Lecture 6: Distributed Generation

Energy Law and Policy

Fall 2013

October

- 10/7 Matt Brakey
- 10/9 RPS/SB 221
- 10/14 Columbus Day
- 10/16 SB 221/315/58
- **10/21 Distributed Generation**
- **10/23 CHP/Biomass/District Energy/CT**
- 10/28 Jeff Burns – Solar/Renewable Power
- 10/30 LeedCo Wind/Energy Storage

November

- 11/4 Oil and Gas Policy/Ken Alfred
- 11/6 Shale Revolution
- 11/11 Fuel Cells/Pat Valente
- 11/13 Transportation Policy/Jim Halloran
- 11/18 Alternative Fuels/Joe Degenfelder
- 11/20 Energy and Urban Policy
- **11/22 Research Papers Due!!**
- 11/25 Economic Development/Iryna Lendel
- 11/27 CSU Energy Plan

December

- 12/2 Student Presentations
- 12/4 Student Presentations
- Dec 9 Make up date
- Dec 14 Grades Due

Lectures

- Class presentations can be found on the Energy Policy Center website:

  http://urban.csuohio.edu/epc/research.html .

Advent of Distributed Generation

- Power generated close to end user
- Grid-connected
- Use of new, cleaner generating technologies
- Smart Grid

Drunk with Power: B. Plumer

- Problem: Developer wants to take waste gas from carbon black operations into a generator
  - 1/3 of power used in operations
  - 2/3 of power can be sold
- Power can be net metered: utility buys power back at its displaced generation cost.
  - Utility has incentive to keep that price low.
  - No value given for strategic location of DG
- Developer wants to sell to nearby industrial facility
  - Under Louisiana regulatory rules, he cannot do this.

Problem for Industrial Users

- Electricity generation is responsible for 40% of US GHG emissions.
- Large scale industrial users need to find ways to reduce GHS
- But power generation is "governed by a bewildering patchwork of regulations that depress innovation, thwart efficiency improvements, and hinder the adoption of cleaner forms of energy."

Status of Today's Utilities

- 3200 Electric Utilities are America's biggest industry – generating 75% of nation's power
- Historical monopoly status has created problems:
  - Utilities have clung to inefficient power generation strategies.
  - Grid has fallen into disrepair
  - Powerful lobbyists intent on maintaining status quo

Advent of DG

- Local distribution enables reduction of waste
  - Power losses in transmission.
  - Reduction in building new lines.
- Allows for more co-generation
  - Half of energy lost as heat in power generation
  - Could be used to heat facilities, homes, make more power
- Need smarter grid to direct flow of electrons

What is preventing this?

- Most utilities have no incentive to reduce sales of power.
  - Regulators have been slow to tie utility profits to reduced sales.
  - Try to accomplish efficiency through mandates, like building codes.
- Some states had “decoupled” profits from the amount of sales.
  - Pioneered in California – utility guaranteed return for reducing sales.

Revenue Decoupling

- **Align utility profit motives with energy efficiency investments** -- "revenue decoupling"
- SB 221 gives the PUCO the ability to establish rules for a "revenue decoupling mechanism" - a rate design or other cost recovery mechanism that provides the recovery of the fixed costs of service and a fair and reasonable rate of return, irrespective of throughput or volumetric sales.
  - Other than the energy efficiency mandate, little has been done to decouple revenue from volumetric sales.
    - And FE clearly sees no decoupling – they continue to oppose the mandate.

Other Barriers

- Ban on private wires/microgrids
- Stand by fees
- Abandonment/exit fees
- No valuation for environmental costs (externalities)
- Limited net metering
- Limited wholesale market for DG.

More Barriers

- Limited Help from Portfolio Standards.
  - Utilities usually looking for large scale renewable energy generation.
  - Portfolio Standards do not apply to CHP or Waste Heat Recovery systems.
- Complicated interconnect rules, charges by utilities for approving interconnections.

EPRI View

- 80% rise in utility rates by 2050 with centralized power production model.
- No one seriously challenging the current regulatory framework favoring centralized grid.
- What are options?
  - Advocacy for a regulatory framework overhaul
  - Legislators and regulators are captured by the industry they are regulating.

