HIGH PERFORMANCE CLIMATE PROTECTION

Systems Solutions for Systems Problems

Ned Orrett, P.E., Resource Performance Partners, Inc.

Good news! Solutions already exist to actually *decrease* our greenhouse gas emissions rather than just slow their increase. Better yet, innovations in technology, design methods, and management practices are rapidly providing more solutions that both reduce greenhouse gas emissions and support our health, quality of life, natural environment, business climate, and economies.

Opportunities run the gamut from simple and inexpensive home retrofits, to complex, multi-stakeholder regional projects. Examples include:

- More energy and water efficient household appliances
- Industrial facility resource efficiency improvement projects
- Photovoltaic panels for buildings
- Climate-friendly transportation fuels
- High-performance “green” buildings and development
- Smart urban planning and transportation schemes
- Sophisticated municipal water, wastewater, and solid waste utility programs that increasingly supplant resource throughput with efficiency services
- Projects to comprehensively reuse agricultural waste locally
- Sustainability Management System / ISO 14001 EMS for organizations
- Utility ratepayer aggregation for competitive energy services

The list expands daily as new technologies and strategies rush to the market. As it becomes apparent that more attractive options are becoming available, the next step is to explore means to integrate these technologies and strategies more fully and effectively into our economy. Instead of simply offering photovoltaic solar cells into the market, for example, perhaps our entire approach to energy may be adjusted to a way that is far more beneficial from multiple perspectives.

This section suggests that benefits will expand exponentially when we transform our approach from incremental solutions to greenhouse gas emission reduction to whole system solutions. Three examples of solutions that combine large emissions reductions with multiple benefits are presented.

A SYSTEM APPROACH

Nobody ever set out to generate greenhouse gases. These emissions are the unintended by-products of the many other things that people *have* wanted to generate, like readily available transportation, light in our homes and offices, and water to drink, bathe in, and irrigate gardens. As we become aware of and begin to address GHG emissions, a natural first step is to take whatever individual action we can. However, it soon becomes apparent that individual efforts are constrained by institutional barriers. A whole system approach is needed to improve leverage to achieve the results needed. The challenge is big, but so are the rewards.

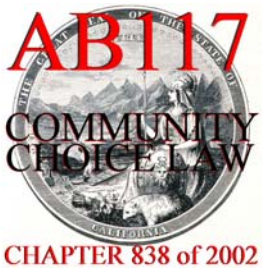
Whether the private sector's focus on immediate value, or the public utility tradition of meeting all resource demands imposed upon them, the conditions required for designing enduring solutions (as occur in nature) are rarely present today. The goal of reducing GHG emissions within a meaningful timeframe calls for design solutions that extend beyond the traditional boundaries of current resource management, public policy, and business practices. Climate change is a systemic challenge that realistically requires a systems-level response: integrated planning and implementation that engages people and institutions from multiple disciplines and jurisdictions. While there is a growing awareness of the interrelatedness between resource flows and their impacts, it is difficult for institutions and organizations to reorient themselves to take advantage of this knowledge.

The financial advantage of taking a larger view is compelling, however, and will inevitably educe better design practices and technologies — for individual projects, organizational structures, and beyond.

This systems orientation — based upon an understanding of how the individual pieces and resource flows relate to one another — is the context for the examples outlined below. These examples represent systems-oriented approaches that can be pursued immediately in the areas of energy, water, and agricultural waste to significantly reduce our County's greenhouse gas emissions. As important as these specific examples may be, the main intent here is simply to illustrate that large opportunities exist, and that they await discovery more often in the space *between* today's institutional and infrastructure boundaries than within.

❖ ❖ ❖ ❖ ❖

COMMUNITY CHOICE: ***A Tool for Transforming Local Electricity Service***



Electricity use alone in Sonoma County in 2001 caused 950,000 tons of GHG emissions, and presented a collective tab of $350 million.[1] This is a significant portion of the County's total contribution to global warming, and a major drain from our economy. Fortunately, means are available to reverse both effects.

