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## How to unleash affordable, clean energy generation for the US: removing barriers to using energy twice

The US could make major cuts to its energy costs and carbon dioxide emissions through the expanded use of clean electricity generation which makes use of 'waste' heat as a fuel source – CHP. The actions required to make the difference are outlined here by Thomas R Casten.

Local electricity generation plants could use energy twice, reducing fuel, pollution and cost. Studies show there is the potential to cut US emissions by 20% and save consumers US\$80-\$100 billion per year. Yet, there has been little progress in moving from inefficient central generation. Why is this?

So, why has US overall generation efficiency remained at 33% since 'Ike' (Dwight D. Eisenhower) was in the White House? Combined heat and power plants (CHP) achieve 65%-95% efficiency. Why haven't markets deployed more CHP plants which use energy twice? Is waste energy recycling just one more 'wannabe' technology looking for a government hand-out? Or are there systemic barriers to energy generation efficiency?

Let's start with the basics of how the regulated monopoly electricity industry earns profits. Regulators approve prices for each class of electricity customer which enable the utility to earn a rate of return on invested capital, if, and only if, the total electricity sales to each class of customers are as projected. This means more sales, more profits; lower sales, lower profits.

This simple logic explains the 100-year history of worldwide utility bias against local generation. Anyone who generates their own power reduces utility sales and profits. 'But wait,' you say, 'haven't governments deregulated the electricity industry?' Understanding partial deregulation in the US requires a bit of electric monopoly history. In the good old days (for utilities), governments gave utilities a protected monopoly of both generation and distribution. Any competition would cut utility profits, so utilities lobbied hard for state, federal and local regulations that largely barred anyone but a utility to generate or deliver electricity. The historic utility bias was against all generation, not just local generation.


### RECENT HISTORY – PURPA AND THE 1992 ACT

For example, prior to the passage of the 1978 Public Utility Regulatory Policy Act or PURPA, any generator of electricity was subject to the Federal Power Act – an onerous requirement. PURPA was the first attempt to deregulate the industry and usher in the benefits of competition to electricity generation. PURPA did not touch the monopoly on distribution of electricity. It dealt only with generation. The utility community fought PURPA to the Supreme Court in three different cases and stalled its effectiveness until 1984 when the Court ruled with prejudice against the utilities' lawsuits. PURPA allowed anyone to generate and sell to the host, or, to sell to the local distribution utility at that utility's 'avoided' cost, providing the new generation plant used energy twice and was somewhat more efficient than the US grid.

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A 50 kW unit at a university in Pittsburgh, Pennsylvania

Utilities countered with a barrage of strategies to block local generation. They demanded high payments for back-up service in order to make CHP less financially attractive. Since electricity distribution remains a protected monopoly, no other party could supply a back-up service. They stalled approvals for interconnection of local generation to their distribution system and repeatedly demanded wildly expensive interconnection systems in the name of safety. They refused to interconnect at distribution voltages, forcing local generators to transform power to transmission level – 69,000 V or higher – even when the distribution system could absorb all of the power, and avoid capital and line losses.



Colorado State University – 801 kW dual turbine system installed, Fort Collins, Colorado

Congress watched and was lobbied, and in 1992 enacted the Energy Policy Act, which allowed anyone to generate at wholesale, without any requirement for efficiency. This legislation removed the requirement to recover and recycle part of the ever-present waste heat. In a delicate balance designed to avoid states rights fights, the Federal Energy Regulatory Commission made it economically imprudent for any state regulated utility to refuse to move independently generated power through their transmission wires, but said nothing about distribution. This opened the door to wholesale electricity generation competition and had a profound impact on the operation of existing coal and nuclear plants.

Between 1990 and 2003, the average nuclear plant went from operating just over 60% of the year to 90% operation, and coal followed suit. The independent power industry built 120,000 MW of new remote gas-fired central generation as they rushed to compete at the wholesale level. Many states required their utilities to sell off or separate their generation assets, reducing monopoly protection to electricity distribution.



Baltimore Refuse Energy Company – a 4.2 MW turbine generator installed by Turbosteam in Baltimore, Maryland

This did nothing to remove the bias against local generation, which is the only way to recycle otherwise wasted energy. The thermal energy left over from industrial processes does not travel very far and can only be converted to electricity on the site. But electricity generated on the site could be used by the host, thus reducing monopoly distribution company sales (and profits). Other hosts require thermal energy for processes and for space conditioning that could be supplied by using the normally wasted energy from on-site electric generation, but once again, the thermal energy will not travel very far. One must build a new electricity generation plant at the host, or amid several host plants in order to make use of the by-product heat and displace boiler fuel.

Once again, the new CHP plant could then sell electricity to the site host, reducing distribution utility sales and profits. Even though the power could be sold to the utility at the right price and allow the utility to keep the host as a customer, utilities have continued to equate local generation to loss of profits.

