

# Issues and Concepts in Projecting Baseline Emissions

Leon Clarke

Climate Change Expert Group Global Forum

OECD Conference Center, Paris

March 19-20, 2013

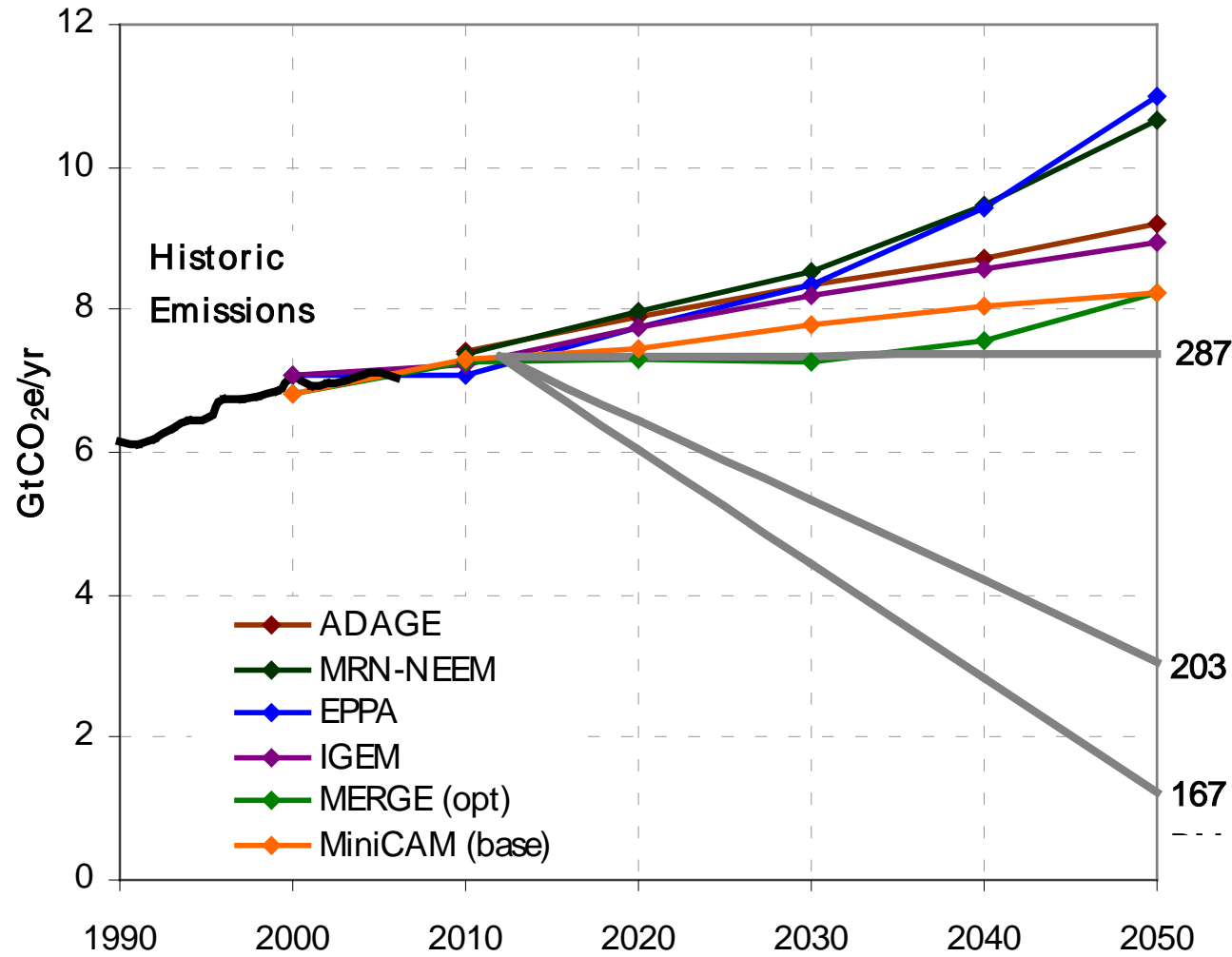
# The modeling community has produced many baseline scenarios

- ▶ Individual papers by individual modeling teams.
- ▶ Community exercises
  - Asian Modeling Exercise (2012) [Global, Asian Countries]
  - EMF 22 (2009) [Global, US, EU]
  - AMPERE (2013) [Global]
  - LIMITS (2013) [Global]
  - EMF 27 (2013) [Global]
  - EMF 24 (2013) [US]
  - EMF 28 (2013) [EU]
  - RoSE (2013) [Global]
- ▶ There is a lot of inertia in these baselines.
- ▶ There is often lock-in to particular underlying projections.
- ▶ Some studies specifically explore alternative baselines.

# Some background for interpreting scenarios from the modeling community

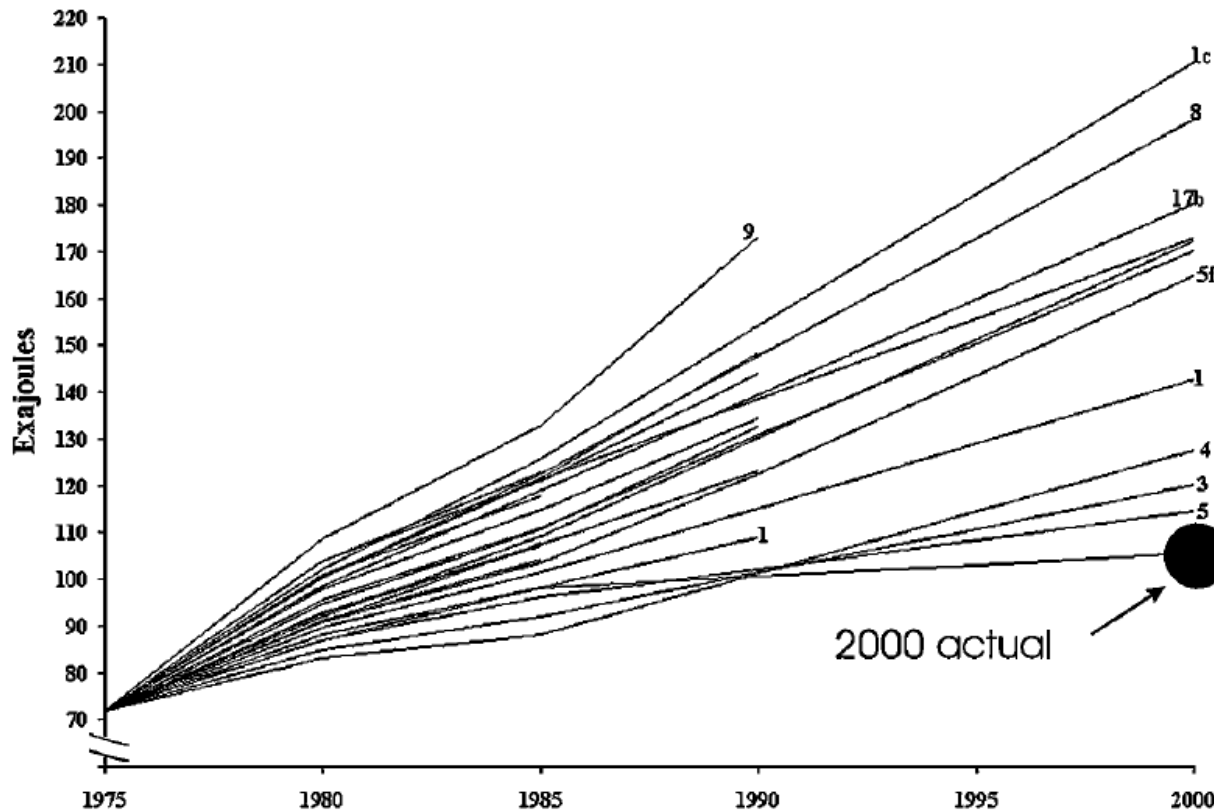
- ▶ Interpretation of “likelihood” of different baselines is difficult
  - Modelers are not necessarily trying to create “best guesses”, but their baselines are certainly informed by their perceptions of how the world might evolve.
  
