



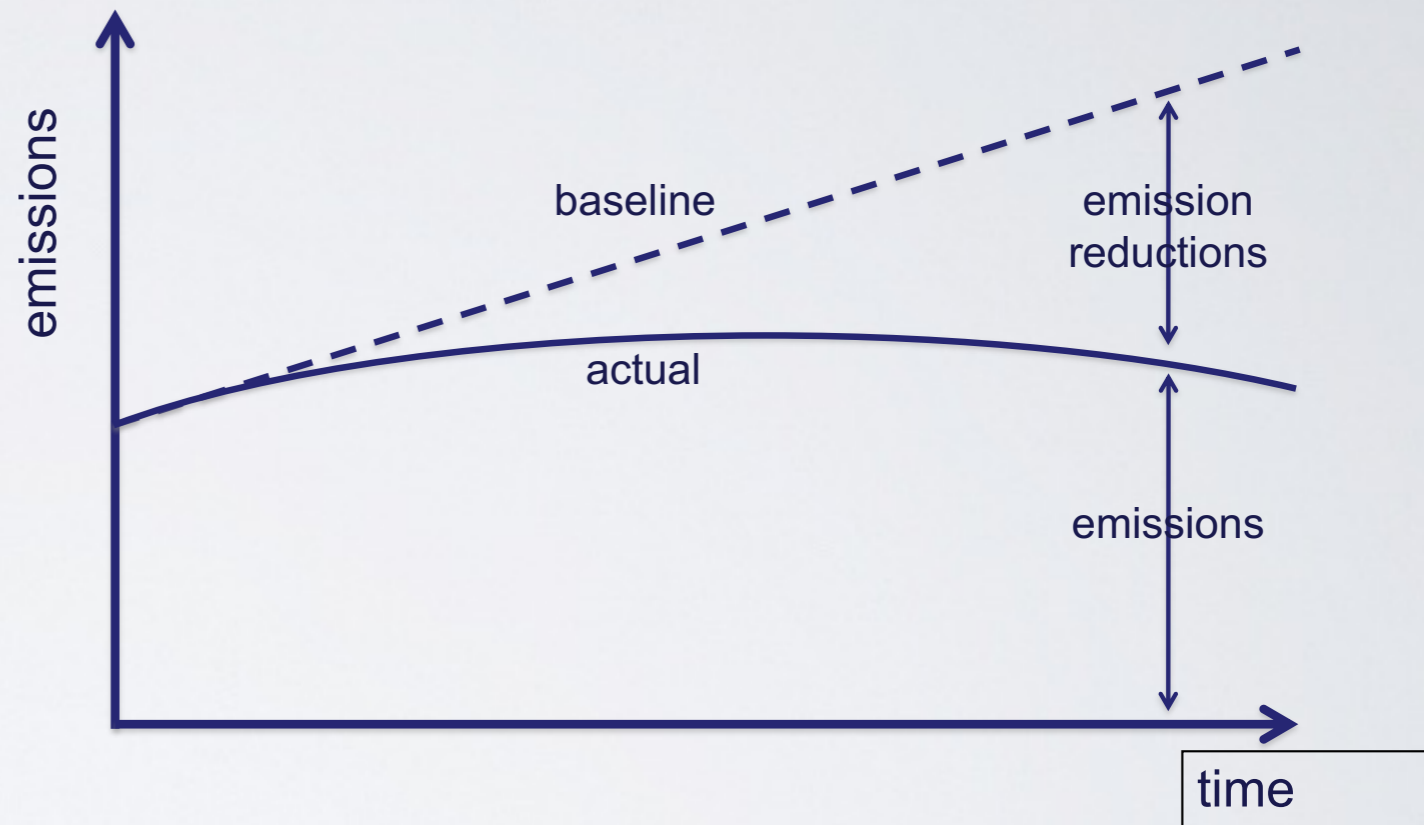
# **QUANTIFYING EMISSION REDUCTIONS**

## **THE CASE OF CARBON OFFSETS**

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UC Santa Cruz

# KEY TAKEAWAYS

- Emission *reductions* can never be quantified with certainty
  - Actual emissions can
  - Counterfactual emissions are more problematic
- Challenges are greater at the project level



# WHY IT MATTERS

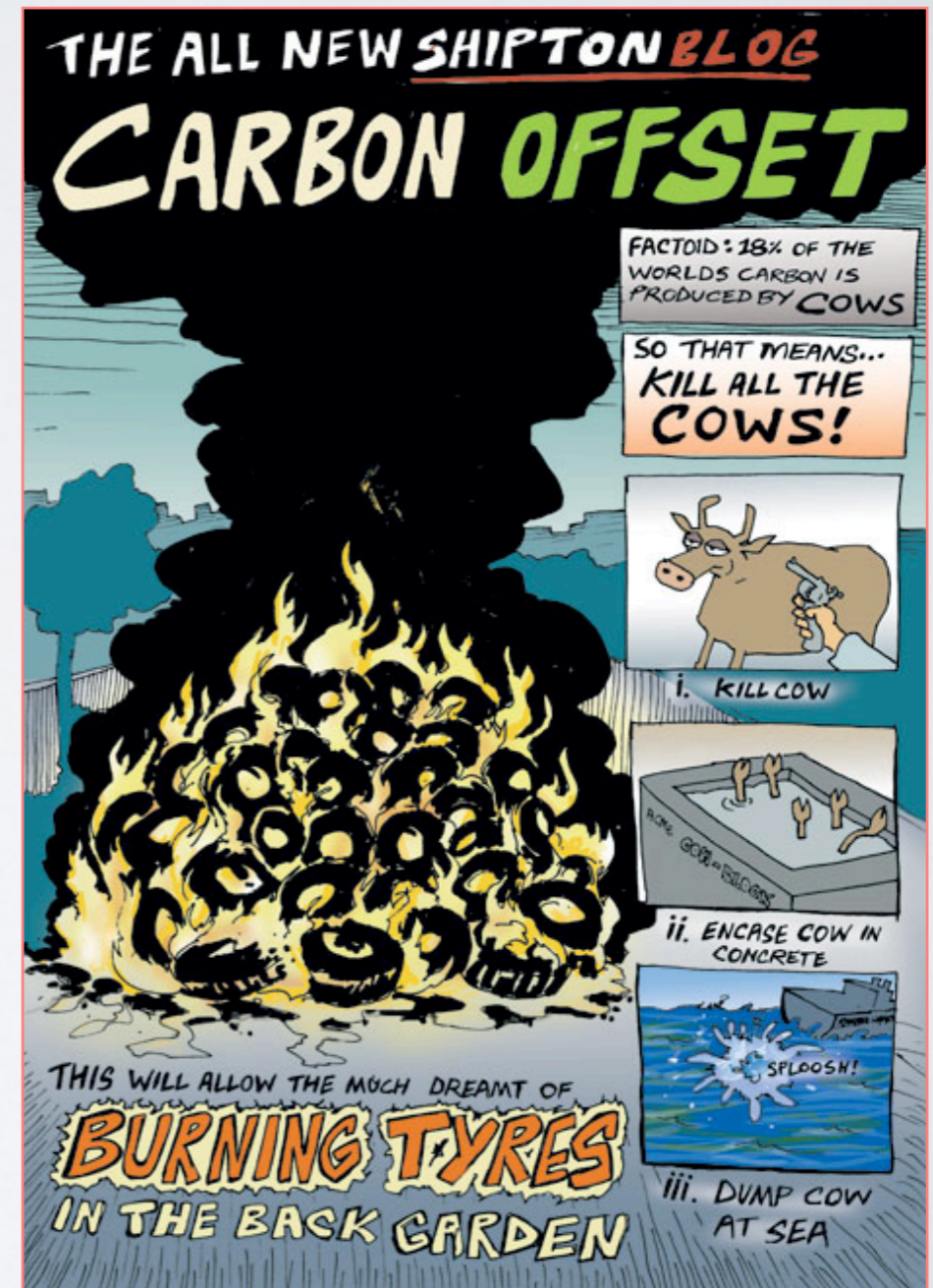
- Competitive grant programs
- Communicating benefits
- Carbon offsets
  - Voluntary
  - Clean Development Mechanism
  - Sectoral
- Research: understanding what works



