



Chapter 5: Local Action Plan Long Term Initiatives Sustainable Energy

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Planning for Sustainable Energy

Every community can move toward supplying its energy in ways that are clean, secure, affordable, and that meet citizens’ needs abundantly. This is called a sustainable energy system. Achieving it will mean increasing the supply of energy that comes from locally based, renewable sources. It will also mean using sources of energy more efficiently. Many communities are already moving in this direction. You can, too.

How Does Your Community Meet its Needs for Energy Now

A good first step in developing a plan to meet a community’s energy needs now and into the future is to understand how the community currently gets its

energy. Most citizens in a community have no idea where their energy comes from. Many have no idea that a typical community now spends as much as 20% of its gross income buying energy. Because most of this energy comes from outside the community, 80% of those dollars immediately leave the local economy. This means that most towns are slowly bleeding to death economically.

Achieving a sustainable energy future will require putting in place a very different energy supply system than most cities have now. On average for the U.S. communities use very little renewable energy. The Department of Energy (DOE) estimates that the U.S. in 2004 got only 5.7% of its energy from renewable sources. Business as usual projections forecast that the U.S would get only 1% more renewable energy by 2030.¹

¹ U.S. DOE, U.S. Energy Information Administration, “Annual Energy Outlook 2006,” p. 11. The EIA also forecasts annual world energy consumption growth by fuel to 2030 as follows (reference case IEO2006 model): Oil – 1.5%; Natural Gas – 2.5%; Coal – 2.5%; Nuclear – 0.9%; Renewable/other – 2.4%. This projects an overall annual growth of energy consumption of 2%. Source: Energy Information Administration, “International Energy Outlook 2006,” June 2006. Both sources available at www.eia.doe.gov, 30 October 2006.

<u>U.S. Primary Energy Sources</u>	<u>2004</u>	<u>2030 (projected)</u>
Petroleum products	40.3%	40.0%
Natural Gas	23.2%	20.7%
Coal	22.6%	25.7%
Nuclear Power	8.2%	6.8%
Renewable Energy	5.7%	6.7%

Table: Business as Usual Energy Projections

The projection from the Energy Information Administration (EIA) for 2030 could also be called the “do-nothing” option. It illustrates that little progress towards using renewable energy can be expected without deliberate action on the part of cities, regions, states and the federal government. But as described throughout this manual, change is coming. The way we currently meet our energy needs will not continue.

Nearly 40% of primary energy used in the U.S. now goes to producing electricity. Most of this is coal that is burned in central station power plants, contributing to global warming and producing enormous quantities of waste heat and pollution. The resulting electricity is then shipped through massive power lines to the final customers. In the whole process, well over two thirds of the original energy is lost. These huge inefficiencies in electrical

generation and distribution systems mean that electricity supplies only 16% of the energy that is delivered to customers.

The remaining 60% of primary energy is used directly in buildings, industrial processes and transportation. There are large inefficiencies in these uses as well. For instance, an automobile is approximately 1% efficient at converting the energy stored in fuel into actually moving the driver. All of the remaining energy produces heat and pollution.² Following the 1979 oil price increase, tougher vehicle efficiency standards reduced U.S. use of oil 15% over the five years at the same time that the economy grew by 16%. Given that there are cars now on the road getting over 60 miles per gallon, and the vehicle fleet average is 21 MPH, there obviously remains a large scope for increased efficiency.³

In addition, existing energy systems are vulnerable.⁴ Recent estimates of the economic costs of ordinary power outages and power fluctuations in the U.S. put the cost of such disruptions as high as \$188 billion annually.⁵ This number would obviously be dwarfed by significant natural or terrorist disruptions.

In part because of this, many industries have moved to supply part or all of their own energy. By 2001, “non-utility” providers (an owner of electric generating capacity that is not an electric utility) were providing one-sixth of the nation’s electricity. There is a rapidly expanding marketplace for distributed energy.

Enormous economic and energy security benefits can be obtained through greater use of “distributed” energy sources, meaning energy sources physically close to, and matched

² Because of heat and combustion losses, the engine, transmission, and tires (and other energy-consuming components such as options) of a standard automobile convert only 20% of the gasoline’s energy into movement of the vehicle. The people in the car may constitute only 5% of the weight of the car that is moved forward (150 lbs of 3000 lbs). Hence, 20% efficiency to move only 5% of the car’s weight means only 1% of the fuel’s energy moves the people forward. See Paul Hawken, Amory B. Lovins and L. Hunter Lovins, *Natural Capitalism – Creating the Next Industrial Revolution*, Little, Brown, 1999, p. 24, and generally Chapter 2: “Reinventing the Wheels.” Steve Heckerth, a contributing editor to *Mother Earth News* and electric vehicle advocate, estimates that the lifecycle of carbon-based fuels used in internal combustion engines (the “sun to wheel efficiency of biofuels”) is only 0.01% to 0.07% – see Steve Heckerth, “Why We Need Electric Cars,” *Mother Earth News*, October/November 2006.

³ CAFE (Corporate Average Fuel Efficiency) standards for vehicles enabled the country to increase the fuel efficiency of new U.S.-built cars 7 mpg in six years. Europe achieved similar savings but did it through higher fuel taxes rather than efficiency standards. Between 1977 and 1985, U.S. oil imports fell 42%, depriving OPEC of one-eighth of its market. The entire world oil market shrank by one-tenth; OPEC’s share was cut from 52% to 30%, driving down world oil prices. The U.S. alone accounted for one-fourth of that reduction. On average, new cars each drove 1% fewer miles, but used 20% fewer gallons. Only 4% of those savings came from making the cars smaller.

⁴ For a full discussion of the vulnerability of domestic energy systems see Lovins, A and Lovins H, *Brittle Power*, available for free download from www.natcapsolutions.org/resources.htm#ART, 30 October 2006.

⁵ Craig Morris, *Energy Switch – Proven Solutions for a Renewable Future*, New Society Publishers, 2006, p. 10, citing a report by Primen. Morris notes that power problems are much less in the EU, partly due to underground power lines.

in scale with end-uses.⁶ Most of current “distributed generation” is not renewable. Much of it is gas-fired cogeneration, but increasingly new additions of distributed generation feature solar or wind power.

U.S. Department of Energy Assistant Secretary David Garman notes:

Aside from its obvious environmental benefits, solar and other distributed energy resources can enhance our energy security. Distributed generation at many locations around the grid increases power reliability and quality while reducing the strain on the electricity transmission system.⁷

Envisioning a Sustainable Energy System

Before a town can decide what energy future it wishes to develop, its citizens need to be educated about the technologies that are available and in use in other communities. The community should also understand the costs associated with doing things in a different way and as well as the costs that inaction would impose. For all of the reasons outlined in this manual, continuing to meet our energy needs as we have in the past may not be an option. Failure to undertake an

aggressive transition to the best technologies now available will actually penalize a town. For instance, an examination of one utility’s reluctance to buy wind electricity instead of natural gas plants showed that the decision forced consumers to pay nearly \$200 million in unnecessary electricity bills over the past five years. If the utility had purchased wind, the bills would have been lower, and the community would have been on its way to a carbon neutral future.⁸

A community that wishes to meet the energy needs of its citizens without emitting GHGs must lay out a strategy for transitioning its energy supply from fossil fuels to renewable energy.⁹

Such a plan sets forth:

A vision of a sustainable energy system that will meet the community’s greenhouse gas (GHG) goals/limits and renewable energy goals;

A plan to meet the needs for vehicle fuels, electricity, and facility energy needs and production opportunities;

City/regional government’s intent to take short- and long-term renewable energy actions on a local and regional scale;
and

Partnerships with key stakeholders: utilities, vehicle fuel providers, other levels of government, and major employers or energy users.

Efficient Use of Energy

A sustainable energy plan will be founded on the efficient use of energy. The actions presented in this manual to reduce emissions of GHGs are an excellent starting point. When undertaking an analysis of the opportunities to save energy it is wise to disaggregate energy use so that it is clear what kinds of energy different end-uses require. Studies that aggregate information into sectors such as residential or commercial make it hard to understand what programs will work best, and then what supply measures will enable users to run vehicles, or deliver power to computers most effectively.

Based on the actual needs of a community, a plan will describe where to get additional energy supplies once all the cost effective energy savings measures have been implemented. Fortunately, many studies have shown that it is possible to meet all of the energy needs of a dynamic growing industrial society using energy efficiently and deriving it from

⁶ Amory B. Lovins et al., *Small is Profitable – The Hidden Economic Benefits of Making Electrical Resources the Right Size*, Rocky Mountain Institute, 2002. Available at www.smallisprofitable.org, 30 October 2006.