Keep in mind the ban on private wires. All but one state bans moving electricity across any public street in a private wire. These laws even prevent a company with operations on both sides of a public street that builds a CHP plant on one side from delivering power to their own facilities on the other side of the public street. They can pipe steam, hot water or chilled water across a public street, but not electricity. Some states allow retail power sales by non-utilities, but only by the monopoly's distribution wires, at rates appropriate for moving the power across the utility's entire territory.

#### **RULES DENY VALUE CAPTURE TO MOST LOCAL GENERATION**

Now for the biggest block to local generation that uses energy twice; under current regulations, such plants only capture about half of the value they create. This point, while death to efficient generation, is not intuitively obvious and receives little attention from policy makers and regulators. Here is the brief explanation.

New central generation requires expensive transmission and distribution (T&D) facilities to move the power to users, and these T&D systems have significant line losses. On average nearly 9% of the power generated in the US is lost in T&D, and during peak hours, the losses climb to 25%. By contrast, local generation, regardless of who purchases the power, flows to the nearest power users and has almost no net line losses. Even though local losses might be 2%, the reduction of load on the T&D system reduces net line losses to zero or less. In other words, new local generation avoids T&D capital cost and line losses, and thus creates value for society. But local generation typically cannot capture any of these savings.

Typically, the local generator can only sell power at wholesale, in competition with other central generators. The regulations wrongly assume all power will flow through T&D systems and have line losses, and thus deny this value to local generation. Out of the average 10 US cents per kWh for delivered power to all US consumers in 2008, nearly half went to pay for line losses, return on T&D capital and operations. Although local generation avoids these costs, it is paid the same five cents per kWh that is paid for power from remote central generation. It costs more per kW of capacity to build new small local generation than to build large remote generation, but far less total capital, including T&D. Society would invest less and otherwise benefit from local generation, but the price signal tells the power industry to keep building large remote plants that use energy only once.

Using energy twice – recycling otherwise wasted energy to displace boiler fuel – has another set of advantages versus conventional electricity-only generation. It uses less fuel, produces less carbon dioxide – the major greenhouse gas – and reduces the demand for fossil fuel, thus holding down fossil fuel prices to all. The local generator is seldom paid for these significant economic advantages, helping explain why there is so little construction of new energy recycling plants.

We regulate air pollution with a command and control approach and system that gives grandfathered permits to operate to all existing plants while forcing newer plants to bear the entire burden of cleaner air. Every existing electricity or large steam plant is allowed to continue operating with the level of emissions it had prior to the Clean Air Act, or the level that was approved when the plant was built. It costs more and more money to comply with ever dropping pollution standards and gain a permit to build a new plant. But the existing plants keep spewing out historic pollution. By way of reference, the allowed emissions of NOx have dropped by a factor of 100 since 1980. A new plant in say New Jersey, must reduce NOx to six parts per million, and then compete with a plant emitting 600 parts per million of NOx. Not a level playing field.



CHP could be used to produce clean energy, but only eight states recognize it as such

This grandfathering approach wrongly assumes that old plants will wear out and be retired, and gives no value to cleaner generation. It further explains the failure to build new and more efficient electric power plants. A new plant must invest added money and often use a good bit of their own electricity to power pollution control devices in order to obtain an operating permit. The clean plant must then compete with the grandfathered dirty plants that have no costs of pollution abatement. The public suffers the health and environmental costs of dirty generation and needlessly high greenhouse gas emissions per unit of electricity, while the clean plant gets no financial benefit.

#### WHAT ABOUT SPECIAL INCENTIVES FOR CLEAN GENERATION?

The public began to demand clean energy over the past decade; 35 states now mandate that an increasing percentage of total electricity must come from cleaner generation. These mandates create a separate market and allow all eligible clean generation to compete for the mandated clean energy. Prices for this clean energy have risen above the average retail price of power, providing an incentive to build new wind and solar power plants. These programmes would stimulate new generation, which uses energy twice, if power from energy recycling plants was recognized for what it is, every bit as clean as power from solar and wind. This is not the case.

By and large, the new 'Renewable Portfolio Standards,' or RPS, define eligible generation to include wind, solar, geothermal and wave power. Biomass power usually qualifies, but has some strange restrictions. Some states qualify power from fuel cells, even though the typical fuel cell is less efficient than the average central plant and has significant carbon dioxide emissions. But only eight states qualify CHP or waste energy recycling as clean energy.

Consider a real example. Our company proposes to invest \$170 million to capture and recycle the waste heat from the nation's largest silicon producer (in West Virginia) and generate 50 MW of power 24/7. The generation will require no incremental fossil fuel, produce no incremental criteria pollutant emissions and emit no incremental carbon dioxide. The power is as pristine as power from wind or solar generation. The total clean power per year is equivalent to the power from 150 MW of new wind generation (best wind runs 33% of the time) or 250 MW of new solar photovoltaic power (runs 20% of the time). The wind and solar compete to supply the mandated new clean energy, receiving \$100-\$400 per MWh. The power from the silicon plant, since it is not defined as clean energy under the RPS standards, competes with existing dirty generation and then receives only the average short-run marginal costs – perhaps \$50-\$55 per MWh.

