Five Aces and a Winking Dealer

The Costs of and Reasons for the U.S.'s Failure to Invest in Energy Efficiency

Sean Casten
Turbosteam Corporation

ABSTRACT

The energy and environmental policy of the United States has long been guided by an ideological belief that economic growth is only possible via environmental degradation, and environmental protections are therefore possible only at the expense of the economy. This belief structure implicitly assumes that energy efficiency—wherein the combustion of less fuel leads to lower cost energy and reduced emissions—does not exist. While much has been written about the regulatory barriers to interconnection and non-utility power generation, these barriers are simply subsets of a much larger problem: a regulatory structure that actively discourages investments in energy efficiency, particularly in the electric-generation sector. This structure is directly responsible not only for over-pollution throughout the U.S. economy, but also for unnecessarily high retail electricity prices. However, on a more constructive note, this failure implies that many of the most intractable environmental questions—which invariably take the form of "how much can we afford to pay for pollution abatement?"—are essentially non-issues. From NO_x to CO_2, an investment in previously discouraged energy efficiency will invert all conventional wisdom to become that most desired of creatures: a revenue-generating pollution control strategy. We've paid for bad legislation long enough—the time is now to fix these rules and begin recognizing the economic and environmental benefits of energy efficiency.

INTRODUCTION

Over the past decade, a half century of mismanagement in the United States electricity sector has unleashed a chain of events that are

the tip of an increasingly unstable iceberg. These events include:

- Electricity blackouts in California, New England, New York and Chicago—the latter of which led to more heat-induced deaths than the Northridge earthquake, the Oklahoma City bombing, and the crash of TWA flight 800 *combined*.
- The near-bankruptcy of the state of California and its major electric utilities in the wake of a state-wide power crisis.
- Overburdened transformers on fire in Manhattan.
- The economic collapse of the merchant power industry.
- Growing NIMBY (not in my backyard) fights over electric generator and transmission/distribution line siting.
- The U.S.'s refusal to address the threat of global warming out of fear of economic disruption.

These are not isolated events which we will quickly outgrow—they are manifestations of a much larger problem, which will have catastrophic impacts on our economy, environment, and national security if left unchecked. This larger problem is our national electricity policy—and specifically, its over-reliance on an increasingly inappropriate central power paradigm. The good news is that there is a painless solution that will bring about both social benefits and economic growth: **embrace energy efficiency in the electricity sector**.

Unfortunately, current state and federal energy and environmental policies almost universally fail to reward efficiency. In many cases, existing regulations actually provide disincentives for efficiency, suggesting that regulators are either ignorant of the problem or (more frighteningly) beholden to a small group of corporate interests whose profits are earned at the expense of the broader economy.

The Route to Failure

In 1880, Thomas Edison built the world's first power plant. Like any industrialist, Edison set out to maximize his plant's productivity, producing as much as he possibly could per unit of raw input. Aiming for maximum efficiency, Edison used the best technology available at the time. This electric generator had a paltry efficiency (by today's standards) of just 6 percent, purchasing 100 units of fuel for every 6 it sold as electricity. With the plant sited in downtown Manhattan though, Edison was able to recover the waste heat from this generator and sell

it to a neighboring industrial, gaining revenue from an additional 44 units of heat. On an overall basis, his plant was 50 percent efficient. In essence, he built a heat plant that happened to generate some electric power.

Over the next 35 years, we got better at converting fuel into electricity, and also got better at recovering heat, such that by the early 1910s, our electricity industry was nearly 65 percent efficient. **This was the highest efficiency that the electricity industry ever achieved, and it has gotten steadily worse ever since**. From 1910 to 1955, policies set in place[1] established the "central power paradigm," which granted monopoly privileges to utilities who agreed to build large central plants many miles away from urban centers, connected by an electric grid. The great success of this paradigm is that it allowed utilities to borrow heavily at low interest rates, since their customers were declared legally captive. Simultaneously, individual customers reduced their dependence on any individual generator. Unfortunately, in the course of moving plants out of town and away from local thermal loads, it also led the utilities to stop recovering their waste heat. (Instead, the modern elec-

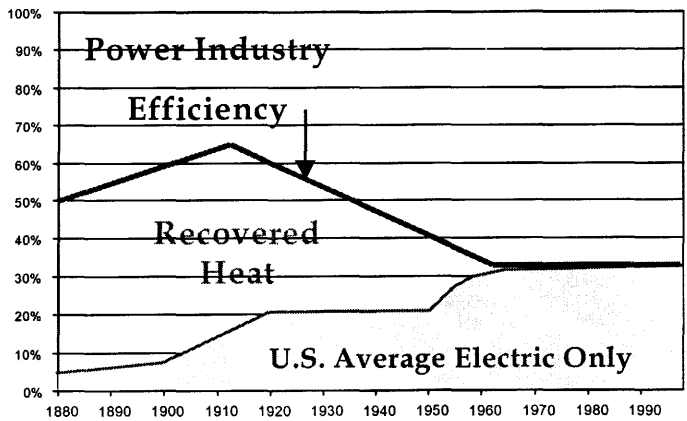


Figure 1. The Efficiency Embarrassment of the U.S. Electricity Industry

[1]Most notably, the monopoly protection of electric utilities, complete ban on competitive sources of electricity at the consumer level and regulated cost-plus pricing models that reward utilities for increasing their capital and operating costs (and thus penalize utilities who invest in efficiency).

tricity industry dumps its waste heat into the environment, either into local rivers or into the air through cooling towers.) Industries and institutions made up for this by installing boilers and furnaces on their own facilities to locally generate the same heat that the power sector chooses to throw away. By 1959, the electricity industry was 33 percent efficient, and it has not improved since.