- ▶ The treatment of policies in baseline scenarios is challenging
  - The breadth of baseline policies can be quite difficult to represent.
  - There are important questions about which policies should be in the baseline – climate, climate-related, and non-climate.
  - Scenarios do generally take into account some non-climate factors such as air pollution.
  
- ▶ Global modeling teams must produce baseline assumptions for all world regions, challenging the ability to get capture regional circumstances for individual countries or regions.
  
- ▶ Most global models have only limited regional detail that would be viable for developing country-level baselines.

# Baseline uncertainty is not relevant only to rapidly developing regions.



From: Fawcett, A., K. Calvin, F. de la Chesnaye, J. Reilly, J. Weyant, (2009), Overview of EMF 22 U.S. transition scenarios, Energy Economics, 31: S198-S211

# There is a long history of retrospective analysis of energy-related forecasts.



**Figure 1** Projections of total U.S. primary energy use from the 1970s. The figure is redrawn from a Department of Energy report (3) and simplified from a summary of dozens of forecasts. Actual use at the end of the century [105 exajoules (4)] is indicated. Forecasters clearly did not anticipate the ability of the economy to limit growth of energy use. Note that the figure suppresses the zero baseline. Sources for the individual curves may be found in Reference 3.

# There is a long history of retrospective analysis of energy-related forecasts.

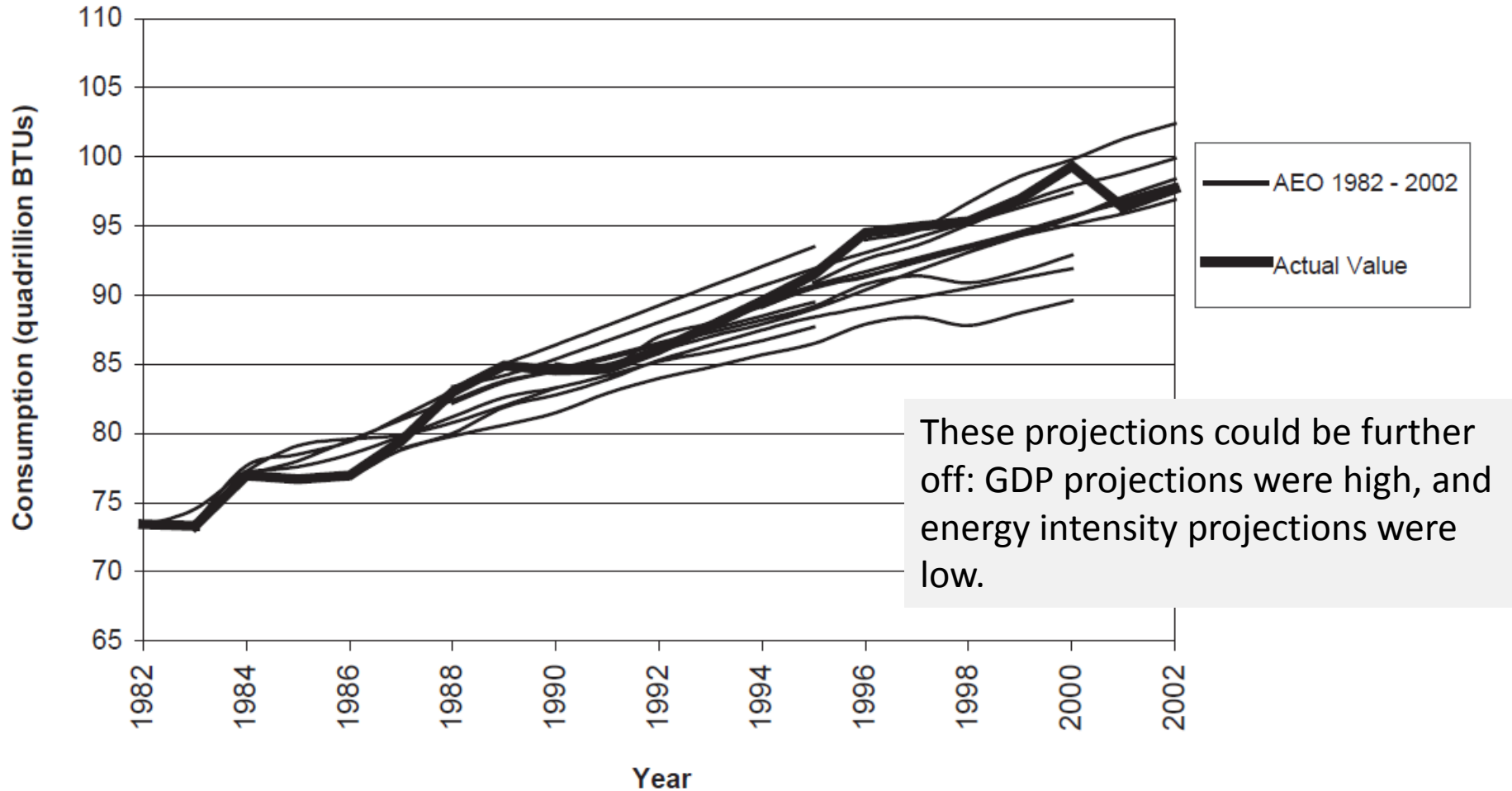
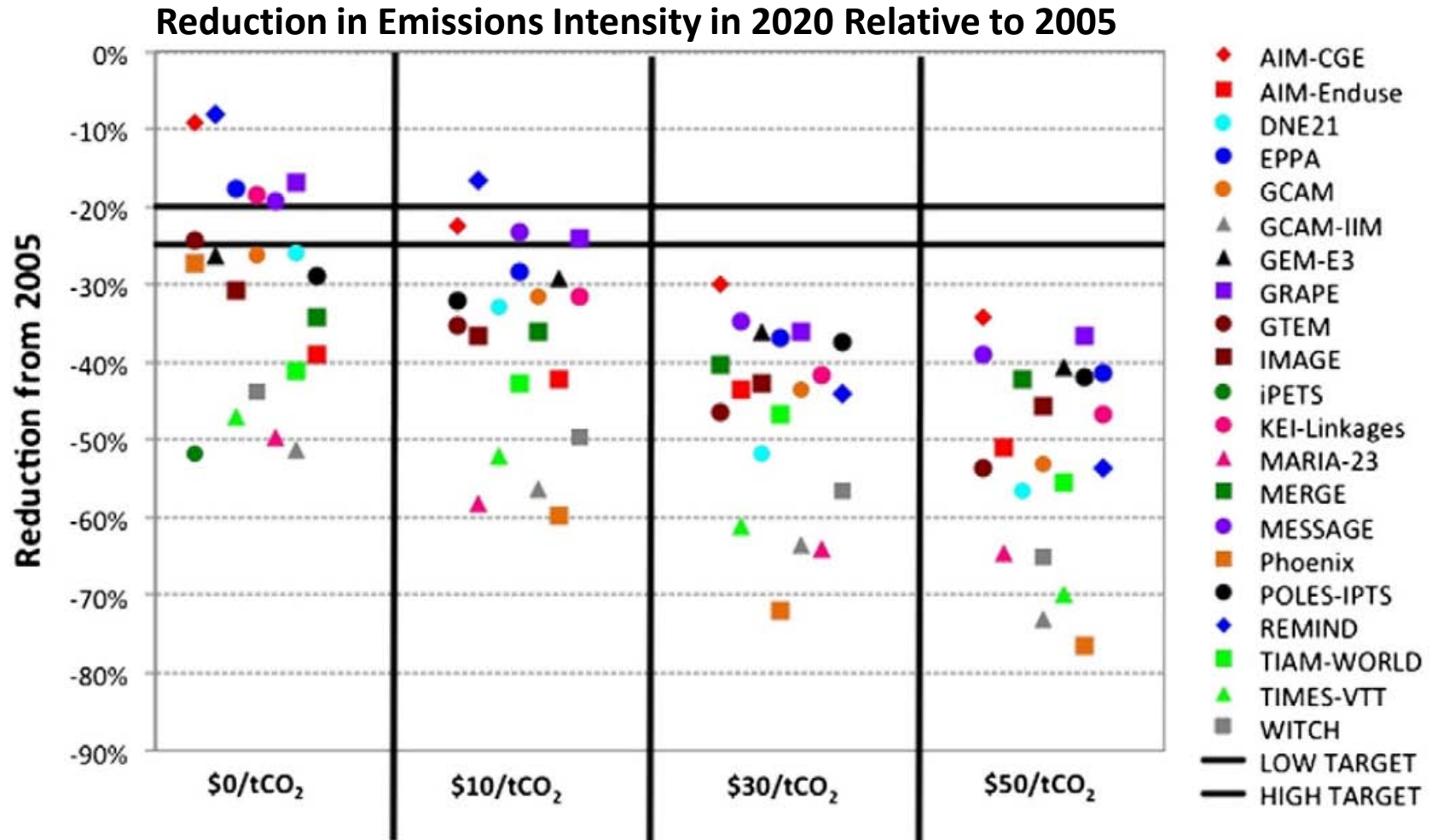


