the Energy to Lead

Utility R&D as a Public Good

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> Austin, TX
> November 2015

gti

Topics

- Definition of public goods
- Examples of public goods
- The Case for Operations Safety & Integrity R&D
- The Case for End-Use Efficiency R&D
- Where do we Stand?
- Example of Shale Gas R&D
- Benefits and Conclusions

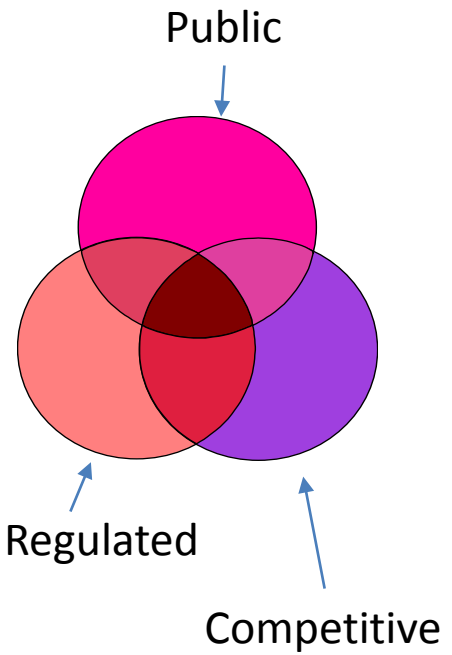
Definitions of Public Goods

- Classic Definition[(1)] :
  - Joint and non-rivalrous consumption
    - One individual's consumption does *not* prevent another individual from consuming the same good
  - Non-excludability
    - The good cannot be withheld from others
- Examples: lighthouses, national highway system, drinkable water, national defense, pure physics, running trails, clean breathable air

Definitions of Public Good (cont.)

> California Definition[2] :

- Public interest RD&D activities are directed toward developing science and technology the *benefits of which accrue to (California) citizens* and that are not adequately addressed by competitive or regulated entities
- Regulated RD&D activities are directed toward developing science and technology, *the benefits of which are related to the regulated functions of the entity* making the investment
- Competitive RD&D activities are directed toward developing science or technology, the *benefits of which can be appropriated by the private sector entity* making the investment



R&D in the Electric and Gas Utility Industries [3]

- Where the benefits of public-interest R&D may be important are health, safety, environment, energy efficiency, and “pre-commercial” technical information
- Examples:
  - Combustion science (benefits: lower NOx without sacrificing efficiency)
  - Residential heating and cooling ducts (benefits: reduction in wasted energy)
  - Venting technology (benefits: safety, reduction in furnace corrosion)

