International Partnership for Hydrogen and Fuel Cells in the Economy

U.S. Country Update

23rd IPHE Steering Committee (SC) Meeting

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All-of-the-Above Energy Strategy

*"We've got to invest in a serious, sustained, **all-of-the-above energy strategy** that develops every resource available for the 21st century."*

- President Barack Obama

"As part of an all-of-the-above energy approach, fuel cell technologies are paving the way to competitiveness in the global clean energy market and to new jobs and business creation across the country."

- Secretary Moniz,
U.S. Department of Energy

Secretary Moniz at DC Auto Show

Oil Dependency is Dominated by Vehicles

- Transportation is responsible for **66%** of U.S. petroleum usage
- **27%** of GHG emissions
- On-Road vehicles responsible for **85%** of transportation petroleum usage

- **16.0M** LDVs sold in 2014.
- **240 million** light-duty vehicles on the road in the U.S
- **10-15 years** for annual sales penetration
- **10-15 years** to turn over fleet

Poses significant economic, energy and environmental risks to U.S.



It takes decades of sustained effort to turn over the fleet

Office of Energy Efficiency & Renewable Energy

Sustainable TRANSPORTATION

Renewable ELECTRICITY GENERATION

Energy Saving HOMES, BUILDINGS, & MANUFACTURING

Sustainable Transportation Sector

Sustainable TRANSPORTATION

- Transportation Efficiency
- Diverse Fuel Sources
- Domestic & Renewable

Hydrogen and Fuel Cells

Vehicles

Bioenergy

National Energy Goals & Climate Action Plan

Net Oil Imports

↓ **50%** by 2020

GHG Emissions

↓ **17%** by 2020

↓ **>80%** by 2050

Hydrogen & Fuel Cell Budget

Key Activity ($ in thousands)	FY 2015 Approp.	FY16 Request
Fuel Cell R&D	33,000	36,000
Hydrogen Fuel R&D[1]	35,200	41,200
Manufacturing R&D	3,000	4,000
Systems Analysis	3,000	3,000
Technology Validation	11,000	7,000
Safety, Codes and Standards	7,000	7,000
Market Transformation	3,000	3,000
NREL Site-wide Facilities Support	1,800	1,800
SBIR/STTR	TBD	TBD
Total	$97,000	103,000

Office	FY 2015
EERE	$97M
Basic Science[2]	~$20M
Fossil Energy, SOFC	$30M

Estimated DOE Total: ~$150M

[1]Hydrogen Fuel R&D includes Hydrogen Production & Delivery R&D and Hydrogen Storage R&D
[2]Estimated from FY14 appropriation

DOE Activities Span from R&D to Deployment

1. Research & Development

Cost Reductions

- **50%** for fuel cell systems

$124/kW in 2006

$55/kW in 2014*
at high volume
*$280/kW low volume

- **80%** for electrolyzers (since 2002)

2. Demonstration

FCEV Demo

- **>180** FCEVs
- **25** stations
- **3.6M** miles

World's first tri-gen station

GSE, back-up power app.

