RePower Humboldt

A Strategic Plan for Renewable Energy Security and Prosperity





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Prepared by: Schatz Energy Research Center
Prepared for: Redwood Coast Energy Authority

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More online at the RePower Humboldt website:
http://www.redwoodenergy.org/programs/repower

The RePower Humboldt strategic plan is the result of work conducted under the Humboldt County Renewable Energy Secure Community (RESCO) project, funded through the California Energy Commission's RESCO program.

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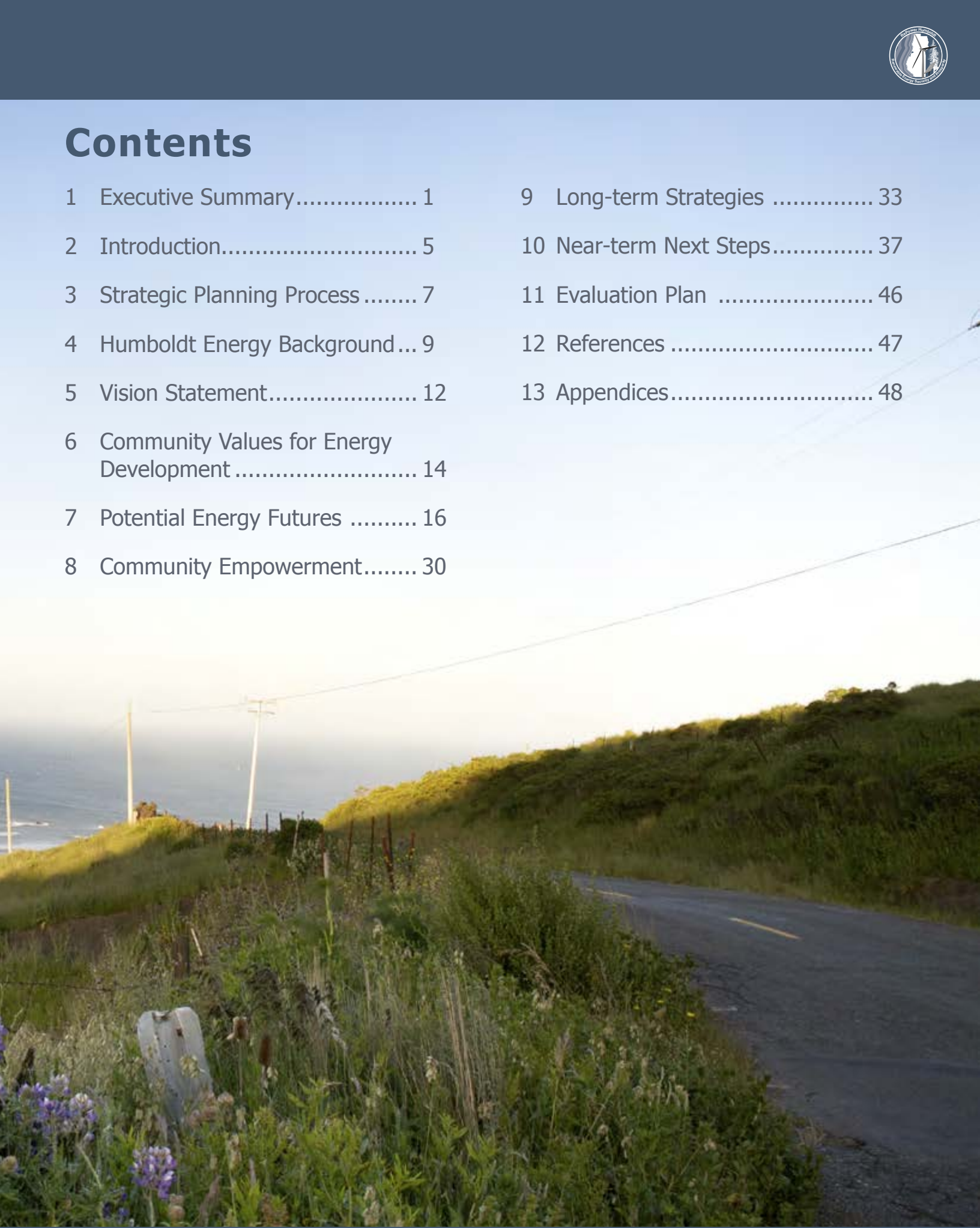


