Carbon-Reduction Tax Dollars Better Spent on Demand Reduction, Not Megagrid Schemes

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To address the challenge of climate change, proposals are flying around to develop renewable energy with megaprojects. A year ago, a *Scientific American* article proposed a "Grand Plan" to pave the desert southwest with 30,000 square miles of solar arrays.[1] Similar proposals, such as the Carbon Bullet, are being promoted for massive transmission corridors to new wind farms. These solutions would create many problems. Though proponents paint the nation's deserts as "wastelands" ripe for development, such projects would place severe burdens on the environment, and would provide dubious carbon benefits at great cost.

The Grand Plan requires nearly half a trillion dollars in government subsidies and up to 500,000 miles of high-voltage direct current transmission wires to carry 3,000 gigawatts of solar power. The transcontinental superhighway of wires, which could be tens of miles wide, would dwarf anything we now know.

ENORMOUSLY EXPENSIVE MEGAPROJECT IDEAS MAY NOT WORK

The ideas for renewable megaprojects are reminiscent of the oil rush. T. Boone Pickens proposes to replace the U.S. electric system's reliance on natural gas with huge wind power developments across the windy Central Plains.

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Natural gas provides nearly 20 percent of our electricity, and studies suggest that the grid could assimilate up to 20 percent wind power. However, wind cannot replace the flexibility of natural gas plants and meet peak loads. In fact, one way to counter the variability of wind is to back it up with natural gas. A one-sided proposal to build megawind projects could increase reliance on natural gas, jeopardizing the promised greenhouse gas benefits.

Land-use requirements per unit of solar energy—which appear at first outlandish—are no greater than the equivalent land required for coal.

The megascale approach to green energy, whether the "Grand Solar Plan," the "Pickens Plan," or massive conversion to biofuels, suffers from an array of problems that rival those of the current energy system. A problem common to them all is that the fundamental assumptions and design approaches of the current energy system are being transferred to planning for renewables. For example, the *Scientific American* authors point out that land-use requirements per unit of solar energy—which appear at first outlandish—are no greater than the equivalent land required for coal.

Replacing one colossal system with another colossal system would miss the opportunity to build an array of innovative and cost-effective local energy technologies. The old idea of using resources as though they were unlimited, or without burden to the environment, leads to depletion and exposure to certain risks. The vulnerabilities of the old system, if not addressed, can lead to collapse of the grid, the resource base, ecosystems, and ultimately to the collapse

DOI 10.1002/gas

of political security. The Green Grid presents a new risk—the collapse of carbon policy.

The power sector is the largest carbon emitter, and a supply-oriented system cannot green itself without decentralization and *reduction in energy sales*.[2] This is an inconvenient truth to the industry that is expected to deliver carbon reductions. A crisis is emerging from the energy industry's narrowing of the carbon debate to supply-side solutions that benefit revenues and profits.

Sempra's Sunrise Powerlink Maquiladora Greenwash

An interesting case that illustrates key threats of the "transmission solution" to green energy is the Sunrise Powerlink line. Proposed as a way to bring renewable electricity from Imperial Valley into San Diego, the line would carry 1,000 megawatts of power. Imperial Valley has solar and geothermal resources, and if tapped could enhance San Diego Gas & Electric's (SDG&E's) renewable portfolio. The utility is supposed to reach 20 percent renewables by next year, and a likely mandate of 33 percent by 2020. The utility, which has 9 percent renewables today, claims it cannot comply without the line.

Two lines already allow 2,850 megawatts of imports into San Diego County, sufficient to meet the regular base load and two-thirds of the peak demand for the county. There are 1,848 megawatts of local resources that have been added or are supposed to be brought on line. However, additional existing resources and potential local renewables were not adequately considered in the planning process. It is difficult on first glance to justify the new line on the basis of need. This was the ruling of the administrative law judge at the California Public Utilities Commission (CPUC), which rejected Sunrise Powerlink.

Environmentalists and local not-in-my-backyard opponents (NIMBYs) were upset about Sunrise for several reasons. The utility chose a "shortest route," which cut right through the center of Anza Borrego State Park, a poor choice of alignment. There is a connection point near the border, convenient for accessing new natural gas power plants in Mexico. These plants would be serviced by a gas pipeline from the coast, where Sempra built a liquefied natural gas (LNG) import facility.

