

Sustainable Transportation Energy Pathways (STEPS)

A Quick Lookback at our Lookback Workshop (yesterday)

December 10, 2015
STEPS Symposium

STEPS team
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ITS UCDAVIS
INSTITUTE OF TRANSPORTATION STUDIES

Participants
4 modeling teams. DoE/Sandia, Chevron, STEPS x2

~30 attendees. Industry (energy co & OEMs), government agencies and labs (federal & state), NGOs, academia

www.steps.ucdavis.edu

How Long Have We Been Doing this Kind of Modeling?

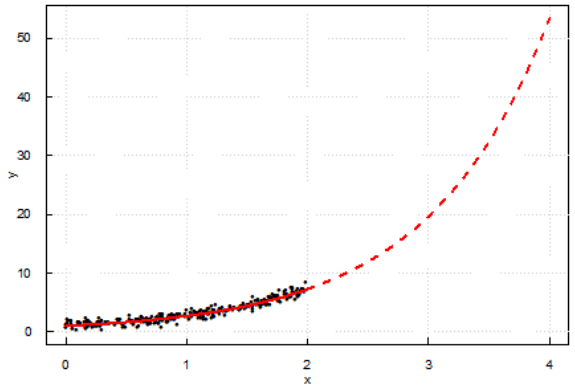
- 1980s
- 1990s
- 2000s
- 2010s

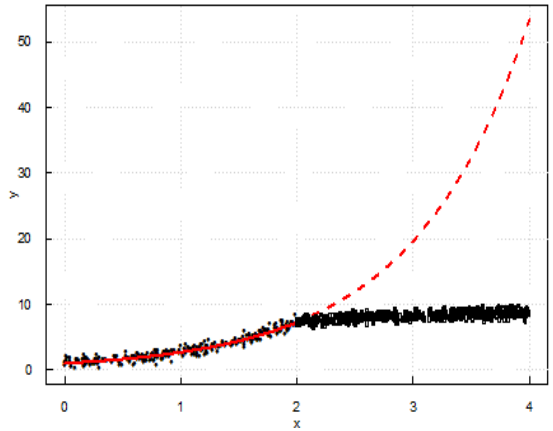
Workshop outline

- Project overview / intro
- Lightning round model presentations
- Deeper dive on model evolutions / retrospectives
- Roundtable discussion