Source: Transform

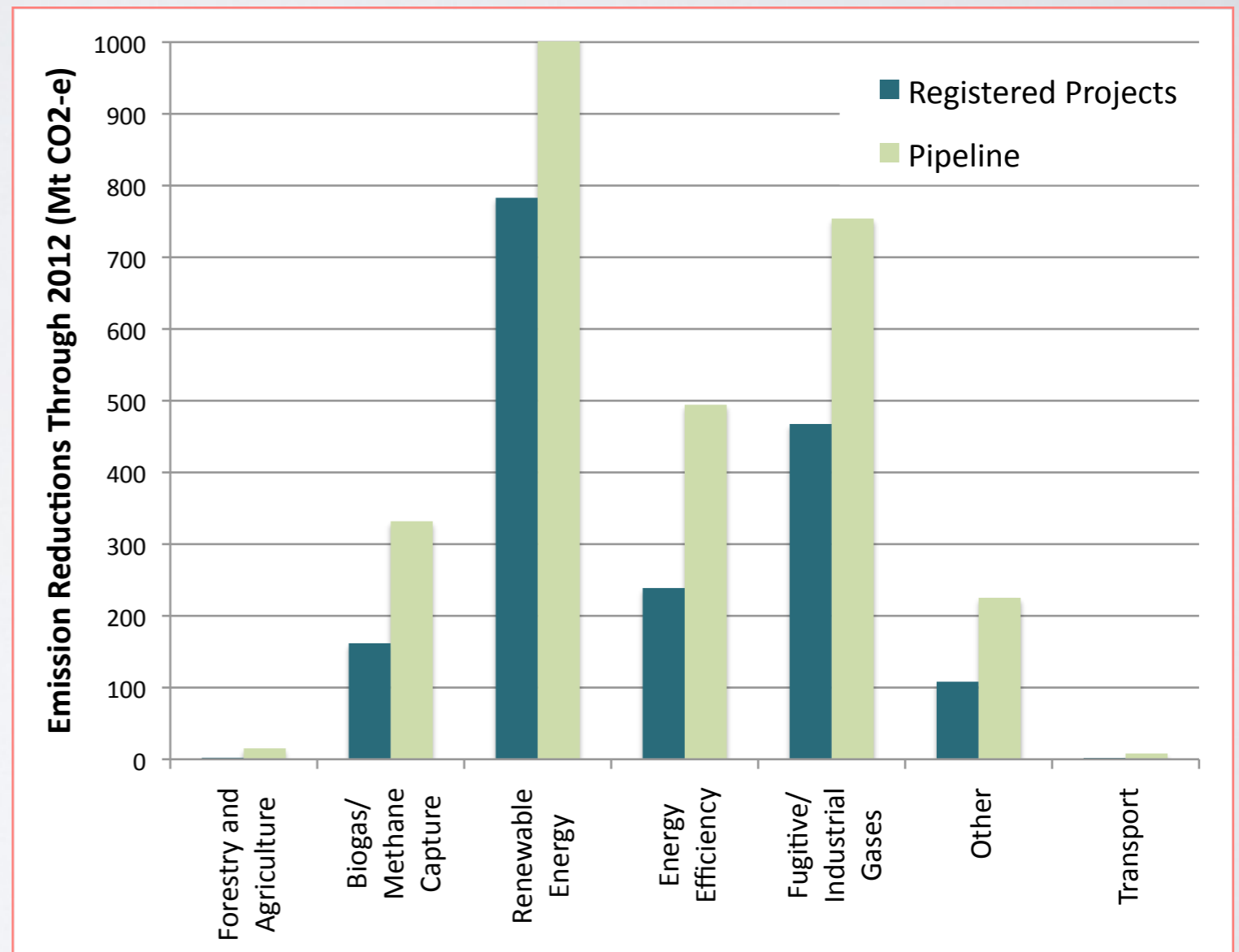
# CLEAN DEVELOPMENT MECHANISM

- Earliest regulatory carbon offset program
- Set up under Kyoto Protocol
- Developed countries purchase offsets from lower-income countries
- CDM has largely vanished, but lessons are important for today



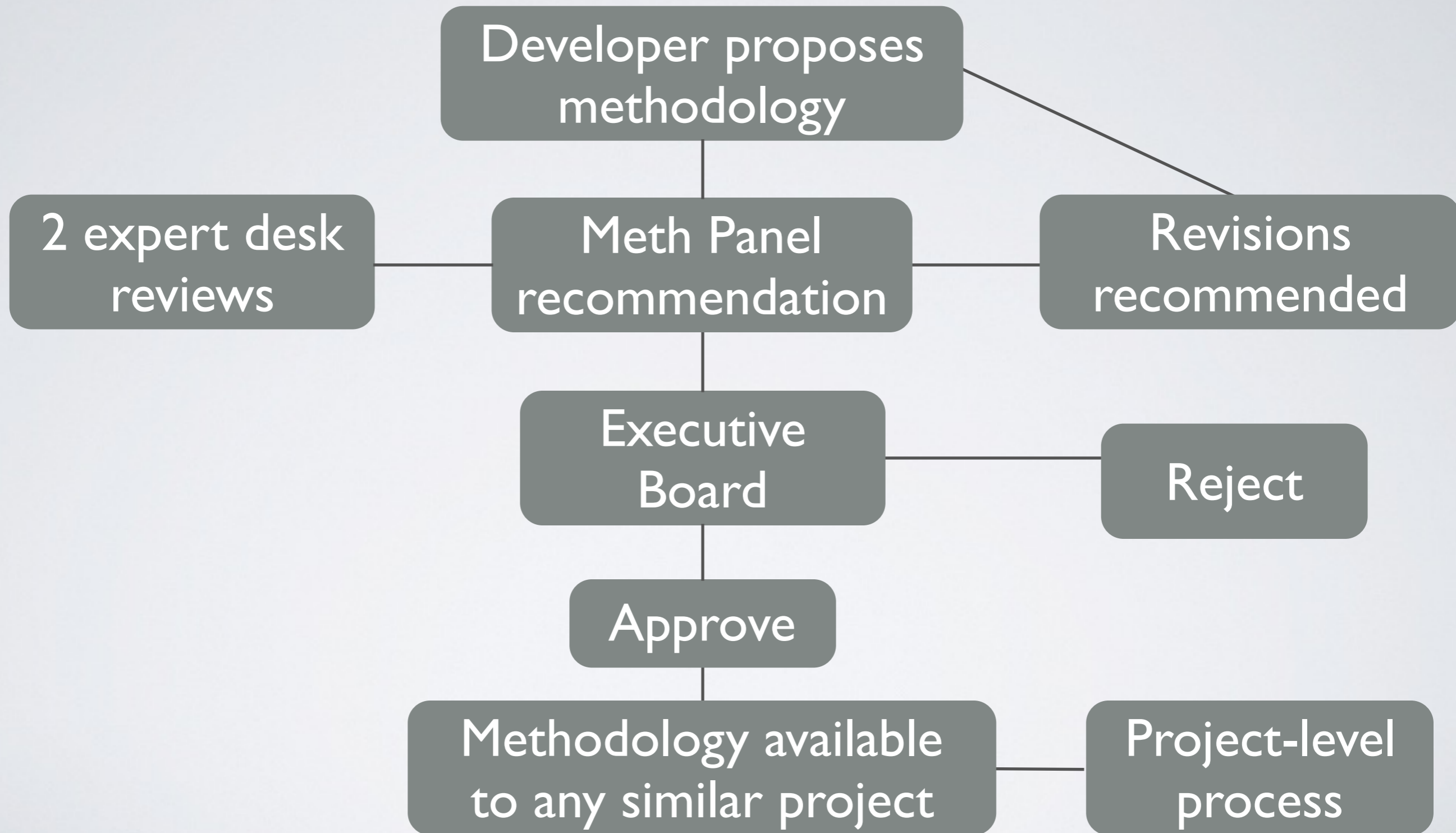
# FEW TRANSPORT PROJECTS

- 32 out of 8377 CDM projects
- 0.3% of emission reductions
- Methodologies were hard to get approved





# CDM APPROVAL PROCESS



# EARLY METHODOLOGIES

<b>ID</b>	<b>Project Type</b>	<b>Location</b>	<b>Status</b>
NM0052	Bus Rapid Transit	Bogotá, Colombia	
NM0083	Fuel switching to LPG	India	
NM0105	Bus Rapid Transit	Bogotá, Colombia	
NM0128	Freight mode shift	Espirito Santo, Brazil	
NM0158	Bus Rapid Transit	Mexico City, Mexico	
NM0201	Freight mode shift	Pará, Brazil	
NM0205	Diesel combustion efficiency	Rosario, Argentina	
NM0229	Bus Rapid Transit	Mexico City, Mexico	
NM0237	Bus dispatch system	Manila, Philippines	
NM0257	Bus dispatch system	Manila, Philippines	
NM0258	Bus Rapid Transit	Mexico City, Mexico	
NM0266	Rail expansion	Mumbai, India	
NM0276	Freight mode shift	Tubarão, Brazil	
NM0279	Transit-oriented development	Nanchang, China	
NM0287	Increasing rail ridership	Medellin, Colombia	
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# TRANSPORT'S INHERENT CHALLENGES

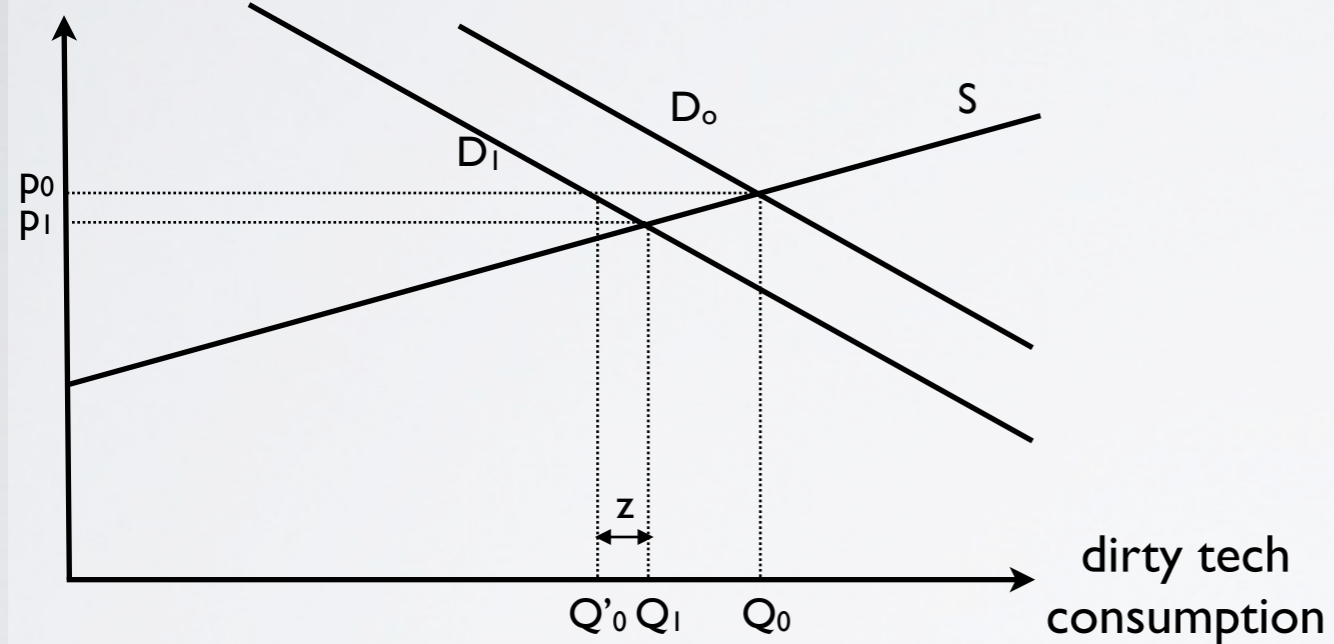
- Complexity of most project types
  - Decentralized decision-making, numerous sources
  - Large no. of mode, route and destination choices
  - Rebound effects, e.g. from lower congestion
- Poor quality of early methodologies
- Lack of Meth Panel expertise
- Other sectors provide low-hanging fruit