The CPUC wanted to overturn the judge's ruling. Commissioner Gruenich proposed a stipulation that SDG&E assure that the line would carry renewable energy. SDG&E refused. Then the commission dropped the renewable requirement and approved a corridor that avoids the state park.

If Sunrise Powerlink is built, it may access natural gas power that will not decrease greenhouse emissions. The power line also increased in price to $1.9 billion. At $1,900, a kilowatt it makes local renewables, efficiency, and demand response look attractive, but megagreens pushed these alternatives aside.

Nuclear Option and Supply-Side Fundamentalism

Some development of central renewable generation is necessary to convert to a low carbon energy system, and transmission wires are needed to access resources. However, much of the frenzy of adding "green transmission lines" to reach renewable energy zones is based on current transmission system use and congestion and assumes that renewables are added on top of the existing system. This ignores the need to *close existing fossil fuel power plants.* This would free up hundreds of gigawatts of transmission capacity for renewables. Closing them may also require physical realignment of some portions of the transmission grid and a major redesign of its operation. But the current grid can carry green electrons as well as brown ones, and—for an efficiently designed system—would not need overall expansion of transmission capacity.

IPCC AR4[3] says that greenhouse gases will have to be reduced 50 to 80 percent below 1990 levels by 2050 in order to stabilize carbon dioxide at a "safe" level. The planet has 40 years or less to completely replace the electric supply with nonemitting generation.

Many in industry and government are considering ways to decarbonize the fuel supply through nuclear power, but this option is not viable. Even if nuclear were given the green light today, it would be a decade before significant new capacity can come on line. From that point, one new nuclear plant would have to be built every four months just to replace the existing 100 gigawatts of nuclear capacity as it retires over the next 40 years.

The result of this approach would be *an increase in carbon emissions*, because of growth in electricity demand from the construction activi-

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ties. And it would be expensive. Estimates of the proposed Turkey Point plant in Florida show "all-in" capacity cost of $5,000 to $8,000 a kilowatt, similar to renewable energy sources.

According to the Energy Information Administration, under base-case assumptions, the nation will need 259 gigawatts of new generation capacity by 2030, which would imply that close to 500 gigawatts of new generation will have to be built by 2050.[4] For this reason, renewable generation must be the centerpiece of the new capacity, and fossil fuel power plants will have to be retrofitted to emit near-zero carbon or shutdown.

California Initiative Ignores Several Key Factors

California's efforts to develop green transmission lines through the Renewable Energy Transmission Initiative (RETI) reveal problems in which green is a pretext for utility infrastructure expansion, with the possibility of minimal or negative carbon impacts.

Utilities maintain that a primary obstacle to compliance with renewable portfolio standards (RPSs) is lack of transmission to haul the electricity from the resource area to the load. There are several critiques of this view:

1. Distributed generation and demand response with islanding can provide much of the supply without new transmission.
2. As renewable resources become operational, fossil resources should be taken off line to free up transmission capacity.
3. Major renewable resources are right next to existing transmission wires.

New transmission can also act as a "back door" for natural gas plants to fill in when the renewables are unavailable. This helps to keep the wires fully used, lowering the average cost per kilowatt-hour on the wire. Putting additional, brown power over the wires generates revenue for the utility and recovers the cost of the investment. In states like California, where profits are "decoupled" from energy sales, and where power generation assets have been divested, transmission becomes a key for making profits. Perversely, a policy designed to reduce the incentive to sell more electricity results in a serious unintended consequence.

The need for new renewables is calculated as a "net short," which involves finding the gap between the current level of renewables and the trajectory of future electric power demand. RETI has not specified how much transmission will be required, but about 14,000 megawatts of capacity would be needed to carry the net short. RETI did not originally take into adequate account the policies that the state is pursuing with regard to higher-priority resources:

1. The Million Solar Roof program to install 3,000 megawatts of distributed photovoltaics by 2016
2. The increased requirement under state policy to obtain all feasible energy efficiency by 2020
3. The increasing targets for demand response that are supposed to ratchet up from the current 3 percent, first to 5 percent and later perhaps to 7 percent of peak demand

Recently, RETI released an analysis of increasing the role of distributed solar and energy efficiency.[5] The report adds to RETI's assumptions that 4,200 megawatts of local photovoltaics will be installed in California by 2020. However, achieving this would (according to their figures) take more than the world's production of thin-film solar modules can produce in eight years. This makes it appear that achieving California's goal would be infeasible by 2020.