As is clear from the figure above, the electricity industry has not only failed to improve its efficiency since 1959, but it is now less efficient than it was in 1880. There is no other industry in the country with such a dismal record of productivity growth. Let's put this in perspective: during the same period, the petroleum industry went from throwing away everything but the heavy fraction of crude oil that could compete directly with whale oil to an industry with virtually no waste of their primary raw material—a single barrel of crude oil now makes kerosene, gasoline, diesel, heavy fuel oils, carbon black, and organic chemicals. The paper industry first drove up the yield on each log, and then steadily increased the recycled content of its products, to the point that it is only the large integrated paper mills that continue to purchase raw wood chips—the rest often operate with 100 percent recycled material as a feedstock. And yet the power industry has found ways to waste a little more fuel every year.

The conventional counter to this argument is that electricity is more valuable than heat on an economic and energetic (or in thermodynamics-jargon, "exergetic") basis, and that we should therefore take pride in the electricity industry's transition to all-electric service. But let's look at this another way. Thomas Edison did the best he could with the technology available. With combined cycle gas turbines capable of 55 percent efficiency, backpressure steam turbine-generators capable of over 80 percent efficiency, and cogeneration still possible from all generator types, the existing industry is not even doing half as well as they could with the technologies available to them. But let's not waste our energy condemning utility managers for such dismal performance. The true culprits are the regulators who designed a "market" which guarantees utility expense recovery—**but does so by putting 100 percent of the responsibility for expense recovery on the captive consumer**. Capital cost overruns on your nuclear plant? No problem, we'll increase the rate base. Steadily falling productivity? No problem, we'll raise electric rates to compensate. Facing bankruptcy in California? No problem, we'll bail you out at the taxpayers' expense. In all cases, we will rely on the U.S.

consumer to pony up any funds necessary to ensure that our friends in the regulated utility sector don't have to. In essence, the utilities are sitting at a poker table, looking at five aces and a winking dealer—we might lament their failure to reject this largesse, but if we want to fix the problem, we need to start with the dealer.

If we conservatively assume that the electricity industry could double its current efficiency (in other words, bring the whole industry up to the efficiency of a current combined cycle plant, and make no significant effort to recover heat), we can calculate that our failure to embrace efficiency is directly responsible for increasing American's energy bills by over $100 billion/year and increasing CO_2 emissions by over 1 billion tons/year. And all of the extra CO_2 we emit increases the earth's temperature, with consequences that we are only just beginning to understand.

There are those who argue that we can't afford to reduce CO_2 emissions, out of the mistaken belief that reducing CO_2 requires that we sacrifice our quality of life. But here's the problem with that logic: energy efficiency puts $100 back in your pocket for every ton of CO_2 reduced. The truth is, **we can't afford not to embrace efficiency**.

Four Options for Energy Policy

So why don't we? To understand, let's first consider the ways in which energy and environmental policies are developed, at a 20,000-foot

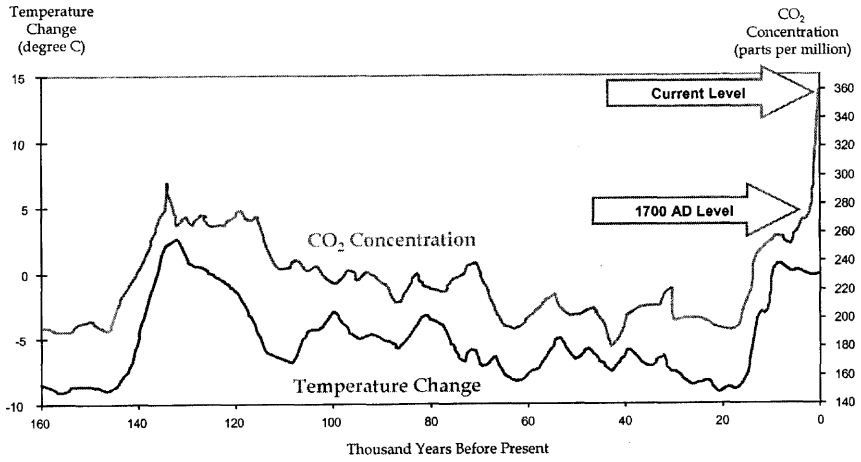


Figure 2. CO_2 Concentration and Global Temperature Change

perspective. Those who are responsible for our nation's energy policy must balance a broad array of economic and social agendas, striking a careful balance between the costs and benefits accruing to each. Stripped to its most basic level, every actual or considered energy policy can thus be placed in one of the four boxes in the following matrix.