⁷ Lovins, *Small is Profitable*, p. 47.

⁸ Jane E. Pater, “Wind On The Public Service Company of Colorado System,” *North American Windpower* magazine, October 2006, p. 44. The study conducted by the Interwest Energy Alliance found that Public Service Company of Colorado’s decisions to purchase 775 MW of wind power beginning 1999, which saved consumers over \$251 million 1999-2005, could have been 1,038 MW instead – which would have saved over \$438 million.

⁹ For more on this topic, see James Kunstler, *The Long Emergency – Surviving the End of Oil, Climate Change, and Other Converging Catastrophes of the Twenty-First Century*, Grove Press, 2005.

the various renewable forms of energy.¹⁰

In most cases, new sources of energy are more expensive than older ones. A good strategy both for protecting the climate and for keeping your local energy bill lower is to buy enough energy efficiency to avoid the need to bring on new sources of power—for example, in the case of electricity, achieving “no load growth.” This is a relatively simple equation to manage: ensure that what the community invests in energy efficiency each year is sufficient to offset any population growth, economic growth and energy-use growth unrelated to the first two. So long as energy end-uses remain unregulated and/or customers do not see effective efficiency incentives, it can be expected that consumers will add devices such as plasma televisions (which use five times the energy of a regular television) and other energy-inefficient appliances that in the aggregate are costly to the community’s residents and businesses.

Proven examples of energy savings opportunities¹¹:

Properly choosing office equipment and commercial and household appliances has saved over two-thirds of their energy use with the same or better service and comparable or lower cost.

Skilled retrofits have saved 70–

90% of office and retail lighting energy, yet the light quality is more attractive and the occupants can see better. In most cases, the better lighting equipment lasts far longer and so more than pays for itself by costing less to maintain.

Motors use three-fourths of industrial electricity, three-fifths of all electricity, and more primary energy than highway vehicles. This use is highly concentrated: about half of all motor electricity is used in the million largest motors, three-fourths in the three million largest. Since big motors use their own capital cost’s worth of electricity every few weeks, switching to more efficient motors can pay back quickly. This plus retrofitting the rest of the motor system saves about half its energy and pays back in around 16 months.

The chemical industry saved half its energy per unit of product during 1973–90 by plugging steam leaks, installing insulation, and recovering lost heat. Now it’s discovered that better catalysts and matching heat to the required temperature can often save 70% or so of what’s left, yet pay back within two years. Next-generation industrial plant design, now moving from the chemical industry into semiconductors, is uncovering 50–75% savings with lower

capital cost, faster construction, and better performance. Early adopters will prosper.

Many of these examples illustrate a new design concept: that whole-system engineering can often make it cheaper to save a larger than a smaller fraction of energy use. This typically comes from integrating the design of an entire package of measures so they do multiple duty (such as better design saving on both energy and equipment costs), or piggyback on renovations being done anyway for other reasons, or both. Good engineers think this is fun. Most economic theorists assume it is impossible.

Efficiency opportunities expand far into the future:

Just selling “waste” heat to other users could cost-effectively save up to about 30% of U.S. and 45% of Japanese industrial energy. (America’s power stations waste more heat than Japan’s total energy use.)

Still largely unexploited are new kinds of heat exchangers and motors, membrane separators and smart materials, sensors and controls, rapid prototyping and ultraprecision fabrication, and radically more frugal processes using enzymes, bacteria, and biological design principles.

¹⁰ ASES, Tackling Climate Change in the U.S., www.ases.org/climatechange, 1 February 2007

NRDC, Reducing U.S. Oil Dependence A Real Energy Security Policy, www.nrdc.org/air/energy/fensec.asp, 1 February 2007

Apollo Alliance, www.fypower.org/pdf/ApolloAll_StateReport.pdf 1 February 2007

Nuclear Information and Resource Services, www.nirs.org/press/10-05-2006/1, 1 February 2007.

¹¹ This list is taken from Lovins, A and Lovins H, Climate Making Sense and Making Money, 1998, www.natcapsolutions.org/publications_files/climate_sense.pdf, 30 October 2006.

Saving materials also saves the energy needed to produce, process, transport, and dispose of them. Product longevity, minimum-materials design and manufacturing, recovery of any scrap not designed out, repair, reuse, remanufacturing and recycling together present a formidable menu of business opportunities that also save energy, pollution, mining, and landfilling. Japan cut its materials intensity by 40% just during 1973–84; but far more is yet to come. Americans throw away enough aluminum to rebuild the country's commercial aircraft fleet every three months, even though recycling aluminum takes 95% less energy than making it from scratch. Smart manufacturers now take their products back for profitable remanufacturing, as IBM did with computers in Japan and Xerox does with photocopiers worldwide.

Many energy savings reduce climatic threats from more gases than just CO₂. Advanced refrigerators, using vacuum insulation and helium-engine coolers, can save over 90% of the energy of a standard refrigerator, thus avoid burning enough coal to fill the refrigerator every year. They also eliminate climate-

and ozone-disrupting cfc's from insulation and refrigerant. Landfill and coal-mine gas recovery turns heat-trapping and hazardous methane emissions into a valuable fuel while making electricity that displaces coal-burning (see the chapter on waste management). Recycling paper (the average person in a rich country uses as much wood for paper, mostly wasted, as the average person in a poor country uses for fuel) saves it from turning into landfill methane, and also saves the fossil-fueled used in manufacturing and transportation. These and scores more examples represent business opportunities with multiple profit streams.

Best Practice Examples of Community End-Use Strategies:

The U.S. Federal Government conducts extensive programs to reduce energy end-use at facilities, with an overall goal of 2% annual reduction in each facility. This is achieved through systematic audits through operations such as the Federal Energy Management Program of the National Renewable Energy Lab and Oak Ridge National Lab.¹²

The Department of Defense's (DoD) Energy Policy includes a

goal of conducting energy savings with less than a ten years payback.¹³ The DoD's Energy Conservation Investment Program saves \$3-4 for every \$1 invested over the investment lifecycle.¹⁴

Leading companies pursuing best practices regarding end-use energy management include multi-national firms Interface Inc., DuPont Corp., STMicroelectronics, ALCOA, ALCAN, Wal-Mart, Honda and SC Johnson. Mid-size or small businesses include Hot Lips Pizza of Portland, OR; New Belgium Brewing of Ft. Collins, CO; the IGA Market in Sacramento, CA.¹⁵

Clean Air Cool Planet is a small, compelling organization dedicated to finding and promoting solutions to global warming. They're a great example of a small non-profit that is making impressive changes in the carbon emissions of all sorts of industries. They partner with companies (Timberland, Verizon, Harbec Plastics), campuses (Harvard, MIT, Yale) and communities in the Northeast to help them reduce their carbon emissions in ways that make financial sense.¹⁶

Leading academic institutions pursuing best practices include

¹² For an overview of the U.S. Department of Energy's facilities program see "Department of Energy – Energy Conservation at Federal Facilities Report" at www.er.doe.gov/epic/docs/FedFacilitiesReport.pdf. Outstanding environmental management examples receive Closing the Circle awards, given annually, from the White House's Office of the Federal Environmental Executive – see www.ofee.gov, 30 October 2006.

¹³ The DoD policy to implement all projects with less than a 10 yr. payback is from "The Department of Defense Energy Manager's Handbook", prepared by the Intuitive Research and Technology Corporation, August 2005, available at www.acq.osd.mil/ie/irm/Energy/Energy%20Manager%20Support/EnergyManagerSupport.htm, 30 October 2006.

¹⁴ See Commander Rob Tomiak, "Department of Defense Energy Management Program", powerpoint presentation, 17 August 2005.

¹⁵ For other small business examples, see the EPA Energy Star awards for small businesses at www.energystar.gov/index.cfm?c=sb_success.sb_2006winners, 30 October 2006.

¹⁶ Clean Air- Cool Planet, www.cleanair-coolplanet.org/, 30 October 2006.

the University of Calgary, Canada; Tufts of Boston, MA.