RETI also takes up the proposal of meeting the balance of the 33 percent renewable requirement with only local solar power. Calculating that this would take 34,000 megawatts of photovoltaics, they point out that 30,000 megawatts "would require 60 times more thin-film manufacturing capacity than now exists." This assertion is built on incorrect assumptions: last year's worldwide thin-film module production rate was 80 percent higher than the 500 megawatts they cited, they omitted mention of 30 percent to 100 percent annual growth, and they did not consider that the program would be built out over a decade instead of a single year.

Thin-film solar panels represent only a fraction of solar modules, although RETI's point is that it may be the most affordable fraction. Production of all solar cells reached 6,800 megawatts last year, of which 5,900 megawatts were installed. This was more than double the previous year. Even if annual growth slowed to 20 percent

DOI 10.1002/gas

global cumulative production will reach 280,000 megawatts by 2020. This means that the solar industry should be able to meet California's demand over the next decade at any planned level.

RETI's report only considers one-third of solar generation to "count" toward the RPS, because it is not incorporated into the RPS program. A feed-in tariff could allow utilities to obtain credit for solar, but such a program does not exist. Utility purchase of customer renewable energy certificates (RECs) would be another way for local solar to help meet RPS goals. But RETI's one-third credit for solar leaves this resource with only a marginal impact on need for transmission.

Energy efficiency is also considered by RETI, but only in two alternatives: either business as usual or a radical and immediate change in course. A more likely outcome is something in between that would reduce the need for transmission but not by as much as the extreme case. More demand response as a way to free up transmission capacity is not entertained, as the focus is on increasing delivery of kilowatt-hours, not better utilization of existing capacity.

The draft report says that energy efficiency could decrease the need for renewables by 16,161 gigawatt-hours, while local solar could provide 7,358 gigawatt-hours. These could reduce the net short by over one-third, but RETI only accepts about 2,400 gigawatt-hours as a feasible contribution. The analysis leaves the need for transmission lines 96 percent intact in the face of the local energy challenge.

SONOMA COUNTY, CALIFORNIA, PLAN GIVES A WAY THROUGH THE WOODS

The Sonoma County Community Climate Action Plan (SCCCAP, www.coolplan.org) is one of the first to take an in-depth look at how new renewables fit in with a comprehensive greenhouse-gas reduction strategy. The plan shows how to reduce carbon emissions in Sonoma County to 25 percent below 1990 levels by 2015. It includes technology selection, policy development, funding strategies, and private-sector opportunities. The goal of this plan is to produce an integrated set of mutually supporting measures that reach the nation's leading greenhouse gas reduction target. The approach also identifies technologies and policy goals that enable the county to go beyond the 2015 target and toward carbon neutrality by midcentury.

Plan Analysis Showed Utility Procurement Plan Lacking

The SCCCAP also analyzed the utility's (PG&E's) emissions-reduction plans. A detailed carbon analysis was conducted on the 2006 Long-Term Procurement Plan (LTPP) filed by PG&E in March 2007.[6] The LTPP outlines PG&E's strategy for reducing its "carbon footprint." The LTPP ignores Community Choice Aggregation.

The LTPP does not show any kind of long-term planning for PG&E to reduce its emissions levels in a trajectory toward near zero at midcentury. In fact, the LTPP called for an additional 2,300 megawatts of new natural gas power plants, along with an attempt to delay meeting the 2010 RPS to 2013. The LTPP projects declining emissions intensity, a fact often cited by PG&E in its presentations to communities seeking to reduce their carbon emissions such as through Community Choice Aggregation,[7] PG&E has no exit strategy from natural gas generation and offers no meaningful greenhouse gas emissions reduction in its business strategy.

The LTPP estimates emissions intensity based on four scenarios and three plans. The

Exhibit 1. Pacific Gas and Electric Company: Carbon Efficiency in Lb/MWh of Load Plus Avoided Load in 2016

	Scenarios			
Plans	**1**	**2**	**3**	**4**
Basic Procurement	342	409	381	385
Increased Reliability	342	409	381	385
Increased Reliability and Preferred Resources	311	352	349	365

