The Employment and Economic Development Benefits Of Combined Heat and Power Systems

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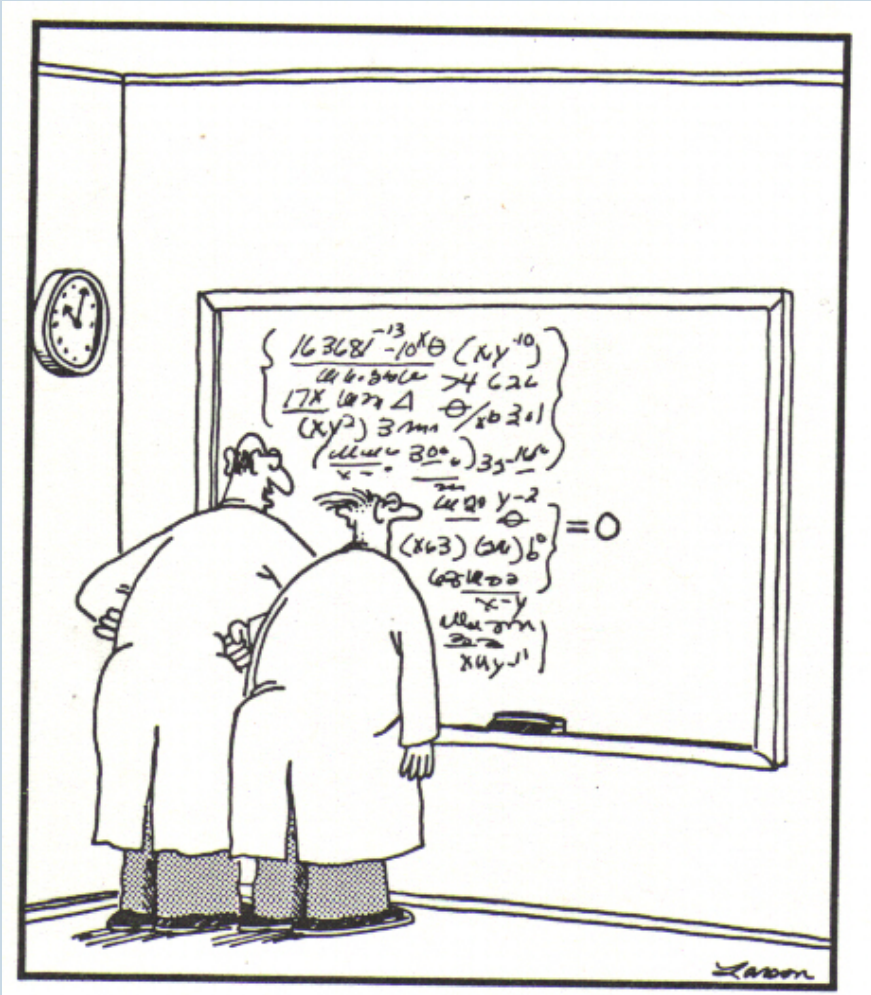
Perhaps the same belief about the lack of opportunity associated with a more efficient mix of generation technologies?



"No doubt about it, Ellington—we've mathematically expressed the purpose of the universe. God, how I love the thrill of scientific discovery!"

Some Perspective and Definitions

The Current Energy Perspective

- A fixed cost of doing business
- A crisis to be managed
- A resource to support economic growth
- A given set of technologies to be supported and maintained

An Economic Development Perspective

- The inefficient use of energy can act like a brake on the economy.
- All energy use has significant environmental impacts; and
- Encouraging a different mix of energy efficient and clean energy technologies can enhance economic benefits.

Defining Economic Development

The programs and policies designed to sustain economic activity — given *changes in population, expectations, technologies, and resource constraints.*

— S. Laitner, 1993

Just How Efficient is the Economy?

From start to finish — from the mining, processing and fabrication, to consumption and, finally, waste disposal — our use of natural resources is at best 15 to 20 percent efficient.

— Adapted from Claasen and Girifalco

It is not possible . . . .

To repeat too often that waste is not something which comes after the fact. Picking up and reclaiming the scrap left over after production is a public service. But planning so that there will be no scrap is a higher public service.

— Henry Ford, 1926

CHP systems are among the many resources that will allow us to eliminate unnecessary waste, and to do so at a profit. . . .