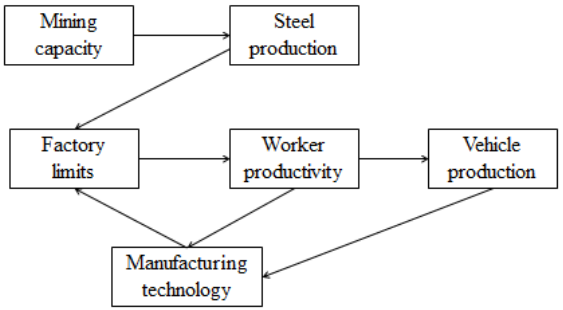
Lookback for forward-looking models

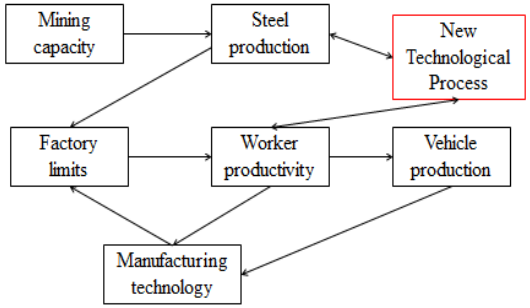
1. Trend-Based





2. Systems-Based





3. Expert Elicitations for unknown systems

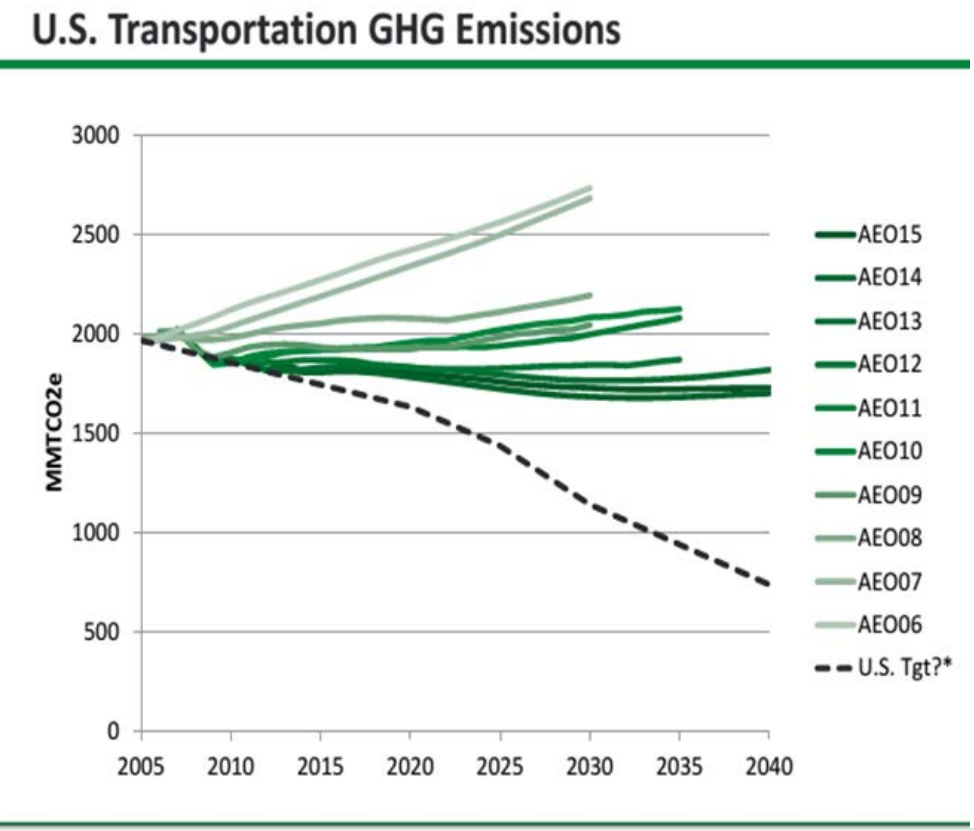
Why?

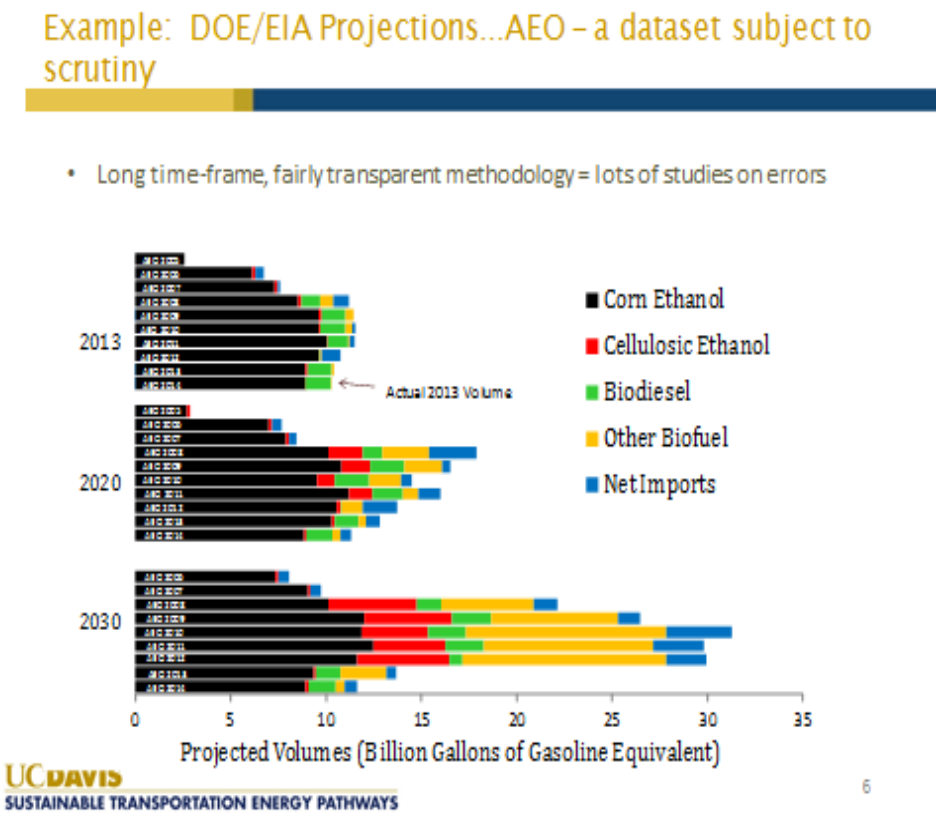
- Reinforce modesty
- Reveal biases, embedded assumptions
- Uncover, explain uncertainties
- Help models improve as aids to thinking about possible or desired outcomes

Types not mutually exclusive!! e.g.,
2. with parameters from 1. & 3.