3. Deployment

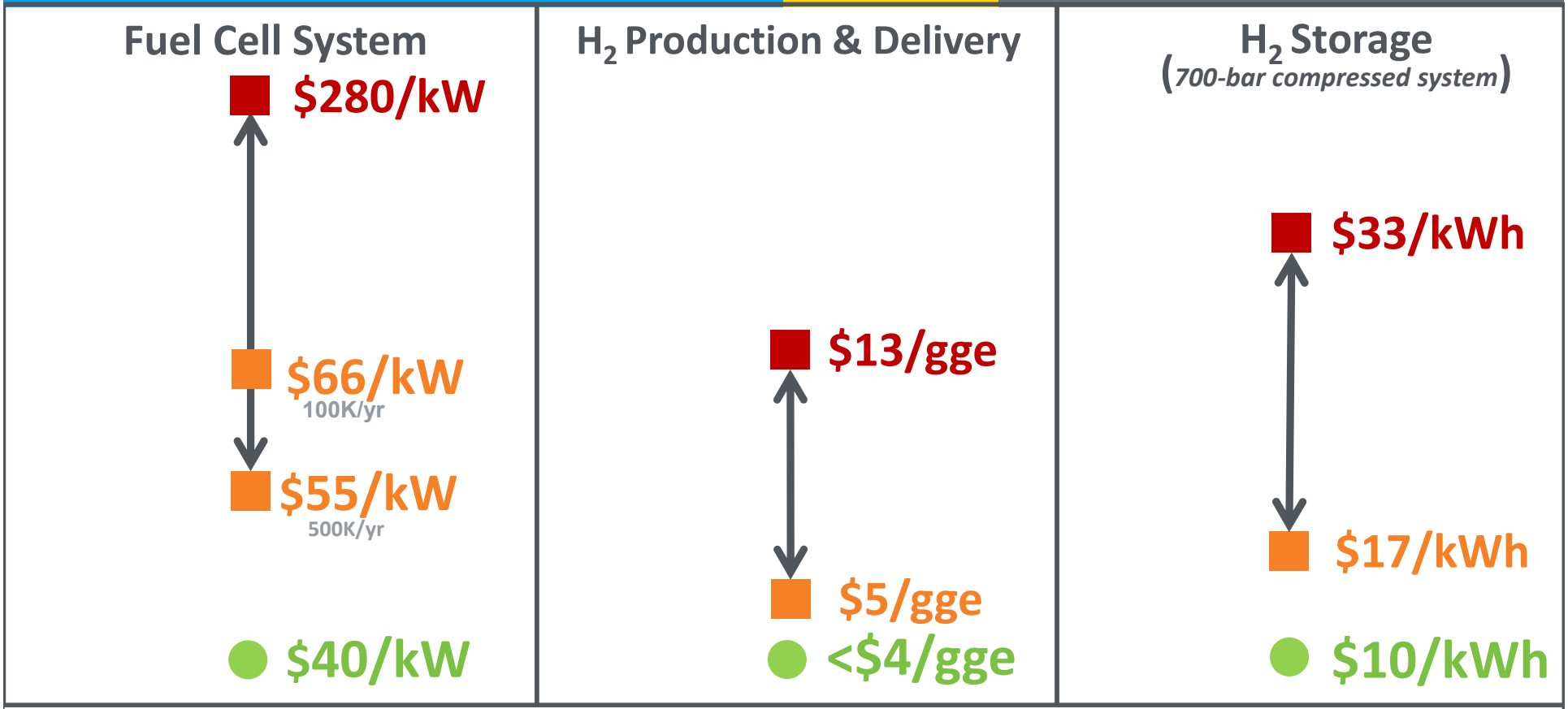
Lift Trucks

- **700** DOE cost-shared deployments led to **>7,500** additional purchases

Emergency Back-Up Power

- **900** DOE cost-shared deployments led to **4,000** additional purchases

DOE Cost Targets and Status



Key Challenges- Examples

- PGM loading
- Catalyst and membrane durability
- Electrode performance and durability

- Efficiency and Reliability
- Feedstock and Capital Costs
- Compression, Storage and Dispensing (CSD) Costs

- Carbon fiber precursors and conversion
- Composite/ resin materials
- BOP and assembly costs

FCEVs are on U.S. Roads Now!

Available for commercial sale in the U.S.