Elaborating on the CHP Potential

Electricity Generation in Context

- The current mix of U.S. electric generation resources provides ~3600 billion kilowatt-hours of electricity at about 7.0 cents/kWh. The annual electricity bill is ~$250 billion out of a total energy expenditure of ~$700 billion.
- Conventional central station power plants provide about 86 percent of total electricity use. The remainder is generated by a diverse combination of distributed generation (DG) technologies using both fossil fuels and renewable resources (wind, biomass, and hydropower resources).
- Combined heat and power (CHP) systems provide thermal, mechanical, and electrical power with system efficiencies of 70-90 percent. This compares to the 31 percent efficiency of our nation's overall electricity system.
- ***What we waste in the production of electricity is greater than Japan uses for all of its end-use energy needs, and greater than the total combined uses of the Central and South American economies.***

A Background Perspective

- A growing number of analysts believe that DG technologies, including CHP and renewable resources, could provide a substantially larger fraction of the nation's total energy needs at costs comparable to or less than conventional electricity resources — and lest there be any doubt, the list of analysts does includes me.
- Unfortunately, the economic discussions of national energy policies have usually been driven by modeling exercises from the Energy Information Administration (EIA) and the Energy Modeling Forum (EMF) — very often suggesting negative impacts as a result of any deviation from the reference case projections.
- Yet, there is an even stronger literature that offers a significantly different set of results (see Appendix for selected references).
- ***Recall that GDP impacts are a function of changes in investment, personal consumption, government spending, and net exports.***
- In the case of cost-effective clean energy technologies, one might reasonably conclude, therefore, that an accelerated investment path should generate a small but net positive benefit for the both the U.S. and individual state economies.

Perhaps the Jackal as a possible Role Model for family of CHP Systems?

"Yo! Everyone down there! This is the jackal! I'm tired of slinking around in the shadows!...I'm coming down to the kill!...Is that gonna be cool with everyone?...I don't want trouble!"

And So We Have a Real World Hypothesis That Might Be Tested and Explored. . . .

- A substantial technology investment that saves money and lowers natural gas prices should provide a significant boost to the nation's economy. But is this a possibility that energy models and policy makers might otherwise recognize as a positive impact?
- Exploring the possibility of expanding Combined Heat and Power (CHP) systems to perhaps 700 megawatts in different states, we might ask: How would the different economies be affected?
- We evaluated this hypothesis in two ways: (i) first using a standard engineering cost assessment as such technologies are expected to perform in (to pick a year) 2020; and (ii) then using a state-specific modeling tools adapted from the IMPLAN database. The states include IL, IA, MI and OH.