Distributed Generation and Public Policy

- Most Critical Energy Policy Decision of Our Times.
  - Decisions today will shape energy policy for next 50 years
  - Powerful lobbying forces present conflicting evidence.
- Addresses problems with transmission constraint.
  - Urban areas cannot add infrastructure.
- Addresses energy security issues.
- Taking sides:
  - Utilities favor centralized power
  - Clean power advocates favor DG
    - Solar, biomass, fuel cells, CHP, WHR – all DG
    - Wind can be either, but usually DG

DG and Jobs

- Local employment and revenue
  - Estimates of $1.40 local return for every $1.00 spent
  - Current system: 50-95% of every dollar spent on conventional electricity leaves the local economy
    - » Sovacool, Electricity Journal, 2010.
- Ohio trade deficit
  - $1.4 billion/yr on coal
  - Import fuel for coal, nuclear and oil generation
    - Natural gas currently imported, but will change.
  - Solar and wind use local fuel sources
    - Biomass mixed

Small Is Profitable

Amory Lovins

- Properly considering value of DG raises value of generation by as much as tenfold.
  - Improves system planning, utility construction and grid operation
  - Improves service quality
  - Avoids societal costs
- Actual value proposition is determined on a case by case analysis
  - Factors determining value are complex

Energy Industry Paradigm Shift

- 20th Century model: centralized generation.
  - Shift away from the early local thermal (steam-raising) power stations toward huge, remote electricity-only power generation.
  - Elaborate technical and social systems commanded the flow of electrons from central stations to dispersed end users.
- Made sense at the time –
  - Economies of scale reduced cost of generation
  - Power stations less reliable than the grid.

Advantages for Centralized Generation that Drove Change

- Cost of generation dropped
  - Economies of scale
- Reliability through redundancy
  - Grid enabled
- Combined diverse loads of customers
  - Created more flexibility in meeting customer loads
- Enabled shared cost of generating capacity
- Enabled urban subsidies for rural service

New Models for Generation

- 21st Century Model:
  - Electricity universally available
  - Centralized plants no longer cheaper
  - But new natural gas generation more reliable
  - Grid is expensive, old, and less reliable
    - Grid had become primary source of power failures
- Cheapest, most reliable power is that generated at or near the customer

Utility Resistance to Change

- Despite these changing circumstances, utilities continued to focus on economies of scale for installed costs of generation on a per kw basis.
- Overlooked diseconomies of scale in power stations, the grid and the system architecture
- Disadvantages are rooted in the disparity of the scale for demand and supply
  - ¾ of residential and commercial consumers use 1-12 kw, whereas power plants are multi-MW

Micro Grids

- Resources are better matched to the multi-kW scale of most end users
  - supplied through 10 MW type distribution substations, rather than 500 MW generation facilities.
- Micro Grids offer important but overlooked advantages to solving problems with grid constraint, reliability, infrastructure failure

Role of Finance

- The first to recognize the changing paradigm were the capital markets.
  - Big generation required huge investment of capital – difficult to raise
- Deregulation ended viability of new large scale generation
  - Too risky to invest so much capital without guaranteed rate of return
  - Big generation takes too much time, inflexible to changing demand and prices.

Combined Cycle Costs

- Cost overruns, inefficiency, financial risk, grid costs all lead to slowing new big generation.
- Restructured markets led to new market entrants –
  - cost differential between combined cycle natural gas and nuclear/coal plants was significant.
  - Micro-generation began to displace centralized generation.
    - Return to midsize – 10 MW range – plants of 1940s
    - Next: return to kW size plants of the 1920s.

Lovins Findings

- Distributed benefits flow from financial economics.
  - lower cost/risk of modular size
  - shorter lead times
  - portability
  - Low or no fuel cost
- DG brings electrical engineering benefits.
  - Lower grid costs, defers upgrades
  - Highest value in grid congested areas and where reliability and power quality are important

Other Drivers

- Capturing benefits require “astute business strategy and reformed public policy.”
  - Externalities are hard to quantify, but may be political drivers
- Security also an important consideration.
  - 9/11 made system security a major concern.
  - Large centralized systems are more vulnerable to terrorism attacks

