

**From:** Gil Masters (gmasters@stanford.edu)  
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**Subject:** Denis Hayes article, so good

Denis is one of my heroes... here's a v. nice article from the Jan issue of Solar Today:

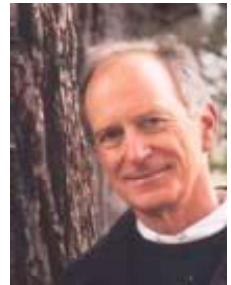
## Charting a Bold Course

**It's not too late for the United States to help lead the world into a carbon-free solar era, but it will take national commitment on the scale seen during World War II.**

Jan/Feb 2009 Solar Today

By **Denis Hayes** | President, Bullitt Foundation

Following decades of denial of climate science by the political establishment, President-elect Obama will take office in a nation that lags behind Europe and Japan in establishing the building blocks for a carbon-neutral future. Once the world leader in renewable energy, America has ceded its place to nations whose governments have made the transition to low-carbon energy a priority.



As a candidate, Barack Obama asserted his intention to promote renewable energy, boost energy efficiency, combat climate change, reduce our dependence on foreign oil and create green jobs. Unfortunately, a doubled national debt was the last and most urgent of many disastrous Bush legacies with which the new president must cope. The more than \$10 trillion we now owe our children and other nations has too many digits to fit on the “debt clock” in Times Square, and the melt-down of the financial sector threatens a global depression.

Those of us who, for the last 30 years, have urged sweeping changes in the nation's energy posture have always understood the power of the interests aligned against change. We were challenging the oil, coal, electric utility and automobile industries, all of which were profiting handsomely from the status quo. We thought we needed crisis — an energy “Pearl Harbor” or energy “Sputnik” — to mobilize the public behind such a far-reaching change. It might take the form of a war in the Middle East, a Chernobyl meltdown, an Exxon Valdez. But these crises came and went without producing a discernable improvement in national energy policy.

Instead, the opportunity now has come in an unexpected form: a financial system that requires trillions of dollars of investment in order to avoid collapse, coupled with the election of a new president with unusual intelligence, a willingness to take a fresh look at everything, a House and Senate dominated by his political party, and a robust mandate for change.

The most effective way to avoid a long, deep, worldwide recession is huge expenditures on green investments, putting millions of unemployed people back to work. For example, President-elect Obama could sensibly spend \$6,000 per house increasing the energy efficiency of 50 million homes. He has already expressed interest in constructing a smart grid — training hundreds of thousands to replace the wave of retiring baby boomer linemen whose departures so worry the utility industry. If the federal government agrees to invest \$50 billion to bail out Detroit, it should demand that the ailing industry retool for dramatic increases in fuel efficiency and retraining of autoworkers and mechanics to understand the new technologies.

Most important, we need a national commitment to solar and renewable energy comparable to our mobilization for World War II, when the United States unleashed its scientific creativity and its industrial power to support the war effort. We need Jimmy Carter's “moral equivalent of war.”

### Reclaiming a Missed Opportunity

The energy situation in the United States is much worse today than it was when President Jimmy Carter left office. Since 1981, our oil imports have grown from 1.6 billion barrels per year to 3.7 billion barrels. Our annual greenhouse gas emissions have grown from 4.7 billion metric tons of CO<sub>2</sub> to 5.9 billion metric tons.

In 1979, President Carter announced that by the year 2000 the United States would get at least 20 percent of its energy from renewable sources. The Solar Energy Research Institute (since renamed the National Renewable Energy Laboratory), which I then served as director, was at the heart of this effort. Leading a team of distinguished scientists and analysts drawn from national labs and major universities, SERI prepared the technical and policy blueprint to meet or surpass the 20 percent goal.

Halfway through his first year in office, President Reagan abandoned the goal. Jim Edwards, the dentist who served as Reagan's first secretary of energy, reduced SERI's \$125 million budget to just \$25 million and fired half its staff. President Reagan ordered the solar water heaters ripped off the White House roof.

The successive administrations of George H.W. Bush and Bill Clinton, bobbing along on a sea of cheap oil, did little to promote energy efficiency or to shift America's economy to renewable energy. And for the past eight years, the United States was led by a president whose failings were so great that an energy policy that began and ended with Arctic drilling was not generally considered among his more glaring flaws. Where do we go from here?