Many utilities have programs similar to Nevada Power, which provides cash rebates for energy efficient appliances and air conditioners, and installs devices that reduce air conditioning electrical demand during summer peaks.¹⁷

The consumer-owned electric utility serving Gainesville, Florida decoupled profits from energy sales to help promote efficiency.¹⁸

Seattle adopted an energy building code in 2004 stronger than the International Energy Conservation Code standards.¹⁹

Berkeley requires energy saving retrofits when homes are sold or significantly upgraded.²⁰

Several cities, including Ashland, Oregon provide extensive assistance to homeowners for energy audits and energy-use upgrades.²¹

Energy efficiency can be implemented very rapidly, by either or both of two quite different methods.²² In the 1970s and '80s, as now, there were high or rising energy prices and a sense of urgency: During roughly 1975–85, most new U.S. energy-using

devices—cars, buildings, refrigerators, lighting systems, etc.—doubled their efficiency, improving at an annual rate averaging around 7%.

If all Americans saved electricity as quickly and cheaply as ten million people served by Southern California Edison Company did during 1983–85, then each year they'd decrease the forecast need for power supplies a decade hence by about 7%, at a cost to the utility around one-tenth that of today's cheapest new power stations.

In the 1980s, skillful utilities captured ~70–90+% of particular efficiency markets, mainly difficult ones like retrofitting house shells, in just one or two years.

During 1990–96, utility facilitation enabled electric customers in Seattle—with the cheapest electricity of any major U.S. city—to save electric load nearly 12 times as fast as those in Chicago, and electric energy more than 3,600 times as fast, even though Seattle electricity prices are about half of Chicago's. This conclusively shows that making an informed, effective, and efficient market in energy-saving devices and practices—as Seattle City Light's efforts helped to do—can fully substitute for a bare price

signal, and indeed can influence energy-saving choices even more than can price alone. That is, people can save energy faster if they have extensive ability to respond to a weak price signal than if they have little ability to respond to a strong one.

Investor-owned utilities, when rewarded for cutting bills, sold efficiency ever faster and more skillfully despite falling electricity prices. In 1990, New England Electric System captured 90% of a small-commercial pilot retrofit market in two months. Pacific Gas and Electric Company captured 25% of its entire new-commercial-construction market—150% of the year's target—in three months, so it raised its 1991 target...and captured all of it in the first nine days of January.

Renewable Energy Sources

Renewable energy generally means power that comes from natural processes such as sunlight, wind, water flows, or earth's natural heat sources (geothermal) and that are inexhaustible. These are also called clean energy sources. Whether these sources are truly *sustainable* depends on whether they take no more from the earth than can truly be renewed, whether they are produced in

¹⁷ Apollo Alliance, "New Energy for Cities – Energy Saving and Job Creation Policies for Local Governments," p. 1:21, www.apolloalliance.org/docUploads/new%5Fenergy%5Fcities%2Epdf, also archived at, www.natcapsolutions.org/ClimateManual/Cities/Chapter5/LongTermInitiatives/SustainableEnergy/ApolloAlliance_EnergyforCities.pdf, 30 October 2006.

¹⁸ Ibid. p. 1:24.

¹⁹ Ibid. p. 1:13.

²⁰ Ibid. p. 1:15.

²¹ Ibid.

²² This list is taken from Lovins, A and Lovins H, *Climate Making Sense and Making Money*, 1998, www.natcapsolutions.org/publications_files/climate_sense.pdf, 30 October 2006.

ways that do not pollute and whether they are deployed in ways that respect people and nature. There are many ways to supply energy, but some, like nuclear power, are neither clean, safe nor cost-effective. Others like hydrogen are still experimental. Others like solar space satellites have unfortunate military applications, and are extremely costly. None of these are considered “clean technologies,” even though they may be argued to be renewable or non-carbon.

Sustainable energy planning does not necessarily mean that the municipal government must go into the energy business using municipal enterprises. This may be a good idea, and many cities are considering “municipalizing” their energy suppliers, but a city can equally well work with existing utilities to ensure that energy efficiency and renewable energy are made available for its citizens and to future generations.²³

Some cities find that it is useful to work with their citizens to develop a long-term vision of what sustainability can mean for their community. Such a vision can motivate people and guide community investment. Without a vision, investments for incremental improvements may not achieve the economic and social advantages of a strategic

plan to meet the community’s needs sustainably.

What is a realistic but aggressive vision for maximizing renewable energy for your community by, say, 2025? How much change can actually be achieved in the next 20 years? A dramatically different future from the one foreseen by the U.S. Department of Energy, is both desirable and doable. Several organizations have offered maps for increasing sustainable energy use:

The Union of Concerned Scientists offers a Clean Energy Blueprint that would achieve by 2020:²⁴

Renewable sources meeting 20% of U.S. electricity needs;

Consumer savings of \$105 billion per year;

Avoidance of 975 new power plants and billions of energy infrastructure costs (such as pipelines, etc.) and retirement of 180 old coal plants and nine major nuclear plants; and

Reduction of natural gas consumption by 18%, coal consumption by 60%, carbon dioxide emissions by 67%, sulfur dioxide emissions by 55%, and nitrogen oxide emissions by 55% from “business as usual” projections.

The Apollo Alliance plan for clean energy cities in the U.S. includes the following goals:²⁵

Generate 25% of electricity from renewable sources;

Reduce oil consumption by 25% by 2025; and

Build efficient transportation systems and high-performance (green) buildings.

The Rocky Mountain Institute’s “Oil End-Game”²⁶ plan proposes that the U.S. could eliminate its petroleum products dependence for energy through:

Highly efficient buildings and vehicles that double fuel efficiency (52% savings);

Domestic biofuels production (25%); and

Substitution of natural gas for the remaining petroleum (25%).

Numerous strategies developed both abroad and domestically illustrate proactive means of creating more sustainable energy policy. For example, the EU has adopted the Energy Intelligent Europe Initiative, tying European competitiveness and quality of life to a transition away from fossil fuels to energy efficiency and renewables.²⁷

²³ See Johnston, David Cay, Some Californians to Pick Their Utility at the Polls New York Times, 3 Nov 2006 www.nytimes.com/2006/11/03/business/03utility.html?_r=1&ref=science&oref=slogin, 30 October 2006.

²⁴ Union of Concerned Scientists, with the American Council for an Energy-efficient Economy and The Tellus Institute, “Clean Energy Blueprint – A Smarter National Energy Policy for Today and the Future,” available at www.ucsusa.org, 30 October 2006.

²⁵ The Apollo Alliance, “New Energy for Cities,” 2006, available at www.apolloalliance.org, 30 October 2006.

²⁶ Amory B. Lovins et al., “Winning the Oil End Game – Innovation for Profits, Jobs and Security,” Rocky Mountain Institute, 2004; available from www.oilendgame.com, 30 October 2006.

²⁷ The strategy was first laid out in Energy for the Future: Renewable Sources of Energy See p. 9, section 1.3.1. An Ambitious Target for the Union europa.eu.int/comm/energy/library/599fi_en.pdf, 30 October 2006.

The German Renewable Energy Act (2001) outlined a renewable energy strategy for that country. The German approach included the “eco-tax” (*Ökosteuer*) that raised gasoline costs by \$.18/gallon by 2004.²⁸ The German Renewable Energy Act calls for reaching 20% of electricity and 10% of primary energy from renewable sources by 2020; and 50% of primary energy from renewable sources by 2050, through the following strategies:²⁹

Fixed remuneration that gives incentives for renewable energy sources (ranging from \$.055/kwhr for wind to \$.574

for solar photovoltaic) that is reevaluated every two years

Simple and transparent structure

Incentives for continuous renewable energy cost reduction

High security for investors

No dependence on public budgets

Financed by energy utilities

Steps taken towards internalizing external costs

City and state governments in the U.S. are also adopting innovative strategies to promote renewable energy.

As of Spring 2006, 20 states plus the District of Columbia have adopted programs that mandate getting a certain percentage of electricity production from renewable sources.³⁰ These “renewable portfolio” programs encourage utilities and citizens to use more renewable energy. California and New Jersey have adopted particularly ambitious goals. Examples of U.S. renewable energy programs include:

Renewable Energy

CASE STUDY: State of California

California’s Solar Initiative (2005) aims to increase the amount of installed solar capacity on rooftops by 3,000 MW by 2017 with investor-owned utilities through.³¹

\$3.2 billion for photovoltaic and concentrated solar rebates;

Exempting low-income households from any rate increases associated with

the program and using 10% of the funds for projects for low-income households

CONTACT

Go Solar California
www.gosolarcalifornia.ca.gov/

²⁸ According to Morris, following adoption of the Eco-tax, gasoline sales fell for four consecutive years and 87% of consumers want a car with higher gas mileage. Gas tax revenues were used to reduce non-wage labor costs such as health insurance.

