



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Establishing the Foundation for Industrial Gasification

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Industrial Gasification: A Challenge for ITP

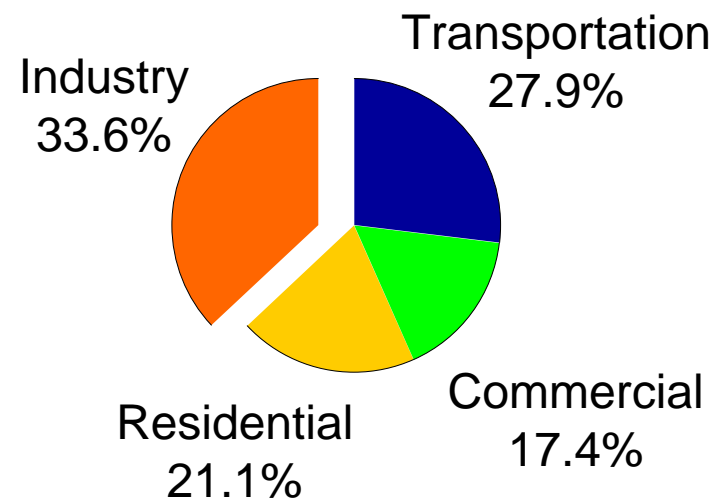
- The Joint ITP/NETL role
- A suggested pathway for establishing the foundation of an industrial gasification initiative
- The need for teaming with industry and States
- The challenge of needing multiple technologies, multiple fuels and of differing sizes



Industry: Critical to National Energy Picture

- Uses more energy than any other single sector
- Accounts for more than 40% of U.S. **natural gas** demand
- Accounts for 28% of U.S. **electricity** demand
- Produces approximately 30% of U.S. **greenhouse gas** emissions
- Energy is key to **economic growth** in domestic manufacturing
- “Many companies have been unable to pass higher energy costs on to their customers, which has sharply reduced their profit margins” *National Energy Policy, pages 2-4*

2004 Energy Use*



*Includes electricity losses

Source: DOE/EIA Monthly Energy Review 2004 (preliminary)



Alternative Fuels and Feedstock Flexibility

ITP Strategies

Near-Term (0 – 2 years):

Pursue natural gas saving opportunities via:

- *Technology and market assessments*
- *Application guides explaining opportunities, implementation strategies, permitting issues, etc.*
- *Training and education*

Potential Nat Gas Displacement (10¹² Btu)

| Application | Near Term (<2 years) | Longer Term (>2 yrs) | TOTAL |
|--------------|----------------------|----------------------|--------------|
| Feedstock | -- | 700 | 700 |
| Process | 300 | 1,380 | 1,680 |
| Boiler | 950 | 800 | 1,750 |
| TOTAL | 1250 | 2,880 | 4,130 |

Longer-Term (>2 years): *Significant process change opportunities exist*

- *Explore opportunities in FE and other EERE technologies*
- *Conduct applied R&D for industrial applications*



Overview and Approach for Establishing the Foundation

- **VISION: Accelerate the acceptance and development of gasification technologies for industrial applications**
- The ITP/NETL joint approach will:
 - Identify market segments where gasification may be applicable
 - Identify industries that have interests and needs
 - Develop pathway(s) for different industries to evaluate gasification
 - Determine the basis for industrial acceptance and the application requirements.
 - Develop a roadmap of key hurdles that must be resolved prior to industrial adoption
 - Develop an RD&D commercialization pathway
- Industry participation will make the difference!



Energy Use in Key Industrial Sectors

(All Figures in Trillion BTUs)

