Energy+Environmental Economics

Long-Term Natural Gas Infrastructure Needs

U.S. Department of Energy Quadrennial Energy Review, Public Meeting #7

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Denver, Colorado

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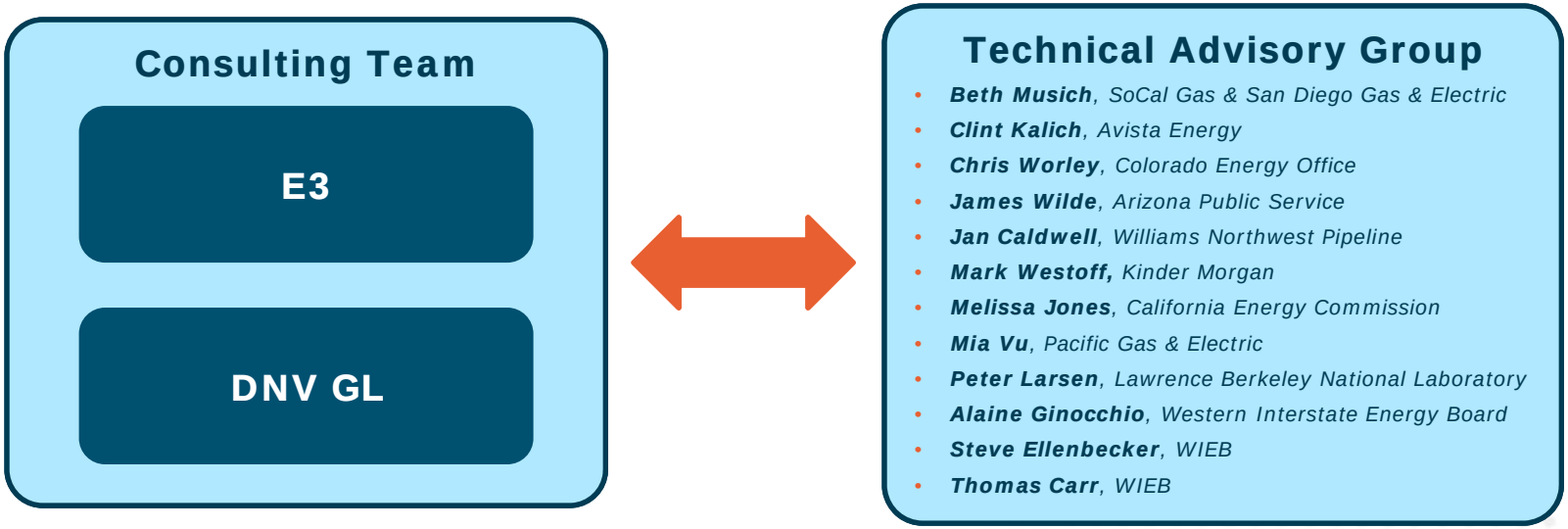
Western Gas-Electric Study

- **The Western Interstate Energy Board hired E3 and DNV GL to investigate the adequacy of gas infrastructure to meet electric sector needs in the West**
- **<u>Phase 1:</u> Will there be adequate natural gas infrastructure to meet the needs of the electric industry in the West approximately 10 years in the future?**
  - What demand for natural gas—electric and non-electric—would be expected on the winter and summer peak days?
  - Do regional pipelines and storage have sufficient capacity to meet demands?
  - Do current market arrangements provide appropriate signals for expansion?
- **<u>Phase 2:</u> Will the gas system have adequate short-term operational flexibility to meet electric industry requirements?**
  - How large might hourly ramps in the demand for natural gas be?
  - Is the gas system physically capable of operating in such a manner as to accommodate the magnitude of these swings?
  - Do current market arrangements provide appropriate signals for more variable short-term operations?

