The Godfather of Energy Efficiency

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1. Introduction

There has been much discussion of energy efficiency lately. Every time I see a discussion of this subject, my thoughts go to a gentleman that shared a title with this paper, which I am posting to scratch this itch (and give myself a nice Thanksgiving present).

His name is Dr. Arthur Rosenfeld, and I had the honor to work with him on a couple of projects shortly after Y2K.

I mentioned Dr. Rosenfeld in section 2.4 of an earlier post described and linked below.

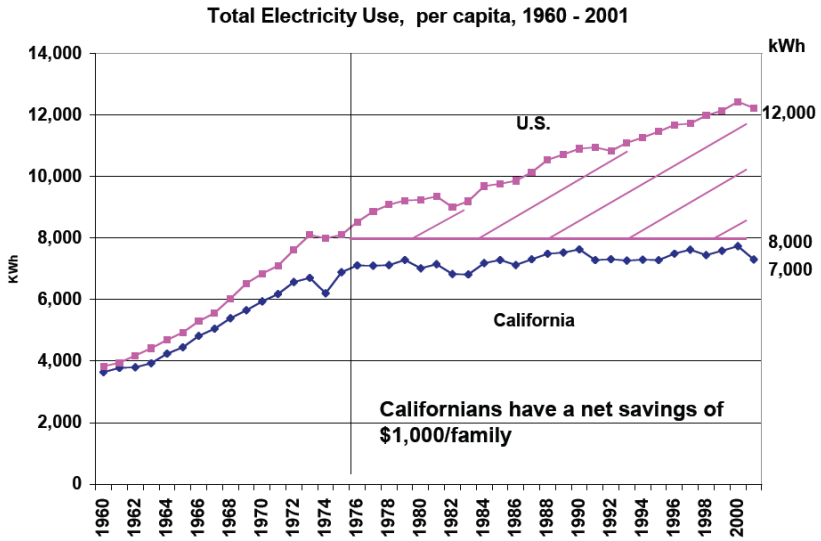
Climate Change, Two Challenges and Five Solutions: This two-part series is mainly focused on the solutions, that is, what we can start doing now (or at least soon) to deal with climate change. Part 1 covers one of the "Five Solutions", moving all electricity production to low-carbon procedures. Also it mainly focuses on methods that I have not covered before.

https://www.energycentral.com/c/ec/climate-change-two-challenges-and-five-solutions-%E2%80%93-part-1

The description in the earlier post is short, but reasonable, so I will repeat it below, followed by additional information on Dr. Rosenfeld.

2. Negative-Watts

One of the first major moves that California made in reducing GHG and other negative products of generating power was to reduce the amount of power required for a given task (improving energy efficiency). Through a long series of rebates for more energy efficient appliances, we (California) have been able to keep our per-capita energy use flat since the early 1970s compared to the rest of the U.S. (see the figure below).



The reason the chart ends in 2001 is that it is from a presentation that was sent to me by a remarkable gentleman, Arthur H. Rosenfeld. At the time I worked with Dr. Rosenfeld (on a demand response project), he was commissioner of the California Energy Commission, and he sent out this presentation in 2005. Below is an excerpt from his article in Wikipedia:[1]

"Arthur Hinton "Art" Rosenfeld (June 22, 1926 – January 27, 2017) was a UC Berkeley physicist and California energy commissioner, dubbed the "godfather of energy efficiency", for developing new standards which helped improve energy efficiency in California and subsequently worldwide…

"[In 1973] *his research focus shifted away from particle physics and instead to energy efficiency. To organize a team of scientists to work on it, he established the Center for Building Science at Lawrence Berkeley National Laboratory…*

"*In 1976, for instance, after he explained to California Governor Jerry Brown* [then in his first two terms] *that a proposed nuclear power plant would not be needed if there were better efficiency standards for refrigerators, the proposed plant was not built. And the following year, standards for new refrigerators and freezers went into effect. Brown recalls Rosenfeld's influence:*

" 'He gave validation to the very unorthodox notion that economic growth could be decoupled from energy growth. He was really the guru of efficiency.'

"Many of the new standards met with stiff resistance from utilities and business groups. They saw the new rules as being bureaucratic 'job killers' and which, if effective, would reduce their revenues. An executive from the utilities contacted Rosenfeld's lab to demand they fire him.