Project Partners

Redwood Coast Energy Authority

The Redwood Coast Energy Authority (RCEA) is a Joint Powers Authority whose members include the County of Humboldt; the Cities of Arcata, Blue Lake, Eureka, Ferndale, Fortuna, Rio Dell, and Trinidad; and the Humboldt Bay Municipal Water District. RCEA's purpose is to develop and implement sustainable energy initiatives that reduce energy demand, increase energy efficiency, and advance the use of clean, efficient and renewable resources available in the region.

Schatz Energy Research Center

The Schatz Energy Research Center (SERC) is working to establish clean energy technologies in our society. SERC specializes in renewable energy, energy efficiency, and hydrogen energy systems. Their work involves research and development, technology demonstration, project development, energy systems analysis, and education and training. In addition, SERC performs feasibility studies, resource assessments, and energy planning studies.

Pacific Gas & Electric Company

Pacific Gas and Electric Company (PG&E) recognizes the potential consequences of climate change are serious and the need for action is urgent. PG&E is committed to proactively taking serious, concrete measures to reduce greenhouse gas emissions from their operations and to helping customers do the same. PG&E is proud and honored to work with the RCEA in climate change efforts.

California Energy Commission

The California Energy Commission is the state's primary energy policy and planning agency. Created by the Legislature in 1974 and located in Sacramento, six basic responsibilities guide the Energy Commission as it sets state energy policy: forecasting future energy needs; promoting energy efficiency and conservation; supporting public interest energy research, development and demonstration programs; developing renewable energy resources and alternative renewable energy technologies; licensing larger thermal power plants; planning for and directing state response to energy emergencies.

1 Executive Summary

RePower Humboldt is a plan to develop the county's renewable energy resources. We are striving to meet the energy needs of the community and secure our sustainable energy future at minimal costs to energy consumers. Developing local renewable energy resources, including energy efficiency, will provide for energy, economic, and environmental security.

Humboldt County has untapped renewable energy resources including wind, wave, hydropower and biomass. Combined, these resources could provide about three times more electricity each year than we currently consume. If electricity is used for heating (with heat pumps) and transportation (with electric vehicles), there is enough renewable energy in Humboldt County to meet all of our present energy needs.

Humboldt County can lead the way toward a sustainable energy future by using local renewable resources to meet the majority of its electricity loads and a large portion of its heating and transportation needs. However, accomplishing this task effectively and efficiently will require comprehensive planning. That is the purpose of the Repower Humboldt study, which includes a thorough analysis of the technical and economic implications of renewable energy development in the county.

The RePower Humboldt study is a collaborative effort of the Redwood Coast Energy Authority (RCEA), the Schatz Energy Research Center (SERC) at Humboldt State University, and the Pacific Gas & Electric Company (PG&E). Principal funding came from the California Energy Commission, with match funding from each of the three participating organizations.

This strategic plan summarizes the key findings and recommendations of the RePower Humboldt study and charts a course for near- and long-term activities that can help Humboldt County realize its shared community vision for a sustainable energy future.

Humboldt County has abundant renewable energy resources. Developing these resources will provide for energy, economic, and environmental security.

Planning Process

The RePower Humboldt strategic planning process was conducted over a 3-year period starting in November of 2009. Key tasks included an assessment of resource and technology options and an economic analysis that considered costs as well as job and economic stimulus opportunities. The study team also examined project development, financing and ownership alternatives, and regulatory and political issues. As a crucial part of this effort, the team made a concerted effort to gather input from a diverse group of county stakeholders and include their views. All of the information collected from this work informed the development of the RePower Humboldt strategic plan.