# MARKET LEAKAGES

- Leakage: Changes in emissions outside the project boundary
  - E.g. cement used for hydroelectric dam
- Market leakage: Induced by price changes
  - E.g. CDM credits for coalbed methane destruction are a de facto subsidy for coal, increasing demand

# TYPES OF MARKET LEAKAGE

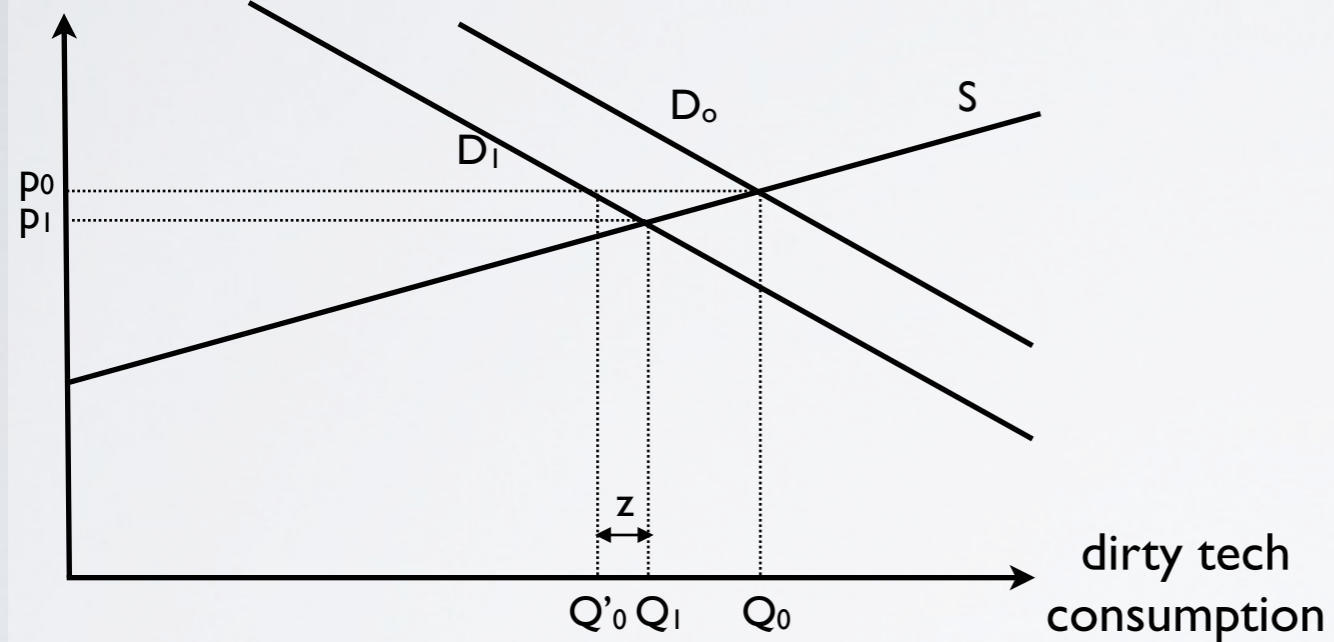
## Rebound Effects



E.g. BRT lowers demand for driving and lowers (time or money) cost of vehicle travel

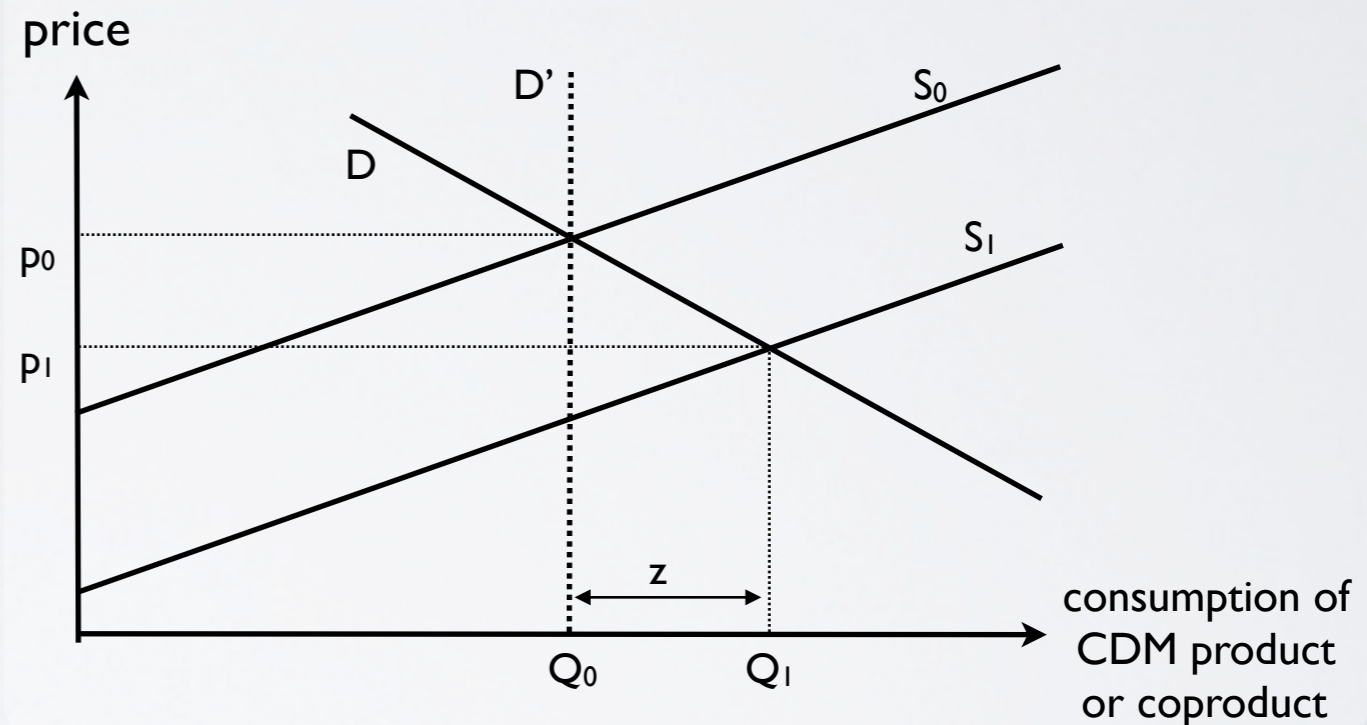
# TYPES OF MARKET LEAKAGE

## Rebound Effects



E.g. BRT lowers demand for driving and lowers (time or money) cost of vehicle travel

## Outward-Shifting Supply Curve



E.g. CDM subsidizes barge movements, lowering the price of freight travel

*In my view, most of the difficulties in transportation methodologies are related to this issue of creating extra demand*

# MARKET LEAKAGE ELSEWHERE

- Rebound effects almost always ignored
- Approach to outward-shifting supply curve
  - Ignored (e.g. renewable energy)
  - Acknowledged but dismissed as “too difficult”
- Dealt with crudely, e.g. capping at rated capacity

# METH PANEL RATIONALES

*[Suppose that] people do not have electricity. Now you construct a hydropower plant... you could also argue that without the project they would not...consume electricity...but sooner or later with higher income these people will have diesel generators.*

Meth Panel member

*Because electricity now has a lower price, you're not going to produce more than one ton of cement. Because the amount of cement you produce is given by the demand for cement.*

Meth Panel member

*The problem is that [the Meth Panel] heard 'rebound effect' from somewhere...It's probably a problem that they feel very insecure about....They relate it to transport and transport only - they don't relate it to energy. And then they ask for something because they think it's of huge magnitude.*

Project developer



# EXPLAINING THE DIFFERENTIAL

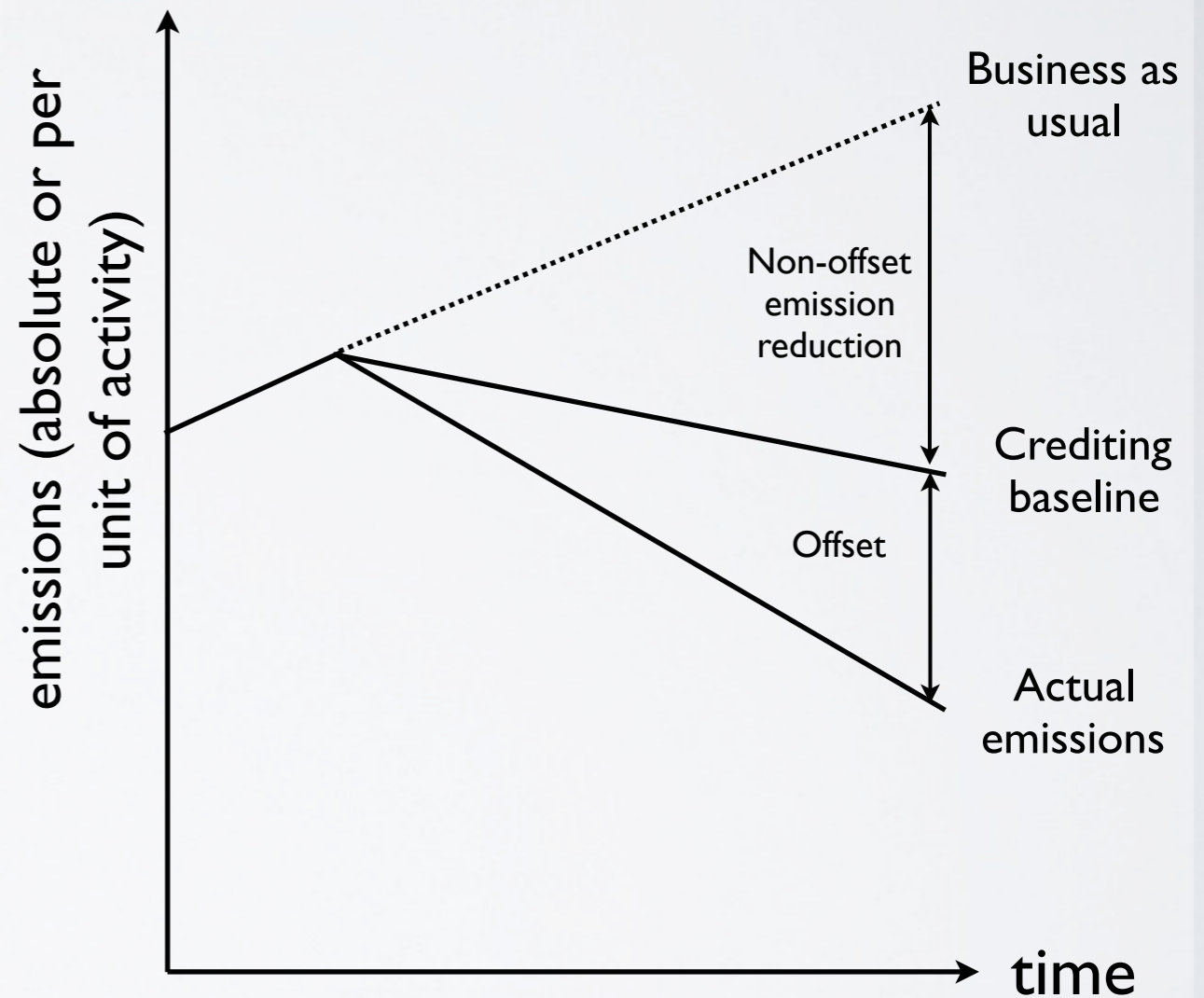
- Transport tools are for ex ante simulation
- Engineering culture of Meth Panel
- Highly sophisticated measurement techniques
- Economic effects ignored or treated crudely
- Some skepticism towards social science methods