Distributed Generation and Manufacturing

- Manufacturing is energy intensive business
  - Half of America's natural gas consumption
  - 30% of America's electricity consumption
- Energy Policy critical to manufacturing
  - Ohio has lost 117,000 manufacturing jobs in the last five years – 2^{nd} highest number in US
  - Energy intensive industries comprise major part of Ohio manufacturing landscape
    - Aluminum, steel, chemicals, glass, foundries

Drivers for DG in Manufacturing

- Rising electricity costs
  - Capacity charges
- New EPA standards for coal fired steam and electricity generation
  - boilerMACT rules
- Natural gas surplus
  - Modular combined cycle plants
  - Combined heat and power
  - Natural gas at ¼ the cost of Europe

BoilerMACT

- Manufacturers use large amounts of steam in their industrial processes – 100,000 lbs/hr
  - Use old coal fired boilers – low sulfur coal
  - Run continuously, inefficient
  - Compliance coal around $90/ton, or $3.60 mmbtu
- BoilerMACT rules came on line in April 2012
  - Convenient time to upgrade to more efficient gas boilers
  - With CHP, get free electricity as by product

Ohio Regulations to Promote DG

- SB 221 – allowed for self generation that is “hosted” rather than “owned” by the facility.
  - Allowed third party owned and operated generation on site
  - Avoids capital outlay, maintaining generation
- SB 221 allowed net metering for renewable power, SB 315 for waste heat recovery.
- SB 315 – provides waivers on DSE-2 rider
  - But value is diminished for those who shed load

What is CHP?

- CHP is the sequential or simultaneous generation of multiple forms of useful energy (usually mechanical and thermal) in a single, integrated system.
  - CHP systems consist of a number of individual components — prime mover (heat engine, boiler), generator (electricity), heat recovery, and electrical interconnection —configured into an integrated whole.
  - CHP technologies typically produce both electricity and steam from a single fuel at a facility.

Ohio Regulations that Discourage CHP

- No net metering for CHP.
  - Utilities do not have to pay value of excess power at the site generated – pay "displaced generation" value (below 138 kV)
  - Utilities have incentive to account for own generation as low as possible (e.g.$0.012/kw-hr).
  - Above 138 kV can access wholesale market
- Stand by fees are not constrained.
  - Subject to PUCO oversight, but little is done to constrain stand by fees.

Standby Rate Structure

- PURPA (and PUCO) requires utilities to provide standby power for self-generators.
- Rates for standby set by state regulatory agency.
- Utilities are entitled to recover their costs for having infrastructure and generation on "standby" in the event that power is needed for:
  - Self generation down time
  - Self generation insufficiency

Industry Contracts

- Full Requirements Contracts
  - Customer agrees that entire load is serviced by contract
  - Energy charge, capacity charge, ancillary charges
- Supplemental or “Partial Requirement” Contracts
  - Supply shortfall (supplemental power)
  - Supply back up power (scheduled and unscheduled)

Standby Tariff

- Consists of supplementary, back up, capacity, demand, interruptible, and similar charges
- Problem in uniformity of charges among EDUs
  - Not easy to disaggregate cost components
  - Made more confusing by inconsistent terms
- Biggest costs tend to be in the demand/capacity charge
  - Ratchet devices – setting price at highest priced power consumed in short intervals – most controversial

Standby Tariff Controversy

- Utility argument:
  - Tariff necessary to recover costs associated with providing peak delivery
  - Tariff prevents cross subsidization
  - Customers w DG have no obligation to generate
- DG proponent argument:
  - Only the last few hundred feet of wires are unique to self generator
  - Coincident peak times are rare
  - No cross subsidization – defers grid costs, reduces capacity charges

Response of Regulators

- To date, regulatory agencies have sided with the utilities, and allow standby fees.
- But: standby fees have a chilling effect on the adoption of DG.
  - CEI standby rates for 25 MW CHP plant:
    - $84,595/month
    - Assumes no actual power is delivered.
    - $1 mm/year additional costs renders most CHP projects noncommercial at today's power prices, without some sort of government subsidy.