In short, we need to reduce our emissions while keeping more money at home. The laws of physics tells us how to do the former: (1) improve the electrical efficiency of existing uses, (2) maximize the efficiency of new uses, and (3) reduce the unit emissions associated with the supply of electricity. To reduce economic leakage, the physical changes must be accomplished while lowering overall costs, employing locally owned services, or both.

Recent state legislation provides the authority for local government to enable dramatic improvements in these areas. As being used by the City and County of San Francisco to advance towards its national precedent-setting goal of building 200 MW of new non-

[1] Total emissions and costs reflect electrical service to all of Sonoma County except the City of Healdsburg. Emission estimate courtesy of Ed Myers of Provimetrics Corp.

polluting capacity (50 MW solar, 50 MW of other renewables, and 100 MW of efficiency), the two most important components are:

- Community Choice Law: AB 117, sponsored by Carole Migden (D- San Francisco), written by Paul Fenn; now in the Public Utilities Code as Chapter 838 of 2002, and currently being considered for implementation by at least 60 California cities; and

- Revenue Bonds: Proposition H of 2001 (also written by Paul Fenn) amended San Francisco's City Charter to create Section 9.107.8. This provides authority for the San Francisco Board of Supervisors to issue "Solar" H Bonds to finance or refinance any renewable energy or conservation facilities. H Bond Authority may be used for either the public or private sectors, without restriction on either bond repayment mechanism or total amount (state law notwithstanding). Most municipalities and counties in California already have authority to issue H Bonds.[2]

The Community Choice Law provides California cities and counties (individually or together) the opportunity to band together, or aggregate, all electricity customers within their jurisdiction for the purpose of soliciting and negotiating cost-effective, competitive bids from energy service providers on behalf of the aggregation. According to the consumer watchdog group Public Citizen:

> "…[This legislation] *would provide more options currently denied to California consumers to negotiate for cheaper, more reliable, and more environmentally friendly electricity*."[3]

A key element of the Community Choice Law is its "opt-out" provision: Once a community chooses to pursue aggregation, individual customers are automatically included in the aggregation unless they specifically elect to opt out. This feature makes aggregation a viable option, as it simplifies the ability to achieve sufficient market mass to attract competitive energy service proposals.

Opt-out aggregation enables local government to play the role of "buying agent" for its citizens, and is not the same as municipalization. Under Community Choice as applied to Sonoma County, PG&E would retain its role of delivering energy and collecting revenue. Local government would, however, facilitate the process of selecting an Energy Service Provider that would (1) supply electricity through PG&E's existing transmission grid, and (2) coordinate the delivery of efficiency and "distributed generation" services (using both renewable and fossil fuels) to individual customers.

In Massachusetts, the Cape Light Compact (an aggregation of 40,000 customers from a 21 county area encompassing Cape Cod