Fig. 2. Projections and actual values of energy consumption.

# Baselines are the basis for assessments of mitigation options and costs.

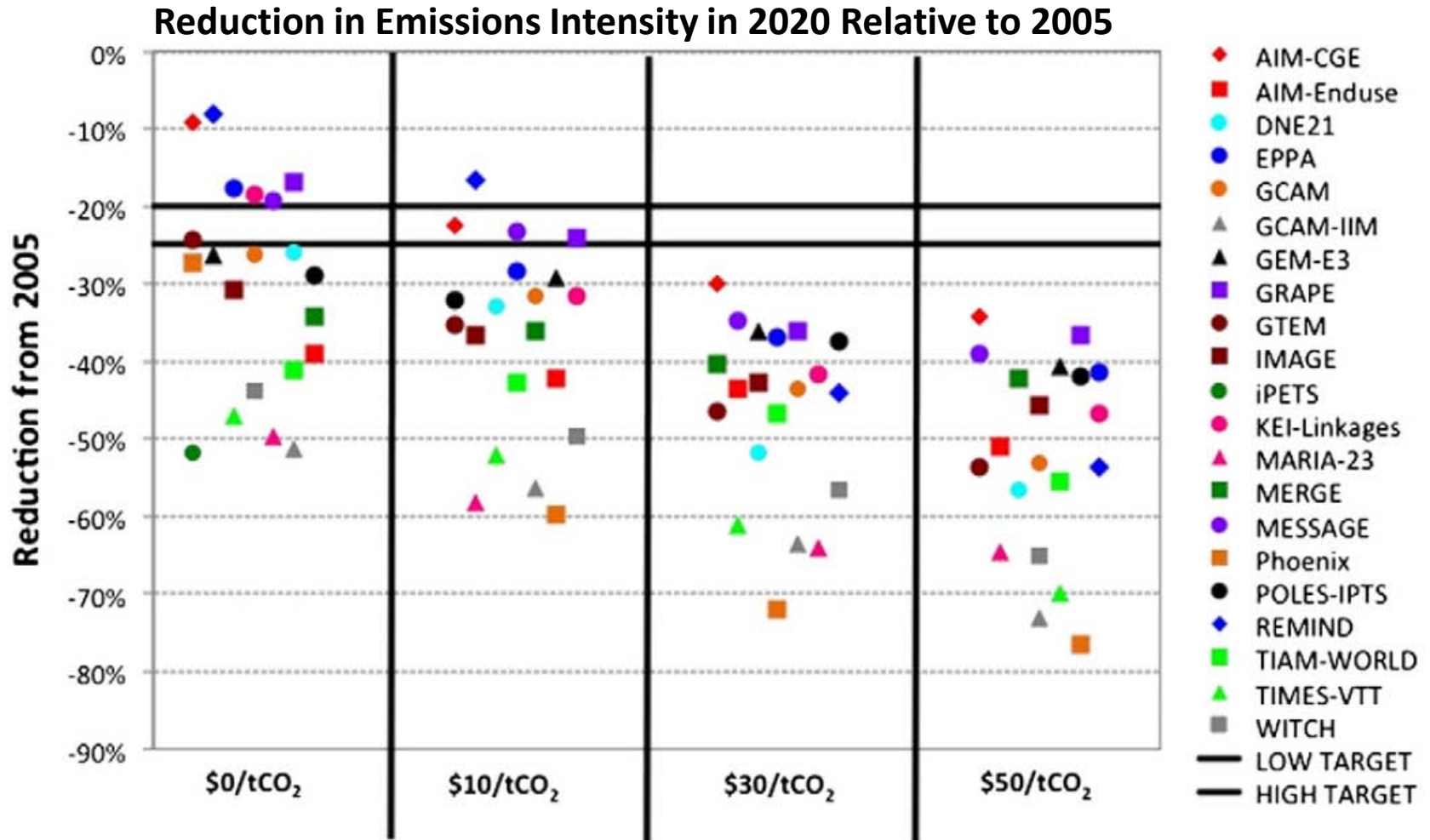
## INDIA



From: Calvin, K., A. Fawcett, K. Jiang, (2012), Comparing model results to national climate policy goals: Results from the Asia modeling exercise, *Energy Economics*, 34: S306-S315

# Uncertainty in baselines is reflected in uncertainty in mitigation costs.

## INDIA

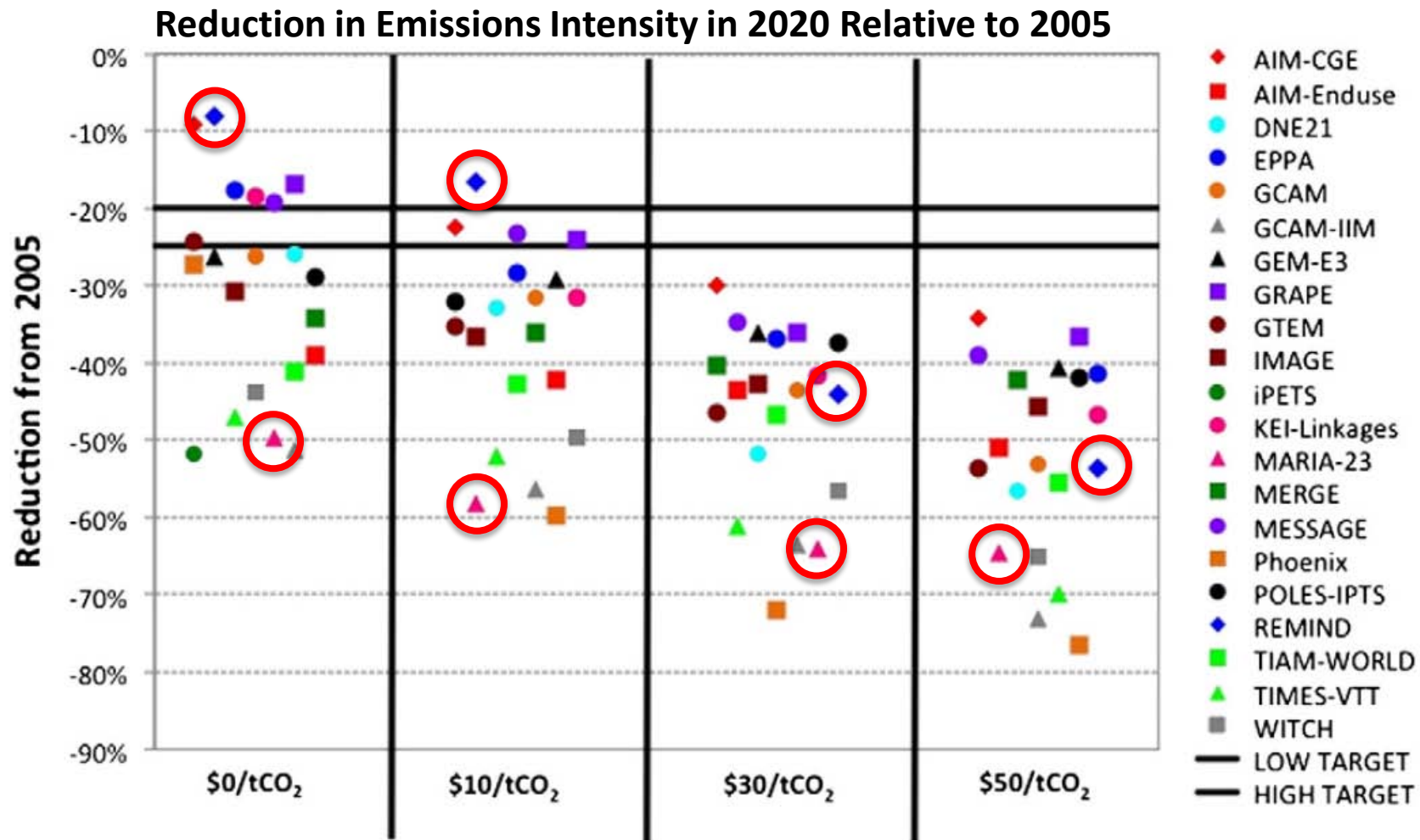


From: Calvin, K., A. Fawcett, K. Jiang, (2012), Comparing model results to national climate policy goals: Results from the Asia modeling exercise, *Energy Economics*, 34: S306-S315