EPA Estimates for Commercial Standby Rates

- EPA has determined that unless the customer can avoid at least 90% of its otherwise applicable rate costs, CHP will not be commercially viable.
- This number is rarely met.
  - Midwest Clean Energy Application Center study of Iowa CHP avoided cost percentages for several CHP projects:
    - Ranged from 74% to 81%

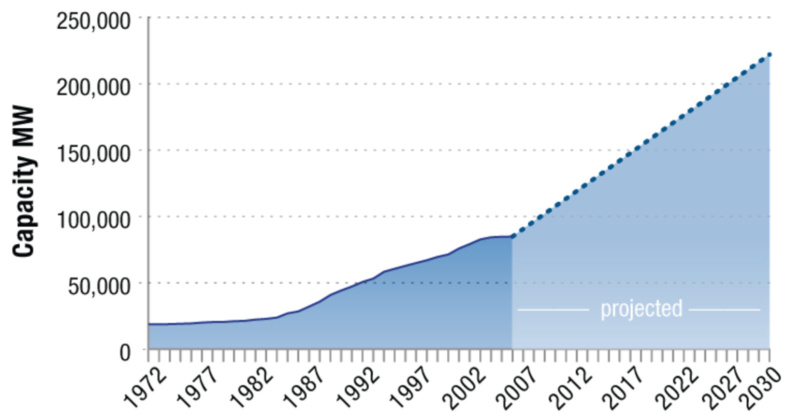
Strategies for Financing CHP

- Problem: manufacturing does not like to commit to 10-20 years
  – Can’t get natural gas prices for more than 5 yrs
  – Don’t know if they will be in business in 5 yrs
- Result: need to find creative ways to finance self generation
  – Heat generation is key – have to do it anyway
  – Find third party to own and operate facility
  – Identify subsidies – tax credits, rebates, low interest loans

CHP's National Potential

If 20 percent of US electricity generation capacity comes from CHP by 2030, then US will see:

- **Reduced annual energy consumption of 5,300 trillion Btu/year**
  - **CO_2 reduction of 848 MMT**
  - **189 million acres of forest or 154 million cars eliminated**
- **$234 Billion in Private Investments**
- **1 Million New jobs Created**



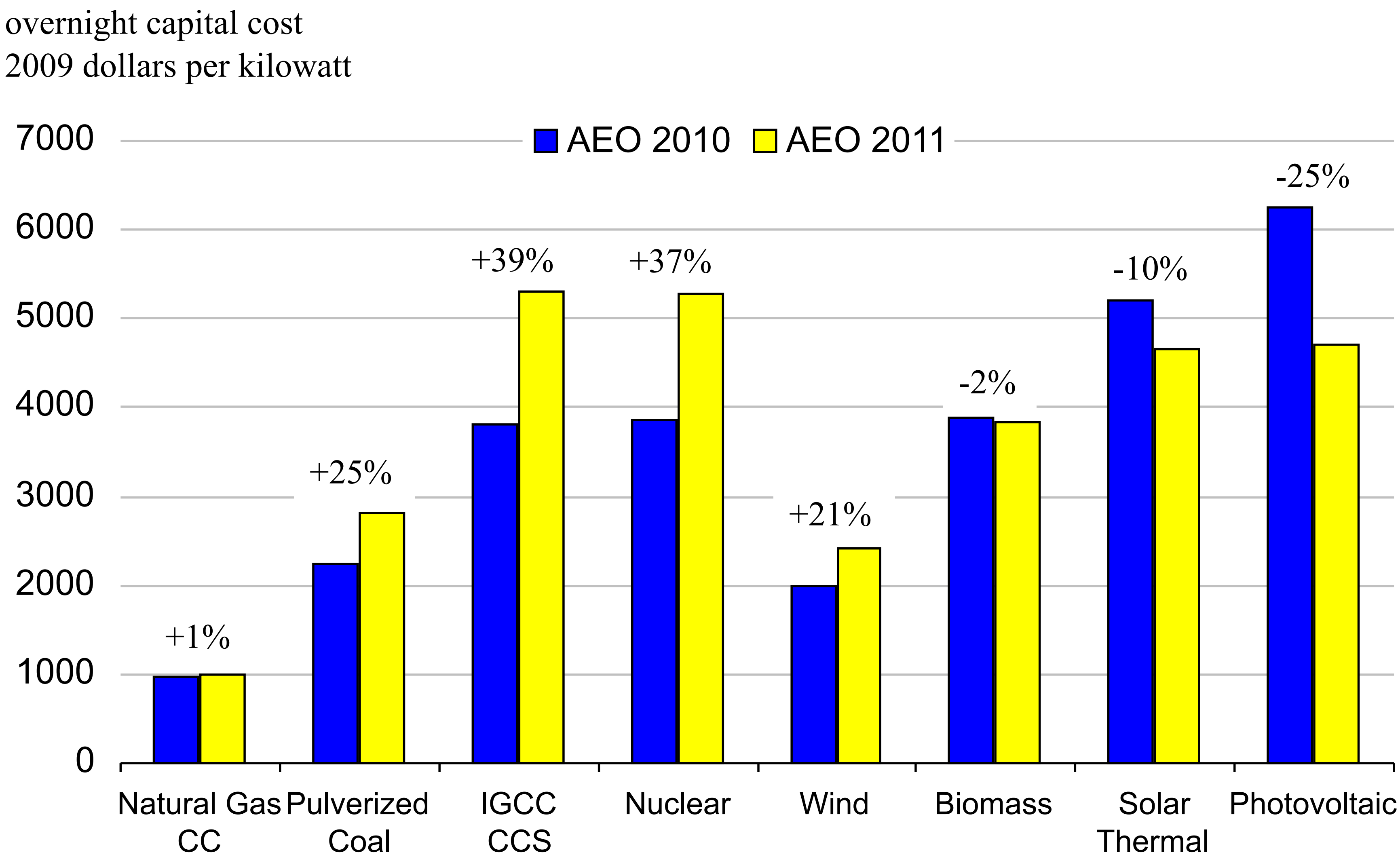
Labyrinth Management Group, Inc
Strategic Environmental, Safety & Health Solutions