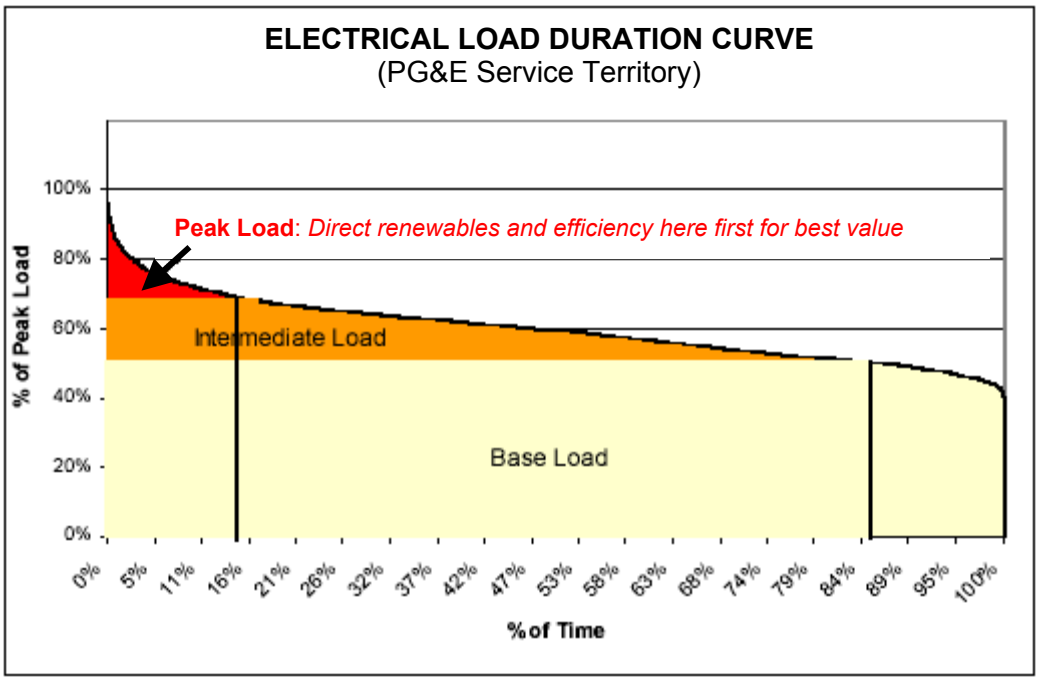
[2] Paul Fenn may be reached at: 510.451.1727; www.local.org

[3] California "Community Choice": An Easy Option to Protect Consumers (http://www.citizen.org/pressroom/release.cfm?ID=598)

and Martha's Vineyard), are being served by a competitive energy service provider under a contract that delivers savings on their electricity bills of 11 to 22 percent, returns control of the ratepayer's energy efficiency funds to the community, and offer two new renewable energy products for consumers choose from.

The City of Parma, Ohio, aggregated its energy customer base of 90,000 and is currently enjoying significant rate savings. Elsewhere in Ohio, the nation's largest aggregated group combined the electricity load of more than 300,000 people across 97 municipalities to secure a competitively bid contract that offers rate savings along with a guaranteed minimum of renewable energy.

The power of local control over local efficiency efforts and distributed generation projects is the key to the profound advantage of Community Choice. Important economic benefits for customers - lowering costs and minimizing price volatility to residents and businesses, and improving energy reliability - are achieved by strategic provision of energy efficiency, load shaving, and load reduction elements (including onsite generation) in a community's resource mix, and generally establishing a new level of demand responsiveness. When the demand side services are enhanced with municipal financial capabilities, as planned in San Francisco, and strategically deployed to make an Aggregation's load profile less costly to serve, green energy technologies will become price-competitive with fossil-fueled electricity generation (see following figure).[4] In contrast to today's mix of services, these will improve community economic benefits and reduce greenhouse gas emissions.



[4] Figure adapted from Fig. 3-2 in San Francisco LAFCO AB 117 Implementation Plan (R. W. Beck, Inc., June 2003)

By giving communities access to electrical load data and providing local control over rate design, Community Choice removes historic barriers to renewable energy and conservation measures, allows the integration of more efficient and better performing solar and other green energy facilities where they perform best, and shares the costs and benefits of such systems across all aggregated customers in the community.

Community Choice Aggregation can also direct financial support toward the high performance design of future facilities. The incremental cost of initially designing buildings or industrial processes for high performance is far less than that of improving poorly designed facilities later. A Community Choice Aggregation could support the development of advanced building codes, and even better, the education and implementation techniques that will advance the performance capability of the entire North Bay development industry. The investment required to do this well is a small fraction of the money that will otherwise leave the community first through excessive energy bill payments, and later in the problematic attempt to mitigate unnecessary GHG emissions and other liabilities. Creatively structured, CCA can avoid this waste by supporting green building efforts that must otherwise compete for scarce municipal funds.

The Community Choice law provides an unusually powerful opportunity for local government to support action to reduce greenhouse gas emissions associated with the use of electricity. The joint progress toward Climate Protection by all Sonoma County cities, and the County government, provides the ideal platform for engaging this tool, for the entire County presents a combined electrical load sufficient to attract the attention of top Energy Service Providers. The total revenue value of a ten-year countywide electricity contract could exceed $1 billion.