| Sector | Natural Gas | Residual Fuels | Distillate Fuels | LPG/ NGL | Coal and Coke | Derived Net Electricity | Other | Total Use, Net |
|-----------------|-------------|----------------|------------------|----------|---------------|-------------------------|-------|----------------|
| Chemicals | 1984 | 50 | 9 | 51 | 284 | 602 | 749 | 3729 |
| Mining | 1268 | 5 | 262 | 0 | 77 | 355 | 631 | 2598 |
| Pet Ref | 948 | 70 | 4 | 33 | 0 | 123 | 2300 | 3478 |
| Forest Products | 659 | 152 | 21 | 9 | 279 | 327 | 1825 | 3272 |
| Steel | 456 | 29 | 5 | 0 | 48 | 163 | 971 | 1672 |
| Glass | 194 | 3 | 0 | 1 | 0 | 54 | 2 | 254 |
| Aluminum | 189 | 0 | 1 | 1 | 1 | 246 | 3 | 441 |
| Metalcasting | 136 | 0 | 1 | 2 | 0 | 63 | 31 | 233 |
| Agriculture | 77 | 0 | 339 | 221 | 0 | 221 | 14 | 1072 |
| TOTALS | 5911 | 309 | 642 | 318 | 689 | 2154 | 6526 | 16749 |

Taken from "Profile of Total Energy Use for US Industry", Energetics, Inc. for the US DOE, 12 / 04.

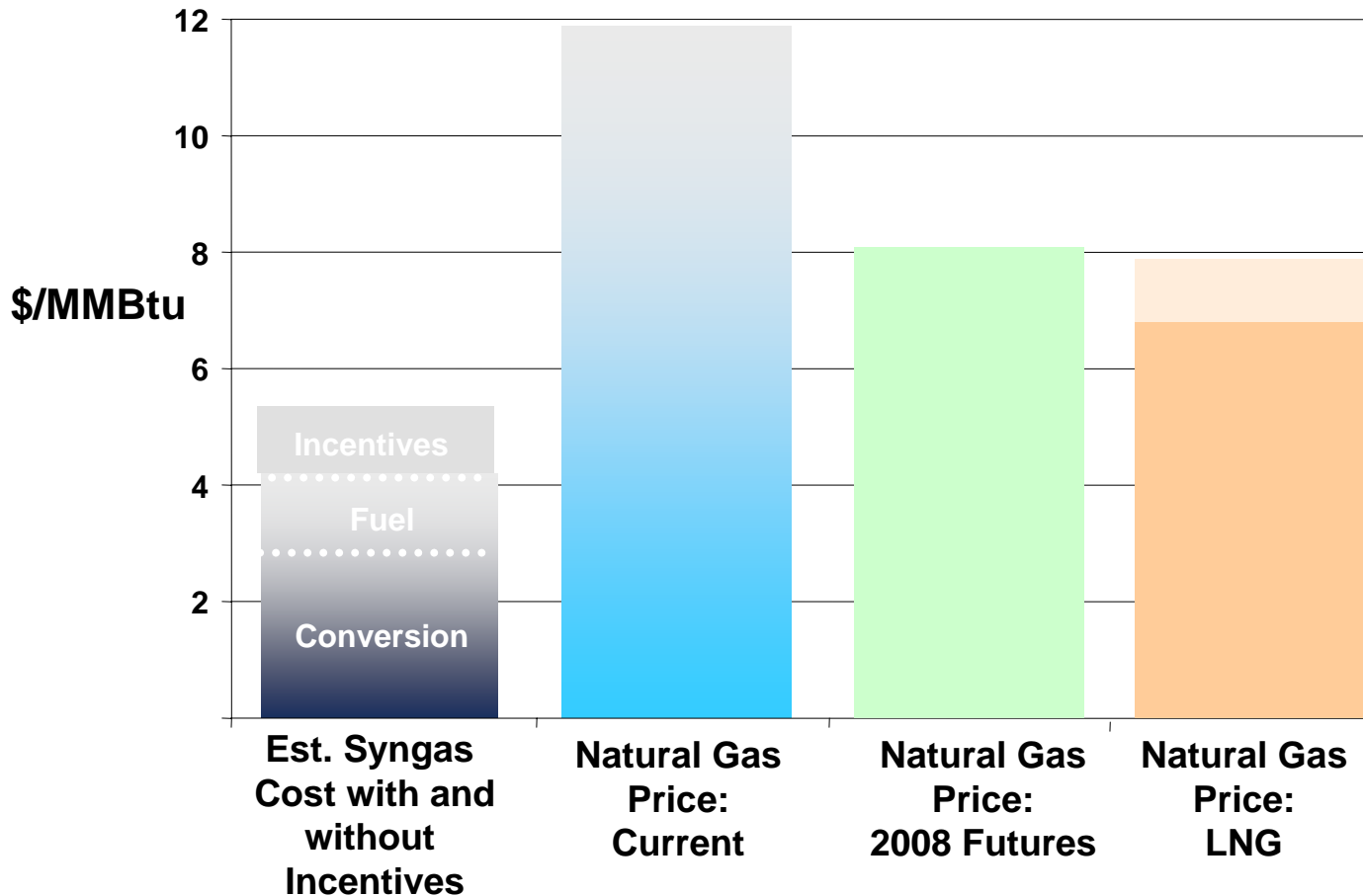
LPG / NGL = Liquefied Petroleum Gas / Natural Gas Liquids