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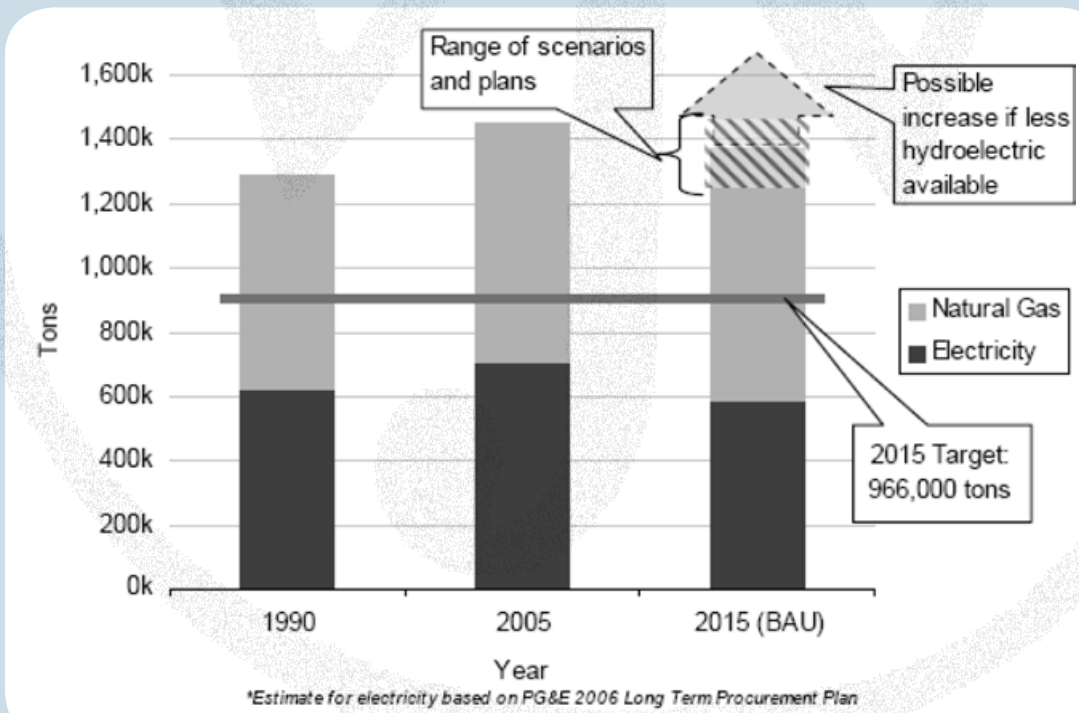
scenarios represent a range of projected load growth, demand profiles, and the availability of existing resources. The plans represent development of different portfolios of new resources. Since implementation of AB 32, the law requiring higher RPSs, PG&E is updating projected carbon intensities to include the new 33 percent RPS requirement by 2020. Early updates of the LTPP show PG&E using the same trajectory for carbon intensity as in the 2006 Plan. **Exhibit 1** shows the intensities estimated for 2016 (in pounds per megawatt-hour).

Exhibit 2 shows total emissions from electricity and natural gas that could be expected in Sonoma County in 2015. *The emissions totals exceed the local target by 35 to nearly 60 percent.* There is the possibility of further increases based on the availability (or lack) of hydroelectric power. One significant feature of SCCCAP is that emissions-reduction measures are structured as public works projects. These are at the scale of water supply systems, wastewater treatment plants, or highways. Procedures for executing public works are familiar to local governments. The SCCCAP was framed as *infrastructure enhancement based on the known effects of climate change on public health and safety.* This framing enables local government to bring important policy and financial tools together to rebuild infrastructure.

There were several lessons learned in developing the SCCCAP that shed light on statewide and national efforts to reduce carbon emissions.

- Reductions in transportation emissions equivalent to other sectors are problematic and probably not achievable in the near term. Long-term restructuring of communities to be less dependent on automobiles will be required.
- Reducing emissions from natural gas is problematic because it will have to be eliminated as an energy source (i.e., you do not want to replace HVAC systems twice—once to improve efficiency, again to eliminate natural gas).
- The electric sector is the most easily solved problem from the standpoint of financing and technology.
- Maximizing emissions reduction in the electricity sector can partly make up for less-responsive sectors.

Exhibit 2. Baseline, Current, and Projected Levels for GHG Emissions From Electricity and Natural Gas Use*



*Estimate for electricity based on PG&E 2006 Long Term Procurement Plan

DOI 10.1002/gas

- Electric vehicles, biofuel production, and virtual capacity must be integrated into local electricity supply planning.
- Most importantly, tools and techniques exist to make minimizing emissions from community-scale electricity practical, replicable, and cost-effective.