"Appliance manufacturers also complained about the new requirements, although they innovated to meet them. The resistance from utilities and manufacturers was eventually overcome when it was calculated that those new standards had yielded billions [of dollars] *annually in energy savings for California consumers. 'The first time we put standards on a product, we tend to get objections that this will be the ruin of civilization as we know it,' Rosenfeld said. 'But then people get used to it.' In 1999, he estimated that the changes the commission mandated were saving the nation $10 billion a year.*

"The new standards also reduced California's air pollution, equivalent to taking millions of cars off the road. Appliances such as the refrigerator later used only 25% of the energy as older models, despite often being larger. Large-screen TVs, which were estimated to previously use up to 10% of an average home's electricity, were also included in the standards. In 2009, California approved the nation's first efficiency requirement for televisions. It was estimated that they alone would save Californians $8 billion over the following decade.

"Since 1973 per capita electricity use in California has remained flat, while for the rest of the nation it increased nearly 50%. That trend was attributed in part to the energy conservation efforts led by Rosenfeld. Energy scientists credited Rosenfeld for those savings, dubbing the term "Rosenfeld Effect" as a way to explain how the cost reductions were achieved. He became a 'rock star' in energy efficiency circles. James Sweeney, an energy scientist at Stanford, says Rosenfeld is 'absolutely the most fundamental person in causing the California government to start paying attention fully to the opportunities for energy efficiency.' "

[1] Wikipedia Article on Arthur H. Rosenfeld, https://en.wikipedia.org/wiki/Arthur_H._Rosenfeld

3. Additional Information

3.1. Rosenfeld's Law

In addition to the Rosenfeld Effect (see the main image of this post), *he is also behind "Rosenfeld's Law," which states that the amount of energy required to produce one dollar of economic output has decreased by about 1 percent per year since 1845.*[2]

His many admirers included former Secretary of Energy Steve Chu, who has called him a "hero." "Art was one of the most decent, generous, engaging, passionate, and thoughtful people that I have known. His wonderful persistence in asking interesting, important questions and being completely open to new ideas makes him a compelling colleague," Chu said. "The climate crisis has given his work even greater significance. Indeed, it is no exaggeration to say that the field Art pioneered is now indispensable in how we transition to a sustainable future."

Rosenfeld was famous for his detailed calculations, but he also had a knack for translating the results into terms that could be easily understood. For the layperson, results were expressed not in scientific units but in terms of equivalencies, such as how many cars would be taken off the road or how many power plants that would not need to be built. In 2010, 54 scientists from 26 institutions around the world co-authored a paper proposing the "Rosenfeld," a unit of measurement to express that very concept—they defined the Rosenfeld as electricity savings of 3 billion kilowatt-hours per year, the amount needed to replace the annual generation of a 500 megawatt coal-fired power plant.

3.2. Awards

As the energy savings accumulated, so did recognition for his work. He received the Szilard Award for Physics in the Public Interest in 1986, the Carnot Award for Energy Efficiency from the Department of Energy in 1993, and the Berkeley Citation in 2001 from the University of California.

In 2006 he won the Enrico Fermi Award, one of the nation's oldest and most prestigious awards for scientific achievement. In 2010 he was awarded the Global Energy International Prize, established by Russian scientists in 2002. That year he was also voted into the National Academy of Engineering.

In 2012 Pres. Obama named him one of 11 recipients of the National Medal of Technology and Innovation, one of the highest honors bestowed by the United States Government upon scientists, engineers, and inventors.

And just last year the Tang Prize Foundation announced that it was awarding to Rosenfeld its 2016 prize in Sustainable Development "for his lifelong and pioneering innovations in energy efficiency resulting in immense reductions in energy consumption and greenhouse gas emissions around the world."

[2] Julie Chao, Lawrence Berkely Lab, "Art Rosenfeld, California's Godfather of Energy Efficiency, Dies at 90," Jan 27, 2017, https://newscenter.lbl.gov/2017/01/27/art-rosenfeld-californias-godfather-energy-efficiency-90/

3.3. Early Career

Rosenfeld was born in Alabama in 1926. He served in the U.S. Navy for two years at the end of World War II, then entered graduate school at the University of Chicago, where he became, as he often said, "Enrico Fermi's last graduate student." On the strength of a recommendation from Fermi, he later moved to Berkeley in the 1950s to work as a physicist in the Nobel Prize-winning particle physics group of Luis Alvarez.