*All economists want to be Nobel Prize winners....This is a technical issue, how to discuss heating values, how to discuss biofuels. I never discuss medicine because I am not a doctor.*

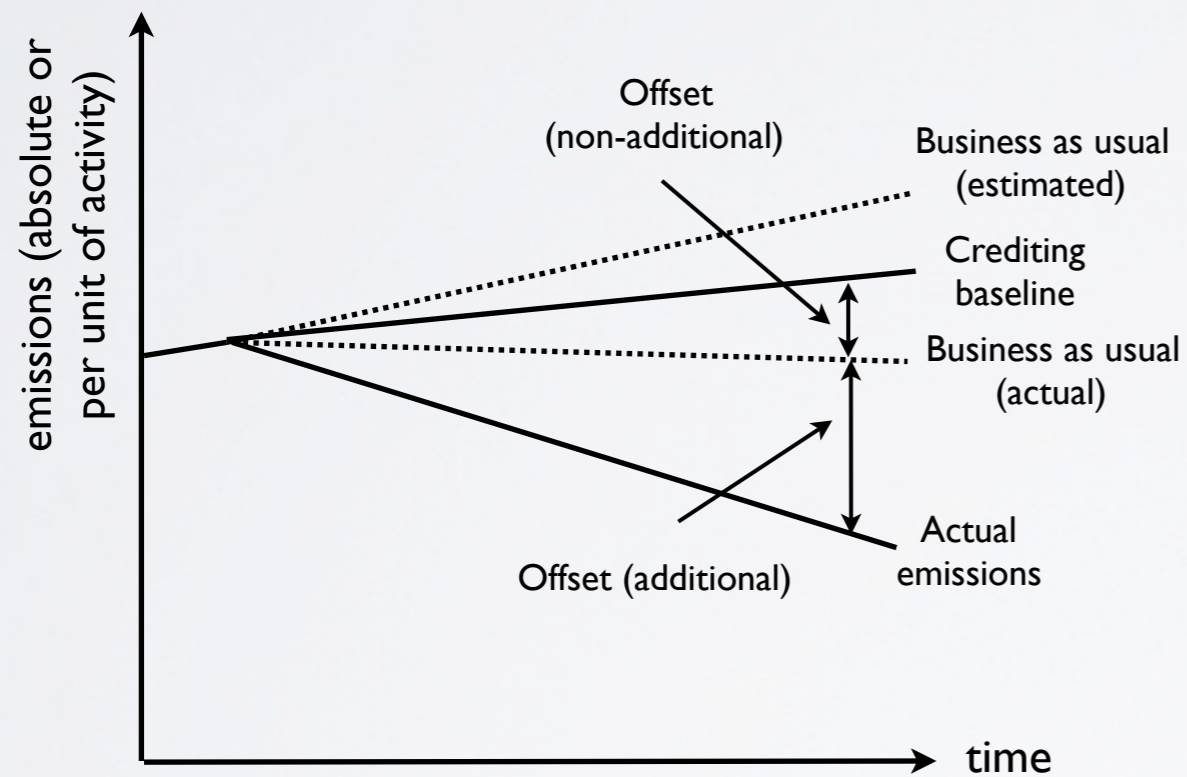
Meth Panel member

# SECTORAL TARGETS

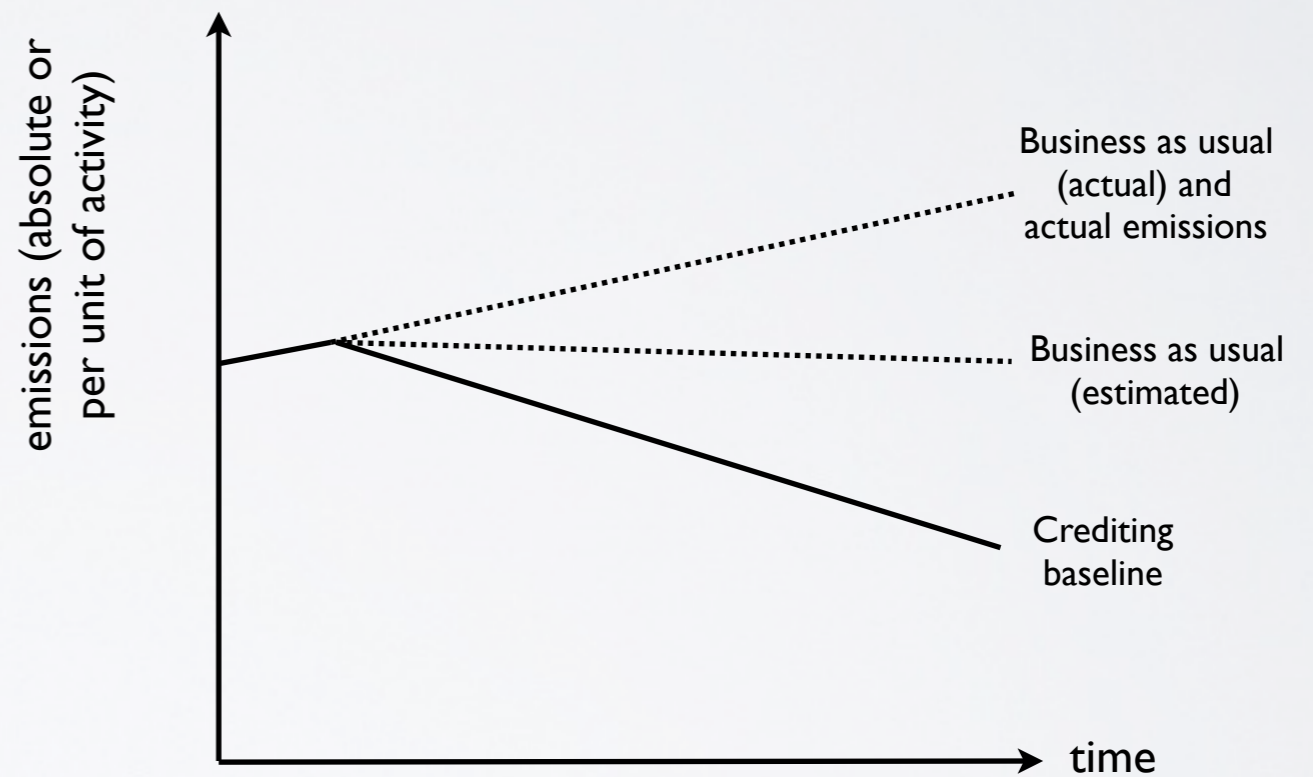
- Alternative to project level program
- Crediting baseline set for each non-Annex I country
- Opt-in
- No-lose