Plan Attains Objective Through Community Choice Aggregation

The focus of carbon-reduction efforts in the SCCCAP was based on distribution of emissions *within Sonoma County,* as well as *the sectors where growth has occurred.*

Transportation accounts for about two-thirds of emissions, with the remainder split between electricity and natural gas **(Exhibit 3)**. Although other local emission sources and sinks exist, for the initial reduction effort these were considered minimal.

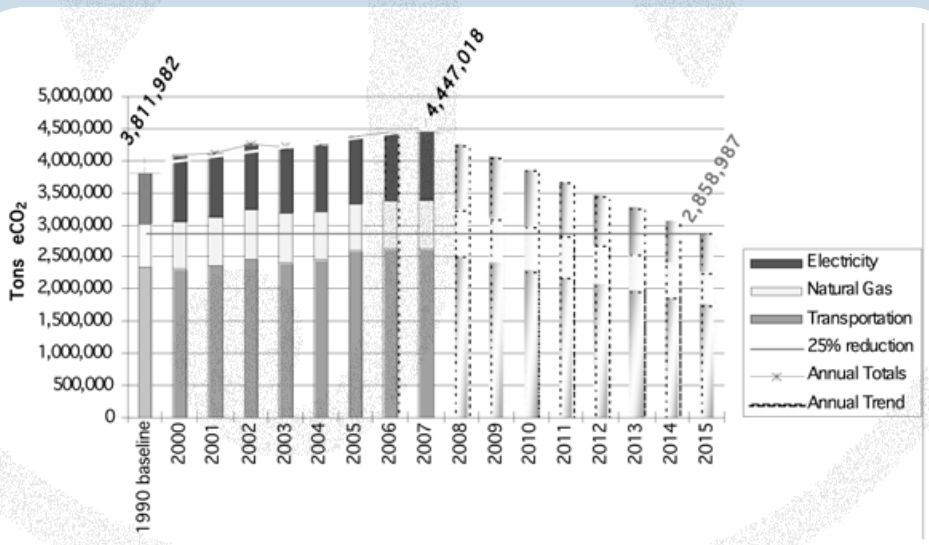
The plan focuses on local actions to reduce emissions from electricity, natural gas, and transportation fuels. Three observations were made at the outset:

1. The ability to physically colocate energy production facilities and end-users of heat has high value.
2. It is critical to integrate solutions for building energy, transportation energy, and energy used by municipal services (i.e., water supply and wastewater treatment).
3. Detailed assessment of local resources for serving thermal and electrical needs is key to a high-value local energy system.

Development of a local, minimum carbon electricity generation portfolio was accomplished based upon the above observations. As shown in **Exhibit 4,** there are sufficient resources within Sonoma County to support an electricity supply consisting of over 66 percent renewables. The portfolio is 80 percent carbon-free, and the fossil fuel portion of the portfolio is highly efficient natural gas combined heat and power units.

This portfolio assumes that delivery of energy-efficiency upgrades is aggressive and well funded, and that the local power authority is able to implement demand response as part of the initial portfolio. Virtual capacity[8] development is essential to reducing the need for higher-cost peaking generation. The plan found that with appropriate funding mechanisms, efficiency programs can be designed to overcome economic barriers to uptake of best available technology

Exhibit 3. Sonoma County Total CO_2 Emissions: Electricity, Natural Gas, and Transportation (Updated 2008)



Source: Climate Protection Campaign.

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for most social groups (i.e., renters, low-income homeowners, and small businesses).