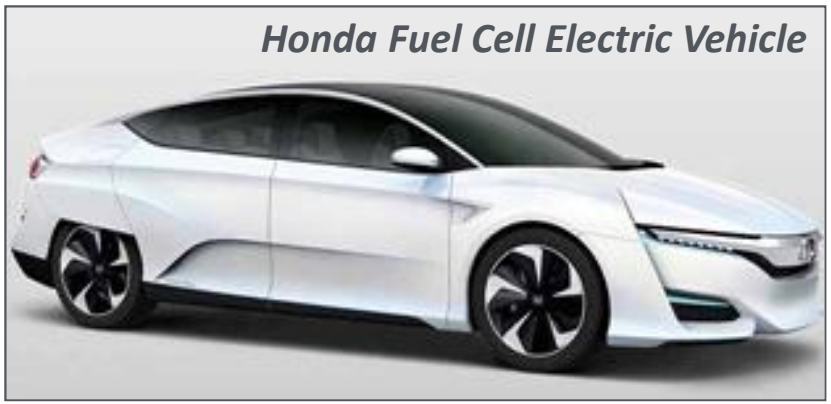
Toyota Mirai Fuel Cell Vehicle

Click to see video of Secretary Moniz driving FCEV

Now Leasing…

Hyundai Tucson Fuel Cell SUV

In Auto Shows…



Honda Fuel Cell Electric Vehicle

FCEVs at the 2015 Washington Auto Show

Energy Department's Secretary Moniz provides detailed comments on FCEVs and progress along with portfolio of technologies during keynote remarks

World's First Fuel Cell Cargo Trucks

facebook

U.S. Department of Energy Office of Energy Efficiency and Renewable Energy
Hydrogen fuel cell cars are beginning to hit #American roadways. #DidYouKnow fuel cells are also being used at the airport? Our office is providing funding support for the development of 15 zero emission #hydrogen fuel cell-powered cargo tractors that FedEx is using to load packages at their world hub at Memphis International Airport in #Tennessee. Our Deputy Assistant Secretary for Sustainable Transportation, Reuben Sarkar, and Fuel Cell Technologies Director, Sunita Satyapal, attended the ribbon cutting ceremony last Thursday and had the opportunity to drive one of the fuel cell powered cargo trucks. Learn more in this Memphis Business Journal story: http://bit.ly/FuelCellShipping.

Like · Comment · Share

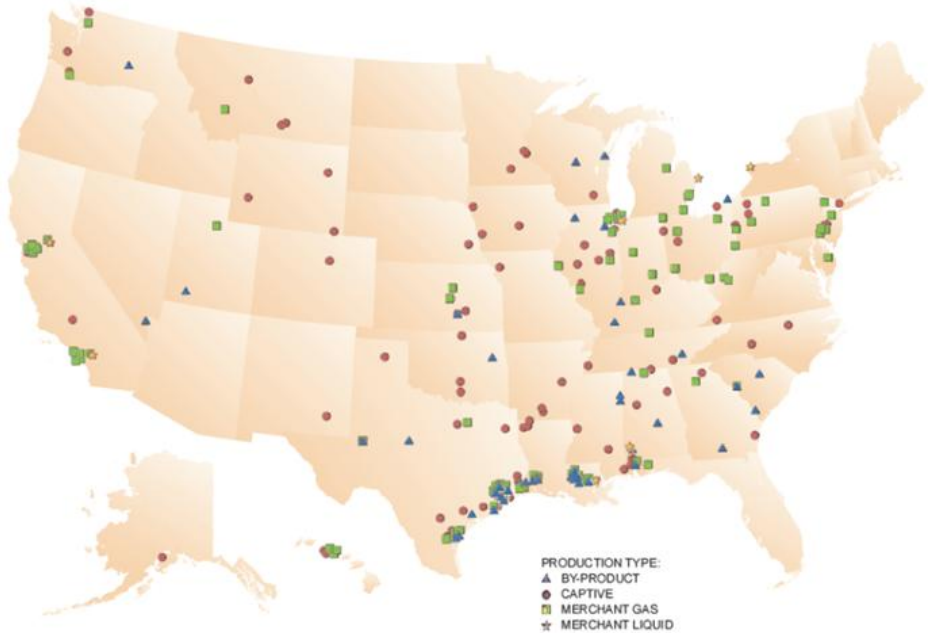
FedEx, Desiree Evans-Hoover, Arkansas Energy Now and 220 others like this.