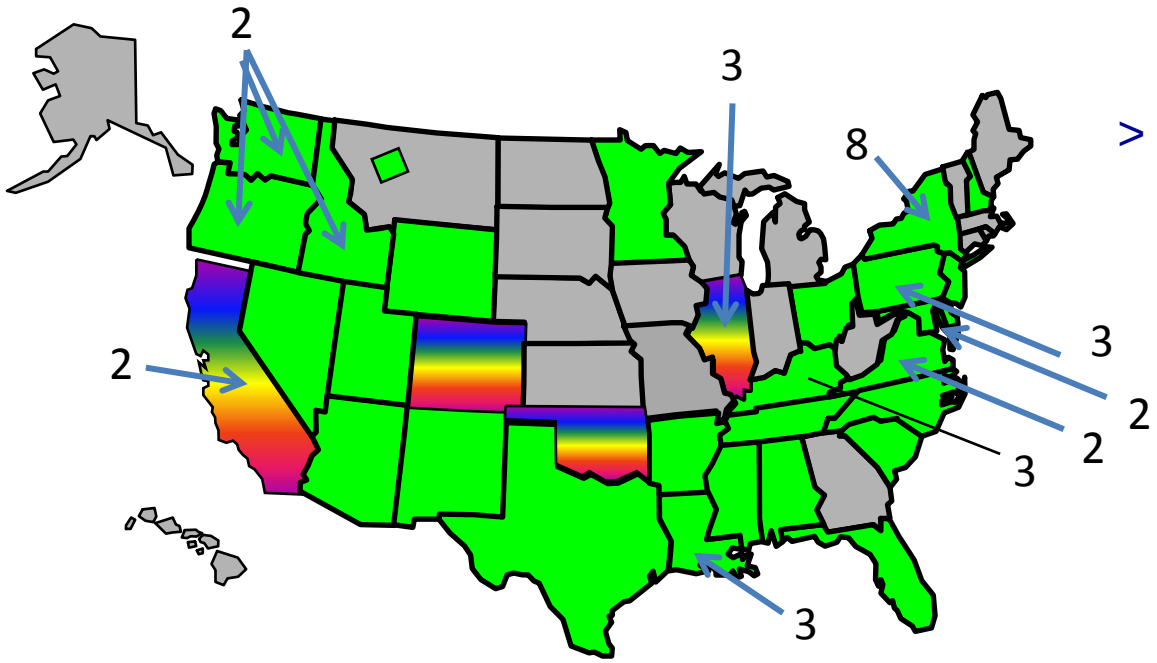
Operations/Midstream R&D

- Examples: distribution and pipeline safety and integrity R&D
- Who benefits: Gas consumers, the general public, utility
  - Enhanced safety, deliverability, and more effective Distribution Integrity Management Programs (DIMP), reduced emissions
  - Reduction in the escalation of O&M costs (avoided costs), shared with consumers in the next rate case
- Manufacturer benefits?
  - Yes, but … it would have been impossible for a manufacturer to recover decades of R&D costs selling, say, 100 plastic pipe locators a year

End-Use R&D

- Examples: venting safety and end-use efficiency R&D
- Who benefits: Gas consumers (all consumers through reduced demand; high-efficiency equipment users benefit the most)
  - Venting safety is a pure public benefits play
- Utility (dis)benefits?
  - Loss of load due to energy efficiency, at best utility is neutral even with decoupling (mostly gas-to-gas replacement)
  - Maybe some minimal load switching if higher-efficiency equipment is available vs. the competition
- Manufacturer benefits?
  - Yes, but, with few exceptions, U.S. appliance manufacturers do not fund R&D for increased efficiency above and beyond regulatory requirements
  - And appliance manufacturers for the most part produce both gas and electric equipment and are indifferent to type of fuel used