²⁹ Dr. Manfred Fishedick, Wuppertal Institute, “The German Renewable Energy Act – Success and Ongoing Challenges,” 2004. Available at: www.wupperinst.org/download/renewables/ICORE.pdf, 30 October 2006.

³⁰ See map of state systems as of 2005 provided by U.S. Department of Energy at www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm, 30 October 2006.

³¹ The incentives apply only to investor owned utilities because the California PUC does not have jurisdiction over municipal utilities. See www.cpuc.ca.gov/PUBLISHED/News_release/52745.htm, 30 October 2006. www.seia.org/solarnews.php?id=93, 30 October 2006.

Renewable Energy

CASE STUDY: State of New Jersey

New Jersey's Clean Energy Program calls for 1,500 MW of solar electricity installations in the state by 2020 through:³²

A Renewable Portfolio Standard of 6.5% by 2008 with a target of 20% by 2020.³³

The Clean Power Choice program that offers consumers the option to purchase renewable electricity;

Financial incentives for high-performance green buildings

Creation and trading of "Solar Renewable Energy Certificates" which financially reward distributed energy producers who help utilities meet renewable portfolio requirements

Examples of renewable energy goals adopted by U.S. cities include:

Renewable Energy

CASE STUDY: Santa Monica, CA

The city of Santa Monica, California set goals and programs include:

100% renewable energy purchases by city operations

25% of community electricity from renewable energy sources by 2010, including 1% from distributed sources

Maximizing non-petroleum fuel use in city fleet vehicles (80% already achieved)

Posting "Sustainable City Progress Reports" on the internet that include pages on GHG emissions, energy use, renewable energy, and transportation

The 2006 "Community Energy Independence

Initiative," which will demonstrate how "energy efficiency, solar energy and distributed generation can work together effectively and how greater energy independence provides economic benefit to the community" through 50 pilot projects on buildings. These projects will lead to a city-wide effort.³⁴

³² A report on the program found that overwhelming demand was causing significant rebate delays – see Steven Lacey, RenewableEnergyAccess.com, "The Price of Success – Inside the New Jersey Clean Energy Program, 12 October 2006, at www.renewableenergyaccess.com/rea/news/story?id=46172, 30 October 2006.

³³ See New Jersey Clean Energy website: www.njcep.com, 30 October 2006.

³⁴ City of Santa Monica Environmental Programs Division website, www.santa-monica.org/epd, 30 October 2006.

Renewable Energy

CASE STUDY: San Diego, CA

In 2003, the San Diego, California region adopted the “Regional Energy Strategy 2030.” This program articulates nine goals to “achieve an integrated approach to meeting the energy needs and supporting the prosperity” of the region. The goals address energy security, efficiency and sources, including:³⁵

In-county capacity to generate 75% of summer electrical demand peaks (to be achieved by 2020);

Supplying 40% of electricity from renewable sources of which 50% are in-county;

Supplying 30% of peak electrical demand from “clean distributed” sources;

Reducing per capita electricity peak demand and total consumption to 1980 levels; and

Reducing natural gas per capita consumption by 15%.

Renewable Energy

CASE STUDY: Chicago, IL

Chicago, Illinois programs include:

The Chicago Solar Partnership, begun in 2000, which combines solar energy unit production in the city with city purchases of solar power and various financial incentives for business and residents to install solar panels;³⁶

The Bike 2015 plan which encourages Chicagoans to make at least 5% of all trips less than five miles via bicycle, and also aims to reduce bicycle accidents;³⁷

A goal to generate 20% of electricity for city facilities from renewable sources by 2010;

Home weatherization for low-income families; and

City support of Spire Solar Company so that jobs from solar manufacturing will be retained in Chicago, and the city will have access to solar cells.

³⁵ San Diego Regional Energy Office, “Energy 2030 – the San Diego Regional Energy Strategy,” 2003, available at www.sdenergy.org, 30 October 2006.

³⁶ The Chicago Solar Partnership web site, www.chicagosolarpartnership.com, 30 October 2006.

³⁷ See www.bike2015plan.org/, 30 October 2006.

Bridging the Gaps Between Alternative Energy Scenarios

At present, most energy planning is done in a disintegrated fashion. Little connection (i.e., whole-system thinking) is drawn between the planning that is done to supply vehicle fuels and planning that ensures supply to residential and commercial facilities (electricity and direct consumption). Vehicle fuel is delivered by the private sector, partially in response to state and federal government taxes/incentives and regulations.

For example, vehicle fuel planning typically takes three forms:

Fuel production and distribution planning by private energy providers (e.g., petroleum companies and, increasingly, bio-fuel companies);

Air quality planning by local air quality boards or districts;

Alternative fuel plans created by state or local governments.

Communities can intervene in these systems to ensure that energy is supplied in ways that are cost-effective and secure.

Best Renewable Energy Practices to Supply Fuel Examples

Private sector:

- As of summer 2006, 65 privately owned biodiesel manufacturing plants had opened in the U.S. with 49 more under construction.³⁸ In 2005, BP launched its “low-carbon energy” business, an \$8 billion investment over ten years to provide cleaner power sources.³⁹ Through the U.S. Department of Energy’s Hydrogen Plan, BP, which produces 5,000 tons of hydrogen daily, collaborated with Ford Motor Co. and DaimlerChrysler in 2004 to build hydrogen fleet fueling stations in California, Florida and Michigan.⁴⁰ The company expects to complete engineering studies in 2006 of a hydrogen power plant in Carson, CA, using petroleum coke as a fuel. The carbon

emissions from converting natural gas to hydrogen (4 million tons per year) are planned to be sequestered underground.⁴¹

Air quality planning:

- The South Coast Air Quality Management District serving the Los Angeles metro area has an extensive Clean Fuels program that co-funds dozens of demonstration projects annually.⁴²
- British Columbia government’s climate change plan includes programs of the air quality division designed to reduce GHGs and improve efficient use of vehicle fuels, including the “Scrap-it Program” that rewards demolition of older, highly polluting vehicles in exchange for rebates on cleaner vehicles and a goal for attaining 30% green vehicles in the government’s fleet by 2008. The program also publishes tests of hybrid performance.⁴³

³⁸ Information about the growth of biodiesel through private investments is available at the website of the National Biodiesel Board; www.biodiesel.org/resources/pressreleases/gen/20060629_willienelsonpacifcbiodieselopening.pdf, 30 October 2006.

³⁹ BP Sustainability Report 2005 “Making Energy More,” www.bp.com/liveassets/bp_internet/globalbp/STAGING/global_assets/downloads/S/bp_sustainability_report_2.pdf, also archived at www.natcapsolutions.org/ClimateManual/Cities/Chapter5/LongTermInitiatives/SustainableEnergy/bp_report_2005.pdf, 30 October 2006.

⁴⁰ BP corporate website, press release 27 April 2004: www.bp.com/genericarticle.do?categoryId=2012968&contentId=2017980, 30 October 2006. The first Los Angeles area hydrogen fueling station was a partnership with the South Coast Air Quality Management District. BP has also invested in several hydrogen fueling sites in the EU.

⁴¹ BP Sustainability Report 2005, p. 43., www.bp.com/liveassets/bp_internet/globalbp/STAGING/global_assets/downloads/S/bp_sustainability_report_2.pdf, also archived at www.natcapsolutions.org/ClimateManual/Cities/Chapter5/LongTermInitiatives/SustainableEnergy/bp_report_2005.pdf, 30 October 2006.

⁴² In 2004, the AQMD contributed \$15 million to the total of \$44 million that funded 63 projects including expansion of natural gas and hydrogen fueling infrastructure and natural gas vehicles. See www.aqmd.gov/tao/Demonstration/index.htm, 30 October 2006.

⁴³ See “Weather, Climate and the Future – BC’s Plan” at www.env.gov.bc.ca/air/climate/cc_plan/pdfs/bc_climatechange_plan.pdf, also archived at www.natcapsolutions.org/ClimateManual/Cities/Chapter5/LongTermInitiatives/SustainableEnergy/bc_climatechange_plan.pdf, 30 October 2006.

