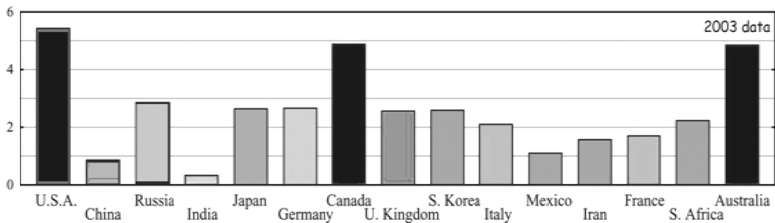


Begin with 100 units of primary energy—coal, say. In generating electricity in a typical power plant, 66 units of energy go right up into the sky as waste heat. For automobiles the waste is even worse. It's as if, when you cooked a meal, you were to take two-thirds of the food and immediately dump it into the garbage.

Then, when we use the electricity, there is further waste, as when inside a lightbulb, heat is made along with light. To continue with the meal analogy, it's as if, after you served the food (the one-third that was left), each diner threw away 90 percent of that. Wouldn't that be appalling? You'd have to say there was something wrong with any food plan that operated this way. In other words, about 3 percent of the energy in the fuel gets turned into light.

— physicist and playwright Phillip F. Schewe, 2007



An American, Australian, or Canadian uses twice as much fossil fuel as a European.

Lifestyles that consume twice as much energy (and produce twice as much garbage) per person are characteristic of the two developed countries to reject the Kyoto treaty, the U.S. and Australia (and, under a conservative government, Canada also made such noises). In 2007 data, Saudi Arabia joined the big-black users club.

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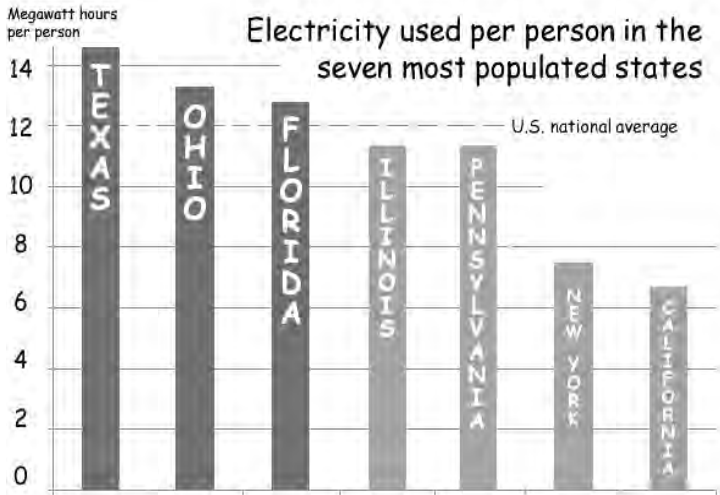
Doing Things Differently

I recently attended a post-performance discussion of Thornton Wilder's play, *By the Skin of Our Teeth*. It won the Pulitzer Prize for Drama in 1943 and features an ice age in Act 1, a deluge in Act 2, and ends with the aftermath of a great war. Almost everyone in my discussion group saw the play from the context of our present climate crisis. They seemed in despair over what could be done about it.

I'd say that they understood the essentials of our climate crunch but could not yet imagine how such problems could be solved. In the next four chapters, I will try to remedy that.

Individually, we have trouble imagining how to go on an energy diet that cuts our carbon consumption in half. Many people feel fenced in by a series of time and money constraints, with little wiggle room. But what is problematic for individual initiative can often be accomplished by high-level energy policy and collective action.