Table does not include energy sources used as raw materials.



Economic Opportunity (Data as of 12/2005)

Syngas is highly competitive at current and projected gas prices





How We See the Issue: Key Observations

- Industry needs alternatives to high priced NG-used for process heating and as a chemical feedstock
- ITP sees fuel flexibility as a critical development area and gasification as an element of fuel flexibility
- Industry “experts” have identified gasification as a partial solution, yet industry has not embraced gasification for various reasons
- Many claim that the technical readiness of compact gasifiers for industry is no longer a technical issue
- This may be the right time to dip our foot in the water!



Is Gasification Technology Ready?

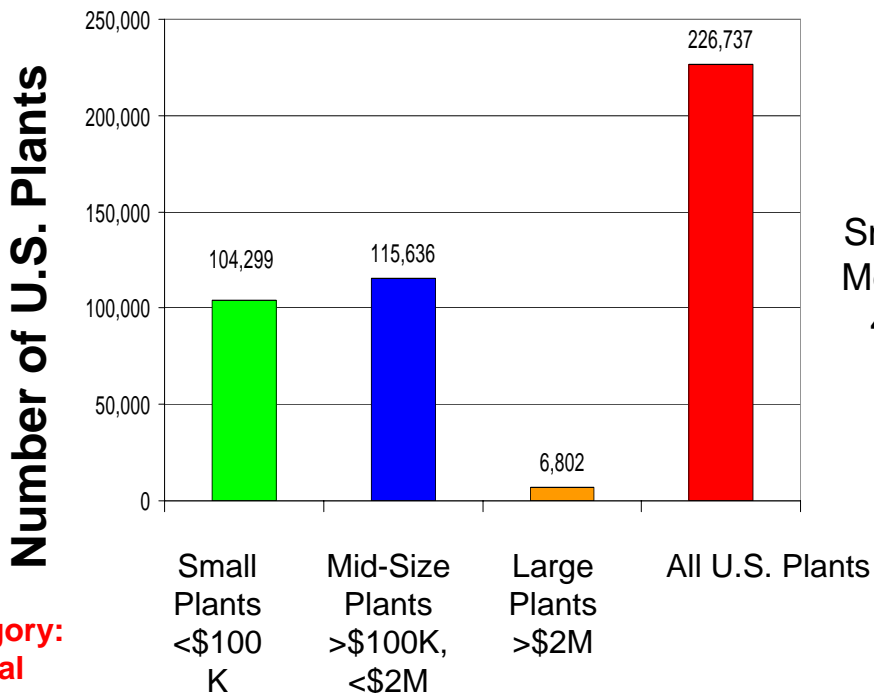
- “There are 385 gasifiers in operation at 117 projects worldwide. These gasifiers are used to produce liquid fuels in South Africa (Sasol facility), chemicals in the U.S. (Eastman), electricity in the U.S., Europe and Japan (Polk, Wabash River, Puertollano, Buggenum, and Negishi facilities), methane in the U.S. (Great Plains) and ammonia fertilizer in China and India. There are several different commercial gasifier designs available, including systems from GE Energy, ConocoPhillips, Shell, Lurgi, Prenflo, and Noell. Each of these systems has been proven in commercial use around the world.”