Policies leading to lose/lose impacts are clearly to be avoided and those with win/win impacts are obviously to be embraced. The really hard decisions are between prospective policies that lie between lose/win and win/lose. Do we ban development to protect an endangered bird? Do we accept pollution as the price of economic activity? Costs and benefits between these two extremes are not easily compared, measured, or verified, and decisions along this axis are never easy. However, recognize two simple truths:

1. The best possible policies would start with the most politically expedient actions, supporting the win/win and prohibiting the lose/lose before going on to make the hard decisions.

2. Any action that leads to a more energy efficient electricity sector is a "win/win." Consumers save money, less fuel is imported, emissions fall, and where energy efficiency includes decentralized generation, the reliability of the electric grid is enhanced.

Sadly, we do not follow this seemingly obvious approach. In actual practice, this simple algorithm is exactly inverted. Here's what we actually do:

1. First, we expend a tremendous amount of effort balancing the lose/win and win/lose decisions—thus, we start by creating an

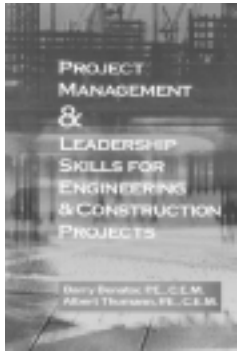
Economic Benefits (Revenues)	**LOSE/WIN**	**WIN/WIN**
Economic Damage (Costs)	**LOSE/LOSE**	**WIN/LOSE**
	Social Damage	**Social Benefit**

Figure 3. Energy Policy-Makers' Decision Matrix

Gain the tools you need to masterfully manage all types of engineering and construction projects...

PROJECT MANAGEMENT & LEADERSHIP SKILLS FOR ENGINEERING & CONSTRUCTION PROJECTS

NEW



By Barry Benator, P.E., C.E.M., and Albert Thumann, P.E., C.E.M.

Project management is the key to any engineering and construction project's success. Now you can learn from the experts real-world tested strategies you can use to lead your projects to on-time, within budget, high quality success stories. Specifics of scheduling, cost estimating and leadership skills are fully detailed. The authors will show you how to organize your project from the very beginning to achieve success. You'll also learn to use win-win negotiation skills during each stage of your project. Real world examples will facilitate your understanding of how to apply every aspect of the material presented in the text. Loaded with forms, checklists and case studies, this invaluable reference is a must for everyone involved with engineering and construction projects.

ISBN: 0-88173-429-2

ORDER CODE: 0514

6 x 9, 226 pp., Illus.
Hardcover, $98.00

CONTENTS

BOOK ORDER FORM

① Complete quantity and amount due for each book you wish to order:

Quantity	Book Title	Order Code	Price	Amount Due
	Project Management & Leadership Skills for Engineering & Construction Projects	**0514**	**$98.00**	

② Indicate shipping address: **CODE: Journal 2003**

Applicable Discount	
Georgia Residents add 6% Sales Tax	
Shipping Fees	9.00
TOTAL	

NAME (Please print) BUSINESS PHONE

SIGNATURE (Required to process order)

COMPANY

STREET ADDRESS ONLY (No P.O. Box)

CITY, STATE, ZIP

MEMBER DISCOUNTS
A 15% discount is allowed to AEE members.
☐ AEE Member (Member No._____)

③ Select method of payment:
☐ **CHECK ENCLOSED**
☐ **CHARGE TO MY CREDIT CARD**
☐ *VISA* ☐ *MASTERCARD* ☐ *AMERICAN EXPRESS*

Make check payable in U.S. funds to:
AEE ENERGY BOOKS

CARD NO.

Expiration date *Signature*

√ Send your order to:
AEE BOOKS
P.O. Box 1026
Lilburn, GA 30048

INTERNET ORDERING
www.aeecenter.org

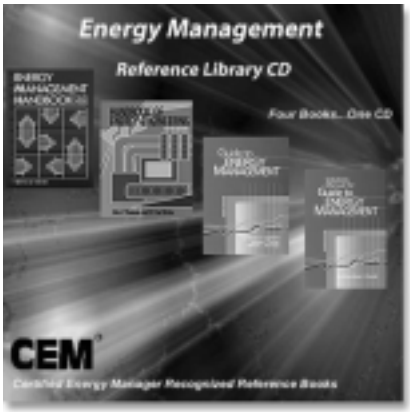
TO ORDER BY PHONE
Use your credit card and call :
(770) 925-9558

TO ORDER BY FAX
Complete and Fax to:
(770) 381-9865

INTERNATIONAL ORDERS
Must be prepaid in U.S. dollars and must include an additional charge of $10.00 per book plus 15% for shipping and handling by surface mail.