Alternative fuel plans⁴⁴:

- Plug-in hybrid vehicles may be available in the U.S. market by 2008. These vehicles represent an opportunity for vehicle fueling to help (if such vehicles are recharged during off-peak electrical production hours) or hinder community energy security (if charging boosts existing peak demands). Both the State of California and the city of Austin, Texas have programs underway to encourage the use of plug-in hybrids.
- Hydrogen fuel-cell hybrid vehicles represent an opportunity for distributed power generation. The vehicles are small electric powerplants on wheels that could generate power for a facility or the electrical grid while parked, if a connection were supplied that delivered hydrogen, and delivered the resulting electricity to the larger electric grid.
- The “Hydrogen Highway Network Action Plan” project of the California Air Resources Board (2004) aims “to support and catalyze a rapid transition to a clean, hydrogen transportation economy” specifically co-funding for three hydrogen fueling stations and the state lease of hydrogen-fueled vehicles⁴⁵

Residential and commercial facility energy planning differs by states. Sometimes it is highly regulated by agencies (e.g. public utility commissions or the Federal Energy Regulatory Commission). In other locales it is a function of the private sector’s handling of fuels.

Community-level facility energy end-use planning typically involves education and/or incentives that affect choices by end-users. Programs to encourage customers to use energy wisely this are described in this Manual’s Chapter 5, Residential Section.

Without such programs electric utilities are vulnerable to major system problems when the utility’s projection (guess) of total potential electrical demand falls short of actual demand. This happened to Los Angeles Water and Power in the summer of 2006 when it underestimated electrical demand during a summer heat wave by 500 MW and blackouts resulted.⁴⁶ Had LA’s energy planning enabled customers to live in buildings that kept inhabitants comfortable without air conditioning, this problem would not have arisen, everyone’s bills would have been lower and far less carbon would have been emitted.

Programs to integrate the use of energy efficiency and renewable energy can deliver significant value to a community.

Sacramento Municipal Utility District. In 1989, Sacramento, California shut down its 1,000-megawatt nuclear plant. Rather than invest in any conventional centralized fossil fuel plant, the local utility met its citizens’ needs by investing in energy efficiency and such renewable supply technologies as wind, solar, biofuels and distributed technologies like co-generation, fuel cells, etc. In 2000, an econometric study showed that the program has increased the regional economic health by over \$180 million, compared to just running the existing nuclear plant. The utility was able to hold rates level for a decade, retaining 2,000 jobs in factories that would have been lost under the 80% increase in rates that just operating the power plant would have caused. The program generated 880 new jobs, and enabled the utility to pay off all of its debt.

Fort Carson Mountain Post in Colorado has set forth a plan to meet 100% of its energy needs with renewable energy by 2027⁴⁷

⁴⁴ For more information on alternative fuel vehicles see: autos.yahoo.com/green_center/.

⁴⁵ See Executive Order S-7-04 of California Governor Schwarzenegger at www.hydrogenhighway.ca.gov/media/execorder_s704.pdf, also archived at, www.natcapsolutions.org/ClimateManual/Cities/Chapter5/LongTermInitiatives/SustainableEnergy/CA_execorder_s704.pdf, 30 October 2006.

⁴⁶ The utility’s response to the blackouts was to increase its planning assumptions about the peak demands from its residential customers – shifting from one megawatt of power being able to serve 750 homes to only 650 homes. (For energy planning in the late 20th century, the general assumption was one megawatt for 1000 homes). Source: Sharon Bernstein and Amanda Covarrubias, “Heat Wave Caught DWP Unprepared,” *Los Angeles Times*, July 28, 2006.

⁴⁷ Fort Carson sustainability program website, sems.carson.army.mil, 30 October 2006.

Delivering a Sustainable Energy Plan

Delivering cost-effective sustainable energy involves two essential tasks:

1. Moving the existing energy marketplace away from the business-as-usual scenario by reducing various market failures
2. Progressing on an investment path towards a sustainable energy future

In undertaking these tasks, it is good to solicit input from such community partners as utilities, vehicle fuel providers, other levels of government, and major employers or energy users

Balancing the Existing Marketplace Away from Business-as-Usual

Environmental economists have long noted a fundamental flaw in market prices: Most prices fall short of capturing the full costs of producing the product or service being offered.

Costs such as the impact of releasing carbon into the atmosphere, the cost of vulnerabilities of central electricity generation, and the various subsidies that the Federal government gives to make historic forms of energy like coal or oil look cheaper, are called

“externalities.” These impacts are massive, but are not reflected in the market prices of energy. One study estimated the externalities of coal-fired electricity to be approximately four times the market price—meaning that in a truthful marketplace, coal-fired electricity would be closer to \$0.21/kwhr instead of the present \$0.04-\$0.06 cents. For nuclear power, externalities are estimated at nine cents per kilowatt hour—nearly double the market cost of running existing plants.⁴⁸

According to the U.S. Department of Energy, coal-fired electricity externalities include acid rain, urban ozone and global climate change.⁴⁹ Other externalities include mercury pollution, radioactivity, pollution from mining, milling, transport and waste disposal, externalities from the use of water, and habitat losses or other ecosystem damage incurred during the coal lifecycle. In the past four decades, governments have slightly reduced price externalities by implementing regulations to protect the environment and reduce damage to human health. Even so, the majority of externalities listed above remain unresolved.

A case can be made that another externality of non-renewable

resources is the denial of that resource to future generations. Interface Inc. CEO Ray Anderson, one of many business leaders dismayed by the consequences of externalities, notes that externalities mean that the market alone cannot provide sufficient constraints on corporations’ tendency to cause harm. A true market, he argues, would force companies to include externalities in the price of their offerings.⁵⁰

In contrast, solar electricity is estimated to have externality costs of one cent per kilowatt hour, in addition to its current estimated costs of 15 to 20 cents. Wind energy is presently cost competitive with coal and nuclear, with similarly few externalities.⁵¹

To achieve a more balanced marketplace, communities can:

1. Use regulations and/or taxes/fees to increase the price of non-renewable energy and provide incentives to providers of clean energy sources of all kinds (e.g., to make solar energy panels with fewer toxic materials)
2. Use regulations and financial mechanisms to
 - Reduce the effective costs of renewable and in distributed energy

⁴⁸ Externality estimates by Thomas Sundqvist, “Power Generation Choice in the Presence of Environmental Externalities,” Lulea University of Technology, 2002, at epubl.ltu.se/1402-1544/2002/26/index-en.html, 30 October 2006.

See also Thomas Sundqvist, Patrik Soderholm and Andrew Stirling, “Electric Power Generation: Valuation of Environmental Costs” in *Encyclopedia of Energy*, Vol. 2, Elsevier Ltd., 2004, pp. 229-243. Mr. Sundqvist estimated coal-fired electricity externalities at \$.16/kwhr, nuclear power at \$.09/kwhr, and \$.01/kwhr for solar power. Current price of coal-fired electricity from Daniel M. Kammen, “the Rise of Renewable Energy,” *Scientific American*, September 2006, p. 86.

⁴⁹ See John Carlin, “Environmental Externalities in Electric Power Markets: Acid Rain, Urban Ozone and Climate Change,” U.S. Department of Energy website: www.eia.doe.gov/cneaf/pubs_html/rea/feature1.html, 30 October 2006.

⁵⁰ For a cogent explanation of the set-up for corporations in the modern marketplace, including externalities, see Joel Bakan, *The Corporation – The Pathological Pursuit of Profit and Power*, Viking Canada, 2004. Anderson quotes from p. 72; also see DVD of the same name.

⁵¹ See Renewable sources of energy, with special emphasis on wind energy, Report of the Secretary General, Committee on New and Renewable Sources of Energy and on Energy for Development, 1998, at www.unepriose.org/WindEnergy/UNreportwind.pdf, 30 October 2006.