About the Study

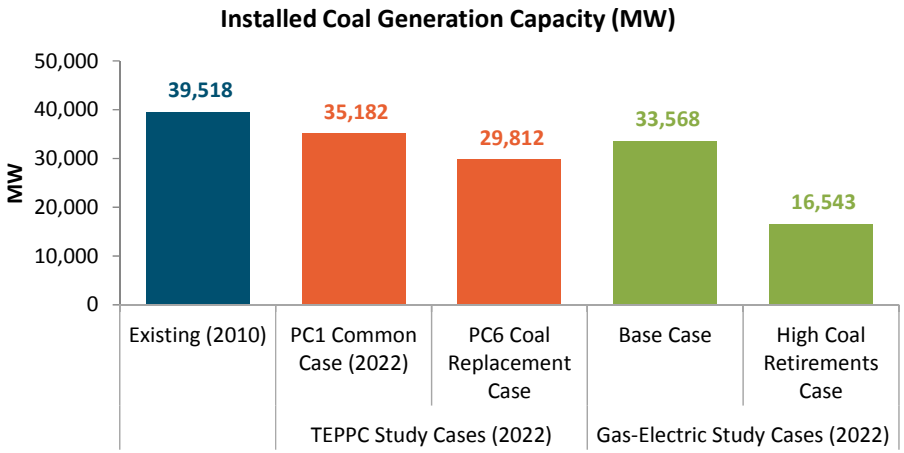
- Study sponsored by the Western Interstate Energy Board and supported by the DOE's National Energy Technology Laboratory under Award Number DE-OE0000422.
- E3 and DNV GL have worked closely with the Technical Advisory Group (TAG), a group comprising WIEB staff, industry experts, and representatives of government offices from around the Western Interconnection

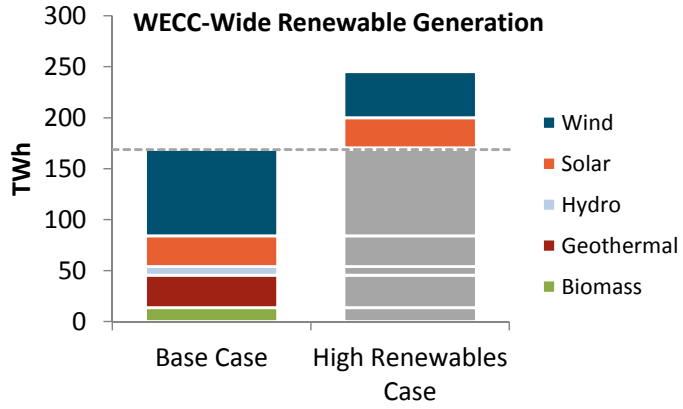


- Phase 1 report released March 17; Phase 2 report will be released on July 30

Scenarios Considered

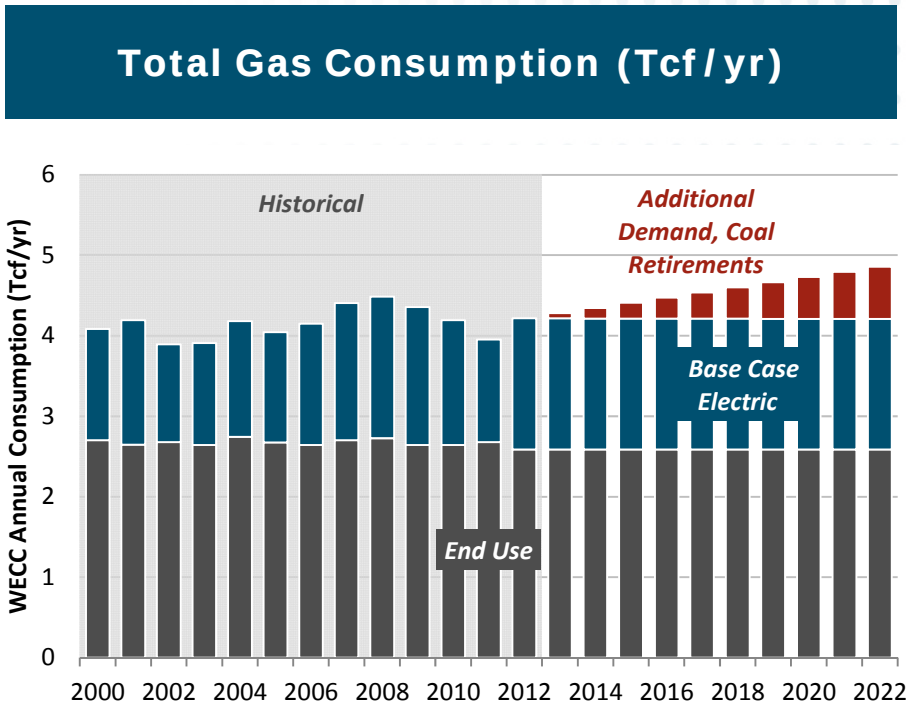
- **Base case**
  - Existing trends through 2024
- **High coal retirements**
  - 50% of remaining coal plants retired
- **High renewables**
  - 27% RPS in WECC
- **High export sensitivity**
  - 2.0 MMcf/d in SW, 1.5 MMcf/d in NW