# Baseline emissions influence, but do not define, the costs of meeting goals.

## INDIA

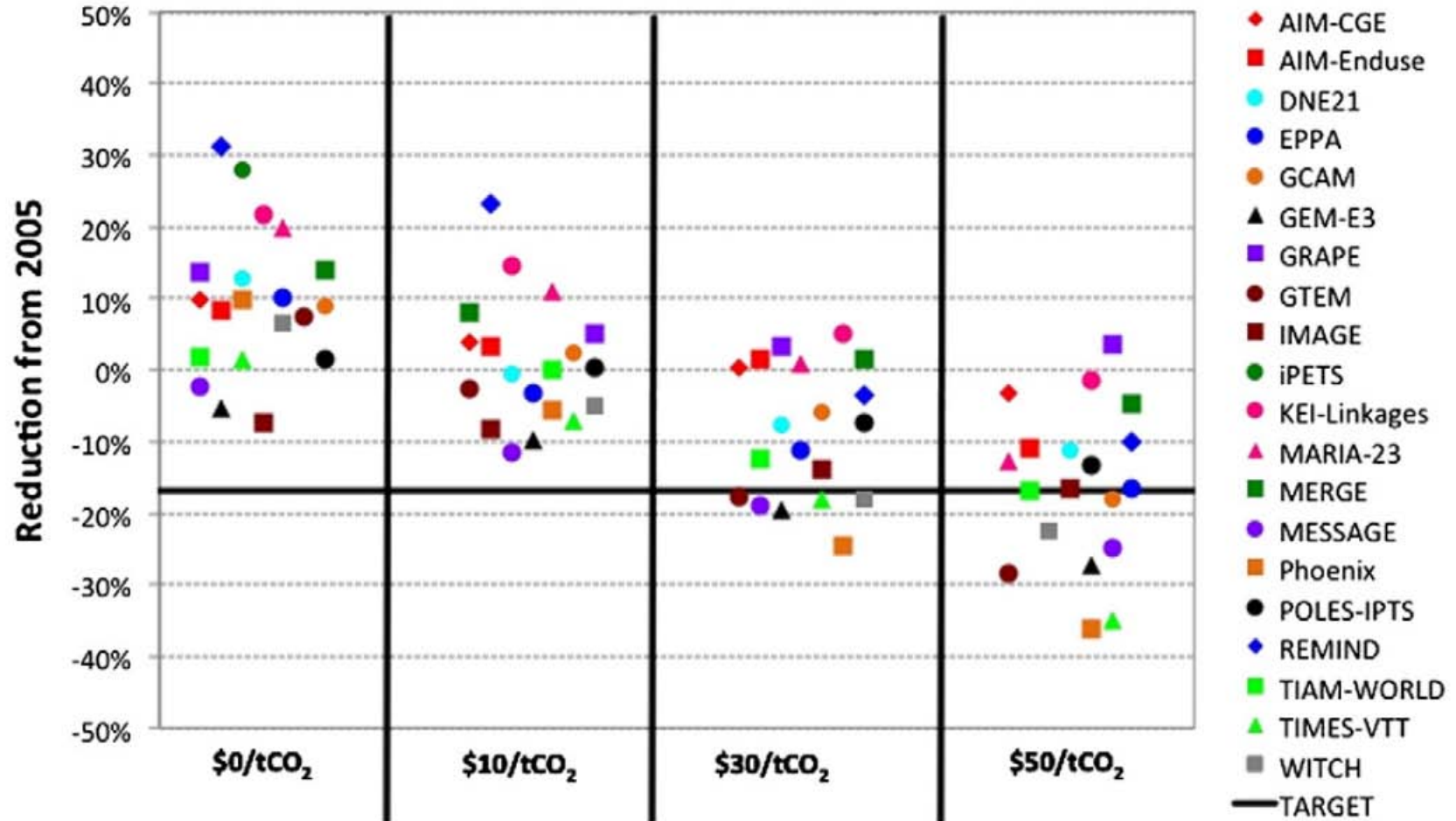


From: Calvin, K., A. Fawcett, K. Jiang, (2012), Comparing model results to national climate policy goals: Results from the Asia modeling exercise, *Energy Economics*, 34: S306-S315

# Baseline emissions influence, but do not define, the costs of meeting goals.

## UNITED STATES

### Emissions in 2020 Relative to 2005

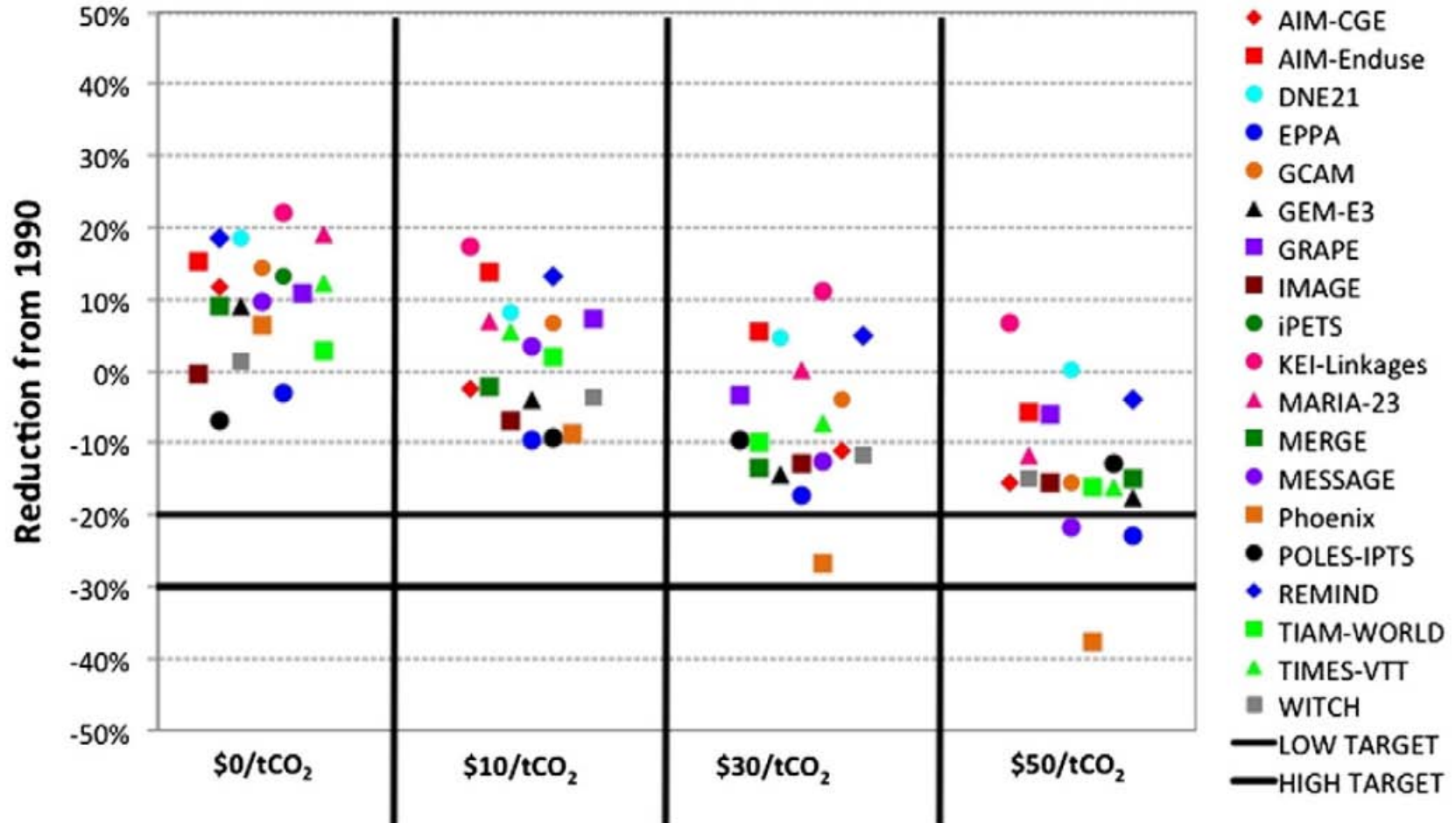


From: Calvin, K., A. Fawcett, K. Jiang, (2012), Comparing model results to national climate policy goals: Results from the Asia modeling exercise, *Energy Economics*, 34: S306-S315