### **Launch a Solar Revolution**

On July 17, Al Gore delivered the coda to An Inconvenient Truth. By far the boldest proposal in his speech was this: "I challenge our nation to commit to producing 100 percent of our electricity from renewable energy and truly clean carbon sources within 10 years."

To no one's surprise, Joe Lucas, spokesman for an association of coal-burning utilities, harrumphed that Gore is "not in the mainstream." Lucas is right. Mainstream thinking is precisely what got us into this mess. Gore is operating in the gutsier tradition of Jimmy Carter's "moral equivalent of war."

What does "the moral equivalent of war" actually mean? Let's consider World War II.

In the four years after Pearl Harbor, America produced 324,750 military aircraft, compared to just 4,000 the previous year. America produced more bombers than did all other nations on both sides of the war combined. We also quickly produced 22 aircraft carriers, 349 destroyers, 422 submarines and 88,410 tanks and self-propelled guns. By the end of 1945, the war was over.

Today, more clearly than even in 1941, a fully engaged United States is essential to a global success in the effort to avoid irreparably damaging the world's climate. Without American engagement, climate catastrophe is inevitable. With America mobilized, nothing is impossible.

Moreover, just as WWII catapulted America out of the Depression, this moral equivalent of war would offer a wonderful tonic for an economy plagued by recession, inflation, skyrocketing debt and a growing negative balance of trade.

Navigant Consulting calculates that the recent eight-year extension of the federal solar tax credit will, by itself, create 440,000 permanent jobs. In an economy in which the federal government has given gigantic tax breaks to conventional fuels for the past century, that solar tax break is a sound conservative policy — but it falls far short of a policy targeting 100 percent carbon-free electricity by 2020. The latter would employ countless millions.

The private sector is starting to gear up. Former oil tycoon T. Boone Pickens is building the world's largest wind farm. General Electric, having built one of the world's largest wind turbine businesses, is jumping into solar energy. Applied Materials is taking orders for gigawatt-scale photovoltaic fabs. The Solar Power International conference in October had 500 industrial exhibitors.

Thousands of startups aim to become the Google of renewable energy. So does Google itself!

In fact, one of the most hopeful portents is that the entrepreneurs and venture funds that defeated the monopolies at Ma Bell and IBM are turning their sights on Exxon and Peabody. We've come a long way since 1980, when über-conflicted oil companies dominated big solar and brilliant scientists with limited business skills dominated small solar. This time the solar industry is populated by seasoned entrepreneurs who seek to take over the energy business. With more than 150 solar manufacturing companies around the world — many of them backed by high-tech titans — the oil industry will not be able to buy them all and shut them down as it did in the 1980s.

## **Make It a Federal Priority**

Government has a tradition of helping sunrise industries supplant their well-entrenched predecessors. Canals were encouraged as more efficient than horses. Railroads were viewed as a way to open the West. The interstate highway system replaced many of the functions performed by railroads.

Some renewable energy sources (e.g., photoelectrochemistry) and storage devices (e.g., nano-enabled ultracapacitors) would benefit greatly from mini-Manhattan Project commitments to R&D. Others are poised to ride learning curves to lower prices through mass production — but they require guaranteed markets to elicit the necessary investment. (Computer chips went from being high-priced luxuries to cheap commodities only because the Air Force and NASA bought them in bulk until their prices fell to a level where the private market took over.) Here are a series of federal policies that, combined with a carbon fuel cap-and-auction, would usher in a solar revolution.

**Target Federal Procurement.** The federal government should buy photovoltaic devices in bulk and install them on all federal buildings, military bases and the backs of billboards — pouring the power into the grid. The goal should be to grow the market in a rapid yet predictable way linked to constantly lower prices.

Large federal purchases of computer chips for the military and NASA drove up the volume and drove down the prices of these semiconductor devices until they were cheap enough that the private sector saw an explosion of demand. Now we have semiconductor intelligence integrated throughout our lives. Serious federal purchases of solar photovoltaics could lead these devices to become ubiquitous.