# IMPACTS OF UNCERTAIN BAU



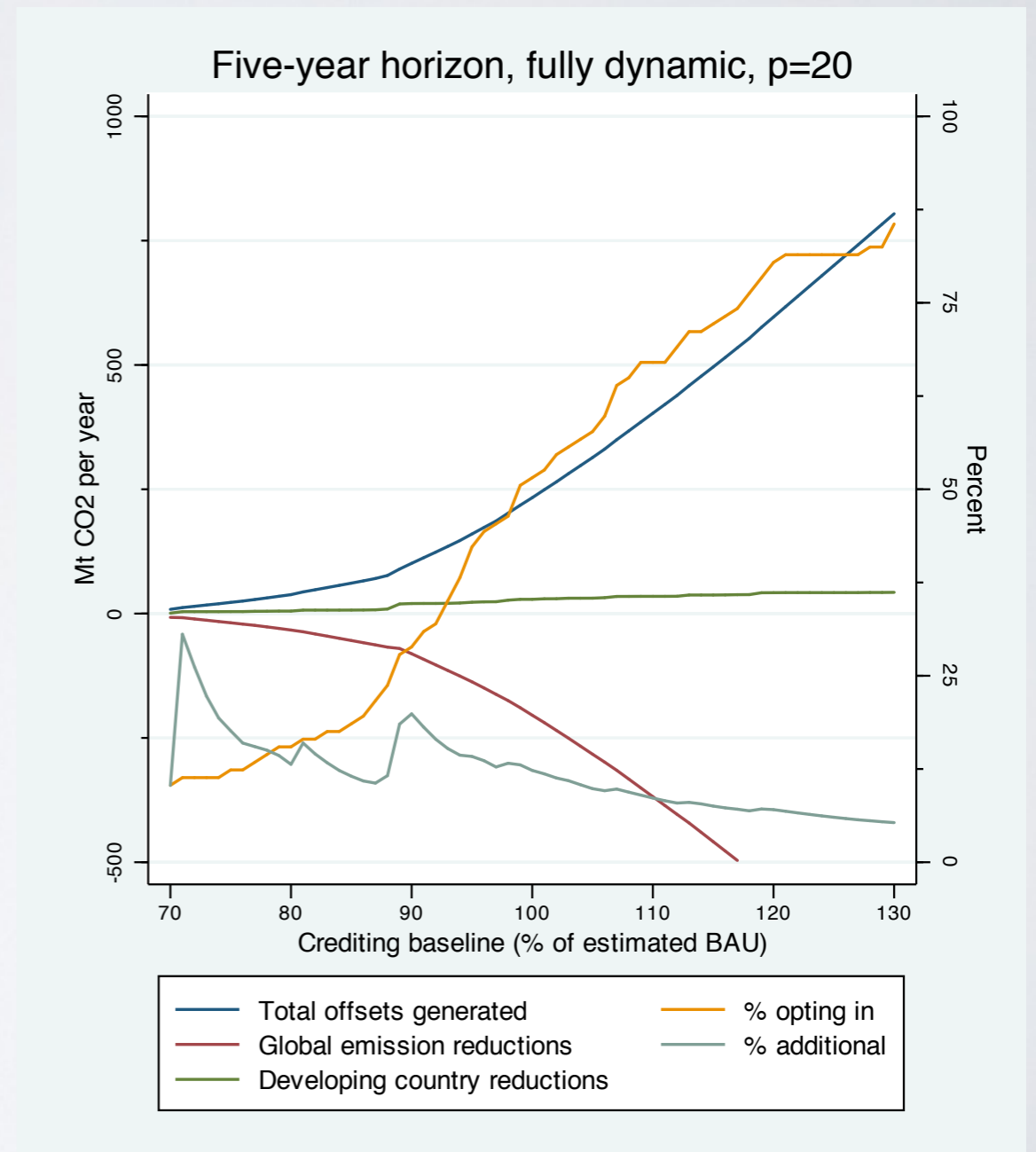
SCENARIO I:  
BASELINE TOO HIGH,  
SPURIOUS (NON-ADDITIONAL) REDUCTIONS



SCENARIO II:  
BASELINE TOO LOW, NO REDUCTIONS

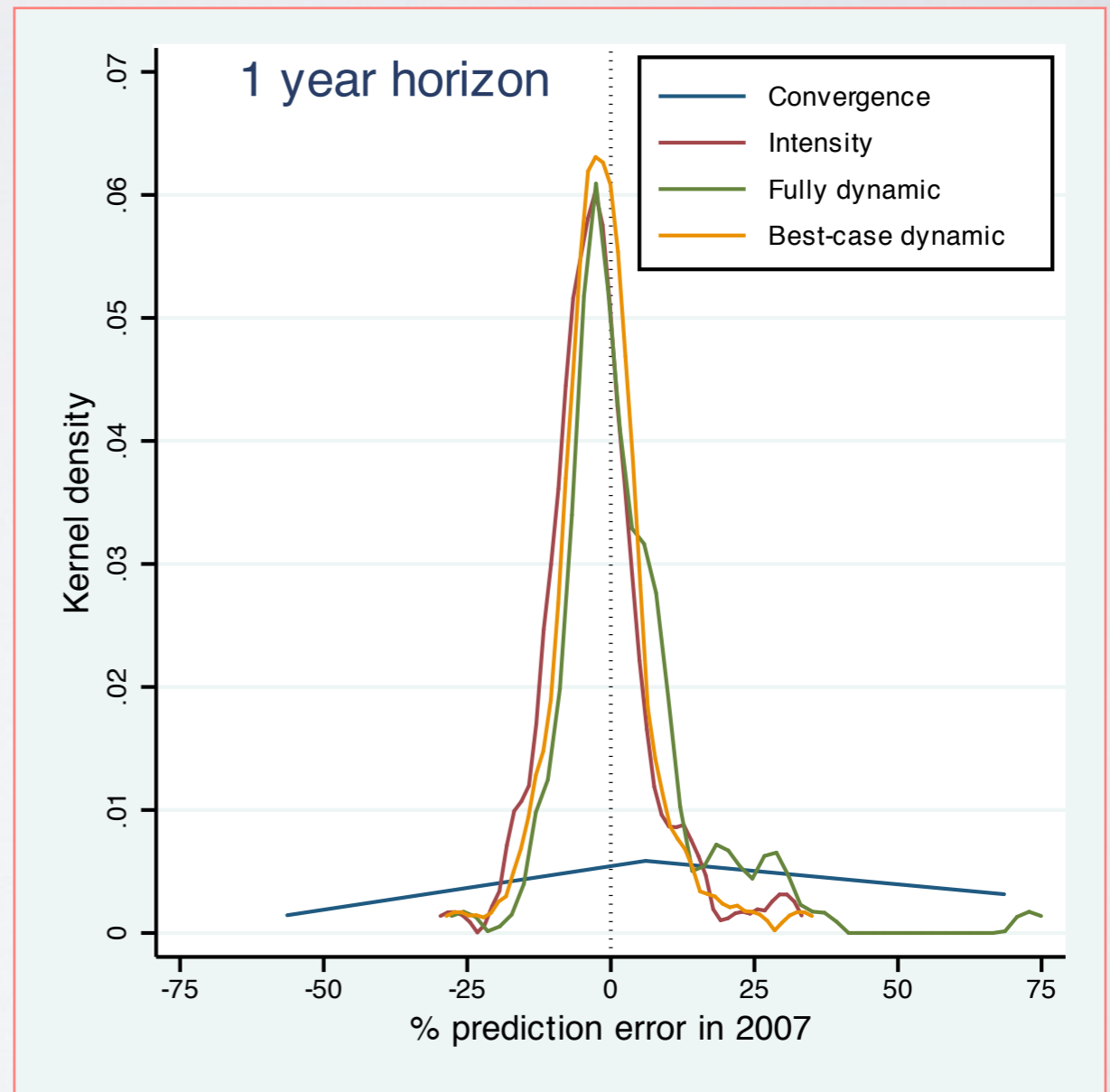
# EMPIRICAL APPROACH

- Simulate the adoption of sectoral no-lose targets in a previous year
- Assume BAU = observed emissions
- Key parameter choice: generosity of baseline
- Abatement costs from McKinsey studies



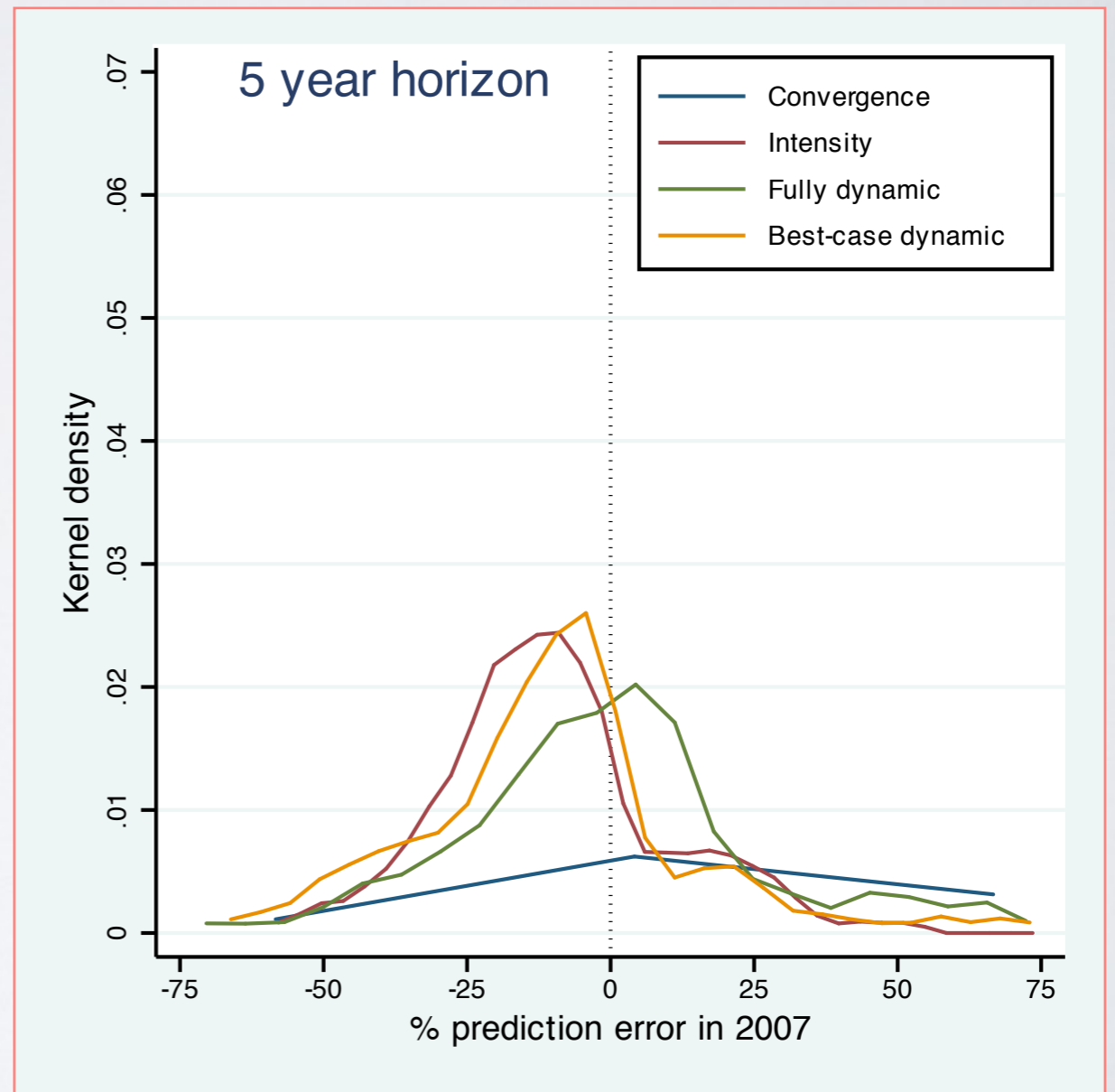
# WHAT'S THE CHALLENGE?