# Baseline emissions influence, but do not define, the costs of meeting goals.

## EUROPEAN UNION

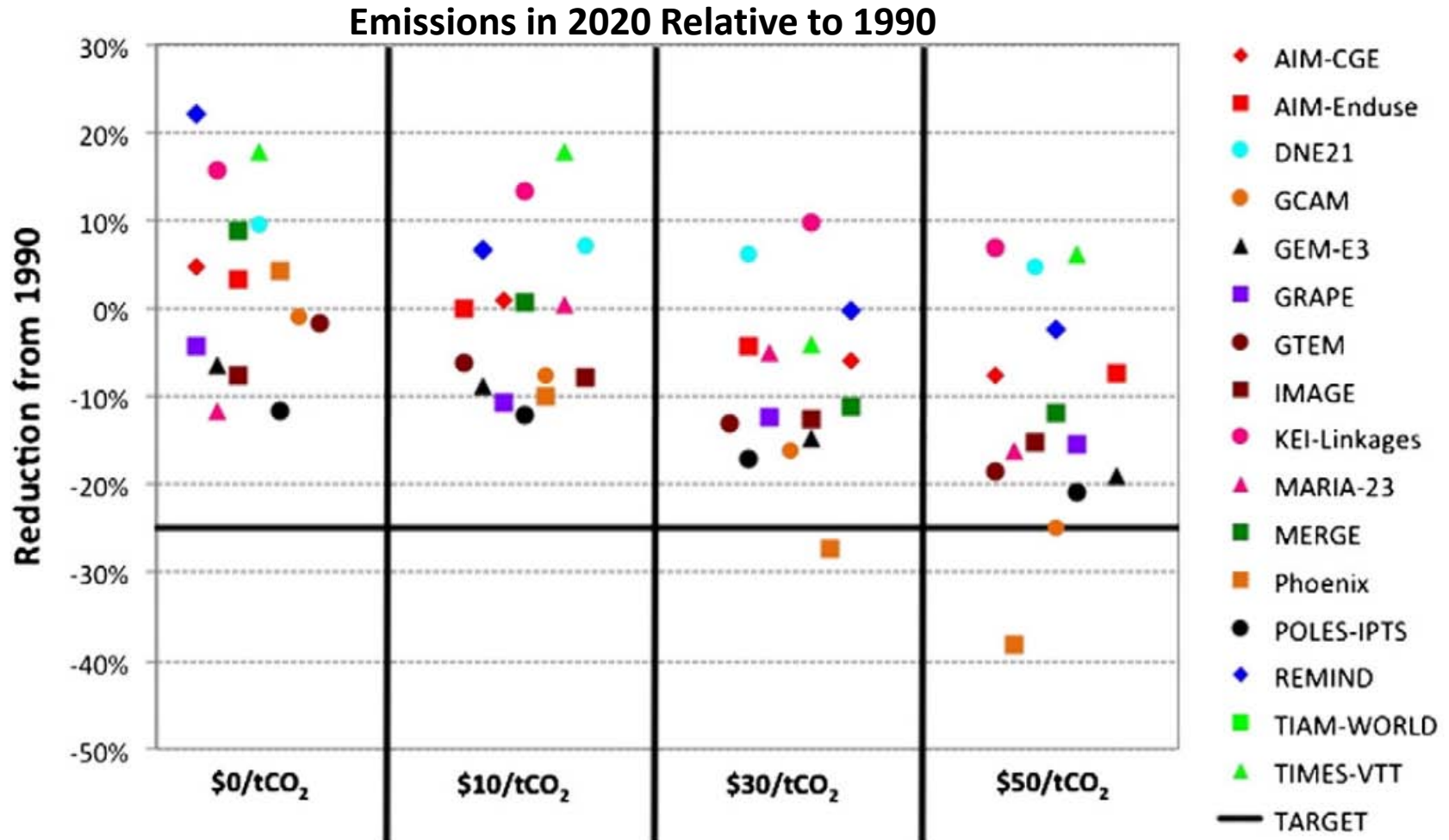
### Emissions in 2020 Relative to 1990



From: Calvin, K., A. Fawcett, K. Jiang, (2012), Comparing model results to national climate policy goals: Results from the Asia modeling exercise, *Energy Economics*, 34: S306-S315