Phase 1 Key Findings

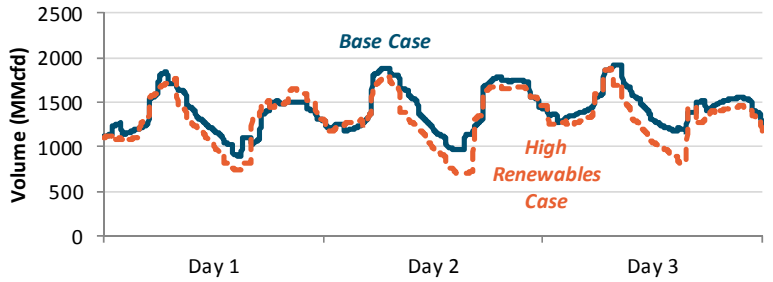
- Western gas infrastructure will generally be adequate to meet the needs of the electric sector except under the most extreme winter weather conditions
- Regions are linked and extreme regional weather events can cause loss of electric load
- Gas generation that does not contract for firm transportation service may be subject to interruption
- Continued growth of the West's natural gas generation fleet will require expansion



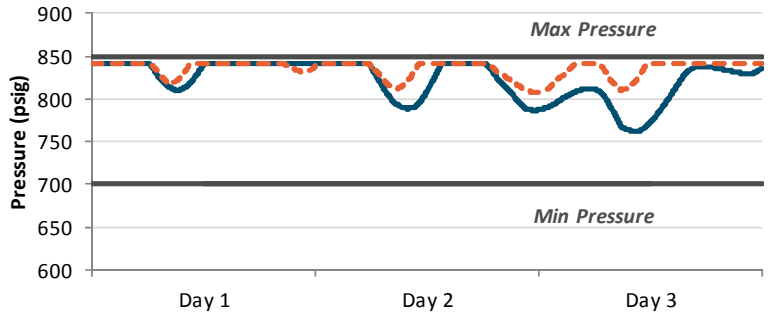
Phase 2 Key Findings

- **Increased variability in gas demand caused by higher penetration of renewables can be accommodated**
  - Renewables increase variability while reducing overall demand
- **Imbalances between gas deliveries and receipts to gas systems can cause operational challenges**
  - These challenges can be exacerbated by renewable forecast errors

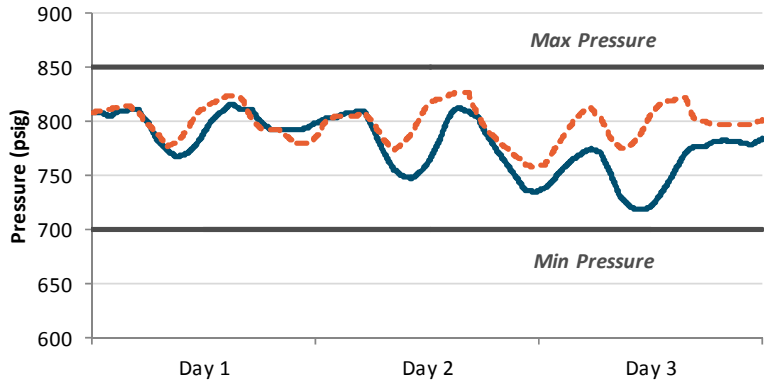
(a) Total deliveries (to Phoenix, Power Plant Alley, Wenden)



(b) Pressure at Casa Grande (upstream of Power Plant Alley)