Source: *What Can History Teach Us?...* (Craig, Gadgil, Koomey 2002)

Trends in Projections Tell Stories (AEO examples)





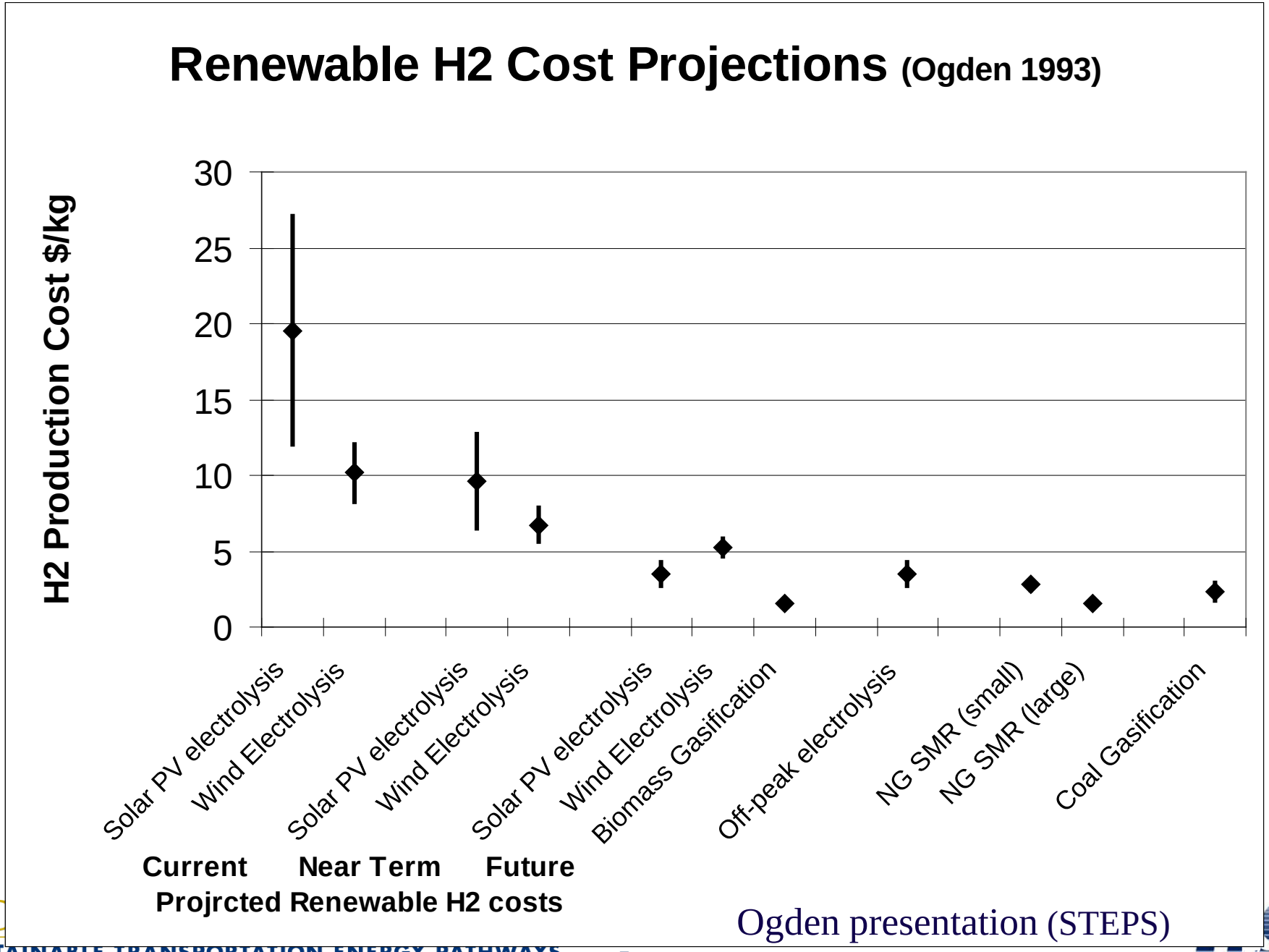
Gohlke presentation (DoE)