Evidence from the application of Community Choice elsewhere proves the ability to reduce electricity bills and achieve significant pollution reductions at the same time. Its capacity for reducing GHG emissions, however, can be expanded beyond anything seen to date. Key means for accomplishing this objective include:

- Working with the CPUC to maximize the ability to direct locally-derived Public Goods Charges ("PGC;" a cost embedded in electricity bills) to efficiency services provided to the local Aggregation;
- Supplementing aggregation and PGC funds with "Solar" H Bonds (as intended in San Francisco) to support additional demand side services that will lower overall costs and improve GHG performance as a standard green component of the community's chosen electricity fuel mix;
- Provide opportunities for individual customers to purchase premium packages of services that go beyond normal electricity services, while benefiting from the bulk purchase opportunity (a large-scale version of Sebastopol's solar rooftop project, enhanced with high efficiency appliances, daylighting, worm bins for food waste, etc.);
- Include solar water heating installations to mitigate significant NO_X and CO_2 emissions from natural gas-burning water-heaters;
- Include water efficiency measures, supported with appropriate financial incentives from water and wastewater agencies, among the energy efficiency

measures employed to minimize the overall cost of electrical service for the Aggregation;

- Integrating high performance energy and water efficiency techniques for ***new construction*** (e.g., including high performance building codes, education throughout the development community, performance-based design fees for architects, etc.);
- Investing sufficiently to develop superior technical information (e.g., detailed load data, penetration of various efficiency measures, growth projections, transmission and distribution infrastructure data, local service capabilities) so all Energy Service Provider bidders will have the data necessary to maximize demand side service opportunities; and
- ***Designing the Energy Service Provider procurement process as an innovation in itself that will help transform the electric utility industry to provide environmentally benign community economic development services instead of mere kilowatt-hours.***

California's Community Choice Law provides an unprecedented opportunity for local governments to plan and implement Kyoto-scale greenhouse gas reductions, if not more, within the electricity sector during the immediate, medium, and long terms. Aside from climate-friendly land use planning, it is difficult to comprehend a greater service local government can provide today than to engage CCA as outlined above.

❖ ❖ ❖ ❖ ❖

"HOLD THE FLOW!" ***Climate Protection Through Water Efficiency, Watershed Preservation, and Economic Development***

Water use is inextricably linked to GHG emissions and climate change. Analyses provided in another chapter of this report describe the GHG emissions due to energy use throughout Sonoma County's municipal water and wastewater infrastructure. Emissions are also created where water is used (e.g., due to local heating, pumping, treatment, etc.). Pollutants discharged into water create additional GHG emissions due to energy demands at wastewater treatment facilities, methane evolved during processing that is not captured, and mechanically enhanced bacteriological respiration. Of particular consequence is feedback through the water cycle itself, because climatic warming will reduce the average winter snow pack, and change the runoff regime into reservoirs to one different than they were designed for. While the principal effect will occur in the Sierra Nevada, there will also be a local effect, given the area of the Eel River watershed upstream of Lake Pillsbury that receives snowfall. In addition to these effects, the economic, social, and environmental costs of expanding the capacity of traditional water and wastewater infrastructure are rising exponentially.

GHG emissions related to water use will be reduced by improving the energy efficiency of both water service infrastructure and all water-using equipment at points of use. Furthermore, any steps taken to reduce the demand for water will save energy, and thereby reduce GHG emissions. Local efforts undertaken to date include:

- **Sonoma County Water Agency:** Designed and built hydroelectric plant at Warm Springs Dam
- **City of Petaluma:** made greenhouse gas emissions a prominent design consideration for its new wastewater treatment plant
- **City of Santa Rosa:**
    - Installed new aeration blowers (shown at right) that use 30% less energy, reduce Laguna Wastewater Treatment Plant GHG emissions by 750 tons eCO2/yr, and save $220,000/yr in electricity costs.[5]