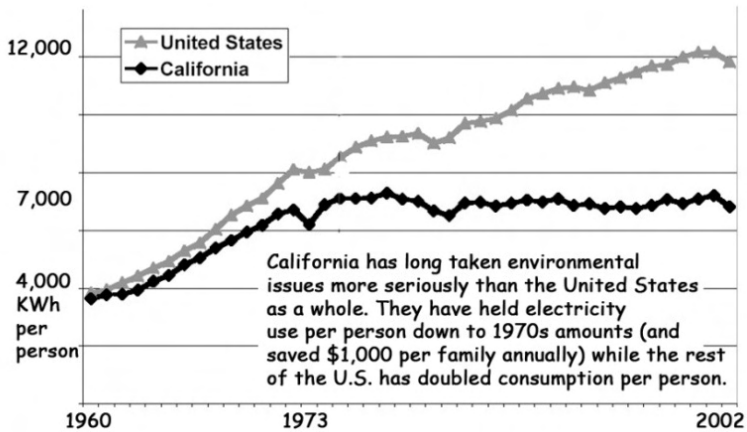
The purpose of this short chapter is simply to show, via comparisons between states and countries, that much has already been done for cleaning up electricity generation. We can do a great deal by simply copying the strategies of the successful.



For example, Texans use more than twice as much electrical power per person as do Californians. They will say that this is because they need to heat and cool more. (Really? More than New Yorkers who, despite their overheated buildings, are almost as frugal as the people of California?)

For some insight, take a look at how this situation developed over a half century. Consumption per person tripled in the United States on average, but it only doubled in California, thanks to how California changed course in

the 1970s. By going their own way, the people of California have kept electricity consumption per capita flat for the last thirty years.



As this shows, it can be done without a drastic diet. California is nonetheless thriving; were it a country, it would have the sixth largest economy in the world. “California’s experience shows that serious conservation is a lot less disruptive, imposes much less of a burden, than the skeptics would have it,” the economist Paul Krugman wrote. “And the fact that a state government, with far more limited powers than those at Washington’s disposal, has been able to achieve so much is a good omen for our ability to do a lot to limit climate change, if and when we find the political will.”

Why can't Texas be more like California? The California Solution shows that good government policy can create a framework within which market forces can operate.

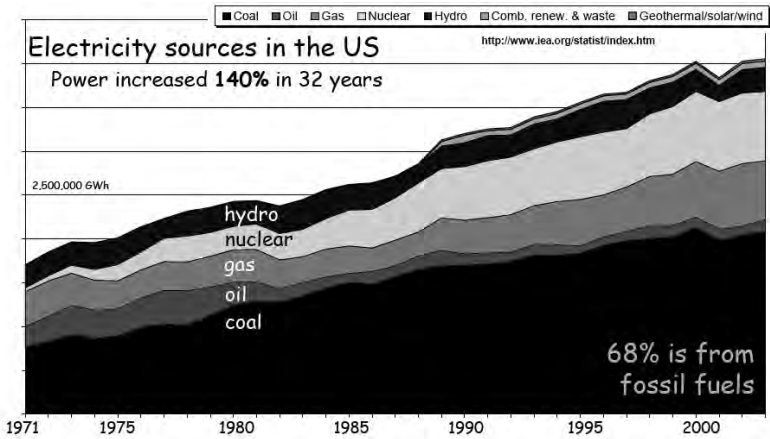
My second comparison, which I call the Nine Percent Solution, comes from looking around the world at how electricity is generated. In France, nuclear and hydro supply all but 9 percent of France's electricity. It appears that minimizing fossil fuels can also be done while maintaining an excellent standard of living.

Because much of the U.S. fossil fuel supply has to be imported, many dollars have to be exported. This dollar drain often goes to governments that are not our friends; our oil payments have financed major terrorist movements directed at us and our friends.