NOW AVAILABLE – FOUR COMPLETE BOOKS ON ONE CD-ROM…

THE ENERGY MANAGEMENT REFERENCE LIBRARY CD



Including over 1900 pages of text, graphics, charts and illustrations, the *Energy Management Reference Library CD* provides an economical training, research and reference resource for today's energy professional. Indexed with bookmarks for convenient navigation, the CD-ROM contains the following four complete books in Adobe PDF® format:

CD ORDER CODE: 0512
PRICE: $395.00

ENERGY MANAGEMENT HANDBOOK, 4TH Edition
By Wayne C. Turner.
This comprehensive 761-page handbook has become recognized as the definitive stand-alone energy manager's desk reference, used by thousands of energy management professionals throughout industry.
Printed hardcover also available, price: $150.00

GUIDE TO ENERGY MANAGEMENT, 4TH Edition
By Barney Capehart, Wayne Turner & William Kennedy.
This best selling book provides a manager's guide to the most important areas of energy cost cutting. Written by three of the most respected energy professionals in the industry, it examines the fundamental objectives of energy management, and illustrates tools and techniques proven effective for achieving results.
Printed hardcover also available, price: $125.00

SOLUTIONS MANUAL FOR GUIDE TO ENERGY MANAGEMENT, 4TH Edition
By Klaus-Dieter E. Pawlik
This practical study guide serves as a valuable companion text, providing worked out solutions to all of the problems presented in Guide to Energy Management Fourth Edition.
Printed hardcover also available, price: $75.00

HANDBOOK OF ENERGY ENGINEERING, 5TH Edition
By Albert Thumann and D. Paul Mehta.
This reference will guide you step by st ep in applying the principles of energy engineering and management to the design of electrical, HVAC, utility, process and building systems for both new design and retrofit projects.
Printed hardcover also available, price: $92.00

NOTE: The *Energy Management Reference Library CD* uses Adobe® Portable Document Format (PDF) software. To access the CD, you must have a CD-ROM Drive, and have Adobe Acrobat® Reader installed on your computer. This software may be downloaded free from www.adobe.com.

ORDER FORM

① Complete quantity and amount due for each CD you wish to order:

Quantity	Book Title	Order Code	Price	Amount Due
	The Energy Management Reference Library CD	**0512**	**$395.00**	

② Indicate shipping address: **CODE: Journal 2003**

Applicable Discount	
Georgia Residents add 6% Sales Tax	
Shipping Fees	9.00
TOTAL	

NAME (Please print) BUSINESS PHONE

SIGNATURE (Required to process order)

COMPANY

STREET ADDRESS ONLY (No P.O. Box)

CITY, STATE, ZIP

MEMBER DISCOUNTS
A 15% discount is allowed to AEE members.
☐ AEE Member (Member No._____)

③ Select method of payment:
☐ **CHECK ENCLOSED**
☐ **CHARGE TO MY CREDIT CARD**
☐ *VISA* ☐ *MASTERCARD* ☐ *AMERICAN EXPRESS*

Make check payable in U.S. funds to: **AEE ENERGY BOOKS**

CARD NO.

Expiration date *Signature*

√ Send your order to:
AEE BOOKS
P.O. Box 1026
Lilburn, GA 30048

INTERNET ORDERING
www.aeecenter.org

TO ORDER BY PHONE
Use your credit card and call :
(770) 925-9558

TO ORDER BY FAX
Complete and Fax to:
(770) 381-9865

INTERNATIONAL ORDERS
Must be prepaid in U.S. dollars and must include an additional charge of $10.00 per book plus 15% for shipping and handling by surface mail.

adversarial relationship between environmentalists and economists.

2. Second, we actually encourage the lose/lose, simply by virtue of the fact that the need for sacrifice is the only point of agreement between the two opposed viewpoints in (1).

3. With these done, we essentially ignore the win/win, assuming that it either doesn't exist or else has already been done.

Of course, the win/win does exist—it just doesn't get done, as evidenced by the efficiency embarrassment shown earlier. With the utilities sheltered from competition, they have no incentive to invest in efficiency. Meanwhile, the rest of the business community is forced to expend capital dollars on win/lose investments—and even the most socially minded of the business community have limited capital budgets. How many investments in energy efficiency were put off after capital dollars were dedicated to mandated pollution control devices—or to other core capital investments? Experience tells us that this happens more than we care to admit.

To see the evidence of this inverted policy logic, let's take a closer look at the actual policies that shape the energy—and specifically, the electricity—industry.

Most Policies Ignore the Win/Win

The overwhelming majority of existing energy legislation does not attempt to achieve the win/win, and is often driven by an ideological belief that win/lose is superior to lose/win (or vice versa). By definition, these policies are not universally bad—they all deliver either social or economic gain. However, they are all predicated on an erroneous assumption that social benefits and economic gain are inherently opposed to one another. A limited selection follows:

Category 1: Support the economy at the expense of society

- The Clean Air Act allowed old coal plants to continue polluting even when new, cleaner plants were being prohibited so as to minimize the economic disruption of the CAA. These enable the old and inefficient coal plants to remain profitable, but do so by actively discouraging the construction of cleaner (and ironically, more cost-efficient) alternatives.