- Increase the incentives for energy utilities and community citizens/organizations to invest in energy efficiency and renewable energy

Examples of leading-edge actions taken by local governments include:

Seattle City Light, the city of Seattle’s public utility, has committed to be carbon-neutral. This utility is reducing its carbon footprint through use of renewable energy sources and purchasing carbon credits to achieve carbon neutrality. The scheme effectively prices its energy as if it had few externalities.⁵² Seattle City Light achieved zero net greenhouse gas emissions in 2005 and 2006.⁵³

Thief River Falls, Minnesota, offers low interest loans and incentives to customers who install ground-source heat pumps—a less electricity intensive system for heating and cooling buildings.⁵⁴

Santa Clara, California, rents solar hot water systems to citizens and businesses.⁵⁵

Honolulu, Hawaii, offers 0-2% loans to homeowners to install solar hot water systems.⁵⁶

The municipal utility in Bowling Green, Ohio, led a collaborative effort among ten municipal utilities to finance a wind-energy farm.⁵⁷

Mason City, Iowa, changed zoning ordinances to allow appropriately sized wind turbines to be installed in residential zones.⁵⁸

The city of Chicago and 47 other local government agencies formed the Local Government Power Alliance. Through it, they negotiated lower-cost electrical service that includes higher levels of renewable energy.⁵⁹

For additional examples, see:

The Apollo Alliance, “New Energy for Cities—Energy Saving and Job Creation Policies for Local Government.”⁶⁰

ICLEI, the International Council for Local Environmental Initiatives.⁶¹

The U.S. Department of Energy’s Energy Efficiency and Renewable Energy home page.⁶²

The National Renewable Energy Laboratory’s home page.⁶³

Investing for Sustainable Energy

Energy is almost entirely produced and consumed by what accountants call “capital” goods—long-term investments in such energy producing devices as power plants, wind turbines, solar cells and the infrastructure like power lines to support them.⁶⁴ Energy is usually consumed by other capital goods—the heating, cooling, and lighting systems in buildings, transit options like cars, and industrial equipment. Capital goods are meant to have a multi-year life, and are often paid for over the item’s lifetime. Large energy producing or consuming systems are expected to last several decades.

Setting and delivering on short-term goals to replace wasteful, fossil fuel energy systems generates excitement, demonstrates commitment and builds institutional momentum towards sustainable strategies, but requires a plan to finance these alternative capital investments.

The success of renewable power efforts will be partly determined by whether such efforts are given consistent support by local and regional governments. Some local governments will be

⁵² Seattle City Light: www.seattle.gov/light/, 30 October 2006.

⁵³ City of Seattle, www.seattle.gov/light/conserves/globalwarming/default.asp, 5 December 2006.

⁵⁴ Apollo Alliance, “New Energy for Cities – Energy Saving and Job Creation Policies for Local Governments,” p. 6, www.apolloalliance.org/docUploads/new%5Fenergy%5Fcities%2Epdf, also archived at, www.natcapsolutions.org/ClimateManual/Cities/Chapter5/LongTermInitiatives/SustainableEnergy/ApolloAlliance_EnergyforCities.pdf, 30 October 2006.

⁵⁵ Ibid. p. 4.

⁵⁶ Ibid. p. 5.

⁵⁷ Ibid. p. 7.

⁵⁸ Ibid. p. 7.

⁵⁹ “Customer Aggregation: An Opportunity for Green Power?” by Edward Holt of Ed Holt & Associates, and Lori Bird of the National Renewable Energy Laboratory, 2001: www.eere.energy.gov/greenpower/resources/pdfs/lb29408.pdf, 30 October 2006.

⁶⁰ The Apollo Alliance, “New Energy for Cities – Energy Saving and Job Creation Policies for Local Government,” www.apolloalliance.org/ and www.apolloalliance.org/docUploads/new_energy_cities.pdf, 30 October 2006.

⁶¹ ICLEI's web site: www.iclei.org, 30 October 2006.

⁶² The Department of Energy, www.eere.energy.gov/, 30 October 2006.

⁶³ National Renewable Energy Laboratory, www.nrel.gov/, 30 October 2006.

⁶⁴ Former Oregon Governor John Kitzhaber, on launching a more sustainable energy future, said that "digging, drilling and burning" is a 19th century technology.

hesitant to take on a leadership role if increased short-term costs threaten to temporarily dampen their business climate.

The solar energy industry in California hailed the California Solar Initiative because it created an 11-year certainty of support for the industry through rebates. This long-term approach will allow the industry to give investors a stable planning horizon that will give them the confidence to change from the business-as-usual course.

The city utility in Burlington, Vermont has invested heavily in renewable generation:

Over 46% of Burlington Electric Department (BED)'s power mix was from renewable sources in fiscal year 2005. This was up from 42% in 2004. BED is continuing to pursue additional renewable sources of power such as wind energy in an effort to add fuel diversity and to stabilize power costs for Burlington consumers. With fossil fuel prices at record highs, renewables act as a means to balance the high cost of fossil fuel based energy. The cost of generating renewable energy, especially in-state renewable energy, is level and generally predictable; unlike fossil fuel its price is not influenced by international

and market forces beyond our control and it does not contribute to global warming. We look forward to increasing Burlington's supply of renewables such as wind energy not only as a way of providing the citizens and business owners of Burlington with clean electricity but also providing them with an affordable and reliable supply. Renewable energy is part of a sustainable and fiscally sound power supply portfolio.⁶⁵

The city of San Francisco boasts one of the nation's most comprehensive sustainable energy programs. It required the use of B20 biodiesel in all city diesel vehicles in 2006, moving to the use of B100 (100% biodiesel) in 2007. All city buildings must meet the U.S. Green Building Council's LEED Silver criteria for green buildings. The city passed a bond to fund putting solar electric systems on residential buildings, and will replace its payroll tax with a green tax credit for solar energy.

Community leaders need to realize that every day new capital investment decisions are made that will affect energy production and consumption patterns for decades to come. To minimize energy needs a community will need to invest in different

equipment choices that provides lasting value because it uses less energy. For example, investing in high performance green buildings that can be expected to be 50% less costly to operate is a good deal, even if there are higher initial design costs.⁶⁶

Every time a community chooses inefficient options like centralized energy supplies, it locks citizens into years of being less competitive. It is important to articulate a sustainable energy future that looks two decades or so into the future, that maximizes your chances for widespread use of distributed, renewable energy, and that uses energy efficiently to help avoid long-term investments that will be uncompetitive or environmentally untenable in the future.

Primer on Sustainable Energy Sources

The primer below is offered as a guide. It obviously cannot address current or specific market conditions, since these are constantly changing. Renewable technologies are evolving rapidly as well. Every community should undertake an up-to-date investigation at the time of a sustainable energy planning process.

⁶⁵ Burlington Electric Department Sources of Power, www.burlingtonelectric.com/sourcepower.htm, 30 October 2006.

⁶⁶ The US Green Building Council has documented that good green buildings typically cost no more to build than ordinary, energy wasting structures. Even if there are an up-front costs, green buildings will typically result in a lifetime savings of up to 20% of total building cost. www.USGBC.org, 30 October 2006.

The following renewable energy sources will be explored further:

Wind-generated electricity;

Solar-generated electricity and hot water;

Biomass-generation;

Waste-generated electricity;

Hydro-generation;

Earth-generation;

Hydrogen power; and

Nuclear power.

Wind-Generated Electricity

Examples: Wind

- Horizontal-axis wind turbines (the most common type of turbine).
- Vertical-axis wind turbines (designed for capturing wind closer to the ground or tops of buildings).⁶⁷
- Wind-capturing devices in the atmosphere e.g. floating wind turbines.⁶⁸

Sustainability Attributes: Wind

- Wind energy can be used in a decentralized network but can also be used in a conventional grid system; wind has no ongoing emissions; requires minimal toxic or hazardous materials for construction and operations. Its costs are competitive to coal and natural gas, meaning that taking externalities into account, it may be several times less expensive than nuclear or fossil electricity that require ongoing fueling and avoidance of full-costs.

Sustainability Challenges: Wind

- Include potential wildlife impacts, other ecological impacts,⁶⁹ visual impacts, maintenance challenges.⁷⁰

Market Challenges: Wind

- Include educating government leaders and customers about wind energy's potential, siting and regulatory challenges,⁷¹ evolving technology, wind's intermittency, and challenges (given intermittency) in integrating with traditional electrical grid management.

Getting power lines built to accommodate intermittent wind resources is a challenge in the current structure of U.S. power grids.

Potential Community Support Actions: Wind

- Begin with giving priority to building wind energy infrastructure, and giving incentives to utilities and customers to buy wind and transition away from coal.

Solar-Generated Electricity and Hot Water

Examples: Solar

- Active or passive solar energy used to heat water, which may be used directly or used to heat buildings.
- Solar lighting design.
- Photovoltaics used to generate electricity directly from sunlight.

Sustainability Attributes: Solar

- Sunlight is the ultimate energy resource; it needs no fuel, in most parts of the world it is reliable (some of the largest recent solar photovoltaic installations are in cloudy Bavaria, Germany), and it is able to operate for long periods without maintenance, making it optimal for "off-the-grid" and dispersed applications.

⁶⁷ Companies developing and marketing vertical axis wind turbines include Aerotecture International Inc., (Chicago, IL – see www.aerotecture.com) and Quiet Revolution Ltd., (UK – see www.quietrevolution.co.uk).