- BAU cannot be predicted with precision, even at the country level
- Need to set generous baselines to encourage countries to participate
- ...which means that most emission “reductions” would have happened anyway



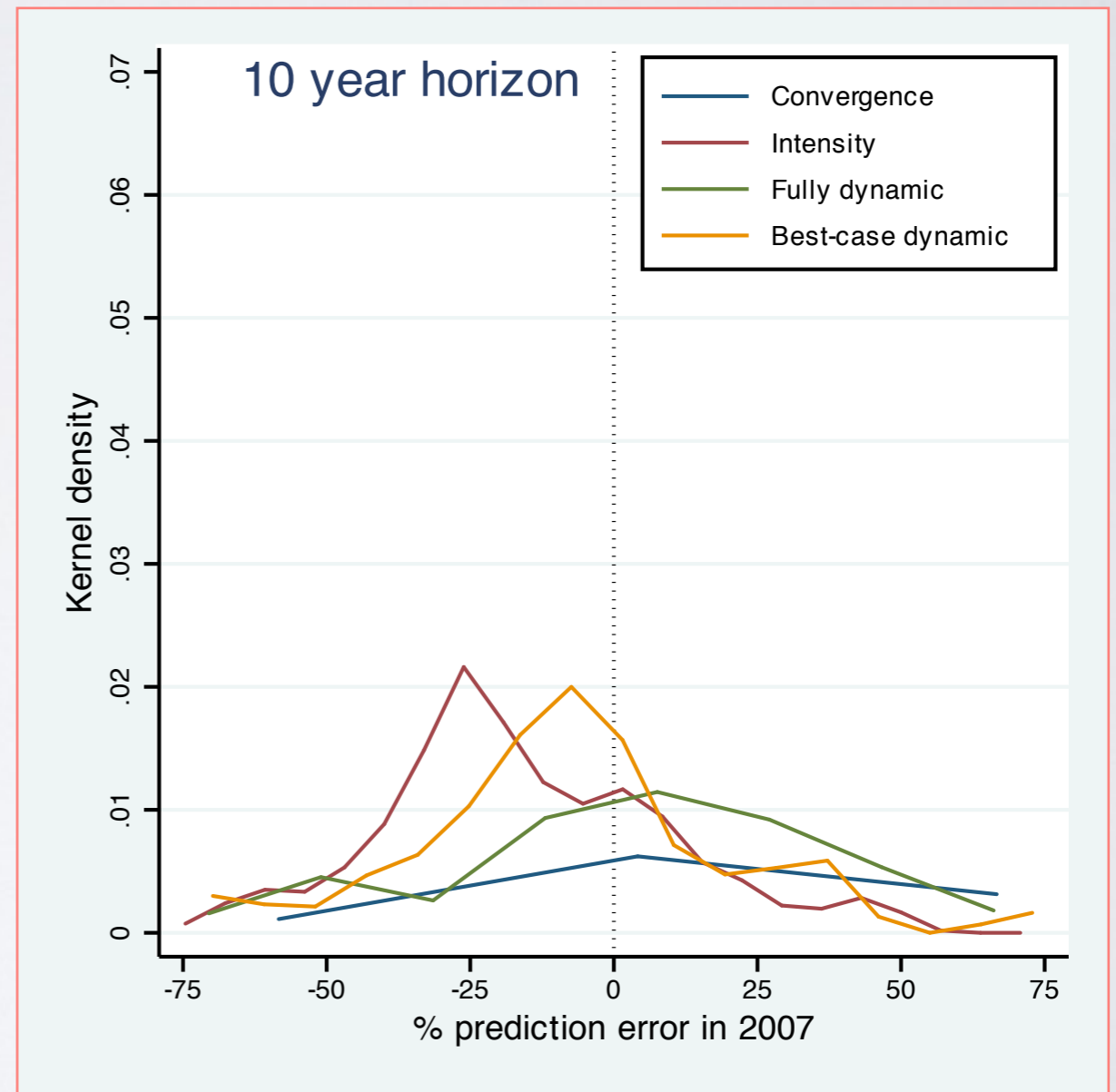
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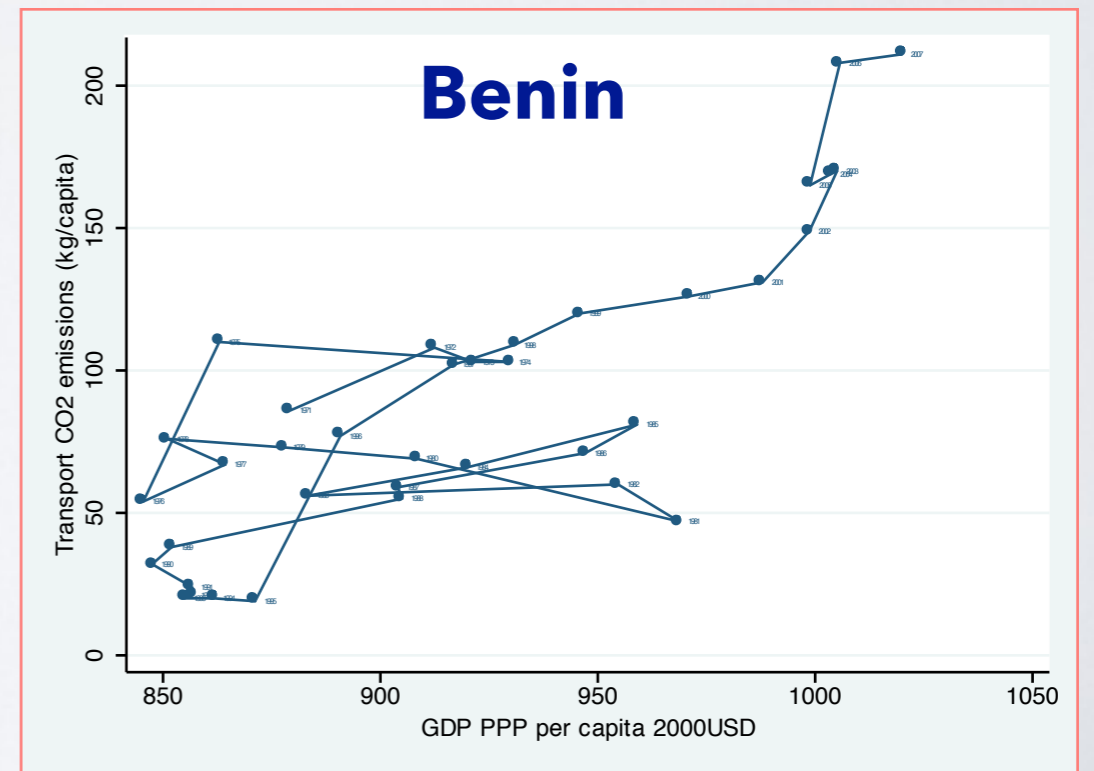
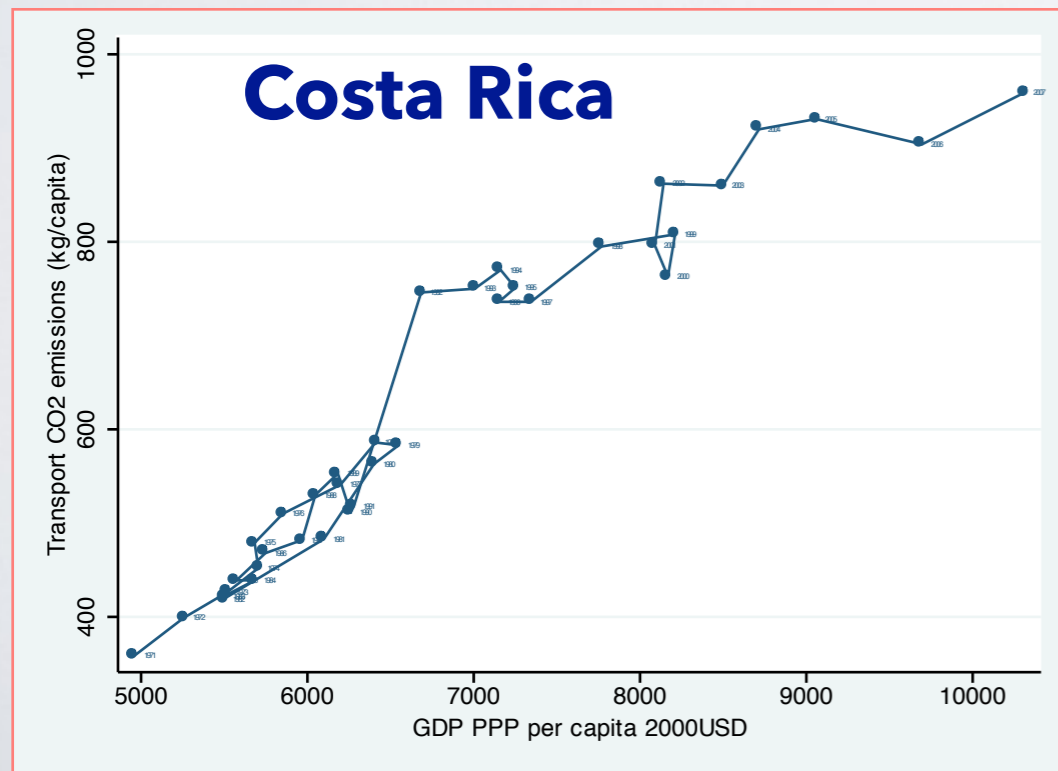
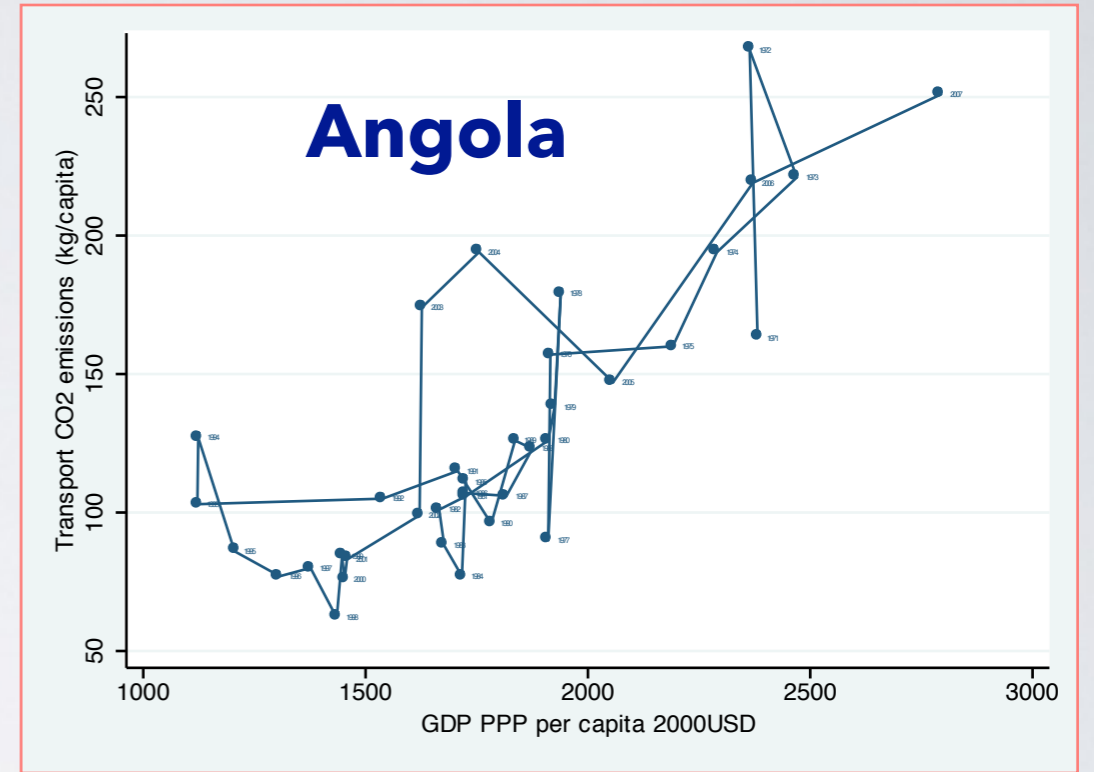
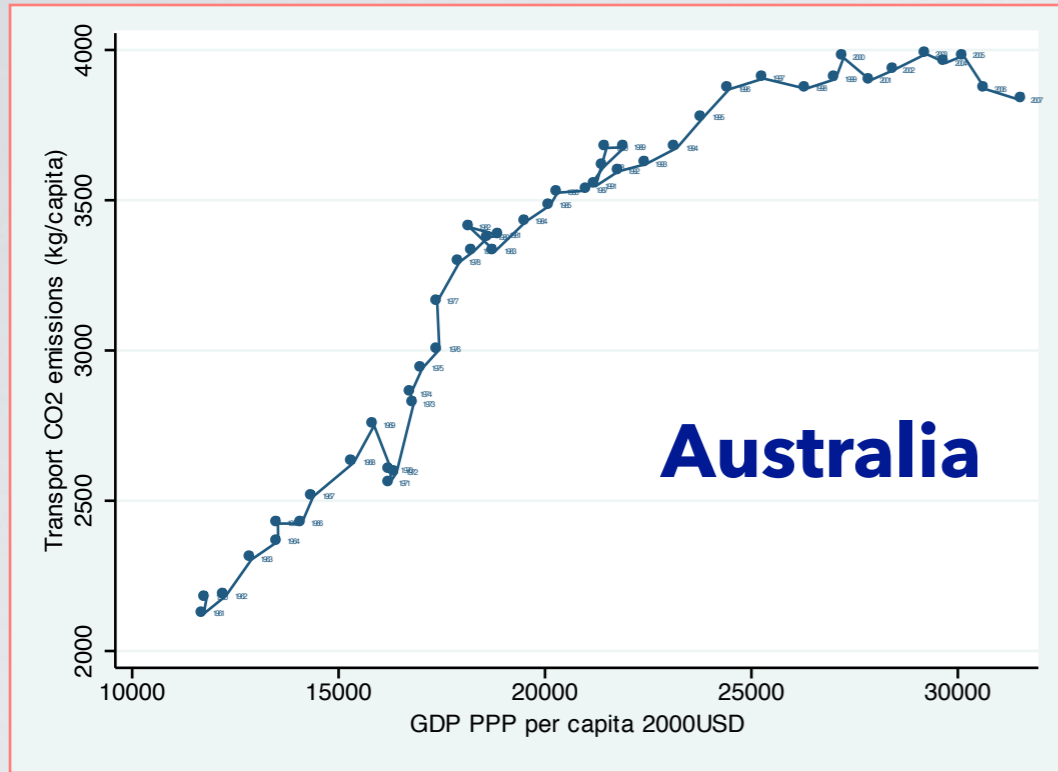