- Desperate for more oil to feed our inefficient system, the supporters of drilling in the Arctic National Wildlife Refuge are essentially arguing that the economic gains of such drilling more than offset the resulting environmental disruption.

- As former CIA Director James Woolsey has pointed out, the subsidization of the oil industry maintains artificially low gasoline prices at the expense of environmental and political disruption.

Category 2: Benefit society at the expense of the economy

- At a broad level, this was the driving intent of the Clean Air Act. The mandated installation of end-of-pipe SO_x and NO_x controls on combustion sources increased the capital and operating costs of these devices so as to reduce emissions of criteria pollutants.[2]

- EPA-mandated emission standards set allowable pollution levels based on pollution per unit of fuel input, rather than per unit of electricity output. As a result, if a plant chooses to double their efficiency (so as to reduce their cost of generated electricity), the EPA will cut their allowable emissions in half as well. In other words, power plants are encouraged to reduce their emissions—but only if they can find a suitably expensive means of doing so.

- Subsidies for cost-ineffective but "green" power generation technologies mistakenly assume that the only way to reduce pollution from heat and power generation is to advance technology. However, when one realizes that *current regulations penalize generators for making the most of technologies that are already cost-effective*, it becomes clear that—absent regulatory overhaul—these subsidies are using tax-dollars to fund the wrong solution to the wrong problem.

- Any support for CO_2 sequestration is implicitly a win/lose, since these sequestration projects are by definition non-revenue generating. (The only possible exception is in the case of CO_2-injection for enhanced resource recovery, but inasmuch as this accelerates the consumption of fossil fuels, its social benefits are lessened.)

---

[2]Interestingly, automotive emissions regulations do not fall into this category, as they are regulated on a g/mile basis, thus allowing manufacturers to achieve emissions limits either with end-of-pipe controls (win/lose) or with enhanced fuel economy (win/win).

If these policies were the only impacts of our failure to embrace the win/win, we might argue simply that they reflect necessary compromises. Unfortunately, these short-sighted policies have much more severe effects: all of these policies have been created in an adversarial environment, between champions of social benefits and champions of economic benefits. These two political factions are thus led to a single point of agreement—the need for sacrifice. As such we find ourselves with a host of "compromise" policies that actually mandate the lose/lose.

Category 3: Penalize society at the expense of the economy

- An unintended, but real consequence of the Clean Air Act was to reduce the efficiency of every power plant that was forced to install exhaust after-treatment. By mandating costs that reduce power plant efficiency, every CAA-compliant smokestack is paying more in capital and operating costs so that they can emit more CO_2.

- Cost-plus rate-setting in the utility industry allows electric utilities to pass all of their costs along to their customers—often at a premium, so as to maintain "fair" profit margins. This sends an abundantly clear message to the utilities: fight any effort to reduce your capital costs, and burn as much fuel as you can.

- At present, it is a felony offense for any non-utility to build an electricity transmission wire. Since the greatest opportunities for combined heat-and-power are de facto on non-utility sites (remember that the utility sites are intentionally located many miles from potential heat customers), this law directly leads to the undersizing of local CHP facilities, which are designed not to maximize their social or economic benefit, but rather to eliminate any opportunity to export power—even though that power is more efficient than that available on the grid. In other words, the ban on private wires forces users to increase their cost of electricity and increase emissions.

- In some states, the restructuring of the electricity industry has included an outright ban on distribution companies owning power generation assets. Since the cost of new transmission and distribution often exceeds the cost of new end-user sited CHP per installed

kilowatt, this means that distribution companies are forced not only to purchase (and re-sell) high-price, high-emissions electricity, but are also forced to install expensive capital to deliver it to their customers.

- The requirements of thermal load matching mean that CHP is always best sited at the end-user—and often "behind the fence," serving not to export power to the grid but rather to displace more expensive electricity that would otherwise be purchased from their utility. Every law that protects the monopoly rights of the utility thus encourages those utilities to take actions to prevent their customers from installing low-emissions, low-cost electricity generation.[3]

A Few Success Stories

While the exception to the rule, there are a few policies that actively encourage the win/win, which deserve recognition. Two are discussed below:

EPA MACT ruling on gas flares

In 2001, the Environmental Protection Administration passed a regulation stipulating that the maximum available control technology (MACT) for cleaning up tail gas from carbon black plants is to combust these gases in a controlled environment and then recover the resulting energy as heat *and/or* power. In essence, this law goes one step beyond the vast majority of environmental regulations to require industrials not simply to control their emissions, but to save money on their electricity bills as well—a true win/win.