⁶⁸ Such devices are held aloft in the atmosphere where wind speeds are higher by various means including balloons or virtual kites – for more see www.magenn.com, 30 October 2006.

⁶⁹ For a summary of the current environmental challenges and solutions with offshore installations, see James O. Jones and Christine Love, "Bringing Offshore Wind Energy to Shore," *North American Windpower* magazine, October 2006, p. 16.

⁷⁰ Gearboxes have been a trouble spot for older wind turbines – given the expense of downtime and of gearbox repairs.

⁷¹ Regarding offshore siting challenges, see John S. Hingtgen, "Shorelines Might Welcome Wind – From a Distance," *North American Windpower* magazine, October 2006, p. 25.

Sustainability Challenges: Solar

- Use of toxics in manufacturing; siting challenges; net energy contribution concerns.⁷²

Market Challenges: Solar

- The cost (15+ cents per kilowatt hour for solar electricity) makes some solar options a difficult choice. More people will buy solar as the costs will decrease. About a dozen new companies promise to have competitive solar electricity within four years.

Potential Community Support Actions: Solar

- Homeowners and businesses have shown themselves to be enthusiastic buyers of solar when incentives are great enough to reduce up-front costs.

Biomass-Generated Electricity

Examples: Biomass

- Bio-gas (a substitute for natural gas or propane) generated from biomass. Biomass can either be specially grown or derived from waste streams—either prior to or after landfilling.

- Agricultural biomass is used directly or for electrical generation.
- Wood-generated energy—wood-fired electrical power plants; direct burning of wood for electricity and/ or process heat; wood can also be converted to hydrogen fuel. Biofuels for vehicles and other users of portable liquid high-energy-density fuels, including ethanol and biodiesel from agricultural products, agricultural wastes and food wastes.

Sustainability Attributes: Biomass

- Biomass generated waste is carbon-neutral in that the biomass stored carbon during growth that is released during combustion (though not at the same rate).

Sustainability Challenges: Biomass

- Though technically carbon-neutral, biomass is nevertheless carbon-based and does not necessarily contribute to the dramatic reductions in carbon emissions needed for climate stabilization.⁷³
- Market challenges include potentially fluctuating prices and supply.⁷⁴
- Potential community support

- Separate collection of biomass from other wastes.
- Incentives for use of local agricultural products or wastes in biofuel development, including public support of small business development to supply local wastes or other biofuels to processing plants and/or convert vehicles to better use biofuels.⁷⁵
- Support (such as economic development tax or financial incentives) for pioneering biofuel retail outlets and/or distribution systems.

Waste-Generated Electricity

Examples: Waste

- Waste to energy systems – using landfill-destined materials to generate electricity and/or process heat.
- Waste biomass to energy (see biomass section).

Sustainability Attributes: Waste

- Can reduce impacts of waste hauling and management.
- Can reduce market and hauling/shipping challenges of recycling markets.
- Support local energy production enhancing energy security.

⁷² Author David Kimble found six studies of the energy returned for the energy input of existing solar PV electricity cells – the results ranged from .86 to 1.4 (1.4 means 40% more energy returned than invested). See www.energybulletin.net/14849.html, 30 October 2006. A solar installer in California states that in California, solar cells provide more energy than was required to make them after three years – see www.solarexpert.com/future2.html, 30 October 2006.

⁷³ For more on this see US Department of Energy, "Our Changing Earth, Our Changing Climate – Biofuels: A Solution for Climate Change", 1999, available at www.nrel.gov/docs/fy99osti/24052.pdf, also archived at, www.natcapsolutions.org/ClimateManual/Cities/Chapter5/LongTermInitiatives/SustainableEnergy/BiofuelsSolution.pdf, 30 October 2006.

⁷⁴ Christopher Juniper of Natural Capitalism Solutions interview with Burlington VT's municipal utility that operates a wood-fired power plant – wood cutters were leaving the market due to closure of paper mills, causing a shortage of wood for the power plant in 2004.

⁷⁵ For example, a small Florida company has developed an efficient way to convert water into a clean burning fuel akin to hydrogen, and is developing auto conversion kits that boost gas mileage and use of cleaner fuels. See website of Hydrogen Technology Applications, Inc., www.hytechapps.com, 30 October 2006.

Sustainability Challenges: Waste

- Waste to energy plants can release toxics into the biosphere—the amount and type depending on the plant’s design and operation and the waste inputs.⁷⁶
- Diverts waste to energy uses rather than reuse or recycling.

Market Challenges: Waste

- High infrastructure costs up front require dedication of waste streams to energy production rather than progressively more recycling.

Potential Community Support Actions: Waste

- Examine legislative definitions of toxic or hazardous waste to ensure they do not interfere with economical and sustainable recycling of such wastes through incineration or other energy-generating means.
- Ensure that landfill costs nearly always exceed the costs of recycling, reusing or incinerating wastes.⁷⁷

Hydro-Generation Electricity

Examples: Hydro

- Freshwater storage power systems (dams).
- Wave-power electrical generation.

actions.

- Tidal-power electrical generation.

Sustainability Attributes: Hydro

- Essentially a solar-powered and infinite resource.
- Uses mechanical systems that require few toxic materials although coatings are likely toxic-based to withstand water damage.
- Operations have low ecological impact though are removing energy from an ecological system.

Sustainability Challenges: Hydro

- Power production not proximate to electrical demand—leading to materials and potential ecological damage from transmissions system installation and maintenance.
- Dams flood ecological systems and human land-uses (including villages/towns) and are difficult for migrating fish to navigate.

Market Challenges: Hydro

- A limited number of sustainable hydro opportunities
- Potentially long permitting processes—often for good reason since hydro can easily cause long-lasting damage to riverine ecosystems and

hydro sites are not often close to where the power will be consumed.

Potential Community Support Actions: Hydro

- Land use and permitting regulations that facilitate power generation at low-head or other hydro sites that are less ecologically destructive than big dam projects.

Earth-Generation

Examples: Earth

- Geo-thermal heat converted to steam and/or electricity.
- Earth-based heat pumps that more efficiently heat or cool buildings using the earth’s ambient temperature.
- Passive earth berming systems that moderate building temperature swings—reducing heating/cooling loads—including thick earth-based walls of buildings.

Sustainability Attributes: Earth

- Perhaps the least damaging to ecosystems, unless critical habitats or unique areas are damaged by the loss of heat to human uses.

⁷⁶ Waste to energy plants are highly controversial – knowledgeable experts are not yet convinced that burning temperatures will *always* be high enough to break down all potential toxics prior to air emission. For more on this technology – see the Waste to Energy Research and Technology Council website at Columbia University www.seas.columbia.edu/earth/wtert/, 30 October 2006.

“Pollution from Waste-to-Energy Incinerators,” October 2006, at Alternative Energy website: www.alternative-energy-news.info/pollution-from-waste-to-energy-incinerators/, 30 October 2006.

⁷⁷ This fundamental strategy is at the heart of highly successful waste reduction systems such as those of Portland, OR; Seattle, WA; and Alameda County, CA.

Sustainability Challenges: Earth

- Ecosystem damage from development and heat removal.

Market Challenges: Earth

- Relatively few sites available for active geothermal.
- Building codes can intentionally or accidentally interfere with innovative earth berming or heat pump systems.

Potential Community Support Actions: Earth

- Facilitate use of earth-based energy sources through friendly zone and development processes.
- Support studies and pilot projects demonstrating efficacy of new technologies.

A sustainable energy primer is not complete without briefly addressing the sustainable attributes of a promising new energy carrier, hydrogen, and the continued controversy regarding whether nuclear energy can be considered a sustainable technology for generating energy.

Hydrogen

Hydrogen, like electricity, is an energy carrier. Though a natural element, on earth hydrogen is bound with oxygen in the very strong bonds of water. To

“liberate” hydrogen takes energy. Once liberated, the hydrogen is attracted to rebond with oxygen to again form water. The flow of electrons generated by this process is the basis for the electricity produced by fuel cells.

Critical questions regarding whether and how the U.S. should adopt hydrogen as a preferred carrier of its energy future include:

Is hydrogen a more efficient carrier of energy than electricity—enough so to justify massive investments in hydrogen carrying infrastructure?

How easily can existing fleets be adapted to use hydrogen, if at all?

What storage technologies will emerge as the standards for the marketplace – facilitating investments in fueling infrastructure?⁷⁸

Can fuel cells that convert hydrogen to electricity both come down in price and find alternatives to premium metals as the catalyst?