# Baseline emissions influence, but do not define, the costs of meeting goals.

## JAPAN

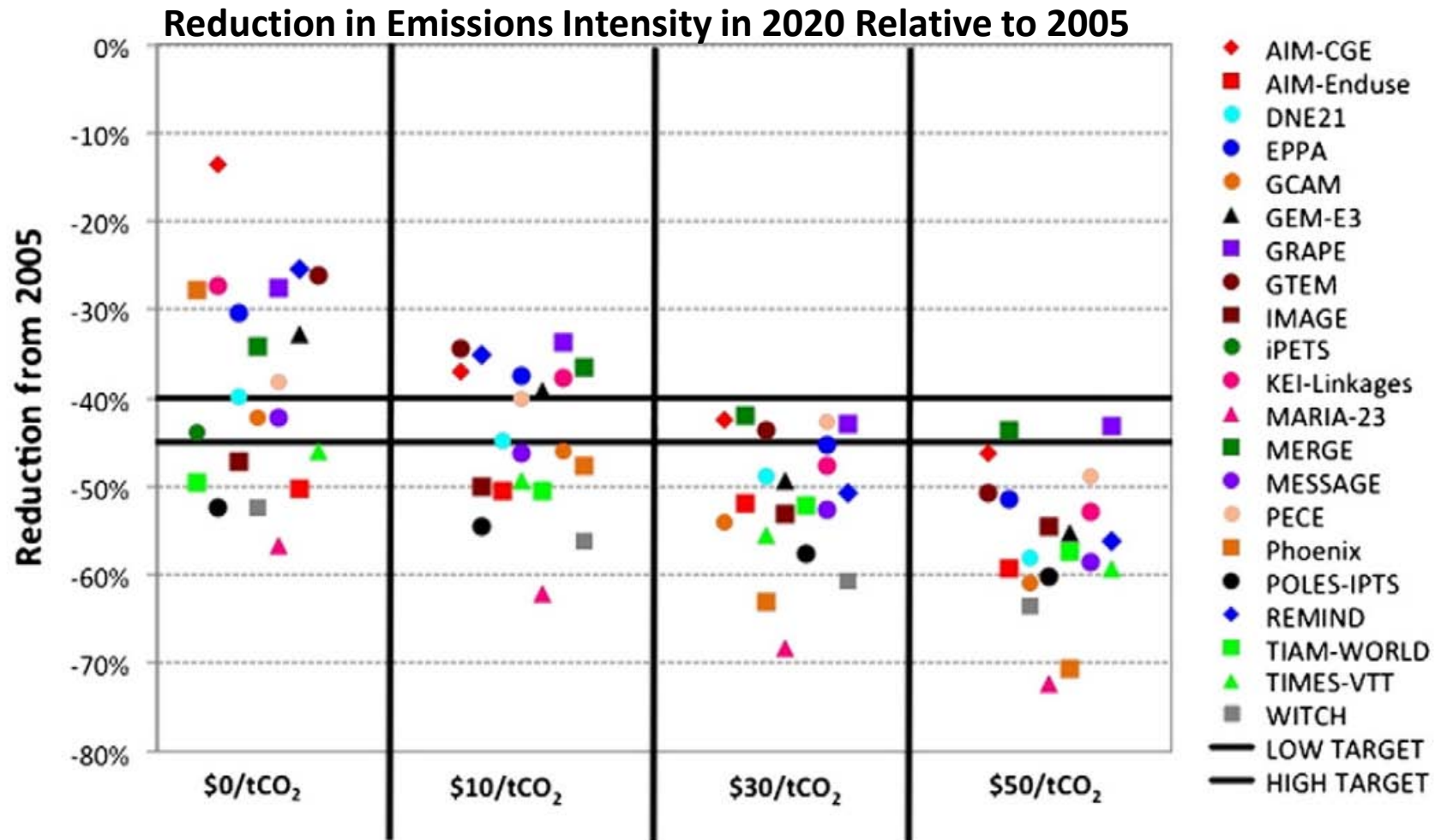


From: Calvin, K., A. Fawcett, K. Jiang, (2012), Comparing model results to national climate policy goals: Results from the Asia modeling exercise, *Energy Economics*, 34: S306-S315



# Baseline emissions influence, but do not define, the costs of meeting goals.

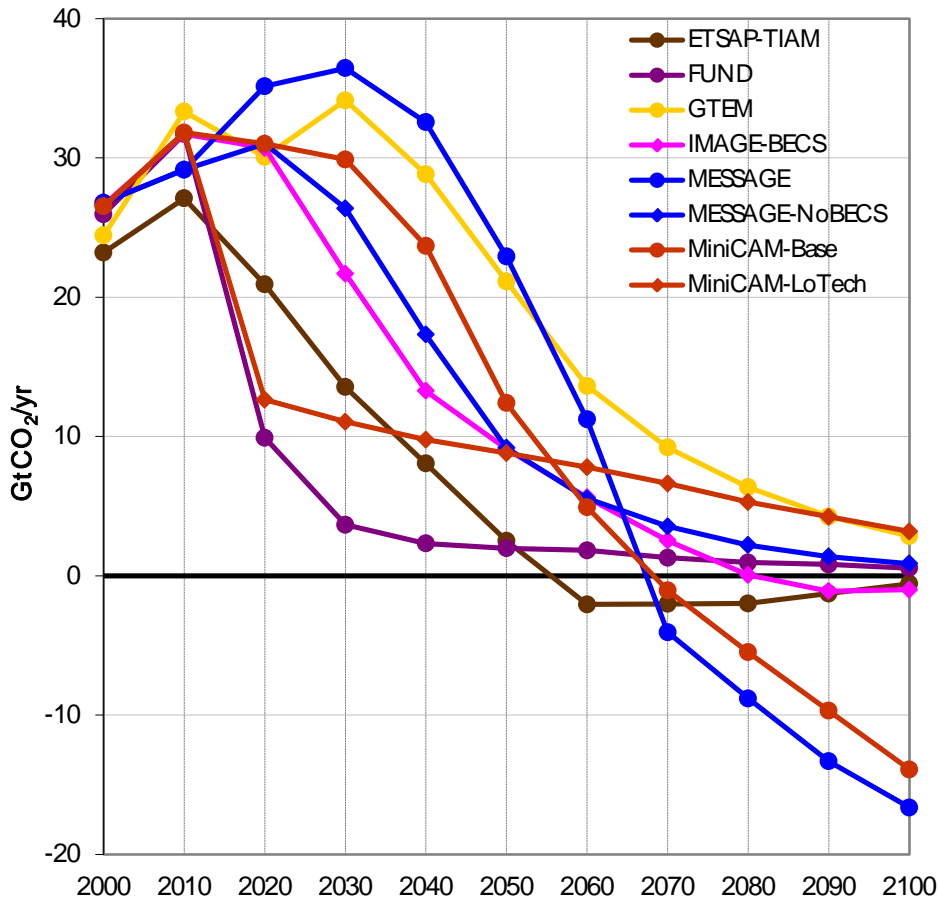
## CHINA



From: Calvin, K., A. Fawcett, K. Jiang, (2012), Comparing model results to national climate policy goals: Results from the Asia modeling exercise, *Energy Economics*, 34: S306-S315