Source: DOE Oct 2010

Other Impediments to Adoption of CHP

- Capital Costs for CHP are High
- Can Involve Critical Operations
- Government Financial Support is Limited
- No RECs
- Environmental Permitting Can Be Complicated

CHP Cost Comparison



Courtesy of Labyrinth

Source: EIA, *Annual Energy Outlook 2011*

Micro Grids

- DG is a single point of generation, micro grid consists of multiple points, together with distribution infrastructure
- Can be separated from the main grid during disturbance
- Commonly use DG with steam loads
- Offer advantages in power quality, reliability
- IEEE standards for micro grids in place, but…
  - *Currently not allowed for under Ohio law*

Self Generation Investment Programs

- Consist of utility buy downs of self generation on a per kW-installed cost basis
  - Ratepayer funded rebate intended to reduce price for adoption of DG technologies
  - Usually designed for peak load reduction
- No SGIP in Ohio
- California SGIP – around $1000-2000/kW installed cost subsidy for renewable power
  - Independent study – all technologies funded by SGIP has paid for itself except storage

Regional Planning

- Identifying DG opportunities by region
- Can help DG through:
  - Identifying “off the shelf” opportunities for CHP
  - Finding commercial buildings near industrial sites that could use electricity or heat
  - Identify institutional facilities with large enough power and heat loads to support CHP
  - Identify district heating opportunties