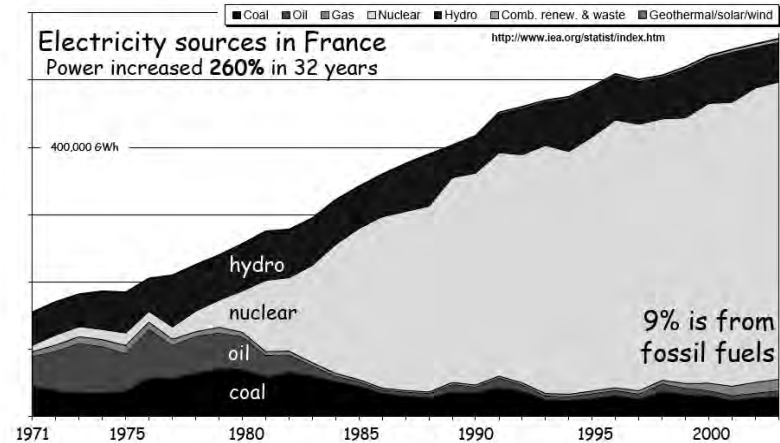
Even without the global fever problems, this U.S. energy policy has been a disaster, much like what our worst enemies might have wished on us if they wanted to weaken us or slowly take us over. A country which owes so much money to Arab and Asian countries is not likely to retain an independent foreign policy for much longer.

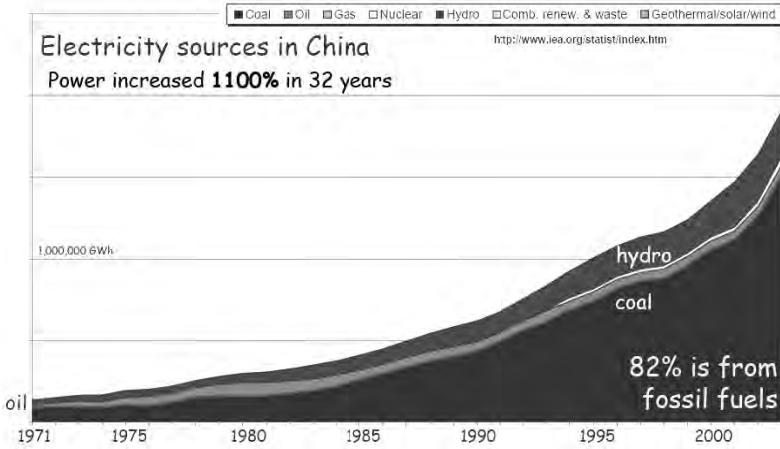
Hundreds of millions of dollars have been spent—successfully, to judge from the lack of Congressional investigations over the years—to rig the system and convince Americans to trust their future to those who sell fossil fuels.

Trusting your energy policy to the fossil fuel lobby is like trusting your health care system to the tobacco lobby.