2014 STEPS biofuel team
(Fulton, Parker, Morrison, Witcover)

A Sampling from Presentations

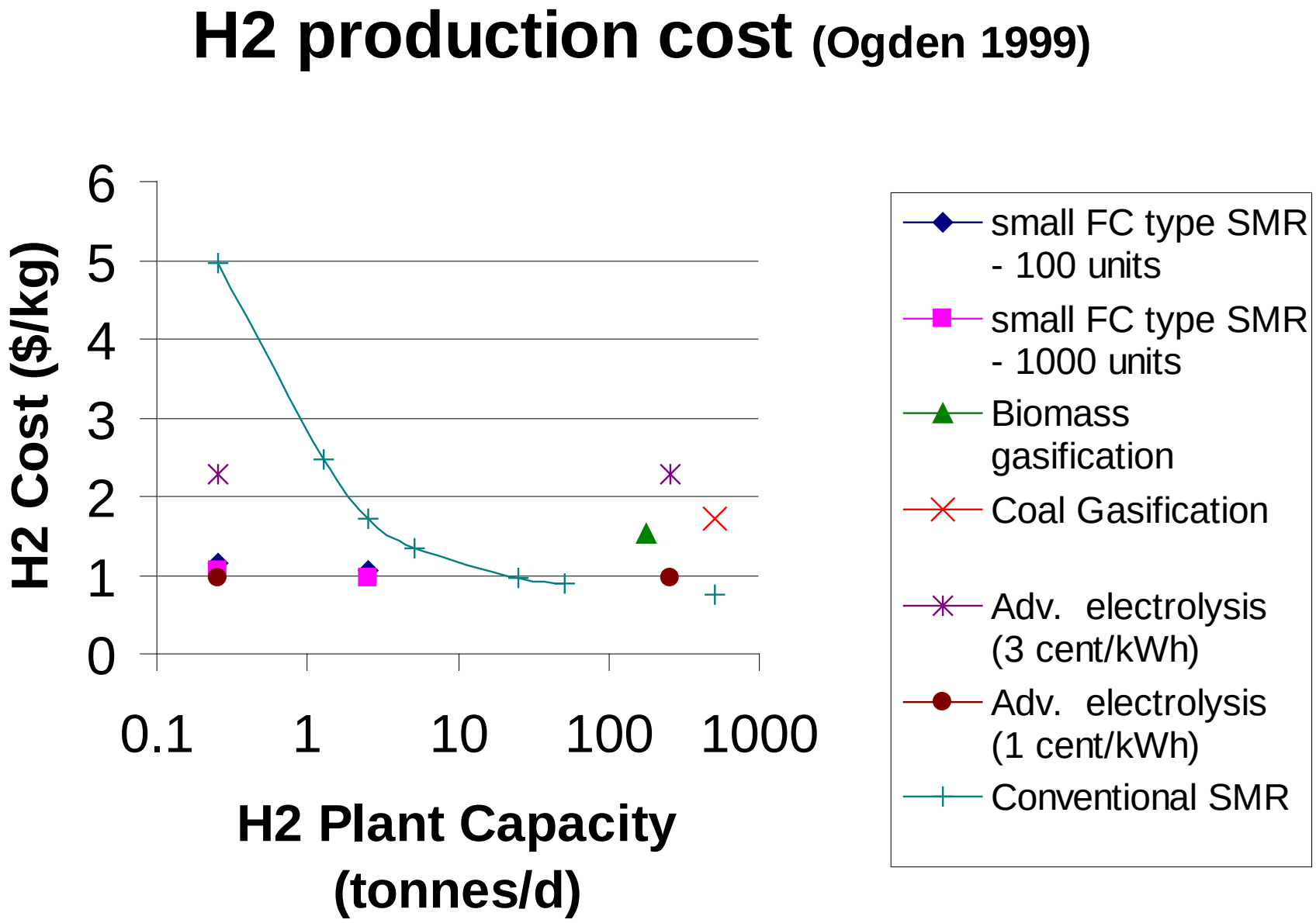
- signals next presntation

1993: What Does It Cost To Produce H2?