Delta Map

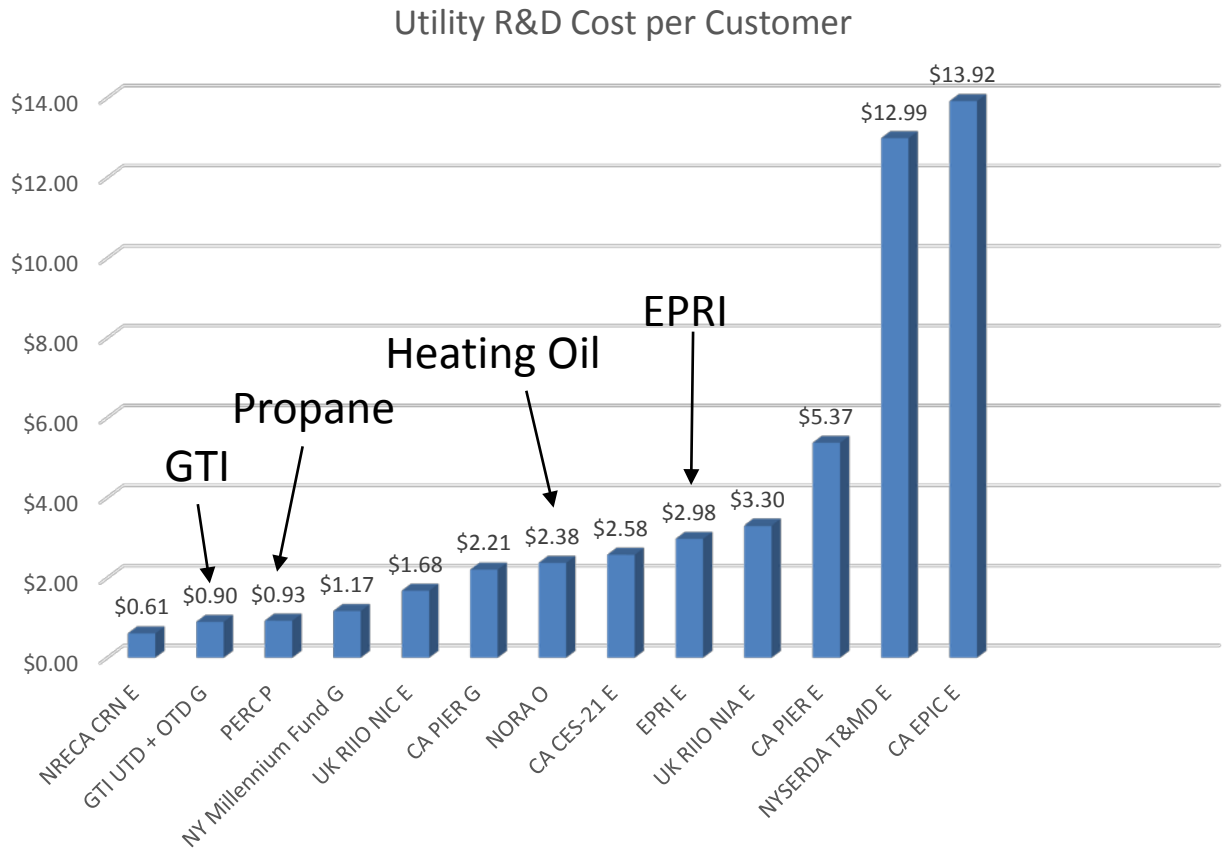


> **Approved States = 29**

Company and Regulatory Approval (# of companies)

Pending filings + approval

Energy R&D: GTI R&D is One of the Best Deals!



Ref:

1. "Stimulating Innovation on Behalf of Canada's Electricity and Natural Gas Consumers, Concentric Energy Advisors, August 21, 2014, p. 39
2. PERC and NORA, based on GTI analysis, April, 2015.

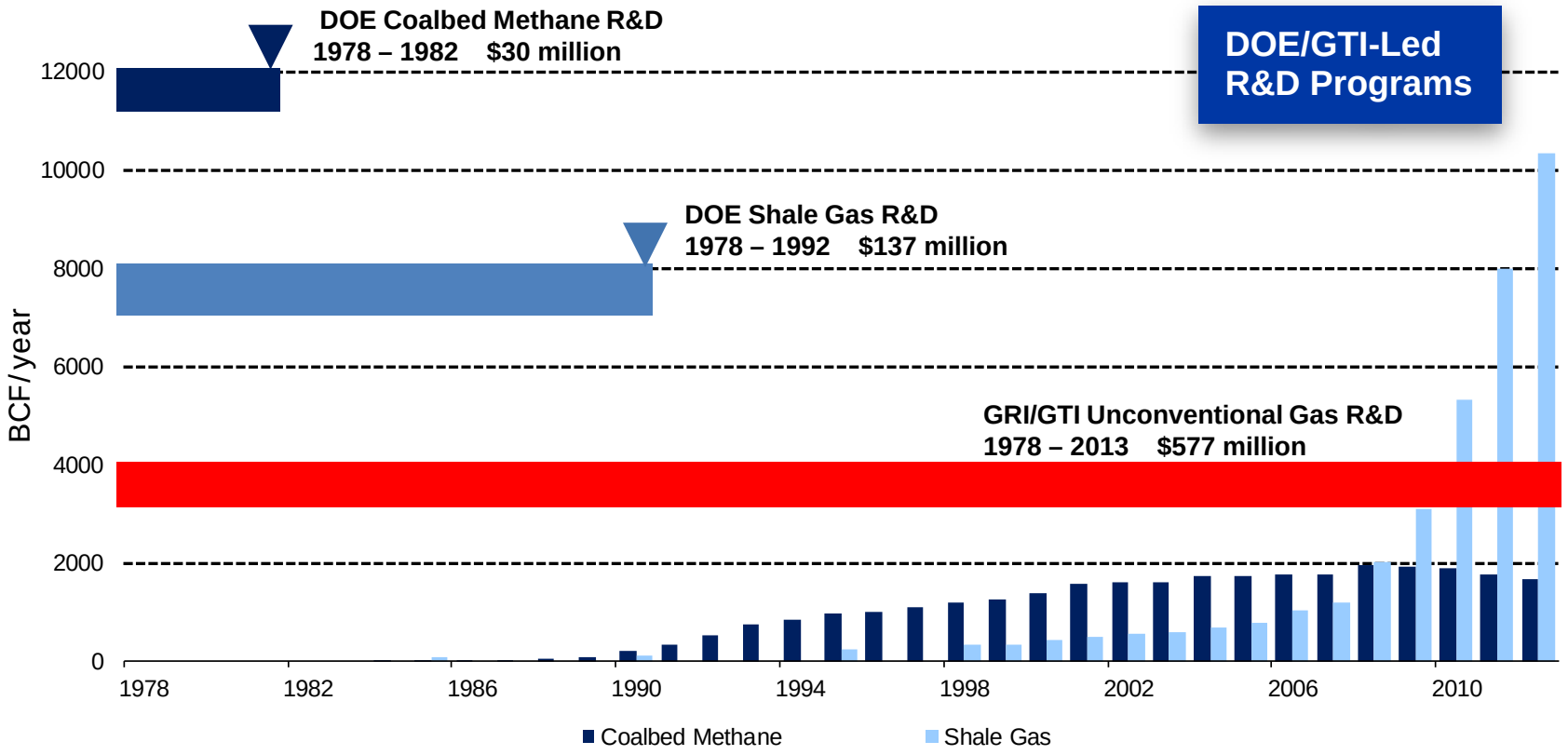
Free Rider Issue Defined (4)

