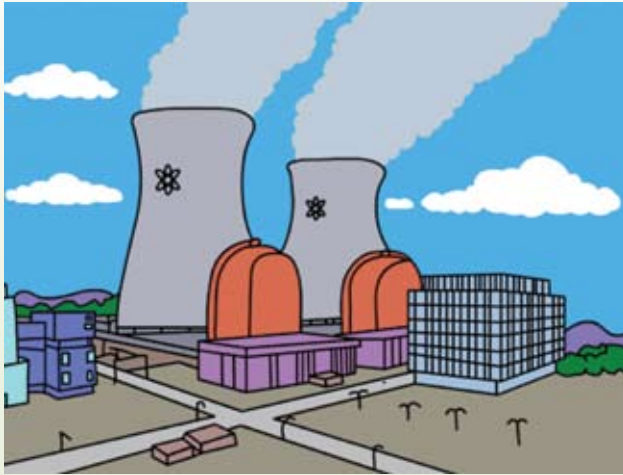


# **Profitably Reducing Greenhouse Gas Emissions**

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August 2008





Homer Simpson's power plant with cooling tower waste (above)  
Electric plant, Craig, Colorado (below)



**E**nergy waste is pervasive. Policymakers don't seem to see it, but ask virtually any school kid to draw a picture of a power plant and you'll see something resembling Homer Simpson's, where massive columns of waste heat are vented into the air.

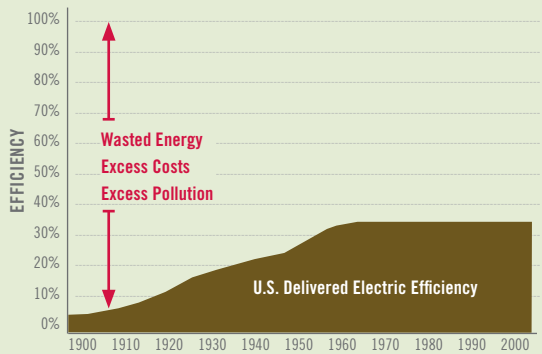
The cartoon, unfortunately, matches reality, as evidenced by this electric generating facility in Craig, Colorado, where two-thirds of the energy within the burned fuel is wasted, released into the atmosphere (see photo on left).

Electric generation waste is the ignored elephant in the room during climate change debates.

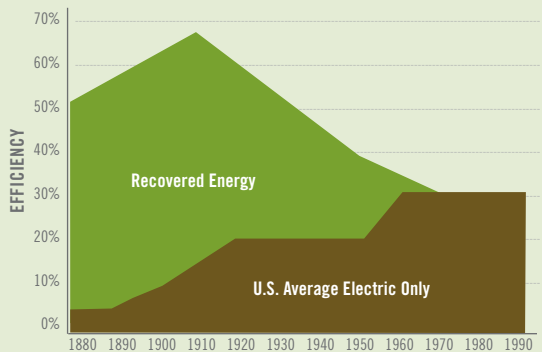
The average U.S. power plant burns three units of fuel to generate just one unit of power. This dismal 33-percent efficiency has not improved by a single percentage point in the past 50 years, since Dwight Eisenhower was in the White House. Despite phenomenal technical advances and a six-fold increase in electricity consumption, generation efficiency has remained stagnant. No other industry is burdened with such a dismal record. The inefficiency of electricity generation is wasteful, costly, and needlessly contributes to climate change.

No law of physics requires generation efficiency to be frozen at 33 percent. Indeed, Thomas Edison's first power plants — because he sought to profit by the sale of both power and heat — achieved

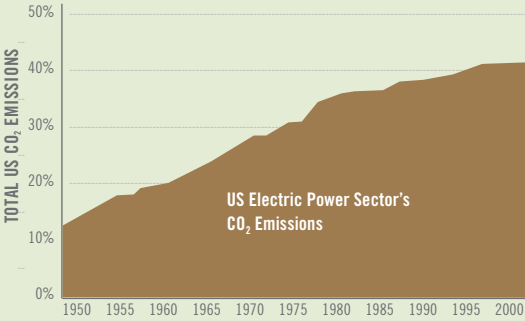
### Inefficient US Electric Generation



### US Electric Industry Fuel-Conversion Efficiency



## US Electric Generation's Contribution to CO<sub>2</sub> Emissions



50-percent efficiencies.