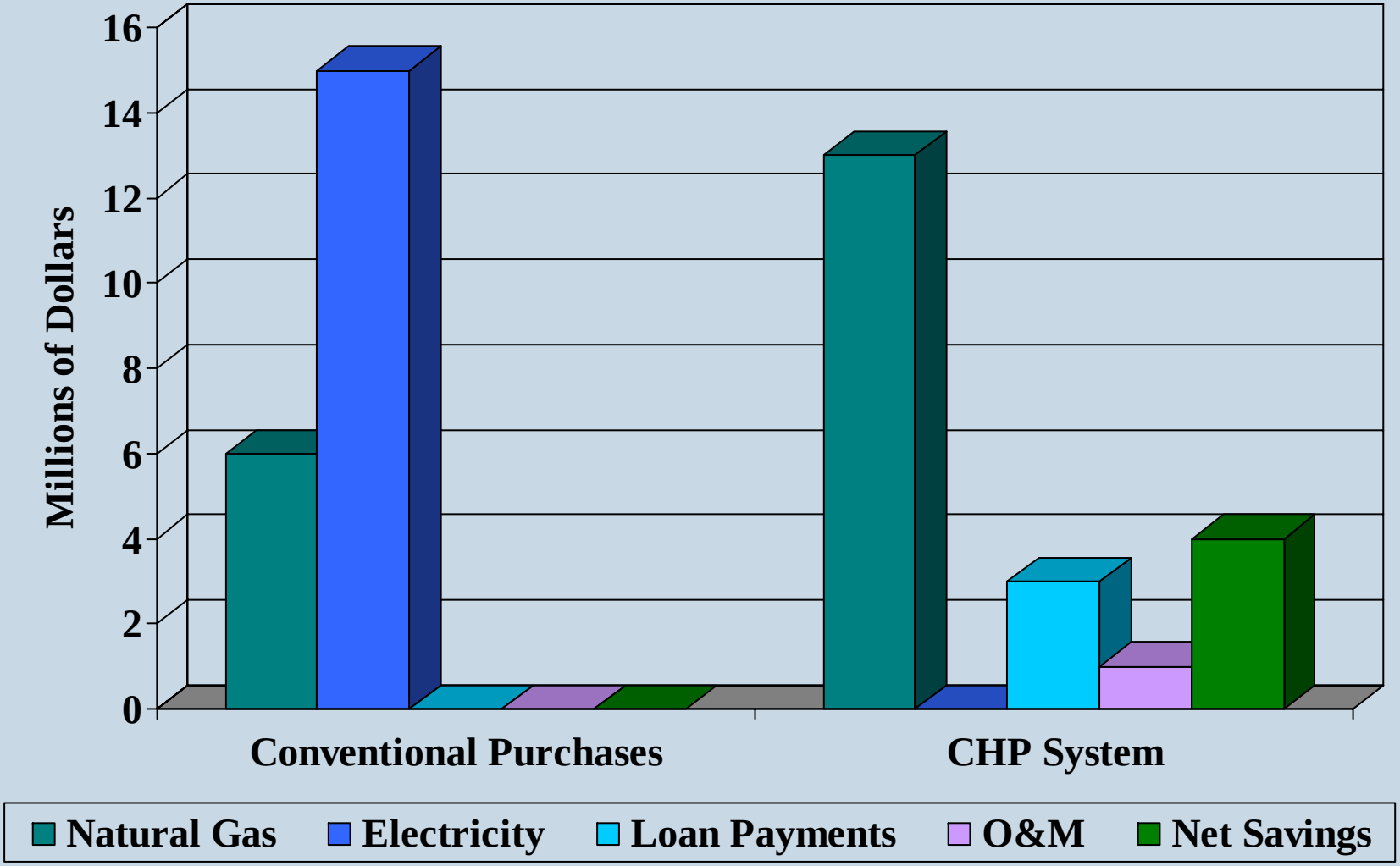
Steps in the Exercise

- Ideally, we would set up a three-step comparison for perhaps the beginning, middle, and end years of a diagnostic scenario exercise. For this review, however, we will examine only the last year of the analysis.
- ***Step one***: Set up a spending scenario to approximate a desired level of CHP in each of the four states; in this case, the addition of 700 megawatts in each state by the year 2020.
- ***Step two***: Match changes in spending with appropriate sector multipliers — in this case, state-specific value-added and employment multipliers provided by the IMPLAN modeling system.
- ***Step three***: Compare and evaluate the results from both the diagnostic exercise discussed here with those from other modeling exercises.