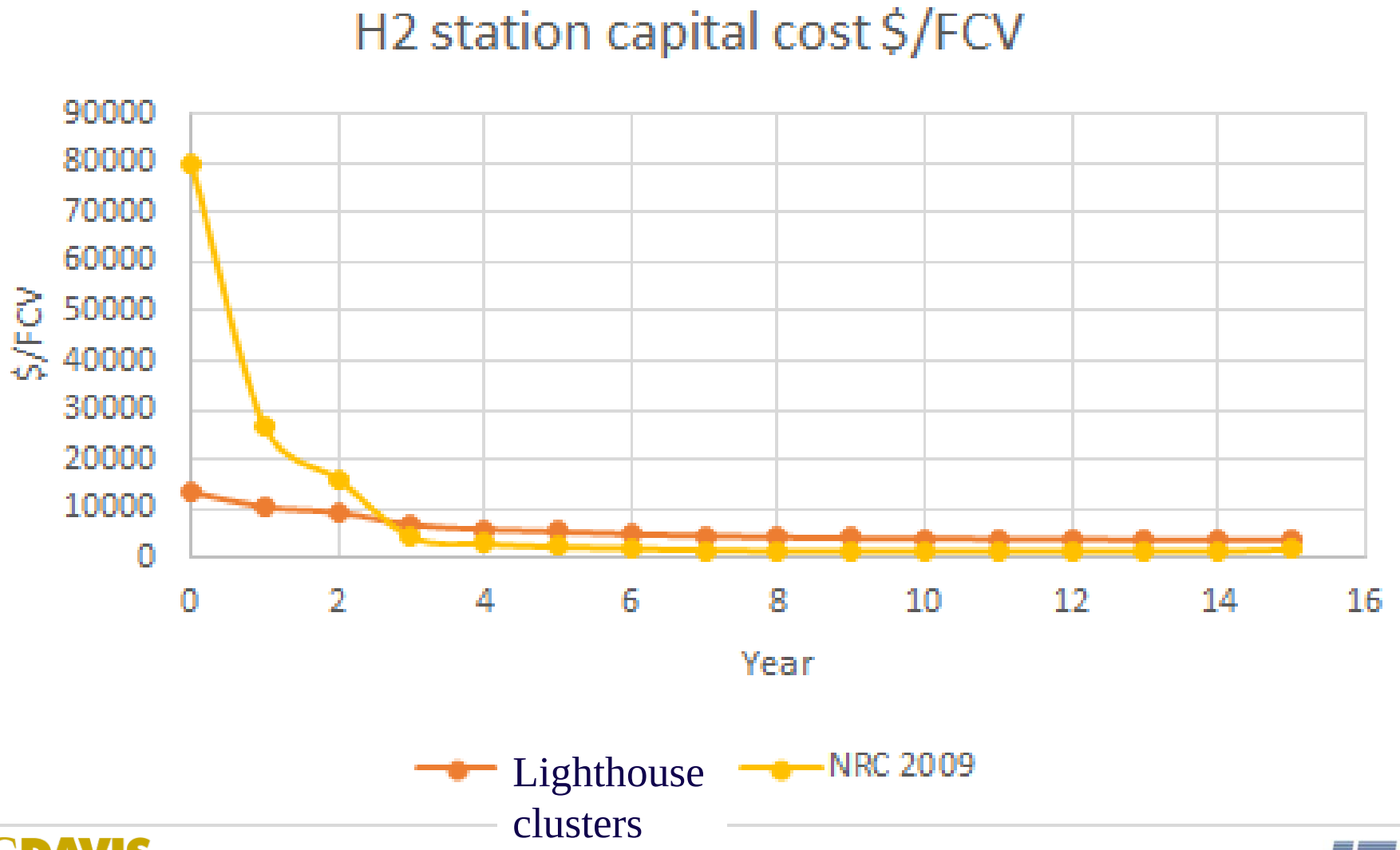


Ogden presentation (STEPS)

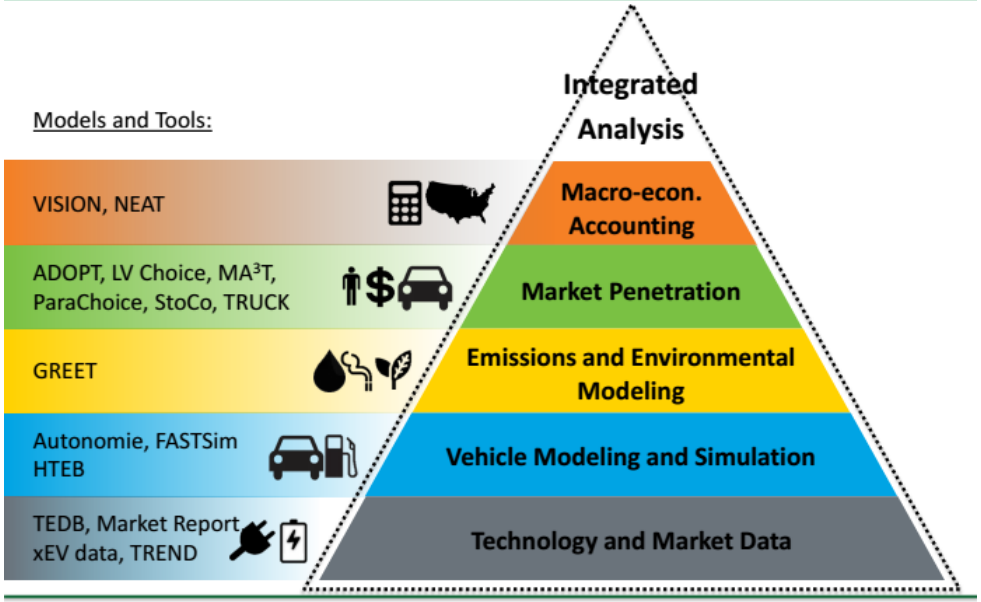
1999: What Is The Cost To Produce H2? Add Estimates For New Small Scale Reformer Tech. (Costs Largely Consistent w/1993)



Compare "lighthouse + clusters" to NRC 2009 study: Better information on early station costs and infra design -> lower early infra capital cost than those estimated by NRC in 2008. But later infra costs are higher.