160 shares

Status of H_2 Infrastructure

Nationwide

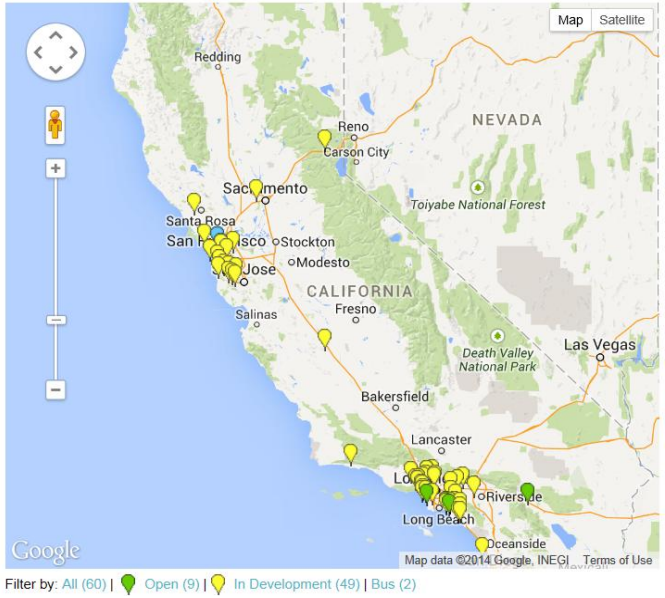
- **1500 mi.** of H_2 pipeline
- **>9M** metric tons produced/yr
- **~50 stations** (~10 public)



Centralized H_2 Production Facilities (source: NREL)

States

- **CA- 100 stations, ~$100M** planned through 2023
- **8 State MOU- 3.3M ZEVs** by 2025
- **Northeast states, Hawaii**



H_2 stations in CA (source: CAFCP)

NE states, California and Hawaii have H2 infrastructure efforts underway

H_2USA to address H_2 Infrastructure Challenges

*Representative sample of member logos

Public-Private Partnership with 4X increase in partners since 2013

H2 Refuel H-Prize

H2refuel
U.S. Department of Energy

$1 million competition for on-site home and community-scale H_2 fueling systems.