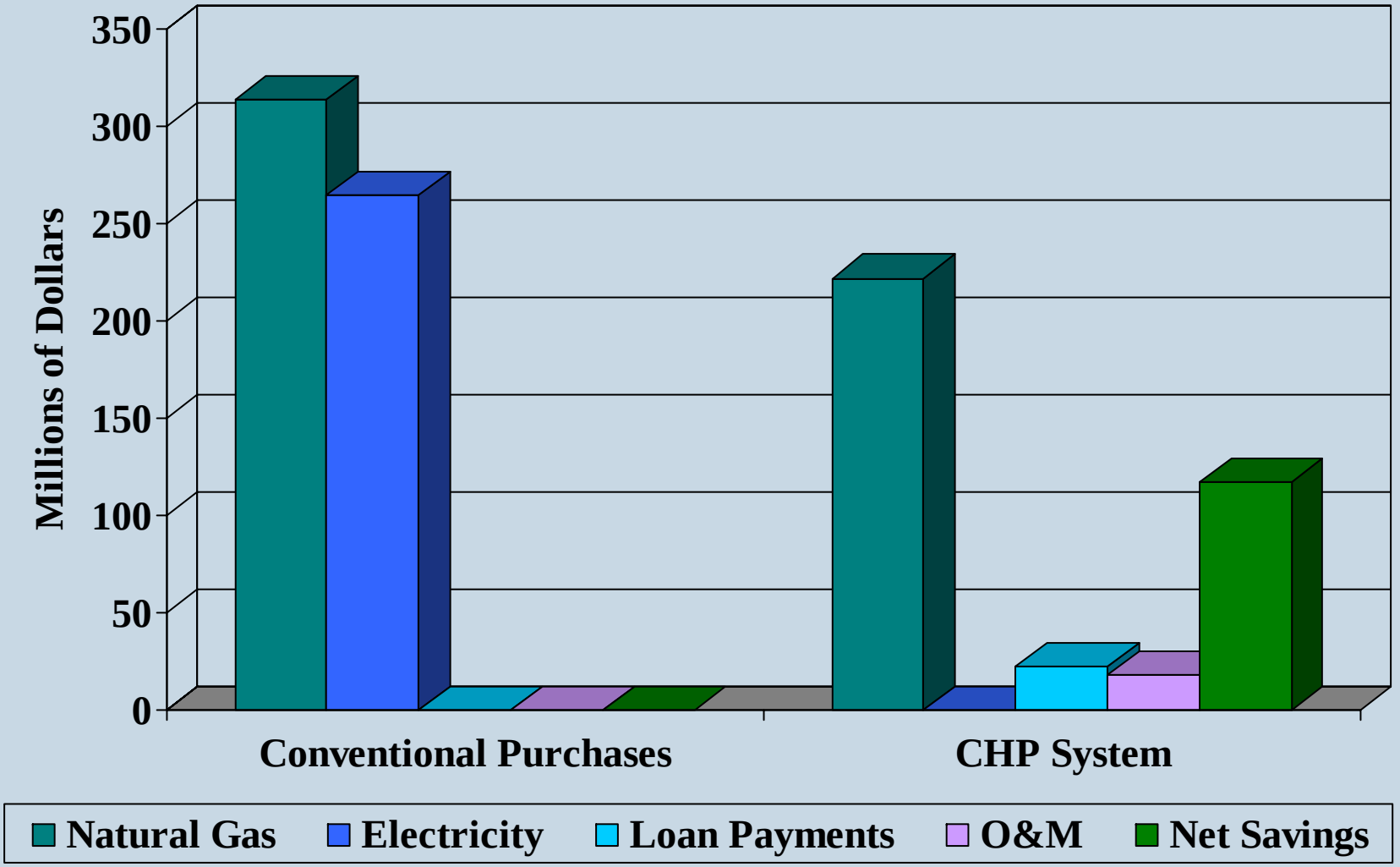
Details of the CHP Thought Experiment from a Manufacturing Perspective

- Based on real world estimates, let's assume a manufacturer now uses a both natural gas for steam as well as separate electricity purchases, with total energy costs of $21 million.
- If the business, instead, installs a 40-megawatt CHP system that lowers NO_x and carbon emissions, it might incur a $28 million capital cost, along with the following annual costs:
  - Financial costs or loan repayments of $3.0 million,
  - Natural gas expenses of $12.7 million,
  - Other O&M costs of $1.1 million, with a
  - Net total annual savings of $4.2 million per year.
- Hence, total energy expenditures are down $8.3 million.
- However, investments, loan and interest payments, and net savings are all up by an amount that would tend to increase contributions to a given state's economy.

A 40 Megawatt Thought Experiment: Plant Level Costs from Buying Conventional Energy Services Compared to Investing in a CHP System



A Second Thought Experiment: 10 Percent Overall Efficiency Gains Plus 700 MW of New CHP from the Perspective of a State's Economy



Further Details of the 700 Megawatt Economywide CHP Thought Experiment

- By 2020 efficiency gains and CHP market penetration might reduce wellhead gas prices by about 6 percent (or more) for all customers (whether they participate in CHP and efficiency investment activities or not).
- CHP and efficiency gains displace new conventional power plants so that, from an economy's larger perspective, the net construction and loan payments are smaller than for those of an individual manufacturing plant.
- Some key changes in energy-related expenditures include:
  - Electricity savings of ~$265 million, depending on retail prices;
  - Reduced natural gas expenses of $92 million, again depending on retail prices; and
  - Lower wellhead prices saving all consumers ~$100 to $400 million, depending on size of the state and its current level of consumption.
- These new investments, loan payments, and net energy bill savings are likely to increase the returns of a state's economy.