Auto companies expect technology debates regarding hydrogen vehicle technology to continue until about 2015. Meanwhile, the question for your community is whether there are cost-effective ways to support the development of a hydrogen

infrastructure as this technology develops.

Nuclear Power

Nuclear electricity can substitute for coal-fired generation as a utility baseload resource. Because the fissioning of nuclear material does not release GHG emissions (though the nuclear lifecycle releases large amounts), nuclear advocates claim that the technology is carbon neutral.

While some people are concerned enough about climate change to advocate using nuclear power as a coal substitute, most advocates do not consider nuclear to be a cost-effective substitute, a sustainable technology, or a viable solution. The first challenge with nuclear is its cost. New nuclear plants rival solar electric in price. Advocates claim that new varieties of reactors will be cheaper, but the past history of nuclear went, in the words of the Economist Magazine, “from too cheap to meter to too costly to matter.”⁷⁹ Nuclear technology is also strongly proliferative of nuclear bombs. Spreading the domestic power technology around the world would certainly encourage more nations to develop weapons capability.⁸⁰

The multi-generation liability of toxic waste still plagues the nuclear fuel cycle, even after a half-century of determined research. A litmus test: would

⁷⁸ Three distinct fuel systems continue to compete to become the preferred system for vehicles: pressurized hydrogen gas, hydrogen cooled to a liquid (becoming denser), and solid hydrogen fuel packs. For information on the latter, visit the website of Uni-Solar, which demonstrated solid hydrogen fuel packs in 2005: www.uni-solar.com, 30 October 2006.

⁷⁹ Economist magazine, August 27th, 2001.

⁸⁰ Lovins, A, Lovins, H, *Energy/ War: Breaking the Nuclear Link*, Friends of the Earth 1980.

your community be willing to site a new nuclear plant or waste dump nearby? New reactor designs may hold promise of reducing the likelihood of catastrophic accidents, but such accidents are only the tip of the iceberg of the unsustainable aspects of nuclear power. Given that few communities would undertake to construct a reactor on their own, this debate is likely to be irrelevant to a community energy plan.⁸¹

Primary Barriers to Address

There are hundreds of barriers that inhibit people from implementing energy systems that are preferable to what are in place now. The 1998 analysis of climate protecting opportunities, *Climate Making Sense and Making Money*⁸² listed 60–80 specific market failures of 8 types:

1. Capital misallocation
2. Organizational failures
3. Informational failures
4. Regulatory failures
5. Value-chain risks
6. Perverse incentives
7. False or absent price signals
8. Absent markets

These include such market imperfections as:

Lack of clarity of benefits to local community

Lack of confidence in the numbers (payback, lifecycle costs) both with city departments and private businesses

Misalignment of the incentives that electric utilities see with the broader interests of the community

The lack of “communicators” who can help all stakeholders understand the benefits of renewable energy

Failure to acknowledge people’s perceptions of risks and how those risks can be mitigated, or how risk perceptions can be reduced

Conservatism of banks and hesitancy to deal with renewable energy investment/loan opportunities.

Some local municipalities have zoning rules against solar panels & wind turbines

Three barriers are particular challenges:

The hassle factor

Things are working fine, why change them? Margaret Mead said that the only person who likes change is a wet baby. The challenges posed by climate change will dictate change. Cities that undertake such programs on their own timeline will enjoy a significant advantage. But overcoming the basic hassle factor will take inspired leadership.

The complexity factor

Why should the city government get involved in a complex field full of experts at utility and energy service companies? As

this Manual has shown, utilities can be slow to move slowly towards a sustainable energy future for a variety of reasons, primarily including institutional momentum or skepticism, regulatory systems and their financial incentive structures. Utilities are critical economic development partners and can be encouraged to embrace the economic advantages of distributed and sustainable energy as part of rate-reduction strategy that will help your businesses become more globally competitive. Unless your utilities are taking a leadership role in sustainable energy, they will benefit from prompting – the nearly four-decade history of environmental activism with utilities demonstrates that not all the best ideas come from the “experts.” In short, the issues are complex but can be grasped by talented citizen’s committees for a sustainable energy future that will empower a community to take on matching production with end-uses, and maximizing the economic development benefits of keeping power generation dollars in the local economy.

The market challenges of distributed power (sustainable or not).

Distributed power generation located near the people who will use the power, and scaled to the size of consumption is a new concept for nearly all Americans. Key barriers to overcome through sustainable energy planning include:

⁸¹ For more on the challenges of nuclear see Nuclear Information and Resource Service www.nirs.org, 30 October 2006.

⁸² For a systematic discussion of such barriers and how to clear them see Lovins, A, Lovins H, *Climate: Making Sense and Making Money*, 1998, www.natcapsolutions.org/publications_files/climate_sense.pdf, 30 October 2006.

Reluctance of citizens or organizations to enter the power production business themselves and/or make long term utility-type investments

Reluctance of financial institutions to fund utility-type investments at competitive interest rates – especially of new technologies with little collateral value

Lack of information flow to all but highly motivated citizens

All of these barriers can be reduced through visionary planning that helps the community understand that its energy future should be in its own hands; that the experts do not have all the answers; and that the energy security and other benefits of a more sustainable approach are serious economic development advantages.

Early sustainable power technologies systems gained a reputation, (deserved or not) for poor performance/ excessive maintenance, safety, cost, aesthetics and provider reliability/ stability.

Like most pioneering technologies, sustainable energy efforts have suffered from some ideas being ahead of available materials, design or maintenance capabilities. Too many people remain stuck in that past rather than observing the almost daily maturation of sustainable energy systems. Modern renewable

energy is a far cry from early systems. Public education is the remedy. Many communities sponsor sustainable living fairs or events that help citizens understand and welcome sustainable technologies.⁸³

Conclusion

Cities and regions can plan for a sustainable energy future: maximizing renewable energy sources; using market forces to balance energy prices through inclusion of externalities in energy prices; and supporting renewable investments through favorable regulations and financing.

While much research and experimentation to determine the right strategy for your community, a significant community of sustainable energy planning practitioners and proven practices is already available to guide the efforts of your community. Modern technologies to save energy and generate renewable energy communities can profitably protect the climate and the economy.

⁸³ A leading example is the annual Community Sustainability Conference and Expo produced with multiple community partners by Fort Carson Mountain Post of the US Army in the three county Pikes Peak region of south-central Colorado, sems.carson.army.mil, 30 October 2006. Numerous other conference formats have been developed – such conferences are also strong economic development opportunities.

Additional Resources

Race to the Top: The expanding role of U.S. State Renewable Portfolio Standards, Prepared for the Pew Center on Global Climate Change, June 2006, Author: *Barry G. Rabe, University of Michigan*

This report builds on earlier Pew Center analyses of the evolving state role in climate policy development, placing a particular focus on the RPS experience to date. It presents an overview of this policy tool and examines key factors in both policy formation and implementation. This work considers the experience of all RPS states but devotes particular attention to five case studies: Texas, Massachusetts, Pennsylvania, Nevada and Colorado that illustrate both common themes and points of divergence among individual state programs. The analysis concludes with an examination of RPS performance to date and some of the leading opportunities and challenges facing future development.

www.pewclimate.org/global-warming-in-depth/all_reports/race_to_the_top/index.cfm

American Energy Initiative Report

"The American Energy Initiative is a joint project of the Worldwatch Institute and the Center for American Progress focused on educating and

inspiring the public and policymakers on the importance of renewable energy to the economic, environmental and national security of the United States. The report, *American Energy: The Renewable Path to Energy Security*, demonstrates the potential of renewable energy and energy efficiency and presents a practical policy agenda for achieving them."

A copy of the report is available on the web at: <http://americanenergynow.org/about/>

Funding Opportunity - U.S. Department of Energy Grant, Solar America Initiative (SAI) Market Transformation: Solar City Strategic Partnerships.

For incorporated cities with populations greater than 100,000. Application deadline: January 10, 2007
tinyurl.com/yyxja, 2 November, 2006

Prince Edward Island Renewable Portfolio--Prince Edward Island is planning to produce 30% of its total energy needs from local, renewable resources by 2016.
www.nawindpower.com/naw/print.php?plugin:content.175

BioTown, USA--this project's long term goal is to meet all the energy needs of Reynolds, Indiana via biorenewable resources, including electricity, natural gas replacement, and transportation fuel
<http://www.biotownusa.com/>



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