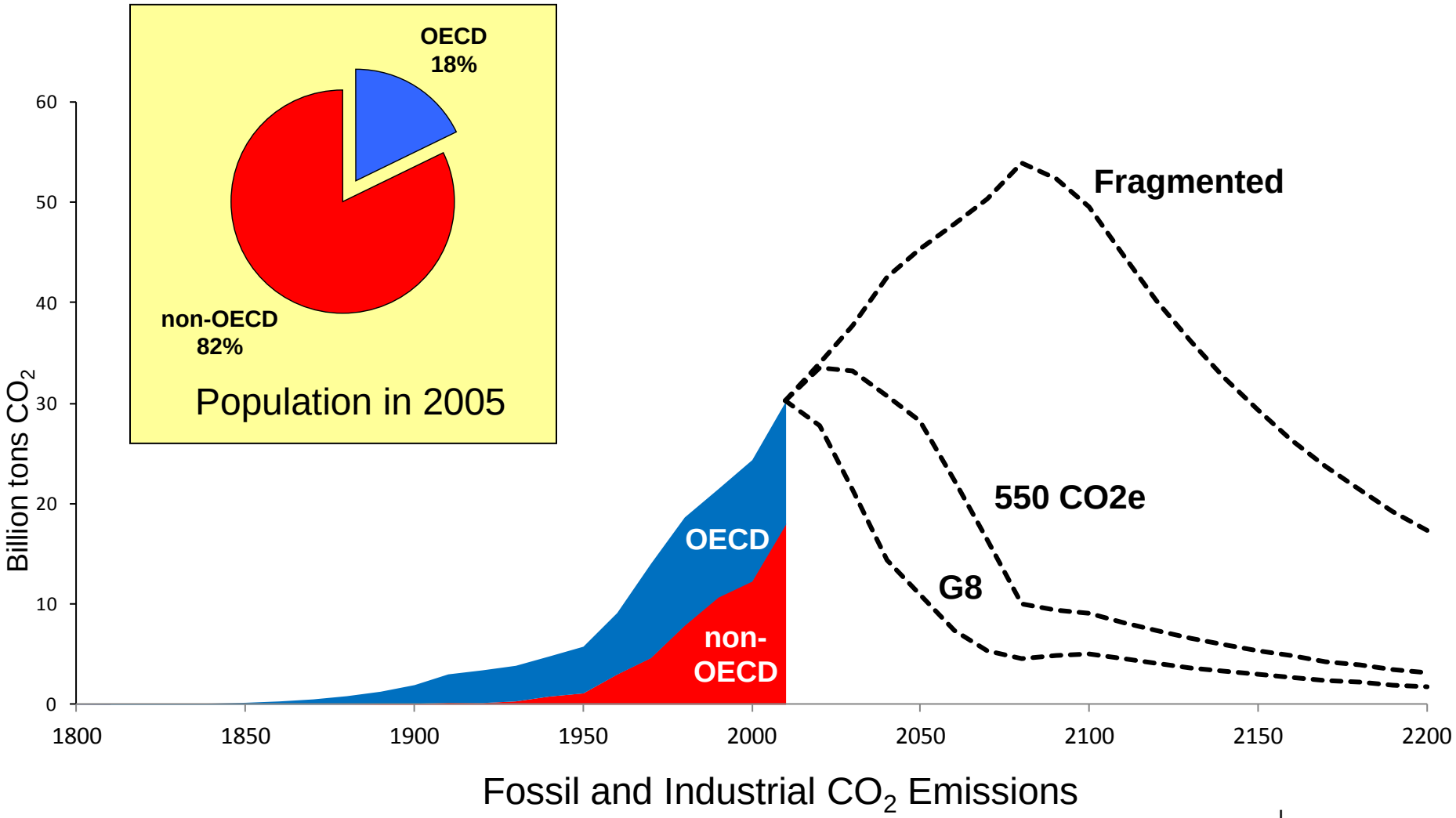

# Key Messages

- Costs of the transition may be substantial
  - Particularly for stringent targets, such as G8
- Technology pathways (both supply- and demand- side) make a difference
  - Successful R&D can save trillions of dollars
- Public acceptance of CCS and nuclear affect the costs
- Access to low-carbon technology in non-OECD countries is essential

***Costs should be viewed in light of expected benefits***

# Thank You

For further information, contact:

**Richard Richels**

Electric Power Research Institute

Senior Technical Executive

Tel: +1 650-224-0939

Email: rrichels@epri.com