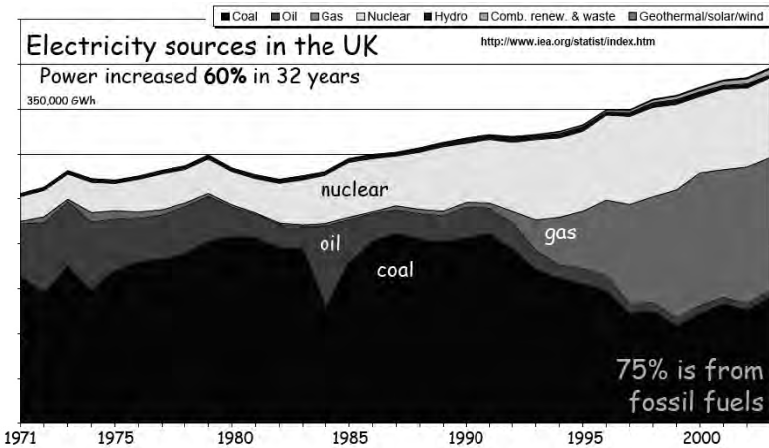


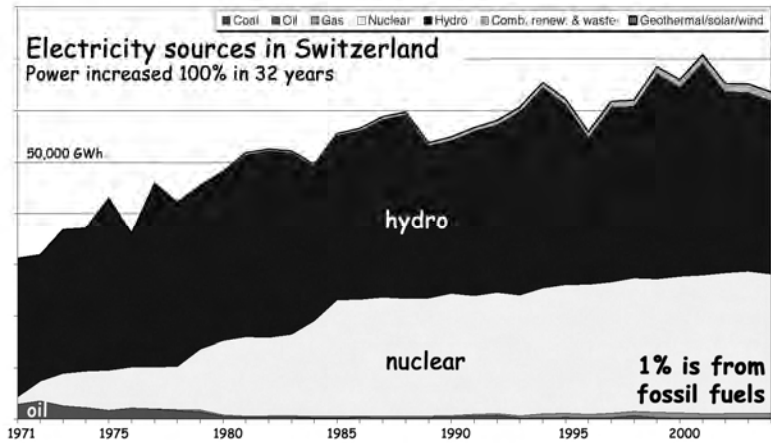
The growth in electricity use in France has been twice as steep as in the U.S. Yet France now gets only 9 percent of its electricity from fossil fuels. (Graphs adapted from those at www.iea.org/Textbase/stats/graphsearch.asp.)



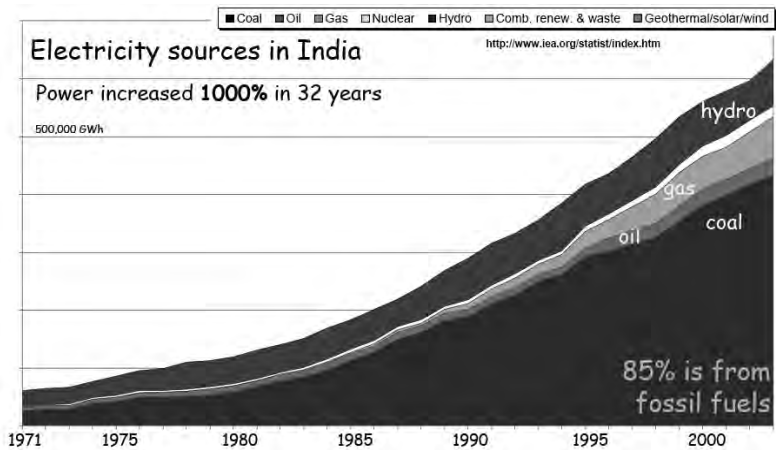


China's use of coal has soared; nuclear power is that light sliver starting in 1993 atop the gray oil sliver. The UK has replaced some of its oil and coal use with Russian natural gas starting in 1992, thereby reducing its CO₂ contributions.





Switzerland added nuclear to supplement hydro and now has 99 percent clean energy. Their total is actually decreasing, presumably from efficiency gains. India, despite enormous hydro resources and many nuclear engineers, is choosing to burn coal to meet electricity needs.





This huge coal-fired plant south of Las Vegas, a major source of the haze over the Grand Canyon, sits atop some of the best geothermal resources in the U.S., in the midst of good sites for wind farms, with year-round sunshine for solar energy.



I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that.