**Construct a Nationwide Smart Grid.** Many carbon-neutral renewable energy sources are intermittent or diurnal. A resilient smart grid will make real-time data available to the grid-operator 24/7 and will embed intelligence on both sides of the meter. The best locations for sources and storage alike are widely dispersed. We need to be able to knit the nation together with a national smart grid. Only the government can assemble the multistate corridor rights and transmission capacity to make such a grid possible. The cost is generally estimated at about \$400 billion spread over 10 years. Forty billion dollars per year is hardly chump change, but remember that the government has invested \$123 billion over the last six months in one large insurance company, AIG, with no chance of the benefits a national smart grid would provide.

**Get Serious About Auto Mileage.** During World War II, Detroit was ordered to stop making cars and start making tanks. Today, Detroit needs to be ordered to stop making civilian tanks and start making cars. Manufacturers should be free to use any technology that can get at least 50 mpg by 2020 and 100 mpg by 2030 — though a preference should be given to electric and plug-in hybrid cars that can also provide distributed back-up storage for the electrical grid. And if Washington awards \$50 billion or so to Detroit to help it get back on its feet and achieve these goals, it should provide parallel incentives to the innovative start-ups like Tesla, Modec, Think, Aptera and a couple of dozen other companies with the guts and vision to challenge Detroit with electric and hybrid cars. It would be tragic if our tax dollars were used to kill these agents of change.

**Build Electrified Railways for Busy Corridors.** America is virtually the only industrial power without high-speed electrified rail — a super-efficient mode of intercity travel that can be carbon-free. If Spain and Italy can do it, America can, too.

**Establish Tough National Building Energy Standards.** We can make all new buildings carbon-neutral by 2025. The astonishing rate at which architects and developers nationwide have adopted the voluntary LEED building standards suggests a deep desire to build structures that will make sense throughout their 50-year lifetimes. We need to build on that momentum to create a new generation of energy-efficient “living buildings.”

**Develop the Green-Collar Workforce.** Reversing climate change has enormous potential to put disenfranchised America back to work. The greatest employment opportunities are for those who will install and maintain photovoltaic and solar thermal-electric facilities, build and maintain wind farms and geothermal plants, and construct and operate the high-speed rail system and smart grid.

We need to increase by a hundredfold the programs, mostly at community colleges, to teach these new skills. Special emphasis should be placed on retraining those who were displaced in the energy transition (such as workers in coal mines) and the inner-city poor who have seen their job prospects disappear in the globalized economy.

## **But How Will We Pay for All This?**

The initial stimulus — to ward off recession and boost employment — will inevitably be paid for with deficit financing. It must begin immediately. I write as a true deficit hawk — appalled to be acknowledging the need to add perhaps another trillion dollars to our national debt. But withdrawing the money from the economy (e.g., in taxes) in order to redirect it to government expenditures would negate the effect of the stimulus.

However, in two years or less President Obama can be in a position to take advantage of a very happy coincidence. In an unexpected “win-win,” the most intriguing potential long-term revenue source in our tax-averse nation turns out to be a climate and energy policy that economists call an “upstream cap and 100 percent auction.” The cap-and-auction would eventually produce hundreds of billions of dollars a year while steering energy investments away from such carbon-intensive fuels as oil, coal, liquids from coal, bituminous sands and oil shale. At the same time, it is the climate strategy most likely to alter the world’s energy markets before irreversible harm is done.

## **Auction — and Account for — Every Carbon Unit**

Any serious program to limit greenhouse gas emissions has to cap carbon at the 2,000 places where it enters the U.S. economy (coal mines, oil fields, pipelines, ports) — not the millions of places where it leaves our smokestacks and tailpipes.

Efforts that focus on emissions themselves are guaranteed to fail because (1) there are far too many emissions sources to efficiently regulate; (2) America periodically goes on a conservative, anti-regulatory jihad, whereas climate policy requires a multi-century commitment; (3) it is impossible to measure, let alone control, a colorless, odorless gas that immediately mixes with the atmosphere from billions of sources (including farms and forests) around the world; and (4) creative traders will find myriad ways to game a system that has multiple sources and sinks. If you liked the \$63 trillion in “credit default swaps” and other unfunded credit derivatives that were traded last year, you are going to love the new derivatives designed around complex international emissions trades.