Denmark, over the last two decades, increased from 33 to 60 percent efficiency, and Germany, Japan, and our other international competitors do a far better job of capturing heat from power generation.

In fact, the current U.S. electric system, by focusing only on power and throwing away the heat associated with electricity generation, is less

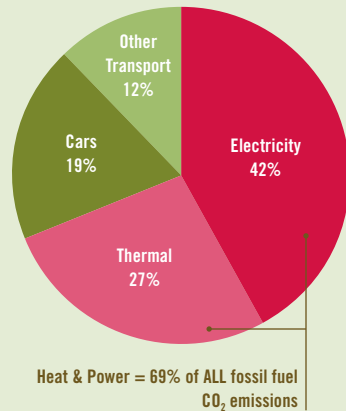
efficient than a century ago. Just returning to efficiencies achieved in the 1920s would save the U.S. some \$70 billion annually.

Why are electricity and thermal generation efficiencies so important to our climate and energy debates? First, electricity generation has become the dominant source of CO<sub>2</sub> emissions, rising from about 12 percent in 1950 to 42 percent today. Second, electricity costs are rising and will soar further as the price of fuel and power plant construction increase.

## Growth of US electric generation

Thermal energy production — essentially the heat used at industrial factories, office buildings, and homes, accounts for another 27 percent of fossil CO<sub>2</sub> emissions. The generation of heat and power is responsible for

## US CO<sub>2</sub> Emissions Sources, 2005



69 percent of all fossil CO<sub>2</sub> emissions in the United States. Compare that 69 percent to the 19 percent attributed to automobiles, which have been the focus of contentious congressional debates about efficiency standards. Missing from these discussions is the elephant in the room — the enormous amount of waste energy and the inefficiency of power and heat generation.

### **Can we capture waste energy?**

You bet. Consider a steel smelter in northwestern Indiana, just across Lake Michigan from the Chicago skyline. Just behind the white and gray buildings is a long line of 268 massive ovens that bake coal to remove impurities and produce coke for the adjacent steel smelter. Similar plants simply vent the ovens' heat into the atmosphere.

By seeing energy waste as a resource, this plant recycles the heat from the coke ovens, and two other plants recycle the blast furnace's flares, to generate 220 megawatts of clean electricity and 400 megawatts of clean thermal energy. The energy is clean because the plant doesn't burn any additional fuel or emit any additional pollutants; it simply captures what had been wasted.

To provide some perspective, energy recycling at this single steel plant supplies more clean power than all the world's grid-connected solar collectors, and it provides more clean electricity than all the wind turbines in Illinois and Indiana combined. Plant managers also annually save 916,000 metric tons of CO<sub>2</sub>, about the same as removing 166,000 cars from the roads. Of particular importance to the company and the overall economy, the steel mill purchases electricity from the energy recycling plants for 25 percent of average U.S. retail electricity prices, and it is saving almost \$100 million annually from reduced energy costs.



**Coker Energy, ArcelorMittal Steel, Northern Indiana**

There are many more examples of profitably reducing greenhouse gas emissions. Pictured below is one of five furnaces at an 80-year-old silicon plant in Alloy, West Virginia. The facility



Electricity, coal and wood chips melt quartz in a large furnace where temperatures reach 3,000° F.

essentially melts quartz rock in order to produce silicon for computer chips, solar cells and 1,500 other products.

Recycled Energy Development LLC is investing \$84 million to recycle the furnace heat into 45 megawatts of clean energy. This will reduce CO<sub>2</sub> emissions by 290,000 metric tons annually, equal to removing nearly 60,000 cars from the road. The factory will purchase the project's

electric output at a fixed price for the next 25 years, allowing the silicon manufacturer to use the savings and extra power to open a sixth furnace and add 30 industrial jobs. So when you hear someone suggest that tackling climate change will hurt the economy, consider that by recycling waste heat, Alloy, West Virginia, is creating jobs and bringing silicon production back to the United States from China.

## **Can we also reduce electric generation waste to mitigate climate change?**

There's good news because we can do two jobs with one fire. Combined heat and power plants (CHP) near thermal loads achieve double to triple the grid's current efficiency by recycling the byproduct thermal energy to displace boiler fuel.