Policy makers have been swayed by the sex appeal of renewable energy, by the power of the lobby for the equipment, and by their lack of knowledge.

It gets worse. Wind and geothermal energy are eligible for a \$20 per MWh production tax credit from the federal government for 10 years, or can take a onetime 30% tax credit as a grant – 30% of their total capital cost paid back in cash. New solar generation receives tax credits worth \$54 per lifetime MWh, new wind or geothermal receives \$10 per lifetime MWh, and biomass receives about \$5 per lifetime MWh, all to induce new clean generation. Until February 2009, local generation which uses energy twice and avoids T&D costs received no tax credit. The stimulus bill provided a limited tax credit which pays a maximum of \$1.34 per lifetime MWh from energy recycling plants. Because of a 15 MW size limit, the larger CHP plants receive either nothing, or a few US cents.

The clean energy tax incentives pale in the face of the subsidy received by old coal plants. All of us pay the health and environmental costs imposed by dirty coal power, which amounts to a subsidy of \$60-\$120 per lifetime MWh – 90 times the tax benefit given to pristine clean energy from waste energy recycling plants<sup>1</sup>. The government does not write the coal plant operator a check or give them a tax credit. But the costs of pulmonary disease, added emergency room visits, premature death, destruction of forests and buildings and lost sick time due to the pollution from coal plants are borne by society, not by the coal plant generator. Taxpayers continue to pick up the costs in the form of Medicare and government health payments. Individuals pick up the cost in the medical expenses and loss of health and life, etc.

It is difficult to develop financially viable new clean generation when the competition receives huge subsidies. The system denies local generation plants more than half of the value they create, with the obvious result.

#### CHANGE THE RULES TO INDUCE PROFITABLE CLEAN GENERATION

The great American philosopher Pogo said, 'We have met the enemy and he is us.' It is us who block clean generation that uses energy twice and would otherwise profitably lower greenhouse gas emissions by 20% and save the \$80-\$100 billion per year, plus provide a host of national security and other environmental benefits. It is us who tolerate 40 - 100 year old regulations which subvert economic logic and force our citizens to pay to warm the planet.

Happily, the rules could be modernized. In principal, the actions are simple.

- Set up a nationwide Clean Energy Standard Offer Program or CESOP, requiring all distribution utilities to offer standard rates for all new clean power, which meet specified fossil efficiency targets. The standard offers can be at a discount to the cost of delivered power from the best new central option and still induce new local generation that uses energy twice, thus

providing the public with guaranteed savings versus conventional generation. The key is to include the cost of delivery. CESOP avoids the utility bias, since it only applies to power sold to the distribution utilities, not power sold to any user. The utilities keep their profits, but build less T&D, have fewer line losses, and create a more robust system far less vulnerable to extreme weather and acts of terrorism. The public gains a discount, say 15%, and enjoys cleaner air and reduced carbon dioxide emissions. The host factories enjoy reduced costs for thermal energy or added revenues from sale of waste energy, thus improving their competitive position and retaining/increasing the amount of US manufacturing<sup>2</sup>.

- Give all generation an equal responsibility for cleaner air and less carbon dioxide emissions by switching to an output based pollution allowance system. Under this approach, every MWh of electricity and every unit of thermal energy receives an allowance of each criteria pollutant and of carbon dioxide equal to the average emission per unit in the base year. Every generator must obtain allowances equal to their actual emissions. Each year, lower the allowances for each pollutant per unit of output. If output grows, adjust the allowance down to ensure it is a true cap on total pollution. Let the market decide whether to invest in efficiency. Let the market also decide the price of allowances, reflecting the myriad actions of all players to increase useful output per unit of fuel to obtain more allowances and to take other actions to reduce pollutant emissions<sup>3</sup>.

These two changes remove the utility bias against local generation, remove the environmental bias against all new generation and allow new generation that uses energy twice to capture more of the value it creates. The subsequent benefits, from the investment boom, lowered health and environmental costs, reduced balance of payments for imported fuel to the reduced defense costs, will all be good for America. But the world will also benefit. Using energy twice significantly reduces manufacturing costs, making US industry more competitive. The global economy will respond by increasing energy efficiency in other markets. This will reduce costs to consumers worldwide, reduce demand for fossil fuel and hence reduce prices, and best of all, significantly reduce global carbon dioxide emissions.

## REFERENCES

1. Studies have variously placed the cost of health and environmental impacts from each MWh of coal-fired electricity at between \$60 and \$120. Cite Harvard and Ontario studies
2. For full details on CESOP, see [www.recycled-energy.com](http://www.recycled-energy.com) and look under 'What RED thinks.'
3. For full details on Output Standards see [www.recycled-energy.com](http://www.recycled-energy.com) and look under 'What RED thinks.'

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