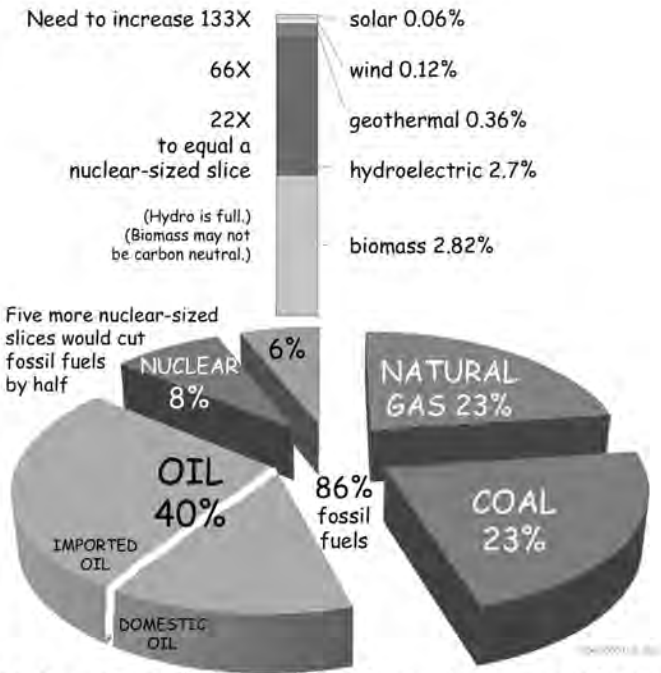
—inventor Thomas Edison, 1931

Governments... spend a small slice of tax revenue on keeping standing armies, not because they think their countries are in imminent danger of invasion but because, if it happened, the consequences would be catastrophic. Individuals do so too. They spend a little of their incomes on household insurance not because they think their homes are likely to be torched next week but because, if it happened, the results would be disastrous. Similarly, a growing body of scientific evidence suggests that the risk of a climatic catastrophe is high enough for the world to spend a small proportion of its income trying to prevent one from happening...

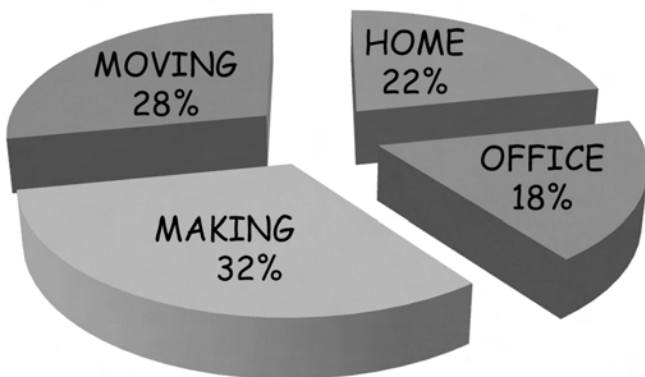
The real difficulty is political. Climate change is one of the hardest policy problems the world has ever faced. Because it is global, it is in every country's interests to get every other country to bear the burden of tackling it. Because it is long term, it is in every generation's interests to shirk the responsibility and shift it onto the next one. And that way, nothing will be done...

Developing countries argue, quite reasonably, that, since the rich world created the problem, it must take the lead in solving it. So, if America continues to refuse to do anything to control its emissions, developing countries won't do anything about theirs. If America takes action, they just might.

— from the *Economist*, 9 September 2006

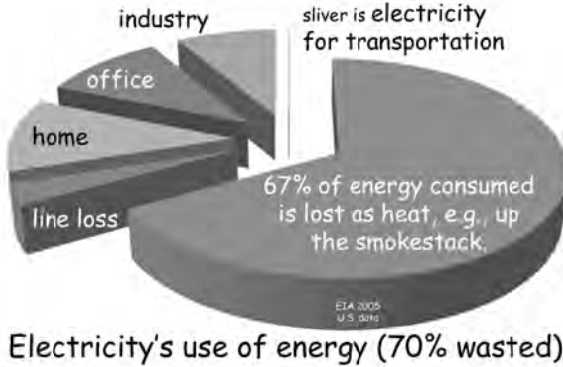


U.S. energy (all uses): **Where it comes from**



U.S. energy (all sources): **Where it goes**

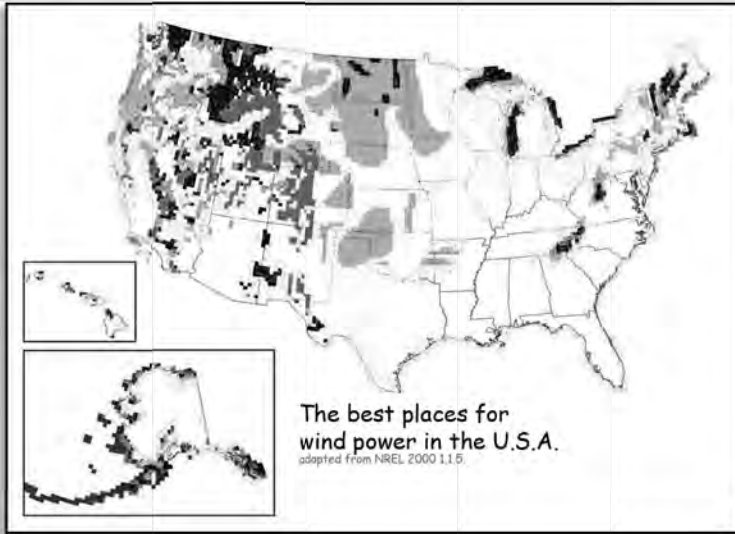
This conventional breakout ignores most of the waste heat.