Maine Law 35-A §3210

Under this state law, utilities selling power in Maine must provide 30 percent of their electricity from "eligible resources," which include both renewable resources and "efficient resources," the latter of which is defined to categorically include combined heat and power. In essence,

---

[3]These actions may take the form of technical objections (e.g., expensive interconnect studies), predatory pricing (e.g., changing rates and/or rate structures in response to a potential competitor), or regulatory objections (e.g., convincing a local PUC to add provisions for expensive standby service well in excess of their actual costs). All would be deemed restraints of trade in an unregulated industry.

this law (like the EPA MACT ruling) goes one step beyond conventional green-power regulations to give power providers the freedom to choose the most economical source of low-emissions electricity, rather than simply stipulating a technology. The success of this law is shown in the figure below, where the penetration of CHP as a fraction of total power generation is shown for every state in the country.

As is clear from the above, Maine sets the pace for CHP penetration, with a full one-third of the state's electricity generated with high-efficiency CHP, thus saving money and reducing pollution. The historically high prices for electricity in the state, coupled with the high penetration of pulp and paper mills (who have long recognized the merits of CHP) no doubt contribute to this success. However, the net impacts of title 35-A §3210 can be estimated by comparing Maine to New Hampshire (ranked 37 out of 50 on the preceding chart)—a state with comparable electricity rates, pulp and paper penetration, and climate, but just 1/20th the penetration of CHP.

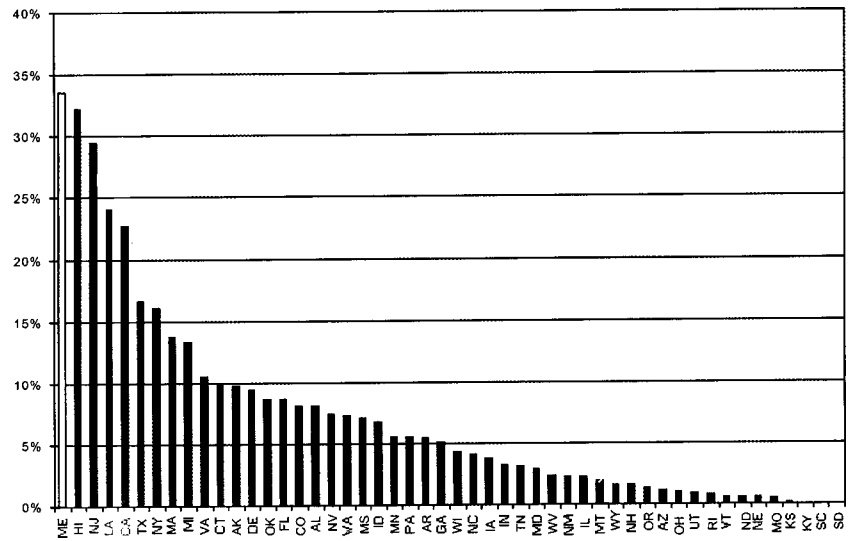


Figure 4. CHP Power Generation By State, Expressed as a Fraction of Total in-state Generation (kWh basis)[4]

[4]Calculations are based on data from FERC reports on installed generation capacity. CHP generation includes both PURPA qualifying facilities and non-PURPA facilities, but is almost certainly an underestimate of total CHP installation due to the lack of quality data sources on "behind the fence" power generation.

Why did this happen?

All of the information presented thus far begs an obvious question: if something is good for the economy, and good for society, why doesn't it get done? This question implicitly contains two deeper questions:

1. *The Laissez-Faire Perspective*: Why do we need policy to support the win/win—won't rational individuals do this anyway?

2. *The Activist-Government Perspective*: Assuming that we do need these policies, this suggests a market externality that government is ideally suited to address—why doesn't it?

Each of these needs to be addressed independently.

The Laissez-Faire Perspective

Adam Smith[5] and his progeny have shown that in a free market, individuals will constantly seek to maximize their profits and therefore instantly optimize to any set of market conditions. Many others have mistakenly extrapolated from this observation to conclude that in today's economy, it is virtually impossible to find new opportunities to increase profits.

This view of the world—espoused most frequently by economic theorists—naturally leads one to conclude that economists don't pick up $20 bills that they see lying on the street, since market forces imply that the $20 bill must not really exist. We need only to refer to Figure 1 to see how many $20 bills are actually on the ground: **the electricity industry is now less efficient at converting raw materials into product than it was at any time in its history**. Of course, Adam Smith's observation applied to free markets—which is clearly not the case in the electricity industry where monopoly rights are guaranteed. In this environment, perhaps we should not be surprised by this failure (although we should certainly be disappointed by it). But do completely free markets also sometimes leave $20 bills on the ground?

The answer is an unqualified yes, for one simple reason: capital dollars are scarce. Organizations and individuals all operate with lim-

[5]Adam Smith's 1776 treatise on the natures of capitalism, *The Wealth of Nations* was the first to postulate that in a free market where individuals are free to pursue their own self-interests, an "invisible hand" steers the aggregated market towards an optimum distribution of capital. This work has been subsequently interpreted by some as an argument for minimizing government intervention in functioning markets.

ited resources, and therefore make choices about how to allocate them. The entire history of finance is one of calculating risk and return, and then using the ratio of the two to ration capital amongst competing investment opportunities. At a corporate level, this manifests itself in rate-of-return thresholds, such that capital dollars are only allocated to projects that deliver the highest returns. Individuals who choose not to spend a little bit extra on a more energy efficient appliance are demonstrating the same behavior.