Rosenfeld played a key role in the development of the hydrogen bubble chambers Alvarez was building to detect particles produced in the new Bevatron at what was then called the Radiation Laboratory (now Lawrence Berkeley National Laboratory). They identified a dozen new particles, and when Alvarez was awarded the Nobel Prize in Physics in 1968, he invited Rosenfeld and others in the lab to Stockholm for the celebration.

3.4. The Switch

Five years later Rosenfeld was leading the old Alvarez group when the OPEC oil embargo struck. Late one Friday evening in 1973, while sitting at the office and thinking about the half hour he would have to wait in line the next day to buy gas, he decided to calculate how much energy could be saved by turning off unused lights. That was the turning point.

"After 20 minutes of uncovering light switches (and saving 100 gallons for the weekend), I decided that UC Berkeley and its Radiation Laboratory should do something about conservation," he wrote in a 1999 autobiography of his career, "The Art of Energy Efficiency."

Soon he switched his focus to energy and the environment full time. He founded the Center for Building Science at Berkeley Lab in 1975, where a broad range of energy efficiency standards and technologies were developed under his 20-year leadership. These include electronic ballasts for fluorescent lighting–a key component of compact fluorescent lamps (CFLs)–and a transparent coating for window glass that blocks heat from either escaping (winter) or entering (summer). He was personally responsible for developing the DOE-1 and DOE-2 series of computer programs for building energy analysis and design that were incorporated in California's building energy efficiency standard in 1978. The DOE-2 series has served as the national standard of building energy analysis for 25 years…

As he wrote in the 1999 article, his calculations questioning the need for more power plants in 1975 angered the utilities: "PG&E called LBNL's then-director Andy Sessler to complain that physicists were unqualified to project electricity-demand scenarios and to suggest that I be fired. Because my wife and my colleagues, including Sessler, had been telling me that I was overqualified to work on energy efficiency, I found the PG&E complaint somewhat comforting."

In 1980 Rosenfeld and a few others decided to form a nonprofit think tank, the American Council for an Energy Efficiency Economy (ACEEE), "in cold fury at President Carter," as he put it. "In his first budget he proposed $88 billion for alternative fuels, and for conservation he proposed a sweater. So we proposed to do a study." ACEEE continues to play a leading role in federal energy policy.

3.5. Later Life

Rosenfeld has influenced and inspired legions of energy researchers. Many still recall wandering into one of his classes and deciding to switch or re-focus their career. His graduate students and those he has worked with and mentored are now leading energy researchers at institutions all over the country, from Berkeley Lab and Stanford University to the Natural Resources Defense Council and the Energy Foundation.

"He was always a model of how to be true to the science and how to work on problems of social significance that are on the cutting edge of science at the same time," said Ashok Gadgil, a former grad student of Rosenfeld's who is now deputy of the Energy Technologies Area at Berkeley Lab. "He's been a role model not just to me but to literally hundreds of other people."

Nearing 70 years old when Bill Clinton came to office, he was nowhere near ready to retire. Instead, seeing some old friends taking on government jobs, "I began to catch a case of Potomac fever," he wrote. In 1994 he moved east to serve in the Clinton Administration as a Senior Advisor to the Department of Energy's Assistant Secretary for Energy Efficiency and Renewable Energy, where he worked on climate change and low-carbon technologies.

In 2000 California Gov. Gray Davis appointed him Commissioner at the California Energy Commission (CEC), and in 2005 he was reappointed by Gov. Arnold Schwarzenegger. As Secretary of Energy, Chu appointed him in 2010 to serve on the Secretary of Energy Advisory Board.

After 10 years on the CEC Rosenfeld returned to Berkeley Lab in 2010 to the Heat Island Group he helped launch in 1985. Its mission is to investigate how cooler surfaces can help cool cities while also cooling the planet. In recent years he was a vocal advocate for cool roofs, co-authoring several papers on how cool roofs can offset carbon dioxide emissions and mitigate global warming. In total he has authored or co-authored more than 400 refereed publications or book chapters.

Author's Comment: It was in the period from 2002 to 2004 that I worked with Dr. Rosenfeld, when he was the CEC Commissioner. The two projects were a pilot AMI system at the Sacramento Municipal Utility District (SMUD) and the Joint CPUC-CEC Demand Response Proceeding, R.02-06-001. For the story of the latter, go to the post linked below, Section 3. Like many things Dr. Rosenfeld touched, this proceeding changed the electric utility industry forever.

https://energycentral.com/c/iu/ami-%E2%80%93-part-2-creating-demand