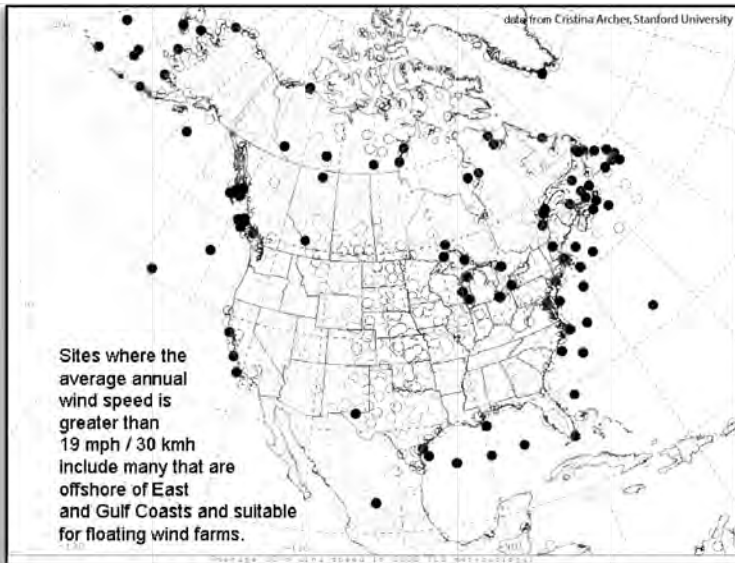
At least for electrical generation, about 70 percent of the fuel's energy is wasted as heat. A small fraction of electrical generation's waste heat is currently captured ("Co-generation") for local heating needs, thus reducing some electrical demand. Much oil is wasted because of idling time in traffic jams.

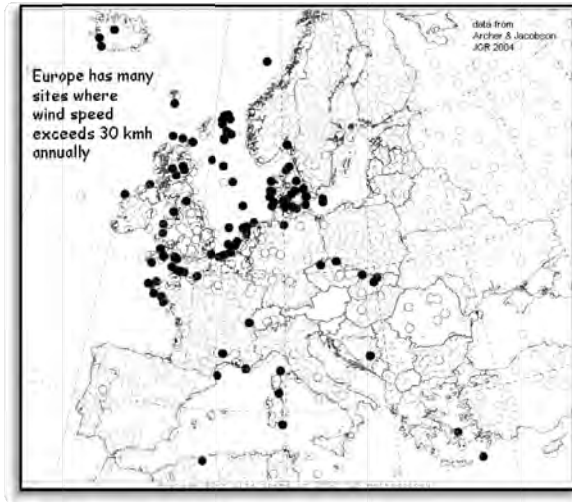


The southern end of a low-loss 1,500 km DC electrical transmission line just outside Boston. All of the DC-to-AC conversion is done in that small building. The transformer farm is for the AC en route to Boston.



Among the best places for wind power is out in the middle of the Great Lakes. There are many windy sites offshore as well (below).





Some C-free electricity sources have serious drawbacks when scaled up too fast. That's because the power grids themselves are already unstable, as frequent power outages remind us. That they don't happen more often is only because most sources and loads are predictable. When unpredictable wind and solar power is added to the balancing act, network outages become more likely.

The current projection for growth in wind has it replacing 5 percent of fossil fuels by 2020 and that may be as fast as we should go unless we use energy storage such as a flywheel or an underground reservoir for compressed air. Some cities in Iowa are planning a 100 megawatt wind farm with 200 megawatts stored underground as compressed air.



GLOBAL How to Treat Climate Change FEVER

WILLIAM H. CALVIN

THE UNIVERSITY OF CHICAGO PRESS
CHICAGO AND LONDON

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