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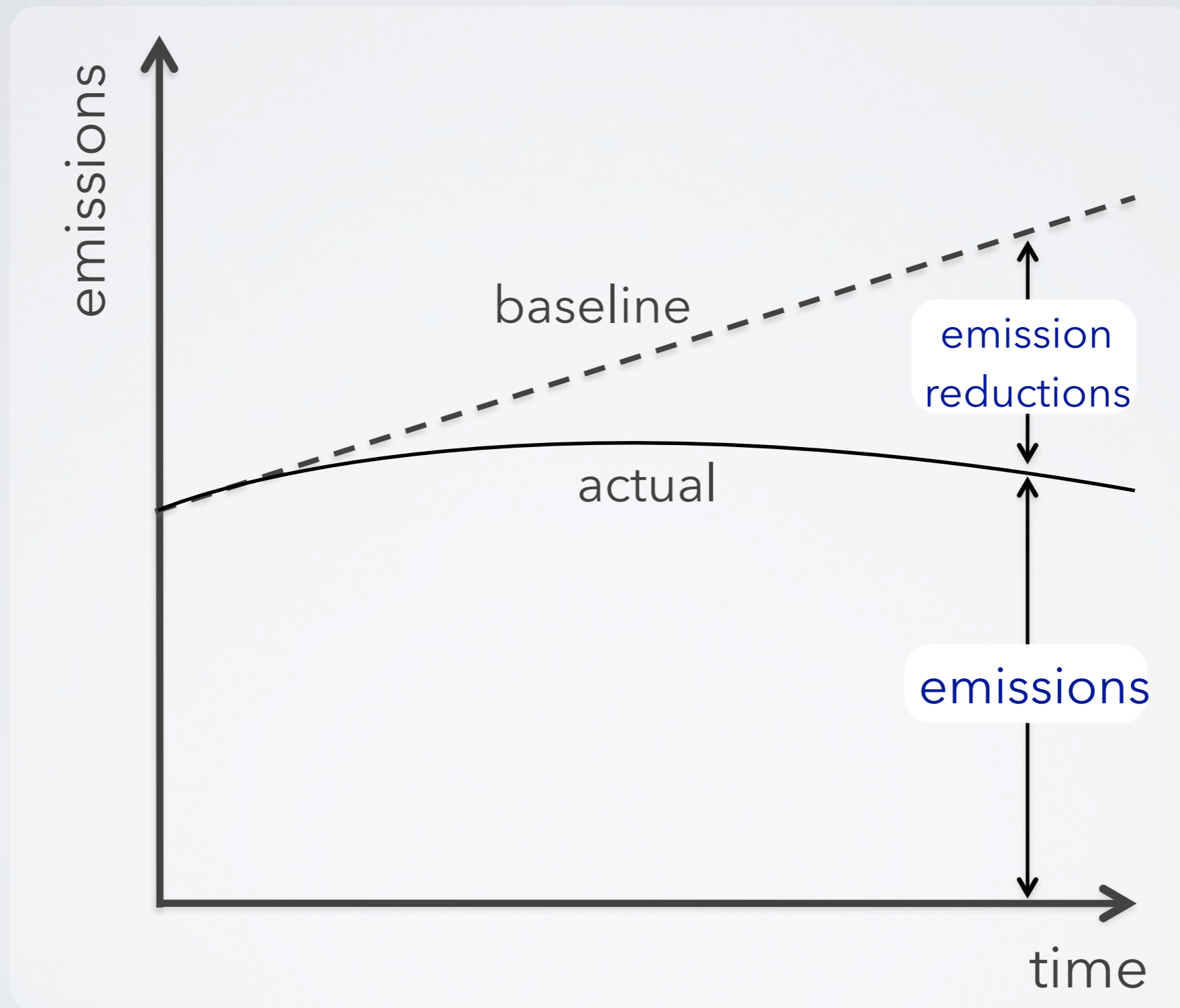