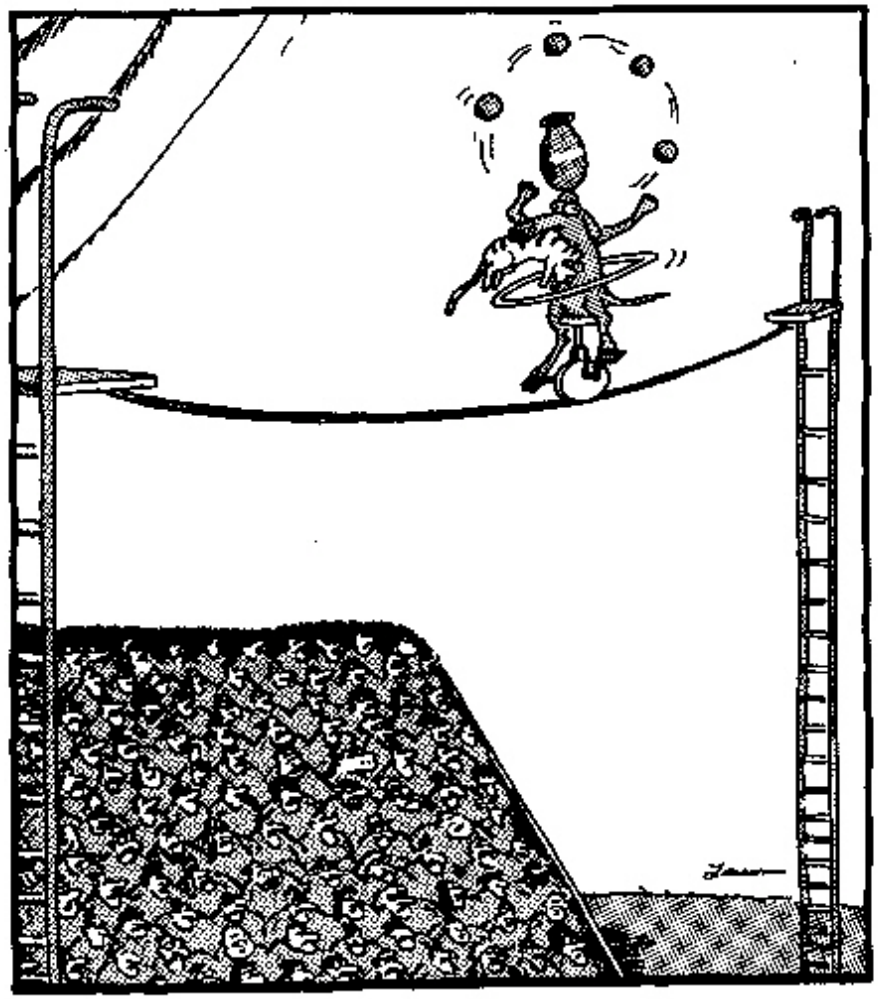
State Impacts from the Addition of 700 MW of New CHP Systems by 2020

States	Net GSP ($MM)	Net Jobs (Actual)
Illinois	155	3,186
Iowa	55	1,175
Michigan	136	3,791
Ohio	135	3,642

While individual states vary in their energy prices and economic structures, it seems clear that CHP systems allow the productive substitution of smart capital for the inefficient use of energy — to the benefit of the economy and the environment.

Conclusions

- The current thought experiment should be seen more as modeling for insights rather than for generating specific numbers and recommendations; yet
- Contrary to the findings of some modeling exercises, the deployment of existing clean energy technologies appears to provide a small but significant boost to the nation's economy.
- This small but positive impact is the result of small but productive investments in more efficient technology, and a reduction in the demand for natural gas.
- In short, if we do it smart, both the economy and environmental quality will benefit. On the other hand, if we do it stupid. . . .



High above the hushed crowd, Rex tried to remain focused. Still, he couldn't shake one nagging thought: He was an old dog and this was a new trick.

The difficulty lies not with the new ideas, but in escaping the old ones

John Maynard Keynes

Appendix: Selected Bibliography of Studies with Positive Economic Outcomes from Clean Energy Scenarios

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- PIRGIM Education Fund, 2005. *Redirecting Michigan's Energy: The Economic and Consumer Benefits of Clean Energy Policies,* Ann Arbor, MI, February (with similar studies done for Iowa, Ohio, Illinois, and Florida)

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