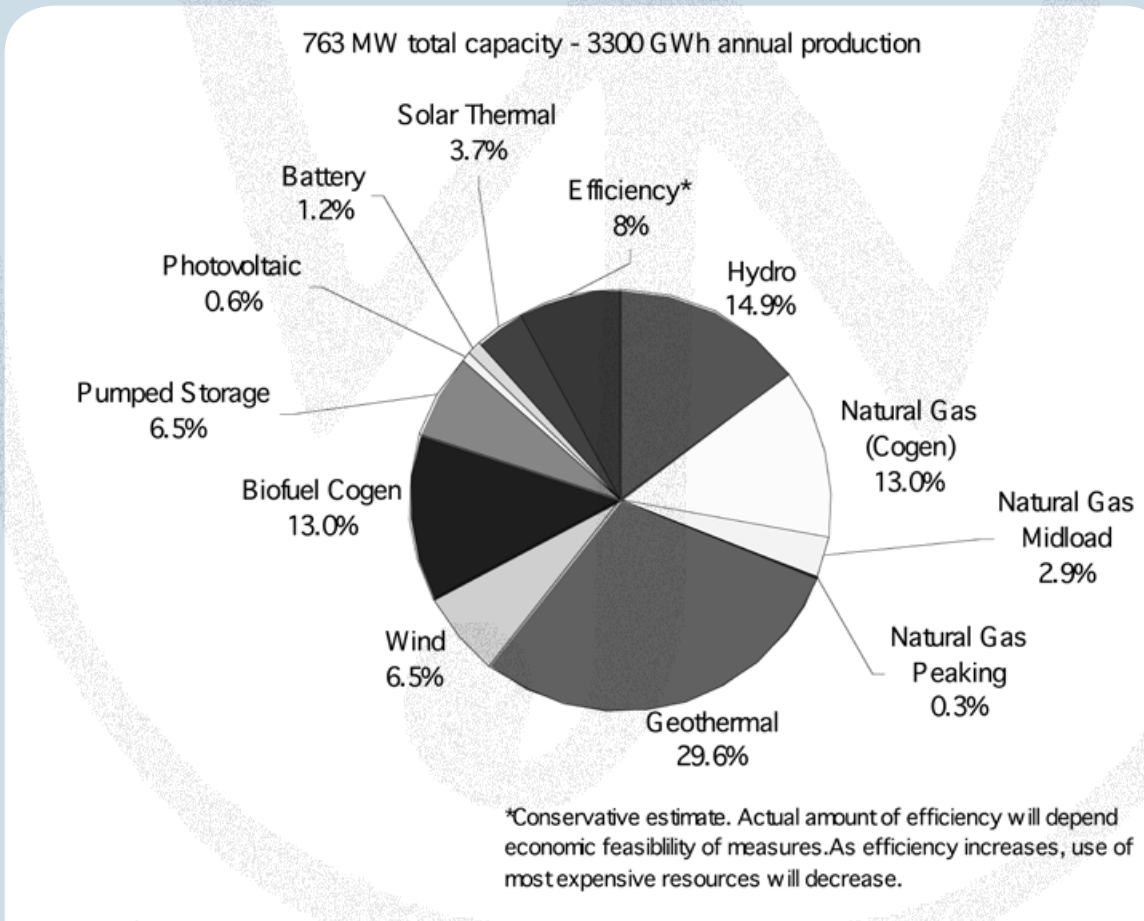
Local energy resources are a focal point of emissions reduction in the plan. Geothermal heat sources in the county were found to be significant.[9] Low-temperature geothermal resources should be exploited for small-scale base load power, along with district heating to replace natural gas. Biomass cogeneration from municipal and agricultural solid organic waste could contribute to low-carbon electricity and natural gas replacement.

The SCCCAP could achieve carbon emission reductions in the electricity and natural gas sectors that far exceed the targets for these sectors. Implementation of the electricity portfolio would result in nearly 60 percent reduction of emissions below the 1990 level **(Exhibit 5)**. Overall, the reductions obtained using thermal measures for natural gas replacement, local electricity generation, and virtual capacity were nearly enough to make up for shortfalls in the transportation sector **(Exhibit 6)**.

The SCCCAP shows that it is possible to make the necessary emissions reductions by implementing aggressive measures at the local level. California has determined that local and regional reduction programs are essential to the success of AB 32 in reaching the state's greenhouse gas targets. The state is still unable to specify a complete set of measures that will achieve the statewide target of reducing carbon emissions to 1990 levels by 2020.[10]

For local governments, proactive carbon emissions reduction is highly advisable. Most localities (those without local, stable supplies of energy) will see inexorable increases in energy

Exhibit 4. SEA Portfolio—2015



Source: Climate Protection Campaign.