VTO analysis portfolio at a glance



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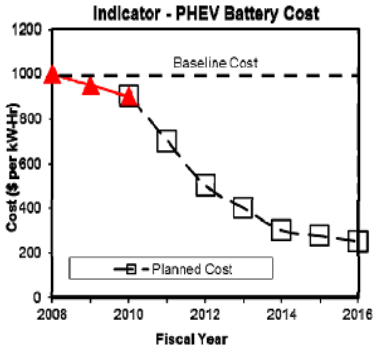
VTO in a look-back workshop context

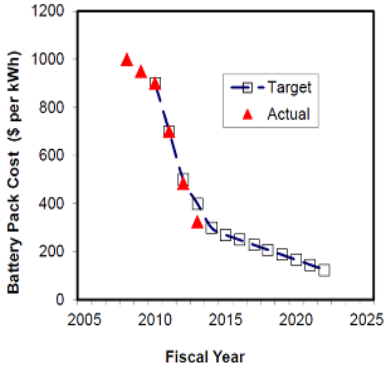
- VTO does not traditionally do look-backs
- VTO analysis stands to benefit from incorporation of look-back methodologies
  - How do technology projections change?
  - How does baseline potentially change?
  - How do accounting methodologies change?
- Preliminary examination and observation of recent repeated analyses over time confirm that results change
  - Program success: DOE targets change
  - External inputs (outside DOE control but important for consideration): Oil prices, OEM offerings vary, new regulations

Were these realistic goals?

- Aim to reduce the production cost of a high-energy battery from $1,000/kWh in 2008 to $125/kWh by 2022



Source: GPRA report for 2012



Source: GPRA report for 2015

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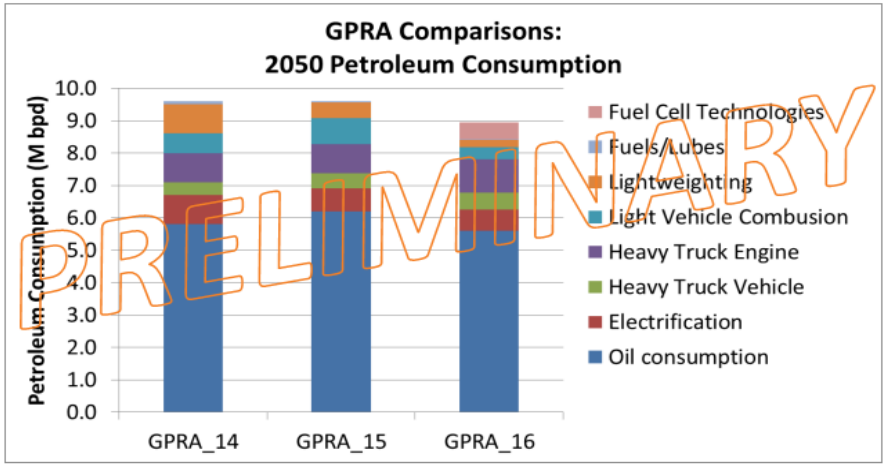
Energy usage projections, 2050



Source: PRELIMINARY from "Vehicle Technologies and Fuel Cell Technologies Program Prospective Benefits Assessment Report for Fiscal Year 2016", T.S. Stephens, C.H. Taylor, J.S. Moore, and J. Ward, in preparation

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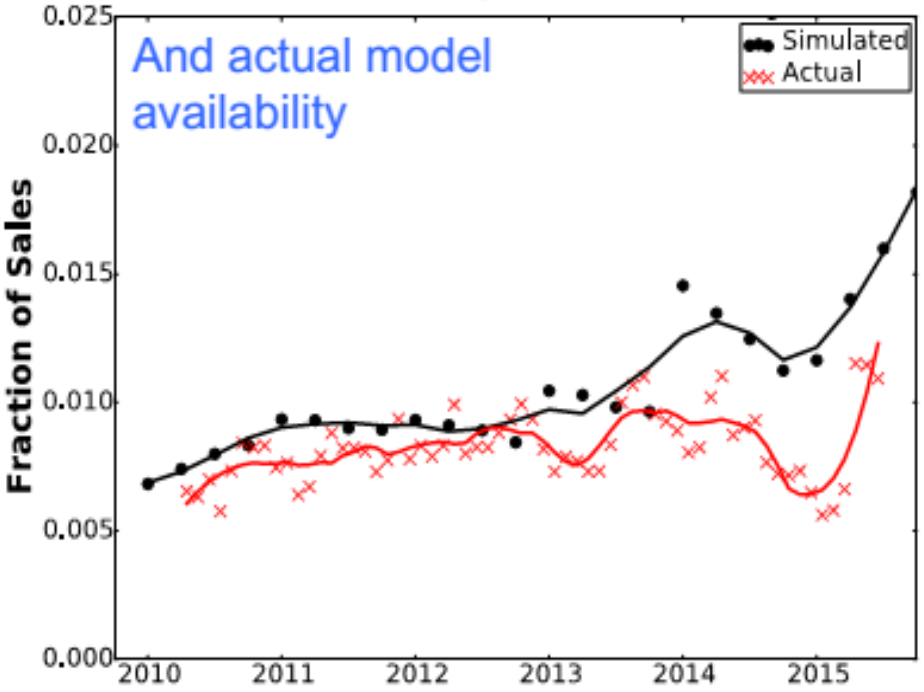
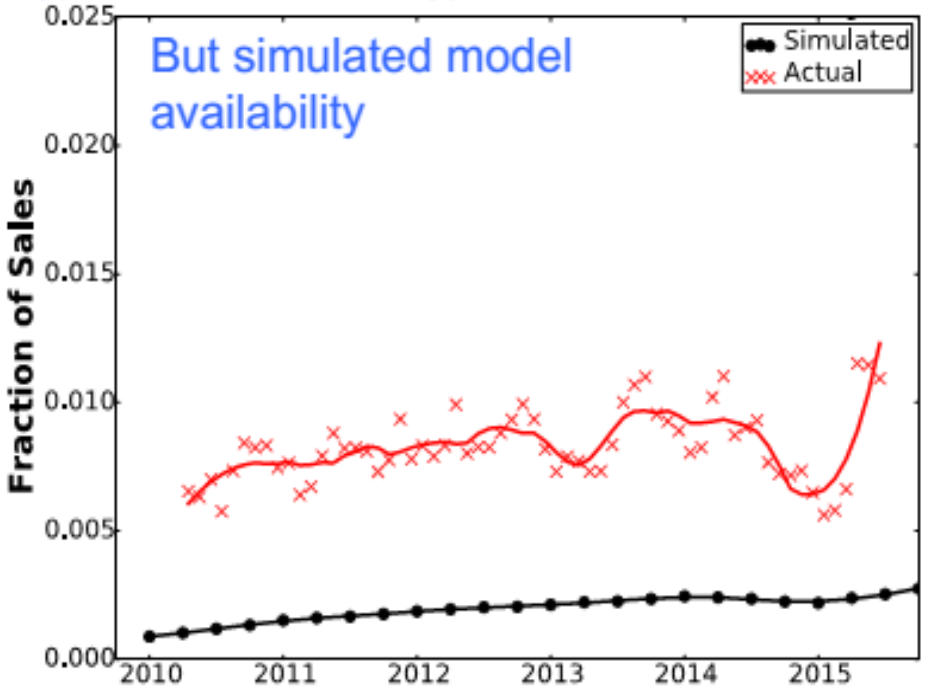
Gohlke presentation (DoE)