Source: Recent survey by the Gasification Technologies Council cited in The National Gasification Strategy (2005)

- However, the technologies now need to be matched with our industrial applications



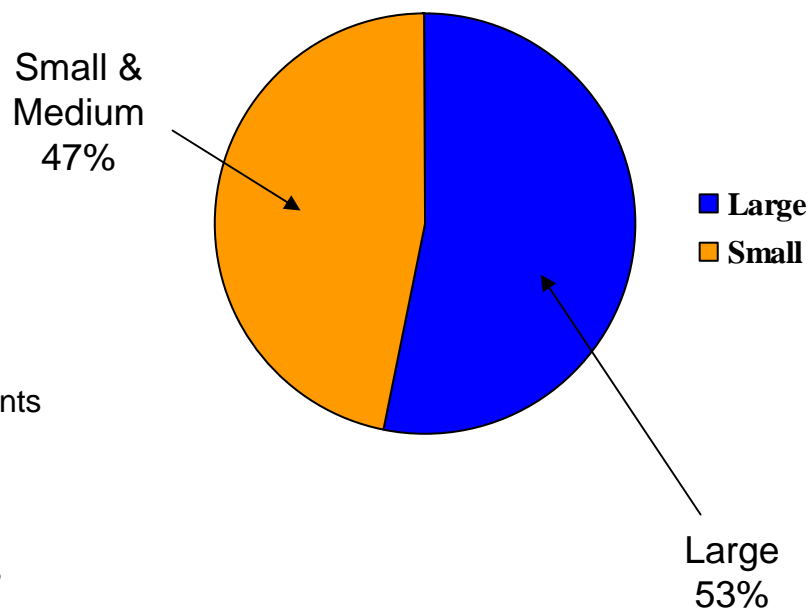
U.S. Manufacturing Plants: By Size



Category:
Annual
Energy
Costs

1998 EIA MECS

Percent of Total Industrial Energy



While large plants use over half the energy in industry, they only represent 3% of total plants. Unless we address access to smaller plants, we risk giving up nearly half of the energy potential.



Industrial Implementation Scenarios

- Producer builds – industry buys output
- Industry builds
 - Industry uses output directly
 - Industry integrates into process
- Industry builds – output is shared among several adjacent facilities



Tax Incentives – EPACK 2005

- **IGCC program** (Qualifying Advanced Coal Project Credit)
 - 20% ITC for gasification components
 - \$800 million total for IGCC (\$500 million for other advanced coal)
 - Secretary of Treasury to establish program within 6 months
 - 75% coal input, electric generation output
- **Industrial gasification program** (Qualifying Gasification Project Credit)
 - 20% ITC (\$130 million max per project) for gasification components
 - \$350 million total
 - Secretary of Treasury to establish program within 6 months
 - Coal, petcoke, biomass or other feedstock for direct use or subsequent chemical or physical conversion
 - “Domestic gasification applications related to: chemicals, fertilizer, glass, steel, petroleum residues, forest products, and agriculture”



Suggested Pathway (1 of 2)

- **Identify most likely industry targets/market sector interest** (12/05-2/06)
 - Identify and contact: industry targets, industry opinion leaders, champions, state/local government, key associations (industry suppliers industry users, oxygen and turbine Co's,)
- **Prepare market assessment of applicable industries** (12/05-4/06)
 - Disseminate market assessment and information about gasification technologies
 - Catalog government incentives
- **Solicit participation and facilitate producer/user workshops and industry by industry white papers** (2/06-6/06)
 - Develop industry by industry approach to applying sng technologies
 - Identify industry concerns, barriers and preferences



Suggested Pathway (2 of 2)

- **Develop industrial gasification roadmap** **(7/06-9/07)**
 - Complete roadmap(s) of technical and market needs or producer and user needs
 - Plant modifications requirements
 - Gas compatibility issues
 - Other risks that affect acceptance
 - State of technology readiness for appropriately sized gasifiers and need for commercial reference designs
- **Identify roles for State and local programs to participate—seek leverage** **(FY08)**
- **Develop an RD&D plan for ITP/NETL supported activities**



Potential Template - Industry White Paper

- **User**

- Plant engineering obstacles
- Gas quality requirements
- Gas cleanup needs
- Delivered price required
- Industries receptive to collaborations
- Availability requirements
- Companies willingness to serve as demo host
- Other production risks

- **Producer**

- Size requirements
- Applicable sng technologies
- Preferred fuel or fuel flexibility required
- Sng cleanup needs
- Scalability issues
- Stand alone or shared output
- Other: environmental or permitting issues