On a national scale, studies for the Department of Energy and the Environmental Protection Agency estimate that such efforts to capture and recycle waste energy would generate 200,000 megawatts of electricity — the equivalent of 400 coal-fired power plants — and produce 40 percent of U.S. power.

## Combined Heat and Power

One example of CHP's enormous potential is in the production of gypsum wallboard, commonly known as sheetrock.

Seventy-four U.S. plants produced 26 billion square feet of sheetrock in 2007, using enormous quantities of natural gas to dry the gypsum and then dry

the sheetrock. By installing gas turbines at each processing line, sized for the just the right exhaust heat, the industry could support 1,500 megawatts of electric production (equivalent to three large coal-fired plants) that would be twice as efficient as the best new electric-only gas fired plant, and three times as efficient as the U.S. average generation. This shift would reduce carbon emissions and natural gas consumption, cut the costs of building construction, and increase profits and tax collections. Everyone wins.

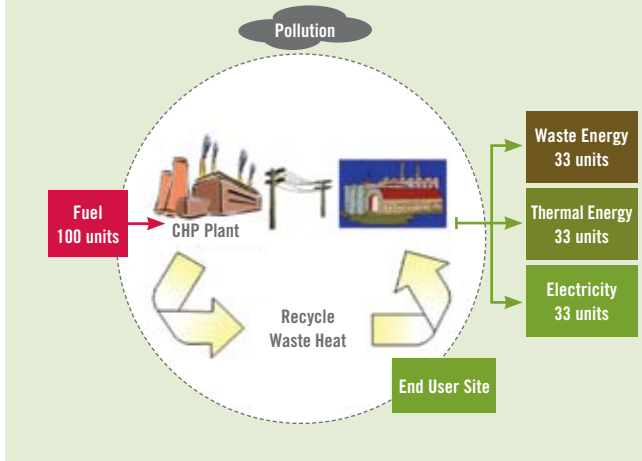
Similar opportunities abound in other industries, including: glass and fiberglass, chemicals, refineries, charcoal briquettes, food processing, foundries, plastics and carbon black (raw material for tires), to name a few.

### Why does inefficiency prevail?

This opportunity, of course, raises the obvious question: why does inefficiency prevail?

It's certainly not a lack of technology — the equipment to capture and recycle waste energy is available, proven, and widely used throughout the world. The key problem is that our energy laws and regulations are outmoded — designed for an era before climate change and rising energy costs were issues. Reforming these rules will not be easy because, as the saying goes, policy losers scream louder than winners cheer.

Nowhere is the task more difficult than in the climate change debate, where conventional wisdom holds that reducing greenhouse gas emissions will hurt the economy. Yet the steel-smelter, silicon-manufacturing, and sheetrock examples demonstrate that we can profitably



lower emissions and burn less fuel if we increase the efficiency of converting fossil fuel into useful energy services.

The economic and environmental health of our country depends on how fast government modernizes energy regulations to give clean energy a chance.

### **How to remove barriers to efficiency?**

Entrepreneurs will deploy clean energy and profitably reduce greenhouse-gas emissions with the following regulatory actions, all of which are discussed in detail at [www.recycled-energy.com](http://www.recycled-energy.com):

1. Allow recycled energy and good-quality CHP to qualify for state Renewable Portfolio Standards.
2. Adopt Clean Energy Standard Offer Programs (CESOP) that purchase clean energy at 85% of the cost of building the best new electric-only central power plants.
3. Adopt output-based allocations in order to spur efficiency and cut emissions of greenhouse-gases and other pollutants. Allow investments to improve the efficiency of dirty power plants. Enable carbon trading, but have all producers of heat and power obtain permits equal to their actual emissions, creating equal carrots for clean energy and sticks against dirty power.
4. Allow local generators to obtain value for the benefits they create, such as avoiding new wires and line losses
5. Have the federal government purchase all of its power from clean energy sources. .

Modernizing these laws and regulations should prompt \$400 to \$800 billion of investment in clean heat and power, cut U.S. CO<sub>2</sub> by 20 percent, and save consumers \$70 to \$150 billion per year. It will propel the U.S. to become the center of excellence for energy recycling — creating a major new export industry.

**For further information:** contact Dick Munson at Recycled Energy Development LLC, 640 Quail Ridge Drive, Westmont, IL 60559 or [dmunson@recycled-energy.com](mailto:dmunson@recycled-energy.com).