Waste Heat to Power Workshop February 15, 2005

Recycling Energy: Affordable Clean Energy Thomas R. Casten

Chairman & CEO Primary Energy, LLC

Primary Energy

- Formed in 2001, after sale of Trigen Energy Corporation
- Mission: Create value by recycling energy
- 14 projects, 5 states, 200 employees
 - Revenues \$250 million/year
 - 2005 EBIDTA \$84 million
 - 785 MW electric, 3.7 million pounds steam
 IPO of five projects, August 2005 as PERC

Energy Train Wreck Coming



- Low-cost electric plants operate near capacity;
 - Load growth will rely on expensive gas generation
- CAIR, T&D investments raising costs of existing power
- As utility coal contracts expire, coal prices double
- High gas and electric prices are squeezing manufacturing margins

Conventional Central Approach 1960 Data (& 2003 Data)



There is a Better Approach: Recycling Waste Energy

But, only decentralized generation can recycle Energy

Defining Recycled Energy

- Recycled energy is useful energy derived from:
 - Exhaust heat from any industrial process or power generation
 - Industrial tail gas that would otherwise be flared, incinerated or vented,
 - Pressure drop in any gas

Combined Heat and Power Options



Recycling Industrial Energy Options



Serving Future US Electric Load Growth

- US electric load grows 1.5 to 2% per year 320 gigawatts of new peak load in 20 years
- New central generation, including wind, requires new T&D capital of \$1,400/kW, suffers 9% average line losses
- On-site generation avoids T&D, and enables recycling of waste heat to displace boiler fuel
- Society believes reducing fossil fuel use and related pollution will increase costs of power
- Recycled energy offers a better option affordable clean energy.

Options to Satisfy US Electric Load Delivered Cost of Electricity versus Fossil Heat Rate



Potential to Recycle Energy



- Convert industrial waste energy into heat and power with on-site energy recycling plants
 - 95,000 megawatts potential , 9,900 MW in service
- Build Combined Heat and Power (CHP) near thermal users to recycle waste thermal energy
 - Potential for up to ½ of all US generated power with CHP plants

Primary Energy's Approach 90 MW Recycled from Coke Production



Growth Opportunity: Recycle Industrial Energy

- Wasted energy streams in nineteen industries could generate 19% \mathbf{O} of US electricity
- Few companies focused on recycling this energy \bigcirc



Recycled Energy in the US

9,900 MW

Recycled Energy in

Source: USEPA 2004 Study

US Industrial Recycled Energy Potential

)]

Gas compressor stations:	16,200	GWh				
Flare & stack gas:	148,000	GWh				
Steam pressure drop:	78,000	GWh				
• Estimated exhaust heat:	<u>300,000</u>	<u>G</u> Wh				
• Total Potential:	492,000	GWh				
• Est. Recycled Energy Cap.	95,000	MW				
 For all remaining thermal load, install CHP plants fueled with gas, coal, and biomass 						

Potential for up to 50% of Electricity from CHP, based on Selected Countries in 2004



Economies of Scale? Central versus Decentralized Generation

	Generation	Transmission & Distribution	Total / kW of Generation	KW required/ kW Load	Total costs/ kW New Load
Central Generation	\$890	\$1380	\$2,270	1.44	\$3, <u>2</u> 69
Local Generation	<u>\$1,200</u>	<u>\$138</u>	<u>\$1,338</u>	<u>1.07</u>	<u>\$1,432</u>
Savings (Excess) of Central vs. Local Generation	\$310	\$1,242	\$1,068	0.37	\$1,837
Central generation capital as a % of local capital	74%	1000%	170%	135%	228%

Local Generation that Recycles Waste Energy:

- Saves fossil fuel
- Reduces capital expenditures
- Reduces pollution
- Is less vulnerable to extreme weather & terrorism
- Substitutes human resources for fossil fuel,
- Is difficult to develop:
 - Needs many more skilled people than central generation
 - Ties up firm's debt capacity, or
 - Requires outsourcing decisions

Why is Central Generation Dominant? Mind-sets and Rule-sets

- Power System does not choose optimal approaches
 - Fails to recycle waste energy
- Industry focuses on core activities, wrongly assumes central generation is optimal way to produce power
- There is much low-hanging fruit for any factory willing to outsource energy to a specialist, recycling its waste energy

Industry Threats

• Multiple threats, train wrecks:

- Natural gas prices highest in world, making off shore industrial production cheaper
- Coal and gas price increases, emission cleanup costs, and new T&D will increase electric prices
- Carbon Dioxide reduction may (and should) be next, money already being spent

 If we do not control high energy costs, job loss will follow, leading to reduced standards of living for all citizens

Industry Opportunities

- Recycle all of present waste streams
- If base thermal load remains, install combined heat and power, preferably with coal, biomass, tire derived fuel
- Investigate joint heat and power production with neighboring facilities to balance load, achieve economies of scale
- Act now, with the urgency this crisis deserves

Primary Energy Commercial Message

- Primary Energy business model:
- Sell us your power plant, at book value, and give us your waste energy streams
 - Pay us 8% for our capital over 15 years and purchase all energy requirements, at today's costs, adjusted for inflation.
 - We drive out costs, maximize recycled energy, pass on half of the savings. This lowers site's energy costs.
 - No liabilities are added to your balance sheet, freeing your resources for core business expansion

Industry Choices

- Ostrich: Head in the sand, betting on LNG, utility commission generosity, and the tooth fairy
- Do It Yourself: Seek approval for study, hire consultants, seek approval for capital, obtain bids, sue non-performing contractors, possibly realize some energy savings in 3 to 6 years
- Outsource: Ask Primary Energy to design and build quickly, take significant risks, and be paid out of savings.

For Audience Members in Energy Policy or Business

- Join Primary Energy and other energy recycling firms to lobby government and industry to adopt modern rule-sets and mindsets
- Focus on recycling energy, build the skill sets to innovate and reduce US dependence on fossil fuel while reducing pollution, improving competitiveness

For Audience Members in Government

- Ask what government can do to start a recycled energy revolution
- Question the present rule-sets and the motivation of those who lobby to retain barriers to efficiency

 Refuse to accept trade-offs between affordable energy and clean energy.
 Force the energy industry to meet both goals

Regulated Utility Members in the Audience

- Consider the best way to use personal and organizational skills to improve the energy system.
- Challenge existing mind-sets and rulesets.

 Find ways to incorporate new thinking in ways that benefit all parties.

Recycled Energy Payoff

- Lead world in reducing CO2 emissions
- Improve competitiveness of US industry
- Dramatically improve balance of payments, substituting ingenuity and capital for foreign fuel
- Decrease grid vulnerability
- Increase standards of living
- Help America provide energy innovation to help the rest of the world
- Make the world a better place

Thank you for listening