    - Designing efficiency improvements for two major reclaimed wastewater pump stations that are projected to reduce energy use 35%, GHG emissions by 140 tons eCO2/yr, and save $70,000/yr in electricity costs.
- **All:** water efficiency services (California Urban Water Conservation Council's Best Management Practices)

In looking to the future, the most promising area for achieving GHG reductions in the water sector, while also generating value elsewhere, may lie with giving more attention to efficiency improvements for customers. Although much progress has been made with basic savings measures, a larger investment may be justified for saving water than ever before because technology continues to improve and fall in cost, and more sophisticated delivery mechanisms are available. Examples include:

Better Technology:

- Modern irrigation controller: automatically recalculates irrigation schedules in response to local evapotranspiration data received via inexpensive radio signal from satellite. Huge potential for reducing peak water (and electricity) use: one recent study identified savings of nearly 5 million gallons per year for less than a 1-year payback at a single Petaluma business park.
- 1.0 gpm toilets (vs. today's 1.6 gpf ultra low flush toilet); waterless urinals
- Real time industrial process controls

Sophisticated Delivery Systems:

- Introduce water efficiency services, charged on the bill, as a profit center for water utilities, thus removing sole reliance upon water sales (and the internal conflict this dependence creates with efficiency services). This eliminates the initial cash hurdle for utilities and customers, simplifies budgeting by spreading costs predictably over time, and protects ratepayers by pegging payments to performance and requiring participants to repay any balance owed when closing an account.

[5] Opportunity discovered and solution designed by Provimetrics Corp. (Santa Rosa, CA)

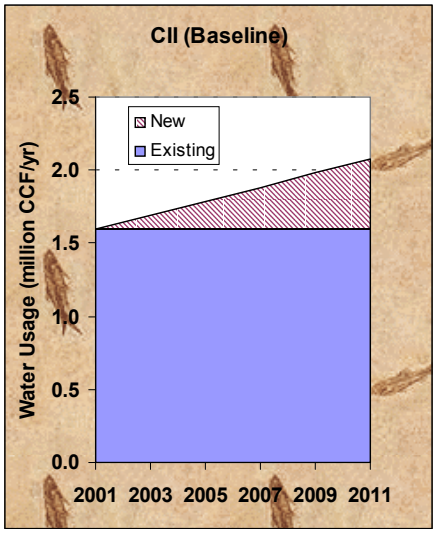
- Apply superior science, engineering, and techniques of innovation diffusion to develop standardized high performance audit procedures for delivery by technicians to all categories of end uses
- Develop efficiency projects that span multiple customers *and* resources, to combine long and short payback elements to maximize total resource savings within the desired financial performance threshold
- Apply rigorous financial accountability to track the average and marginal cost of all water resource alternatives
- Provide opportunity for third parties to offer comprehensive efficiency services, which can often provide more advanced technologies and strategies than those deployed by most public sector utility departments. Private service providers may also deliver services on a performance basis, which enables municipalities to simplify their demand-side budgeting procedures, track results, and achieve better overall financial performance.
- Develop cap-and-trade system for water rights to further improve the market for efficiency services, support least-cost investment in efficiency among watershed users, and eventually attract water back into our rivers and groundwater basins.

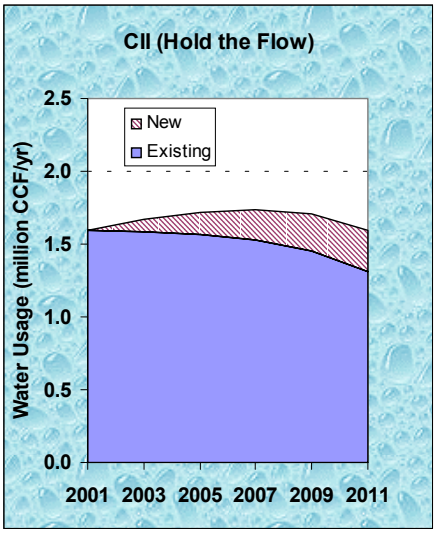
Higher Investment Justified:

Water efficiency funding is often sub optimal because unit investment lags behind marginal water and wastewater costs, funds are typically derived from cash flow and grants instead of the debt financing employed for water supply, wastewater, and reclaim projects; and environmental and social factors are often not valued at all, among other reasons. Accordingly, consideration of the following will generally justify increased investment in water efficiency programs designed for performance:

- Concept: water efficiency projects should be funded at least to a level equivalent to that of providing service from the next water supply, wastewater, or reclamation project, as appropriate. This is measured by:
    - The unit *marginal* capital cost of infrastructure projects (presently skyrocketing), and
    - Marginal unit variable cost (with electricity valued as derived from *renewable* fuel, given the GHG reduction objective at hand)
- System-wide energy benefits provided by water efficiency (e.g., a reduction in irrigation water demand will also reduce the peak energy demand, thereby reducing the cost of energy under a Community Choice Aggregation scheme)
- Value of avoiding potential future economic, environmental, or social liabilities associated with water extraction or wastewater discharge
- Ancillary benefits such as pollution reduction (e.g., improved landscape design and maintenance practices will reduce pesticide runoff from commercial landscapes).

The City of Petaluma sponsored a study in 2002 that applied some of the techniques noted above to the design of a program for all of its non-residential water customers.[6] The result: a $10 million city investment (~ ten times more than planned today) is likely to offset the entire 23% increase in net demand otherwise expected from this sector, and $17 million in related infrastructure costs otherwise anticipated (i.e., $7 million net savings to the City, additional savings to customers, *and* no increase in GHG emissions related to this service). This reflects a program designed to optimize a system, instead of only a part. This study was based upon evidence from other programs, and is steadily being confirmed by local demonstration projects.





Critical to high performance results such as that indicated above is the need to invest considerably more in design intelligence, especially at a systems level, than is now the practice. Quality of design is a leading indicator for whether the eventual outcome will provide incremental or transformational results.

❖ ❖ ❖ ❖ ❖

AGRICULTURAL BIODIGESTER: *Cow-Powered Climate Protection*

An unusual opportunity to create economic, social, and environmental benefits while reducing a significant source of greenhouse gas emissions waits in the agricultural sector. Agricultural waste, including food waste within cities, is a drain on our economy, a potential pollution liability, and a source of GHG emissions (both directly and indirectly via the electricity required by wastewater treatment plants). The largest direct source of agriculturally related GHG emissions in the North Bay is probably dairy manure. This is increasingly a burden for cash-starved ranchers as regulatory pressure rises in response to concerns of nutrient overloading that threatens soil, groundwater, and surface waters, both ashore and at sea. Ranchers have built manure containment ponds to control

[6] *Hold The Flow! Commercial, Industrial, and Institutional Water Efficiency Program for the City of Petaluma*, Edwin Orrett, June 2002.

pollution, but these have the unintended but natural consequence of emitting methane, a powerful greenhouse gas. The portion of manure that does not fully decompose to methane emits strong odors when the ponds are cleaned in the fall, thereby further adding to problems that beset local agriculture. Meanwhile, there remains a strong public desire for open space: a service that farms provide "for free" – that is, as long as they remain profitable.

There are approximately 30,000 milking cows in the North Bay, and most of their manure is presently collected and stored in ponds. The methane emitted from these ponds represents approximately 170,000 tons of GHG emissions per year (expressed as equivalent tons of CO_2).[7] However, this situation can be changed dramatically. A well-established biotechnology called anaerobic digestion can be employed to fully develop the methane potential of the manure and convert it to climate-neutral energy (heat, electricity, and possibly liquid or compressed gas fuel), thereby also avoiding even more emissions. In addition, virtually all of the nutrients will be preserved in biologically stable, odor-free, easily handled liquid digestate for application to the land; and stabilized fibers are recoverable for use in potting mixes or as sterile, absorbent bedding for cows. The economic value of anaerobic digesters further improves when other organic waste material – such as concentrated organic food processing waste – is combined with manure as feedstock. In the Danish practice, a relatively small volume of such material may double the energy produced by a manure digester ***and*** subtract from the GHG-intensive electricity otherwise required by municipal wastewater plants to treat this material.