# FUNDAMENTAL ISSUE





# CO<sub>2</sub> OR CO<sub>2</sub> REDUCTION?

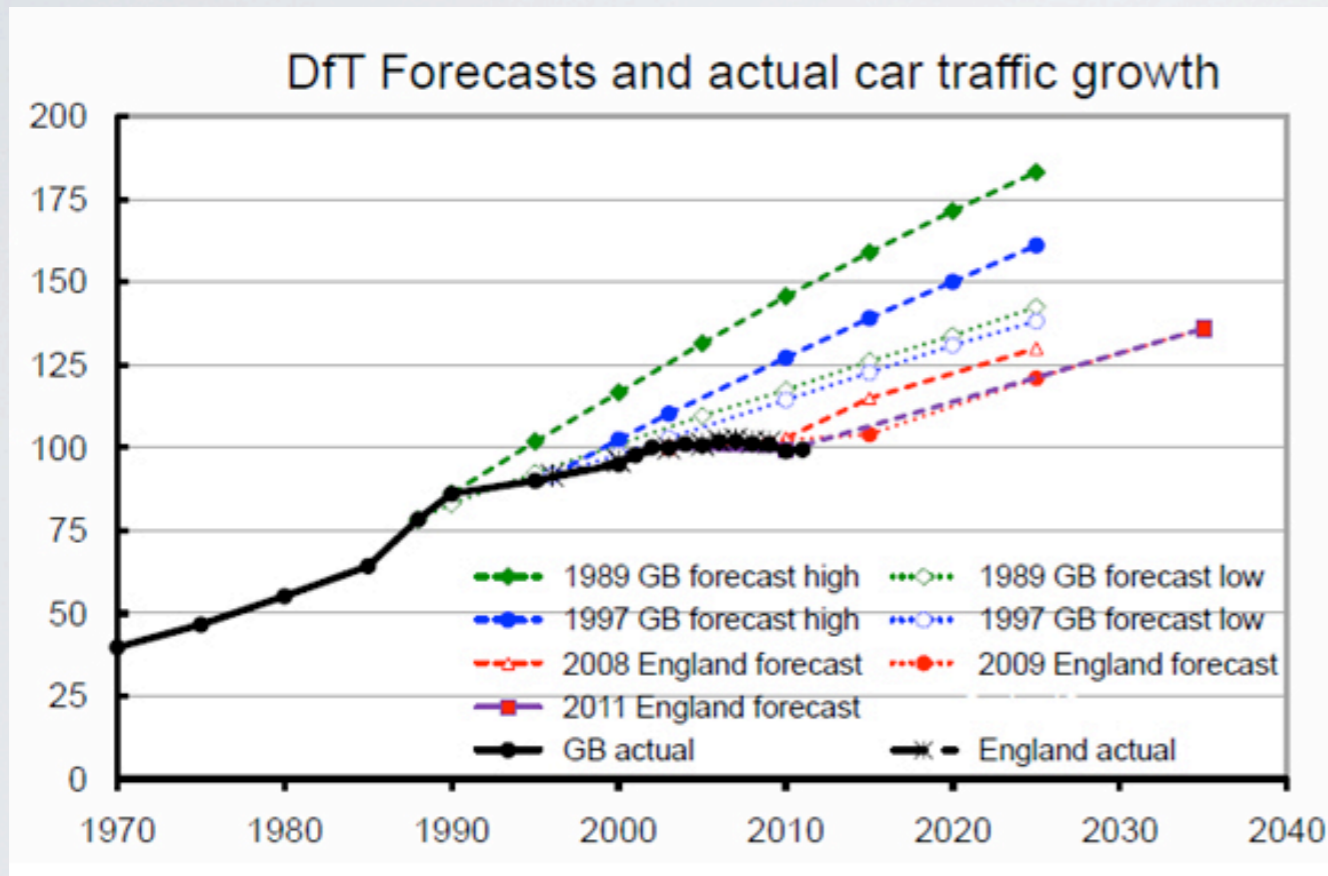


# SUMMING UP

- Carbon trading programs pay more careful attention to counterfactuals – what would BAU be?
- Reveal the challenges with quantifying emission reductions
- BAU by definition cannot be measured
- Emission reductions are hardest to quantify at the project level
  - What will transit ridership be 10 years from now?
- Also hard at the aggregate level

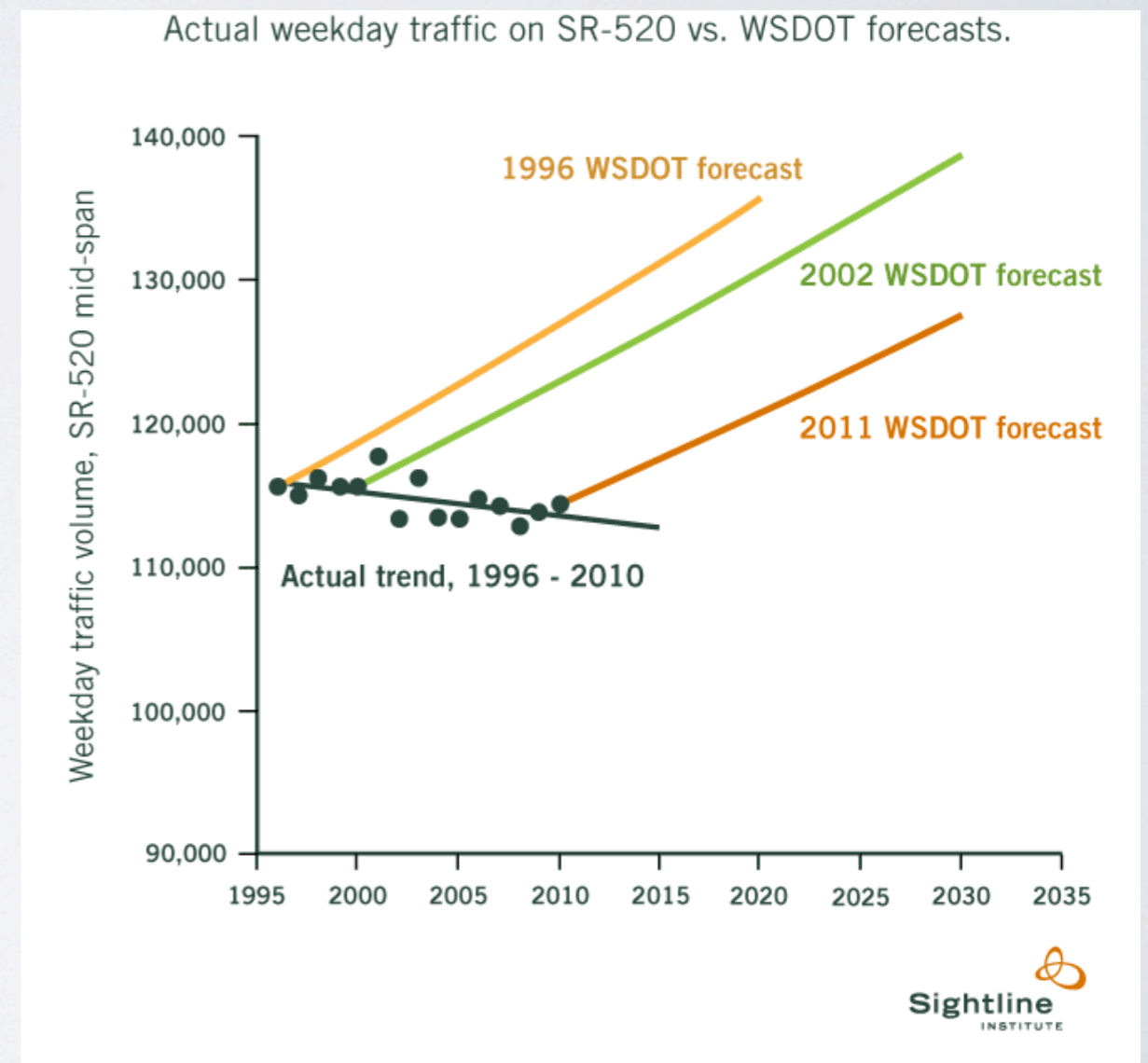
# TRAFFIC FORECASTS

## United Kingdom



Source: Goodwin 2012

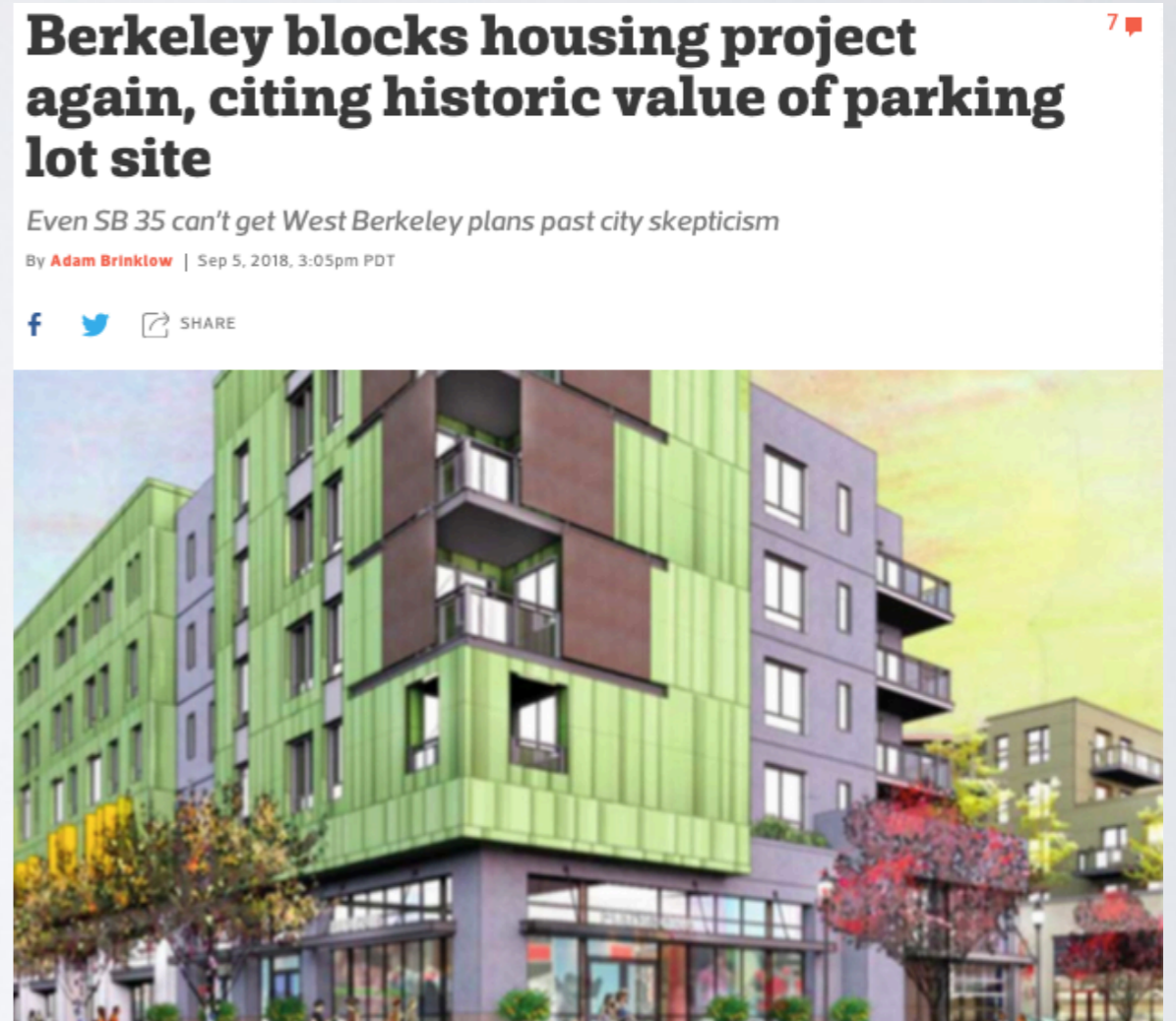
## Washington State, USA



Source: Sightline Institute

# POTENTIAL AVENUES

- Recognize inherent uncertainty in emission reductions
  - Much greater at the individual project level
- To quantify municipal contributions, focus on emission reduction *effort*
  - E.g. km of BRT built
  - Not VKT or GHG



# THANK YOU!

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Woody Carroll/UCSC