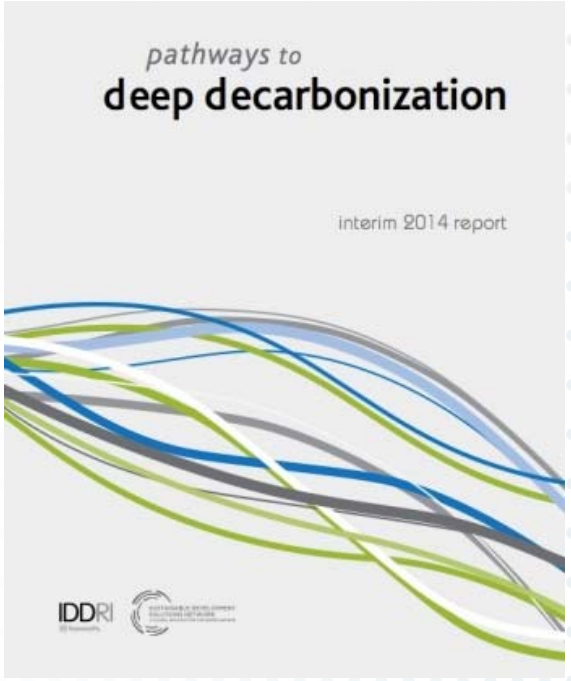


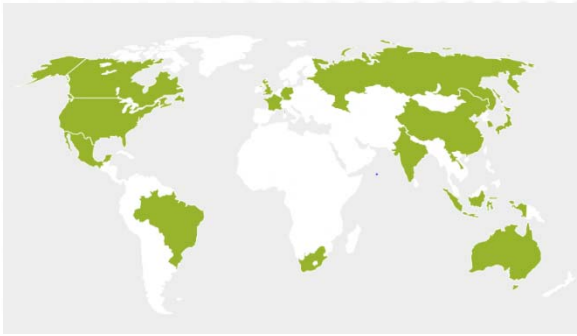
(c) Pressure at Wenden (downstream of Power Plant Alley)



United Nations Deep Decarbonization Pathways Project

- **Collaborative analysis by research teams in 15 nations to explore 2050 decarbonization scenarios consistent with a global temperature increase of 2˚C or less**
- **Country-level analysis reflects local constraints and perspectives within each country**
- **Includes individual chapters from local teams for US, China, Australia, Canada, France, Indonesia, Japan, Mexico, Russia, South Africa, South Korea, & UK**
  - India, Brazil, Germany & others forthcoming
- **July 11: Interim report delivered to UN Secretary General Ban Ki-Moon, available at http://unsdsn.org/wp-content/uploads/2014/07/DDPP_interim_2014_report.pdf**





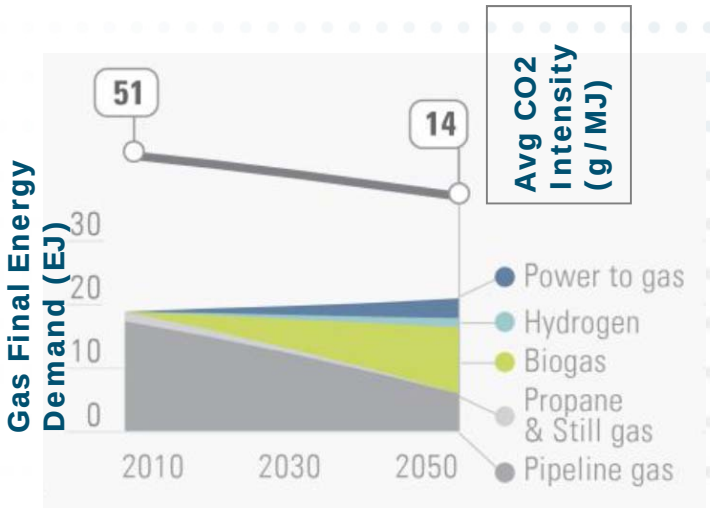
Deep Decarbonization Pathways: US Team Analysis

- **Three energy system transformations needed to achieve deep decarbonization:**
  - Energy Efficiency across all sectors
  - Decarbonization of electric sector
  - End-use fuel switching to rely more heavily on low-carbon primary energy sources
- **Four main low carbon primary energy sources:**
  1. Nuclear generation
  2. Fossil generation with carbon capture and sequestration (CCS)
  3. Renewable generation
  4. Bio-energy