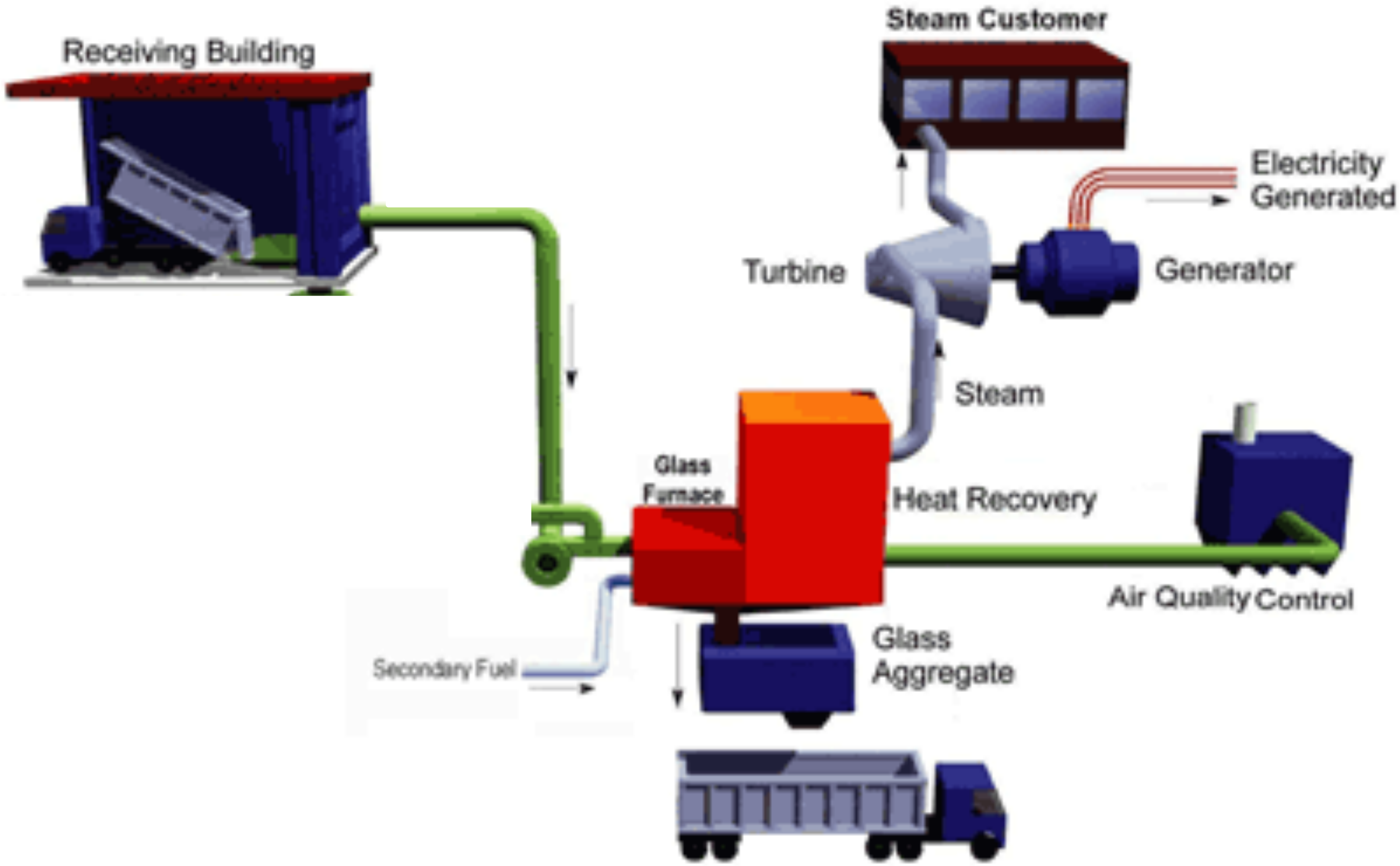
Gray Power – Lisa Margonelli
The Nation

- Midwest: Colossus of Carbon
  - Resistance to climate change legislation from left and right
  - Ohio gets 86% of power from coal; California 1%
- Climate is difficult for wind and solar.
- Green jobs are coming to Ohio – but not as fast as traditional jobs are leaving it.
  - Little appetite for making Ohio less competitive through carbon legislation.

Answer: Cogeneration

- Energy lost as heat from industrial and municipal sector in Midwest is enough for "69 nuclear power plants"
- Using waste heat would:
  - strengthen grid
  - save industry money
  - reduce carbon output.
  - Create local jobs
- Ohio is "Saudi Arabia of Co-gen"
  - Estimated 285 MW available

Example of Waste Heat Recovery Process – Glass Manufacturing



The Case for Gray Power

- Co-Gen cost is around $1500/kw installed cost
  - Nuclear -- $5000
  - Clean coal -- $3000
  - Policy Matters estimates 3 year payout
- Carbon free
- Can be brought on line quickly

Resistance to Gray Power

- Does not “feel” green – no public support.
- Utilities resist – DG is a threat to their basic asset – the grid.
- Clean Air Act – encourages old dirty power
- Tax system discourages new investment.
- Lack of uniformity in state and federal laws created legal complexity.

Solution

- Provide Combined Heat and Power with the same incentives as other green technologies
  - And same loan program nuclear power gets
- Speed up environmental permitting.
- Overcome barriers to DG
- Sensible tax laws
- Provide environmental incentives

CSU Energy Policy Center

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Thank you!