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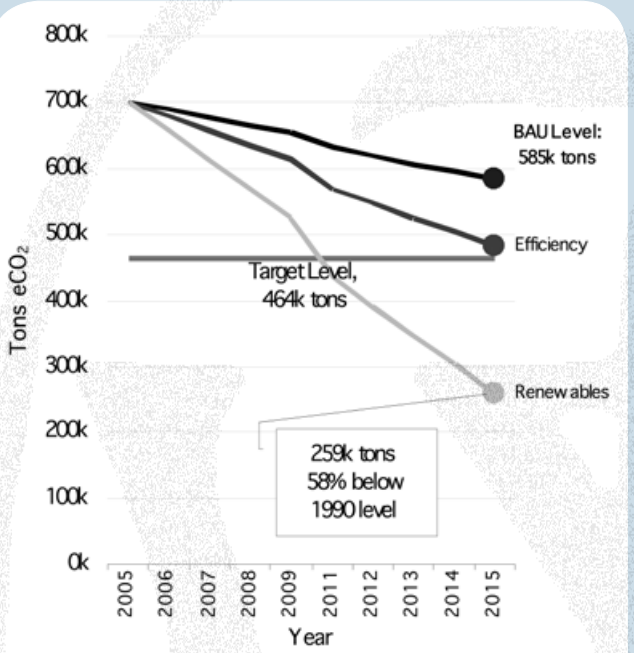
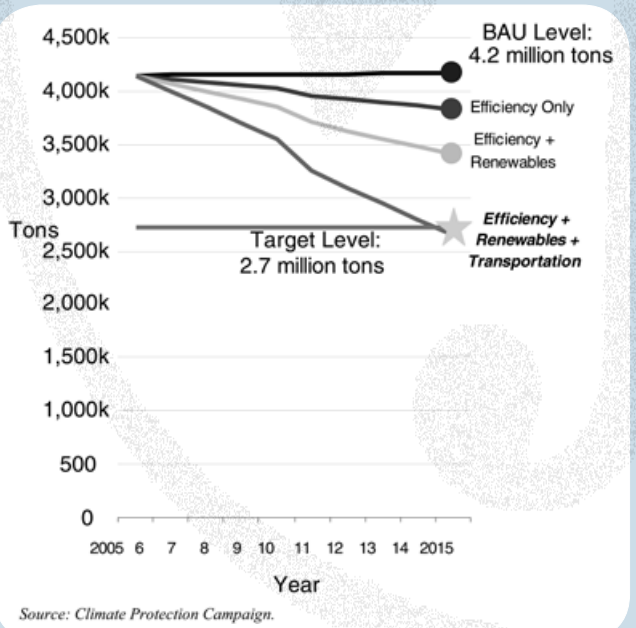
Exhibit 5. Electricity-Sector Wedges for Sonoma County 2005–2015



Source: Climate Protection Campaign.

Exhibit 6. Emissions-Reduction Wedges for Sonoma County 2005–2015



Source: Climate Protection Campaign.

prices. This is partly by design, as the state internalizes the cost of carbon emissions into the price of fossil fuels.

CONCLUSION: RELOCALIZE OR MELT

Centralization of a Green Super-Grid will entrench the U.S. power industry in infrastructure design that is ill suited to the specific needs of a low-carbon system, and will present a choice between requiring a massive public subsidy and significant economic damage, or else a policy collapse with unacceptable consequences in the twenty-first century. A policy discussion about reducing global carbon emissions on the necessary scale must contend with how to green the power sector, reduce fuel use and power sales, and decentralize the power grid. Feasible examples, such as the SCCCAP, could achieve the necessary carbon reductions without massive subsidies or draconian rate increases.

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Accomplishing these reductions will depend upon policy leaders who are willing to take a look at disrupting the existing profit base of energy companies in order to solve the global climate crisis, before it is too late.

NOTES

1. Zweibel, K., Mason, J., & Fthenakis, V. (2008, January). A grand solar plan. *Scientific American*, pp. 64–74.
2. See Fenn, P., & Freehling, R. (2009, March). Obama's Smart Grid legislation, *Natural Gas & Electricity*, pp. 1–7.
3. Table SPM.6, p. 20, Climate Change 2007: Synthesis Report, Summary for Policymakers, IPCC.
4. Annual Energy Outlook 2009, Energy Information Administration. Report #:DOE/EIA-0383(2009), p. 72.
5. California's Renewable Energy Goals Assessing the Need for Additional Transmission Facilities, March 2009. RETI.
6. Pacific Gas and Electric, 2006 Long Term Procurement Plan, Volume 1, Section V—Procurement Strategy by Resource.
7. See Golub, H., & Fenn, P. (2008, February). Community choice aggregation is a new solution for energy markets. *Natural Gas & Electricity*, pp. 18–22.
8. See note 2.
9. State Geothermal Database for State of California, Geo-Heat Center, Oregon Institute of Technology.
10. Climate Change Proposed Scoping Plan, prepared by the California Air Resource Board, October 2008.

  / DOI 10.1002/gas