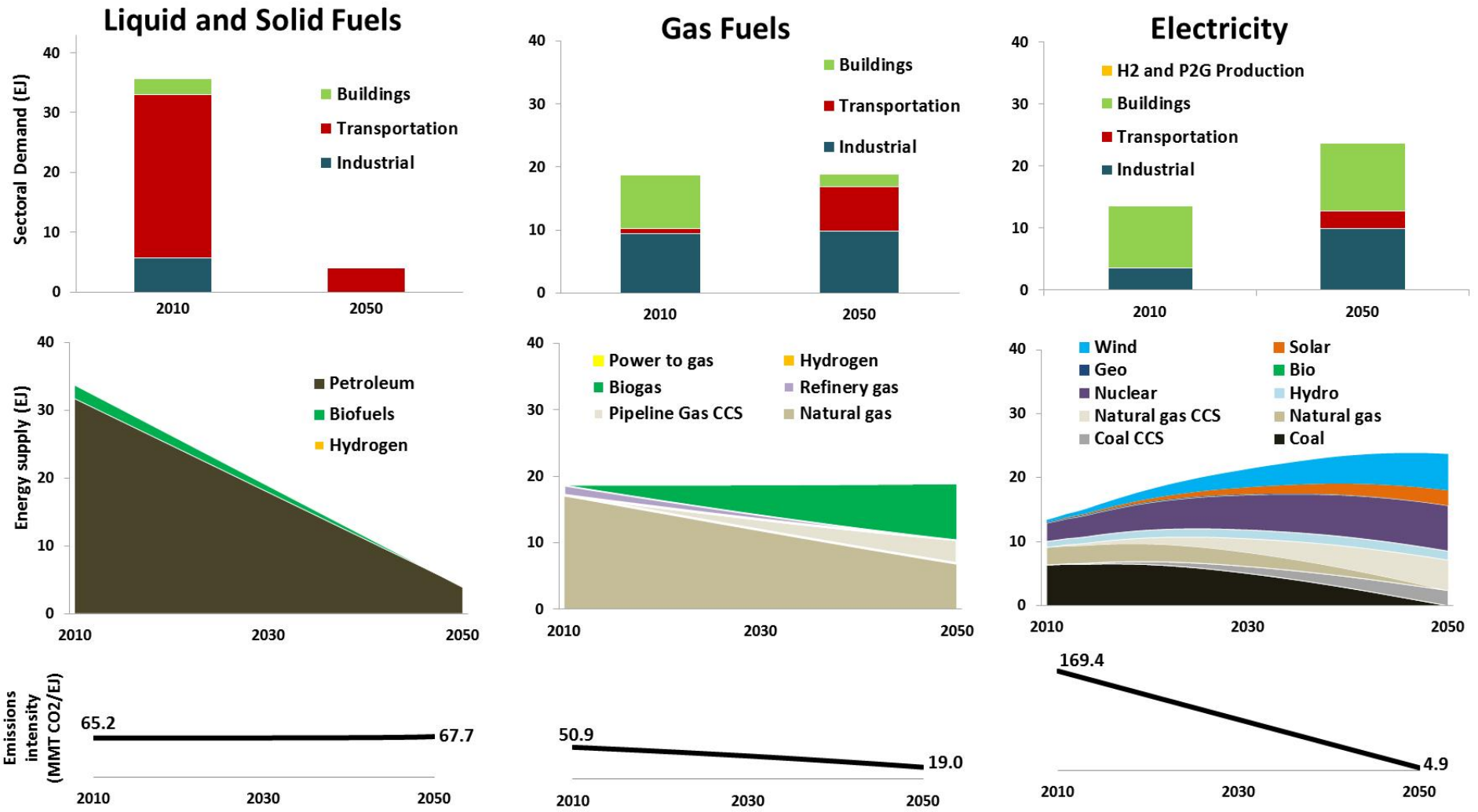
Shifting Role of Natural Gas in US Scenarios between 2015-2050

- **Near term (2015-2030): Increase in gas use to displace coal and oil**
- **Longer term (2030 and beyond): Deliverer of gas from blended supply of:**
  - Natural gas
  - Biogas
  - Hydrogen (H2)
  - Power-to-gas (P2G)
- **Post 2030 demand could stabilize if sufficient low-carbon gas supplies can be developed**

US Gas Pipeline supply mix & resulting emissions factor in High Renewables scenario



Example US pathway: balanced scenario combines low-carbon generation technologies*



*Other scenarios emphasize renewables, nuclear or coal/gas with CCS

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Thank You!

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