# Modeling exercises are consistently used to help understand emissions pathways to long-term goals

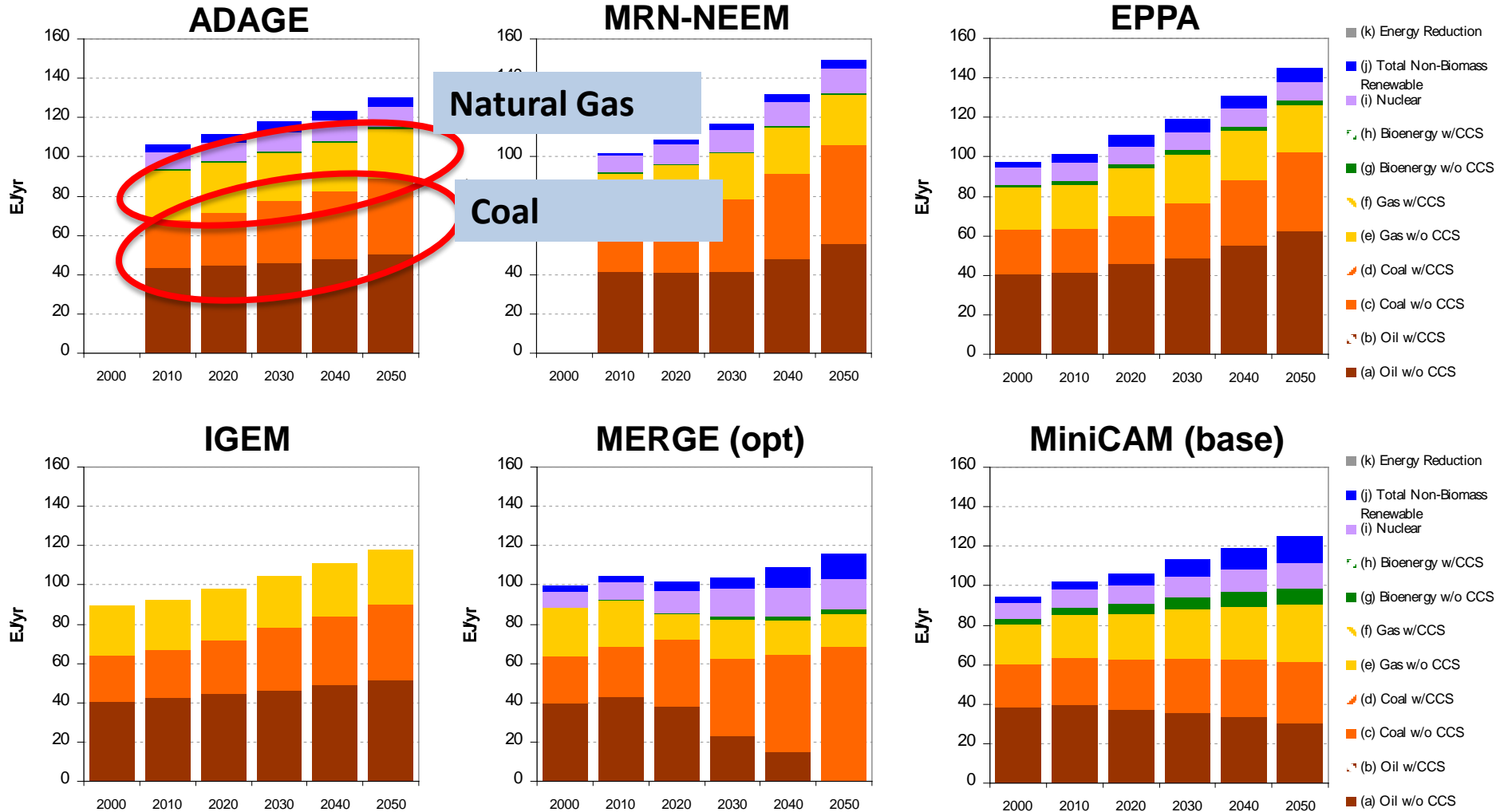
**CO2 Emissions in scenarios reaching 450 CO<sub>2</sub>-e by 2100**



- ▶ There are a lot of pathways toward long-term goals.
- ▶ These pathways can be very different, for example...
  - Degree of overshoot.
  - Degree of negative emissions.
  - Nature of the goal (what is meant by 2 degrees?)
- ▶ All of the new scenario exercises are producing these long-term scenarios, and they form the basis for the IPCC and other assessments.

# How well do baselines reflect changing conditions?

## Primary energy in the EMF 22 reference scenarios

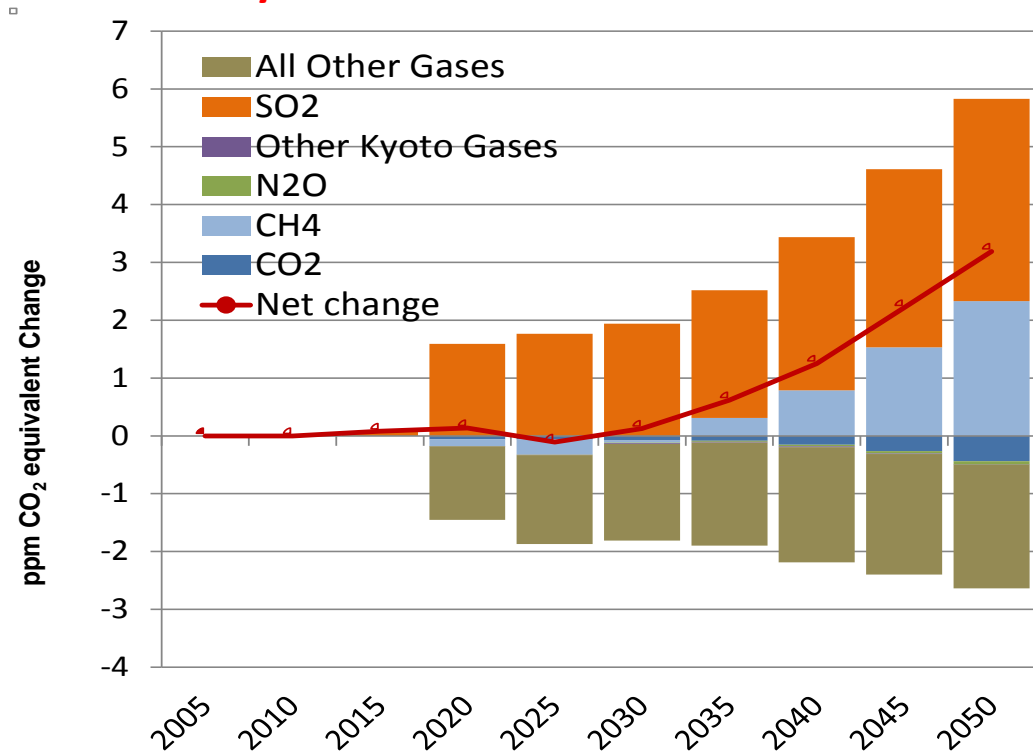


From: Fawcett, A., K. Calvin, F. de la Chesnaye, J. Reilly, J. Weyant, (2009), Overview of EMF 22 U.S. transition scenarios, Energy Economics, 31: S198-S211

# Effect of Abundant Gas on Baseline Radiative Forcing: Countervailing Effects

- Natural gas emits less CO<sub>2</sub> than other fossil fuels;
- Inexpensive natural gas leads to both substitution for other energy carriers, and expanded use of total energy and power;
- Increased use of gas in power generation reduces the use of coal, which in turn reduces sulfur emissions. Sulfur aerosols also cool the Earth and therefore reduced emissions unmask some climate change;
- Natural gas use reduces non-sulfur air pollutants that are positive contributors to climate forcing; and
- The increase in gas use is potentially accompanied by greater losses from gas production and transport. That is, it increases methane emissions.

## Preliminary results – not for citation or attribution





# What are some issues to keep in mind when considering baseline scenarios



Pacific Northwest  
NATIONAL LABORATORY

Proudly Operated by **Battelle** Since 1965

- ▶ The modeling community has produced and will continue to produce many baselines.
- ▶ There is a great deal of uncertainty in these projections. This is unavoidable.
- ▶ There are ways to explore baselines to gain transparency (see the previous talk).
- ▶ There are challenges in defining what should be in a baseline.
- ▶ It is important to think about important unexpected changes (e.g., abundant gas).
  
- ▶ The modeling community is also producing a large set of scenarios that can help to define the range of pathways toward long-term goals and inform the costs of mitigation in different regions.
  - Baselines are an important factor in developing these scenarios.