Diesel vehicles- simulation capturing trends and scales, vehicle model availability is very important

Simulations using historical data for energy prices, technology costs,





Simulation is capturing consumer responses to changes in commodity prices and other market factors. We CAN capture sensitivities.

Garbage in, garbage out: if input projections are off, so are the output projections.

Model evolution and changes [for CA-TIMES model]

- Activity projections – work began in 2008-2010 timeframe
  - post-2012, projections changed significantly due to recession and other trends
  - State population projections reduction (60 million vs 50 million in 2050)
  - VMT projections (per capita growth became unclear)
- Resource projections – oil and gas prices dropped significantly
  - Models typically rely on AEO price projections
- Technology projections – rapid changes in analysis of many different low-carbon technologies
  - Electric, hydrogen and natural gas vehicles
  - Solar PV costs
- Modeling and methodological changes – interest in improving the capabilities of the model
  - Focus on improving representation of specific sectors
  - Additional policies and analyses

California Climate Policy Modeling (CCPM) Forum (2015)

- **Modeling comparison for CA GHG emissions (2050)**
  - **CA-TIMES (UCD)**
  - **CALGAPS (LBL)**
  - **BEAR (UCB)**
  - **PATHWAYS (E3)**
- **Very different modeling approaches**
- **Understanding consistencies and differences between models**