However, there is a second impact when capital budgets are limited. Every dollar of investment that is mandated by win/lose environmental legislation is one less dollar that is available for win/win environmental solutions. How many petroleum refineries are forced to spend the bulk of their annual capital budgets on mandated end-of-pipe pollution control solutions and thus have no money left for investments in plant efficiency (such as heat recovery from stack flares)? How many lumber mills are spending capital dollars on VOC abatement rather than on-site CHP?[6] Seen in this context, it becomes apparent that every law in support of the lose/win or win/lose option is actively restraining those individuals and organizations who wish to invest in win/win. **All non-win/win regulations thus become a net lose/lose, forcing society to underperform both economically and environmentally**.

The Activist Government Perspective

It should be abundantly clear that it is in our best interests to actively support the win/win. This raises a very hard question in respect to the electricity industry: why don't we?

Thus far, we have treated society and the economy at a macro level. However, when we shift our perspective to a finer level of detail, we realize the following:

- The greatest opportunities for energy efficient electricity generation are in the recovery of waste heat through combined heat and power (CHP) applications.

- The greatest opportunities for CHP are in industrial and institu-

[6]Indeed, recent EPA rulings on wood-fired boilers mean that many lumber mills may soon be forced to invest in more costly, fossil-fuel fired boilers rather than their existing carbon-neutral wood-waste units, which in some cases will undoubtedly serve to render CHP uneconomical.

tional facilities at the "end of the wire" relative to the utility-owned central plants.

- The greatest opportunities for energy efficiency investments will thus reduce the annual revenue of the electricity industry (as it is currently structured).

Thus a win/win for society at large becomes a win/lose for the electricity industry. This does not affect the central argument of this article—namely, that it is in our best economic and social interests as a nation to invest in energy efficiency. However, it does mean that such investments will be opposed by the entrenched utility.

Seen from this context, our gross failure to embrace efficiency at a policy level can only be the result of one of the following three causes:

1. Our regulators are ignorant of the scope of—and solution to—the problem;
2. Our regulators are too lazy to tackle the (admittedly large) challenge implicit in the complete restructuring of outmoded electricity regulations, or;
3. Our regulators are too cowardly to confront the entrenched electricity industry and force it to change.

Given the degree to which many regulators' campaign funds are dependent upon the largesse of the electricity industry, it is very difficult not to conclude that cowardice is the most likely cause of our 50-year—and counting—failure. For the benefit of society at large, we can only hope that the cause is simple ignorance.

Recommendations

It is thus recommended that policy makers immediately adopt the following changes to accelerate our realization of the social and economic benefits implicit in energy efficiency:

1) *Examine every existing or proposed energy and environmental regulation to ensure that its primary objective is to preferentially reward the win/win and discourage the lose/lose.*

In some cases, this has already begun, as evidenced both by the examples given herein of good legislation, and by current efforts to transition to output (e.g., lb/kWh) based emission standards.[7] Furthermore,

language in the White House's version of the 2002 National Energy Policy supporting accelerated depreciation schedules for combined heat and power are steps in the right direction.

Emerging greenhouse gas regulation represents an ideal test-bed for this new policy formulation, since every dollar invested in energy efficient electricity generation saves money and reduces CO_2 emissions. Conventional wisdom holds that CO_2 reductions cost money—to the extent that the United Kingdom is now building budgets based on defined costs of CO_2 abatement. The most wonderful thing about energy efficiency is that it inverts this "fact," making CO_2 control a form of revenue generation. **It is thus recommended that laws be passed to recognize this inversion, providing capital to companies who invest in CO_2-control technologies *only* if they can demonstrate that those investments will generate a positive rate of return**. If the conventional wisdom is correct, this policy will not cost the country a dime. If the conventional wisdom is wrong, this policy would represent an investment in the U.S. economy, leading directly to more competitive industries, higher profitability, and a rising tax base.

2) *Recognize that good business practices leave $20 bills on the ground, and craft legislation accordingly to provide additional incentives for energy efficiency.*

As shown herein, existing lose/win energy regulations, coupled with careful capital budgeting processes, lead companies to under-invest in energy efficiency, even though such investments will generate positive rates of return for their businesses. It is thus in policy-makers' best interests to address this market failure. The following regulatory modifications are recommended to address this market failure:

a. Immediately change all pollution control standards to an output basis, applied equally to all generator types to set fixed pollution levels per unit of heat and/or electricity generated. This simple change would increase the number of pollution control alternatives to include a host of revenue-generating technologies, thereby encouraging the win/win—and would recognize that absent this

[7]Sadly, the efforts thus far to change these regulations have been effectively blocked by the minority of Americans who are employed by the coal industry—much to the detriment of the majority of Americans who breathe air and pay electric bills.

regulation many of these revenue-generating investments would not be made.