1st Year
Teams form and submit designs

2nd Year
Selection of finalists and testing

Late 2016
Technical and cost analysis to select winner

Award
$1M

Visit http://hydrogenprize.org/

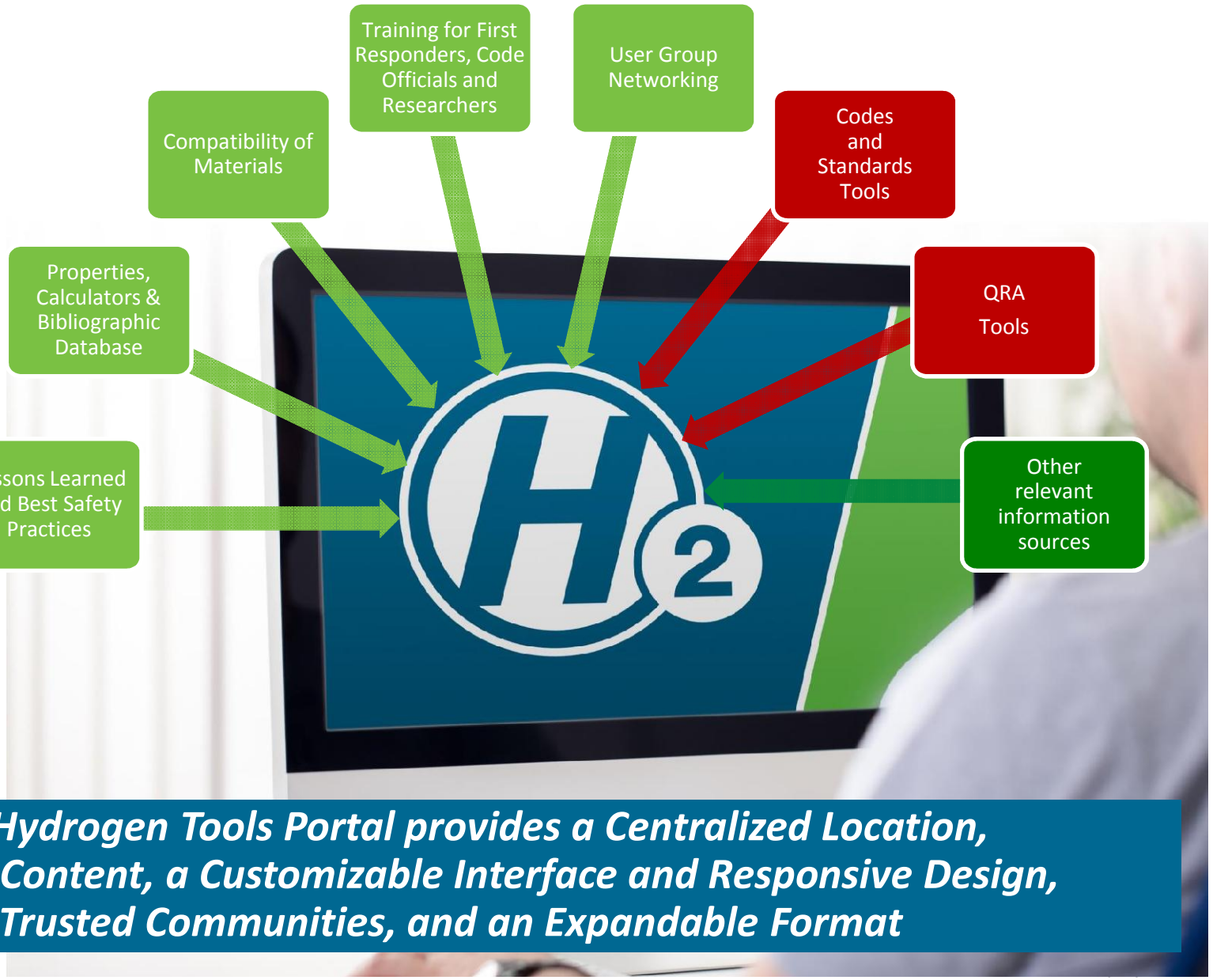
Promoting H_2 fueling system development in the community

Hydrogen Safety Resources

Phase 1 Spring 2015

Potential Future Tools

Share your ideas!



The Hydrogen Tools Portal provides a Centralized Location, Focused Content, a Customizable Interface and Responsive Design, Trusted Communities, and an Expandable Format

Going Forward

- **Continue to strengthen R&D activities and accelerate Tech to Market (Lab impact)**
  - H_2, fuel cells, safety, manufacturing, etc.
  - Cost, performance, durability need to be addressed
- **Conduct strategic, selective demonstrations**
  - Industry cost share and potential to accelerate market transformation
- **Continue to conduct key analyses to guide RD&D and path forward**
  - Life cycle cost; infrastructure, economic & environmental analyses, etc.
  - Medium/heavy duty vehicle target setting underway
- **Leverage activities to maximize impact**
  - U.S. and global partnerships, H2USA, States