Proven anaerobic digestion technology is available to provide this solution (either as one digester on each farm, or as in Denmark, where professionally managed centralized units serve surrounding farms via vacuum trucks). The highly developed interest in sustainable agriculture in the North Bay portends good value for the digester's organic nutrient and fiber products. The interest in maintaining agriculture, consistently affirmed in all local government General Plans, is matched by equivalent political support for open space. And now, there is the possibility to develop more than enough GHG emission reductions (e.g., >200,000 tons eCO_2/yr) with this single program to ***offset all emissions identified for local government***. By managing agricultural wastes in a biologically and economically responsible manner, this will also provide ***climate neutral energy, reduce the energy-intensive manufacture and transport of synthetic fertilizer, reduce the mining and transport of peat moss, eliminate a pollution liability, and improve the financial strength of local family farms.***

---

[7] Assumptions: 30,000 mature cows, each weighing ~1,400 lb, with 3.65 lb of volatile solids per year in the manure per pound of cow, and a maximum potential for 3.84 cubic feet of methane to evolve per pound of volatile solids. With the further assumptions that 70% of this manure is directed into "lagoons" (probably conservative for the North Bay), and that 90% of the volatile solids therein will typically decompose into methane, the annual result is 371 million cubic feet or 8,200 tons of methane emitted from the natural breakdown of manure. Given methane's global warming potential relative to carbon dioxide of 21 (based upon a 100-year lifecycle), this is approximately 170,000 tons/yr of equivalent CO_2. [Reference for methane generation factors: Kenneth Krisch, "*Proposed California Climate Action Registry Protocol for Methane Emissions from California Dairies* (Draft)," Sustainable Conservation: 26 Aug 2002. The number of dairy cows, and applicable manure management methods, are author's estimates and deserve attention from and correction by appropriate agricultural authorities.]

A vacuum truck transports pathogen free, treated manure slurry from the Ribe Biogas Plant to one of 25 decentralized fertilizer storage tanks. The latter serve the 69 farms from which the manure came, and 72 others. The Ribe Plant receives as its fuel wastes from cattle, pig, poultry, and mink farms, slaughterhouses, and food processors. Energy output (heat and electricity), formerly produced by coal, is sold to the City of Ribe. This is one of approximately 20 such biogas plants in Denmark.

A team including UC Cooperative Extension, Resource Performance Partners, and Clover Stornetta Farms, headed by the Southern Sonoma County Resource Conservation District, applied in 2003 to submit a proposal for a grant to develop a self-funding program that will provide anaerobic digesters and crop-based nutrient management services throughout the North Bay milkshed. The team will focus, among other things, on getting past the most important institutional barrier that thwarts progress: inability to wheel renewable electricity at a price that makes the project viable from the outset.

❖ ❖ ❖ ❖ ❖

These three examples of innovative, trans-institutional, multi-stakeholder projects begin to suggest the opportunities available to us here in Sonoma County for reversing our greenhouse gas trend. While they entail greater complexity to design and implement than single-issue or single-product projects, they offer exponentially higher environmental, social, and economic rewards. In Sonoma County we have the technical expertise, the innovative spirit, and the resources to accomplish projects like these and many others. In the process, we will maintain the County at the forefront of the nation's efforts to reduce its climate changing impacts, and do so in a sustainable way. ***When do we start?***

The Author: *Ned Orrett, MS, P.E., co-founder of Resource Performance Partners, Inc., and Technical Advisor with the Sonoma County GHG Inventory Project, is constantly aware of both the enormous vitality promised by a restorative economy, and the vast changes required to achieve them. Accordingly, he is schooled in hope, faith, and whatever bubbles up from his experience, and education in civil engineering and ecology. Mr. Orrett may be reached in Petaluma at 707.769.5335; company information is available at: www.resourceperform.com*