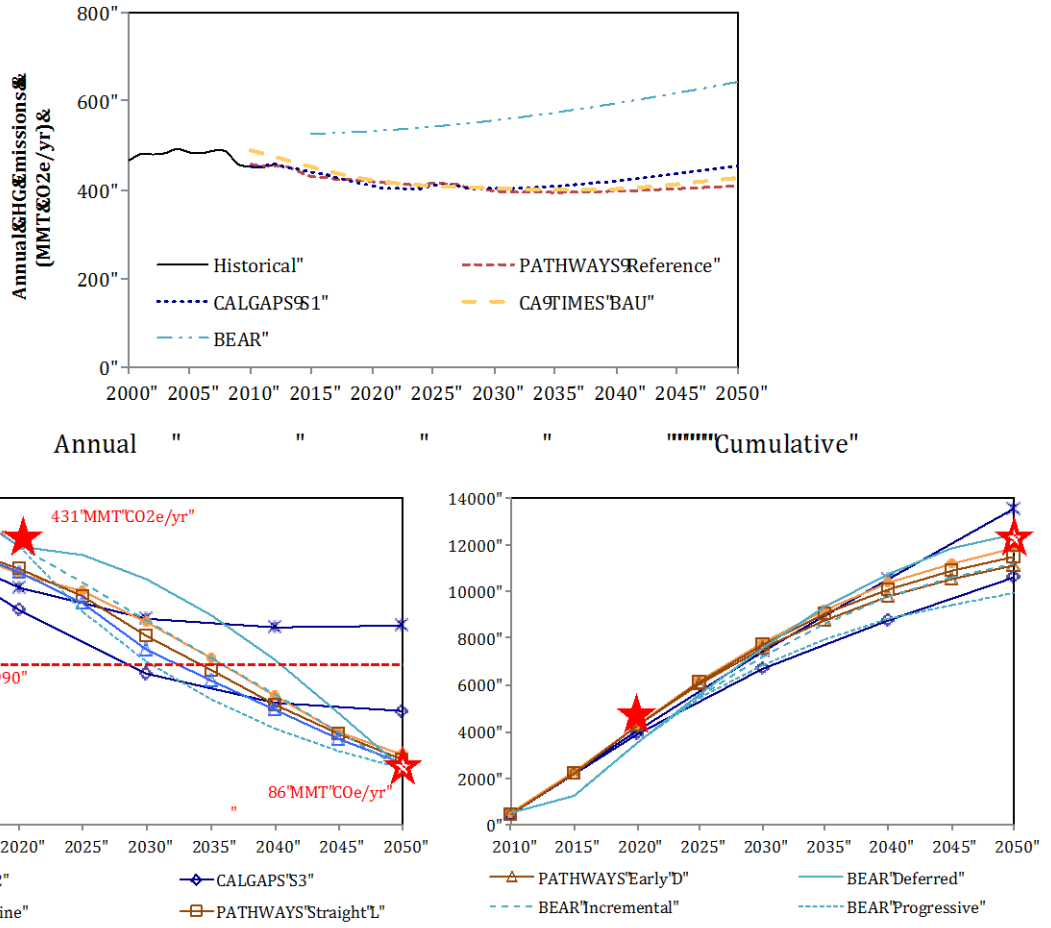


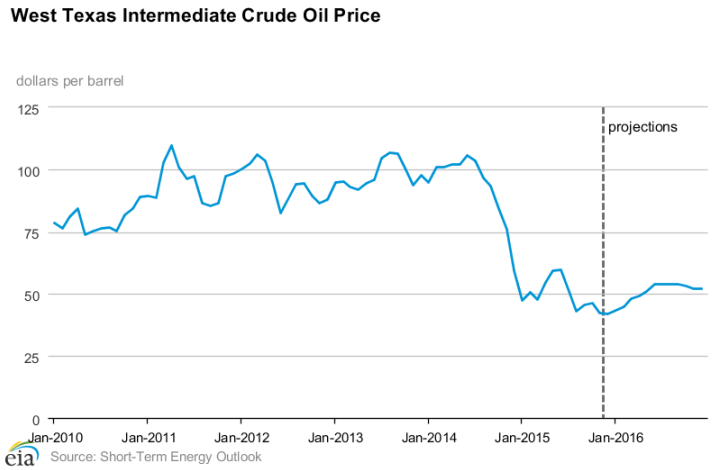
Figure 1. GHG emission trajectories for business-as-usual (BAU) scenarios (top), and selected emission reduction scenarios, including annual emissions (bottom left) and cumulative emissions from 2010 level (bottom right) across four key models to 2050. 2020 and 2050 targets are shown in stars. The cumulative emissions 2020 and 2050 targets are calculated based on a straight-line emission trajectory between the two targets.

Discussion points

Post it session (Roundtable)

Roundtable Discussion

- **Black swan events—"unknown unknowns" that have a significant effect on the model or system**
  - **Motivation for simpler (or more flexible) models rather than complex models**
  - **Possible to capture all black swans through sensitivity / uncertainty analysis? Possible to model "significant disruption" (from 'generic' cause?)**
  - **Ignore black swans and focus on systematic bias**



Roundtable Discussion

- **Retrospective analysis of policy "successes/failures"**
  - **How might they assess effectiveness of past policies?**
  - **Risk assessment needed to understand probabilities of fulfilling future policies**
  - **Distinguish between policy *target*, policy *as set of implemented regulations*, policy *impact* (result of policy as implemented)**
- **Can lookback enhance effective information flow**
  - **About model/results**
  - **To policy (or other audience)**

Roundtable Discussion

- **Best Practices (modeling…lookback?)**
  - **Definitions: baseline, lookback, assumption**
  - **Sanity checks**
  - **Focus on parameters that a) drive the model; and b) hot topics**
  - **How to incorporate lookback into projects? (resources)**

Other insights

- **The EIA lookbacks are very revealing – the evolution in their projections shows trends in "conventional wisdom"**
- **Sometimes simple models are sufficient; models tend to get more complex over time, perhaps increasing realism but also potentially decreasing transparency and not clearly adding accuracy**

Looking forward

- A brief report summarizing key findings from the workshop will be sent to participants as well as to STEPS affiliates
- Feedback and comments are welcome
- Leads in to (proposed) 2016 STEPS project

Thanks!