b. Classify combined heat and power installations as a pollution control device, since every CHP installation displaces a dirtier power source from the grid. This will simultaneously allow organizations to include CHP in their environmental compliance decisions, and will enhance the economic attractiveness of those installations, by providing CHP with the shorter tax depreciation life (3 years) held by other pollution control technologies.

c. Allow facilities to monetize all of their emissions reductions, no matter what the source. At present, environmental compliance can be achieved only by end-of-pipe controls, forcing industrials to make capital expenses so as to offset environmental expenses. Emissions reductions inherent in CHP will sometimes be given credit for displacing boiler emissions, but never for displacing emissions associated with purchased electricity—this directly penalizes any CHP installations that use backpressure turbine-generators, waste-heat recovery cycles, or Stirling engines, and should thus be removed.

d. Extend the logic of demand-side management programs to any projects that can reduce power purchase and local emissions, no matter what the source. Many regulations and utility practices reward individuals for investing in energy efficient appliances, due to the obvious benefits such installations have on reduced fuel combustion, reduced T&D expense, enhanced grid-reliability, and improved local power quality. These exact same benefits accrue to individuals who install CHP at the point of use, and yet these installations are not rewarded under present regulatory or utility-practice.

3) *Overhaul the Central Power Paradigm.*

All of the above are steps in the right direction, but all will be adamantly resisted by the electric utility industry, which will perceive

---

[8]"Point of use" is important—while some deregulation has occurred at the generation level, there has as yet been no deregulation at the "end of the wire," where the local distribution utility retains the monopoly rights to approve or disapprove of a customer's decision to use DG to reduce their electric purchase.

each as an infringement upon their monopoly rights to provide electric power at the point of use.[8] It is also worth noting that many of the regulatory efforts currently underway at FERC may address some of the issues identified in the first two categories of recommendations listed above. However, there is no known current or planned regulatory activity that deviates from the presumption that the ideal way to deliver power to end users is in central plants connected by many miles of wires. As such, the regulatory reforms underway may help us towards the long-term goal, but their success will ultimately be limited by their failure to address the root problem.

With this in mind, it is recommended that an immediate overhaul of the central power paradigm begin on two distinct levels:

a) Remove those features of the central paradigm that were appropriate in the 1920s, but are obsolete in a modern economy. Cost-plus pricing, bans on private wires, and the monopoly protections of utilities who engaged in anti-competitive practices all allowed our nation to electrify, and were appropriate at the time. But their useful life has expired, and they are now costing us—in the form of power outages, excessively high electricity rates and emissions—far more than they create. All should be eliminated.

b) These features need to be removed more gingerly, as they have often delivered small steps in the right direction but reinforced an inaccurate world view—one must be careful in these instances to not throw out the baby with the bath water. The Public Utility Regulatory Policy Act (PURPA) of 1978 is an excellent example of such legislation. PURPA implicitly expects that the best way to encourage CHP is to require that utilities buy CHP-derived electricity at wholesale rates. This fails to reward the most economically optimal CHP, which is located behind the fence, to recover retail electricity prices. However, complete repeal of PURPA would effectively ban all non-utility electric sales, which would be a gigantic step backwards. Similar logic applies to many of the interconnection standards which are now being passed on state and federal levels.

The need for overhaul is obvious and long overdue. It is also an enormous challenge, as it will run exactly counter to the present interests of the utility industry. Great leaders, from Lincoln to Churchill have

recognized that the right thing to do is not always popular, and that it may run counter to entrenched interests. Let's hope that we can find those leaders today, before it's too late.

ABOUT THE AUTHOR

Sean Casten is the president and CEO of Turbosteam Corporation, a Massachusetts-based designer, manufacturer, installer, and financier of high-efficiency steam-driven power generators. Since 1986, Turbosteam has placed over 150 systems into service in 18 countries worldwide that have saved their customers over $100 million in energy bills and reduced global CO_2 emissions by over 3 million tons to date.

Bibliography/Further Reading

For a more detailed overview of the opportunity presented by energy efficiency distributed generation technologies, see:

Casten, Thomas and Sean Casten, "Transforming Electricity." Northeast Midwest Economic Review, Northeast Midwest Institute, November/December 2001. p 3-7.

For a more detailed overview of the capital cost burden imposed by the nations transmission and distribution infrastructure, see:

Zogg, Robert and Sean Casten, "Preliminary Assessment of Battery Energy Storage and Fuel Cell Systems in Building Applications" (Arthur D. Little). Final report to National Energy Technology Laboratory/U.S. DOE under contract number GS-23F-8003H, order number DE-AD26-99FT01038, Item number 1, August 2,2000. (Available on the internet at http://www.tiax.biz/industrydocs/doereports/BES.pdf)

For a more detailed overview of the history of the U.S. electricity industry, see:

Casten, Thomas R., *Turning Off The Heat*, Prometheus Press, October 1998.

Data on CHP penetration by state were graciously provided by Suzanne Watson of the U.S. Combined Heat and Power Association (personal correspondence).