A global cap-and-trade program is conceptually elegant. However, we lack the real-time knowledge, let alone the enforcement power, to make it function. For example, 17 percent of annual carbon emissions come from deforestation. Almost any forest can be protected for less than the cost of sequestering CO<sub>2</sub> at a power plant, so power plant operators will seek to offset their emissions by buying forests. But forests are complex and varied, with vastly different rates of carbon uptake, and even “protected” forests suffer occasional forest fires. Forests affect climate through evapotranspiration and their albedo as well as by carbon storage; on balance, protected boreal forests in the arctic actually make the earth warmer, not cooler. Even where forest protection is clearly desirable climatically, how do we assure the protection of a forest in Papua New Guinea forever?

A better course is to require carbon permits where carbon fuels enter the economy and use other instruments to safeguard forests and farms. Under a cap-and-auction system, it will be illegal to sell a unit of any fossil fuel in the United States unless the seller possesses a permit for the amount of carbon it contains. In setting the number of carbon permits issued — and thus determining how much coal, oil and gas can enter the economy — the government would be establishing an absolute, easily enforced cap on emissions. (Such a system is part of ASES’ policy recommendations for the 111th Congress.)

By reducing the number of permits auctioned each year, the government can guarantee that its carbon emissions targets are met: no fuel, no emissions.

Companies that use carbon-based fuels will know exactly how much less fuel will be available five years and 10 years from now, and they can adjust their investments and manufacturing processes accordingly.

**It’s critical that all carbon permits be auctioned — not given away.** In Europe, emissions permits were given away to large carbon users to ease their transition to the new trading regime. This gave windfalls to the worst polluters, penalized companies that already had invested in efficient new factories and renewable energy, and helped guarantee that Europe would miss its Kyoto targets.

In contrast, auctioning 100 percent of all carbon permits would be fair and transparent. It benefits firms that have voluntarily reduced their carbon footprints and thus need less fuel. It eliminates backroom special-interest pleadings by recalcitrant firms.

If Congress fears a catastrophic disruption to major industries at this delicate economic moment, it could auction enough permits the first year to reduce the previous year's consumption just 1 percent (so the price of a permit will be very low) and get the system started. It could reduce the number of permits the following year by 2 percent, and then by 3 percent or more in subsequent years after the economy has stabilized.

In addition to reducing greenhouse gas emissions with precision, weaning America off foreign oil and accelerating investments in efficiency and renewable energy sources to produce green jobs, an upstream cap-and-auction would eventually produce hundreds of billions of dollars of revenue each year.

Because an auction would draw money from the economy, and because an auction would require at least a couple of years to get functioning and the first year's cap would probably be fairly loose, it would not serve as a short-term economic stimulus. However, over a four- to eight-year horizon — a horizon of great interest to President-elect Obama — it would combine smart climate policy and smart energy policy with sound financial policy.

Over this longer period, the auction revenues could be used to build a national "smart grid" for electricity to coordinate power from intermittent and diurnal sources; construct high-speed electrified railroads that, unlike airplanes, can operate on carbon-free fuels; assure large federal markets for solar technology and the other sunrise industries of the post-carbon economy; and finance large boosts in federal research. To compensate for the slightly regressive nature of the auction, a portion of the revenues should be used to underwrite training programs for green-collar jobs and to help meet shortfalls facing Medicare or other programs that benefit the poor.

### So, In Conclusion

America has unparalleled scientific and engineering excellence, formidable financial muscle, bountiful natural resources, a democratic political system and an entrepreneurial culture well-suited to helping lead the world into a prosperous, carbon-neutral era. For a fraction of the taxpayer money being spent to bail out an overpaid, under-regulated collection of investment banks, brokerage firms, mortgage companies and insurance companies, we can usher in a solar-powered era.

Let's create a political climate that permits — that ensures — that President Obama and the Democratic Congress take advantage of this opportunity. A crisis is a terrible thing to waste.

**About the author:** Denis Hayes is a recipient of the Charles Greeley Abbot Award, is a Fellow of the American Solar Energy Society and chairs the ASES Board of Trustees. He is president of the Bullitt Foundation and chair emeritus of the International Earth Day Network. During the Carter administration, Hayes was director of the federal Solar Energy Research Institute (now called the National Renewable Energy Laboratory). This article draws heavily on Hayes' article published in June in the online magazine Yale Environment 360, [e360.yale.edu](http://e360.yale.edu).

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