- Public goods provide a very important example of a potential market failure, in which market-like behavior of individual gain-seeking does not produce efficient results.
- Production of public goods results in positive externalities which are not remunerated. If *private organizations* do not reap all the benefits of a public good which they have produced, *their incentives to produce it voluntarily might be insufficient*.
- Consumers (or states) can take advantage of public goods without contributing sufficiently to their creation. This is called the free rider problem,
- If too many consumers (or states) decide to "free-ride", private costs exceed private benefits and the incentive to provide the good or service through the market disappears. The market thus fails to provide a good or service for which there is a need

Challenges

- Free rider issue: do we restrict the sale and use of technologies and scientific knowhow only to those state and gas utilities that are funding the R&D?
  - We do not restrict sales
  - Scientific data and technical reports available to funders only, with safety-related exceptions (like the cross bore best practices report)
- Funding mechanism: Utility R&D funding is entirely ratepayer based, and approval process is adversarial and takes time, and R&D can be “settled out” of the rate case

GTI/DOE Research Investments Sowed the Seeds of Unconventional Natural Gas Production Into The Future



Shale expected to exceed 50% of U.S. gas production by 2035

Sources: GTI, EIA, DOE Department of Fossil Energy

Huge Benefits to Gas Consumers of R&D

- For gas shale R&D, based on 2006 prices and 2013 prices, national savings for R, C, I customers of $*53 billion per year*, compared to 30-year R&D costs of $744 million total
- Typical benefit/cost ratio for end-use plus operations R&D ranges from *4/1 to 8/1* for gas consumers
  - World's first high-efficiency furnace
  - Highest-performing industrial boiler
  - Plastic pipe locator
  - Crossbore prevention guidelines

End-Use R&D Value to Utilities & Consumers

- Save consumers money and save energy
- Provide a pathway for innovative natural gas solutions
- Enable efficient fuel choice
- Minimize environmental impacts
- Integration with renewable energy sources
- Allows cofunding with DOE and state R&D agencies; tremendous leverage

Operations R&D Value to Consumers and Utilities

- Enhance safety
- Create operating efficiencies
- Meet and exceed evolving regulatory mandates
- Minimize environmental impact
- Supplement and grow utility technical expertise
- Substantial Leverage of dollars to cofund DOE, PHMSA projects

Conclusions

- Substantial consumer benefits:
  - Enhanced consumer and public safety and enhanced system integrity, increased deliverability and reliability
  - Lower energy costs through supply R&D and increased-efficiency appliances
  - Environmental benefits: lower NOx, reduced methane emissions, reduced CO_2

References

1. Tyler Cowen, “Public Goods Definition and their Institutional Context,” Review of Social Economy, Harvard University, 1985
2. RD&D Working Group, “Working Group Report on Public Interest Research, Development & Demonstration Activities,” Response to CPUC Dec. 95-12-063, September 6, 1996
3. Carl Blumstein et al, “Public-Interest Research and Development in the Electric and Gas Utility Industries,” UC Energy Institute, Utilities Policy, 7 (1998)
4. https://en.wikipedia.org/wiki/Public_good

Glossary for R&D funding chart

- NRECA CRN – National Rural Electric Cooperative
- UK RIIO NIC – U.K. RIIO Network Innovation Competition
  - RIIO – Regulation = Incentive + Innovation + Outputs
- CA CES-21 – California 21st Century Energy Systems Research project
- EPRI – Electric Power Research Institute
- UKRIIO NIA – UK RIIO Network Innovation Allowance
- CA PIER – California Pubic Interest Energy Research Program
- NYSERDA T&MD – New York State Energy Research & Development Authority Technology and Market Development Program
- CA EPIC – California Electric Program Investment Charge
- GTI UTD & OTD - Gas Technology Institute Utilization Technology Development & Operations Technology Development Programs
- PERC – Propane Education & Research Council R&D surcharge
- NORA – National Oilheat Research Alliance surcharge
- E – Electric
- G – Gas
- O – Oil
- P - Propane