We are getting there

Click to see video

Thank You

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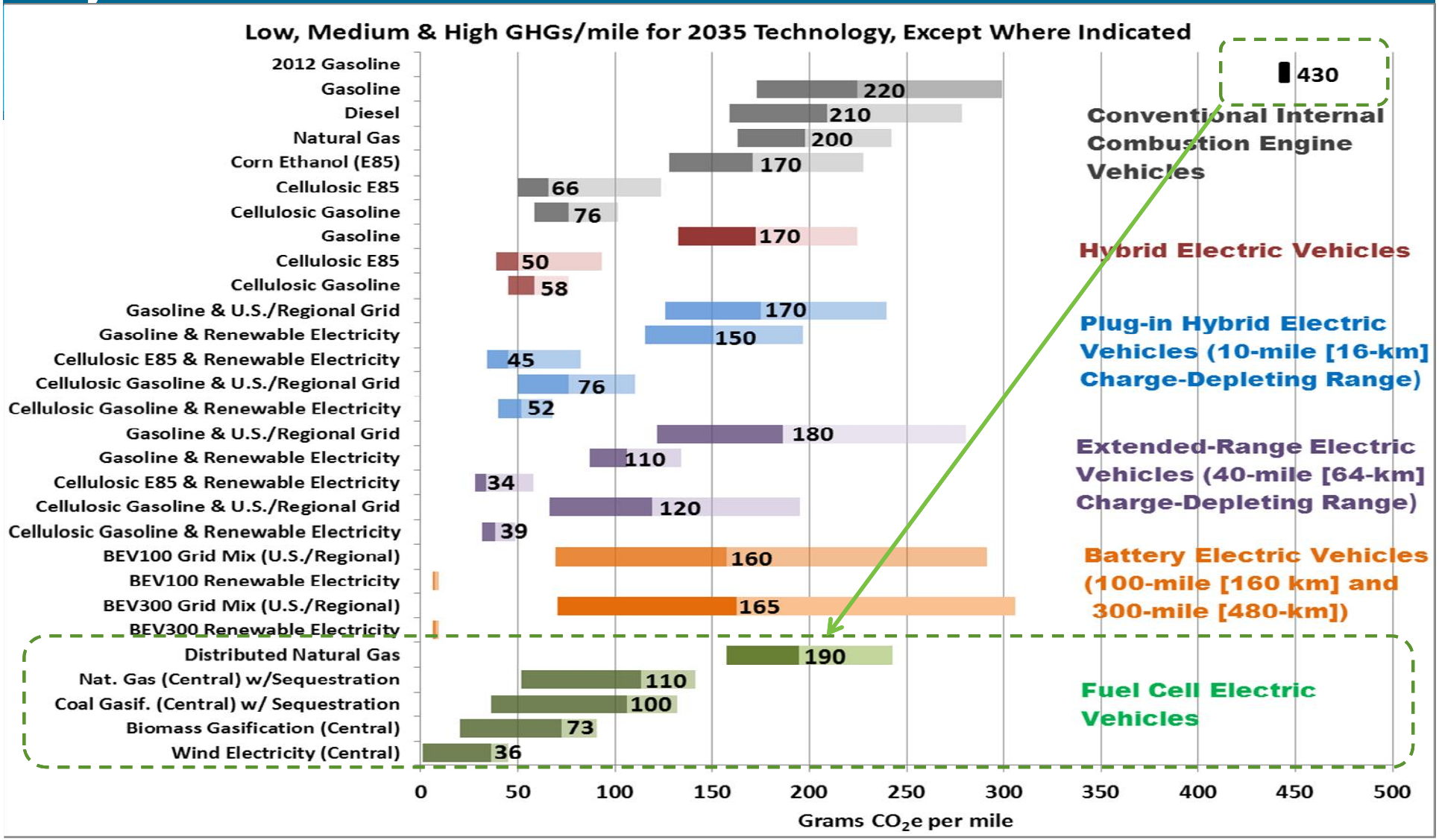
Backup slides

Well-to-Wheels Greenhouse Gases Emissions Projections



Low/medium/high: sensitivity to uncertainties associated with projected fuel economy of vehicles and selected attributes of fuels pathways, e.g., electricity credit for biofuels, electric generation mix, etc.

H_2 from Distributed NG can reduce CO_2 emissions by 50%

Source: http://hydrogen.energy.gov/pdfs/13005_well_to_wheels_ghg_oil_ldvs.pdf