In Humboldt County there are three major types of demand for energy: electricity, fuel for heating, and fuel for transportation. The county is geographically isolated and is almost an energy island. There are only two major connections to the larger electric grid, and the electric transmission capacity that connects Humboldt County to the larger grid is approximately 70 MW, less than half of the County's 170 MW peak electrical demand. For this reason the county generates much of its own electricity, using mostly natural gas and biomass fuels. Natural gas enters the county through a single pipeline from the larger natural gas grid and petroleum-based transportation fuels are primarily imported to the county by barge.

Biomass, natural gas, and petroleum each comprise about a third of the total primary energy consumed in Humboldt County. The annual greenhouse gas emissions associated with energy use in the county total 1.5 million metric tons of CO_2 equivalent. About 60% of these emissions are associated with the transportation sector (the source being petroleum fuels) while the remaining 40% are split nearly evenly between the electricity and heating sectors (the main source being natural gas).

The RePower Humboldt Vision

The RePower Humboldt stakeholder group developed a vision statement for Humboldt County's energy picture in 2030. In that vision Humboldt County is no longer a net importer of energy. The county enjoys a high degree of energy independence through conscientious use of energy conservation and efficiency combined with locally produced and managed renewable energy generation. Significantly more of the money spent on energy stays in the county, supporting more local jobs. Citizens have a diversity of choices for meeting their energy needs and have more local control over energy prices. The county is a thriving research and development center and an incubator for energy technology and related industries. Because citizens, businesses and industries consume modest quantities of energy derived from local renewable sources, life in the county is secure and prosperous.

In addition, a majority of stakeholders identified the following key criteria to be used in evaluating proposed energy development projects and initiatives (in order of importance):

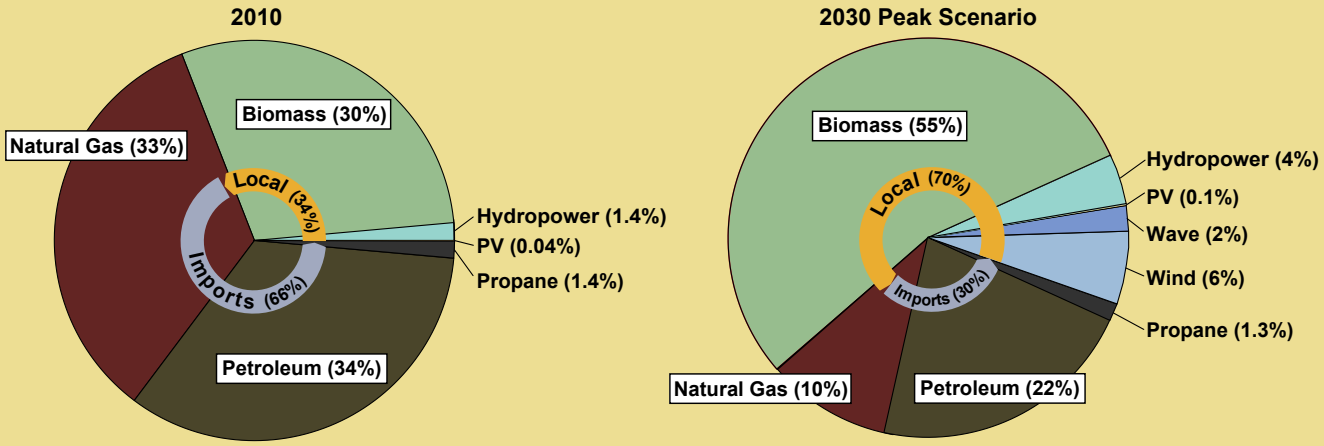
- Environmental Quality/Impacts
- Financial Viability of Implementation and Affordability of Use
- Local Acceptance, Participation, and Control
- Economic Impact on Jobs and Income

Key Findings

It is likely that the following local renewable energy resources and energy technologies will play significant roles in Humboldt County's sustainable energy future (ordered alphabetically):

- Biomass
- Distributed generation

Humboldt County Energy Sources: Where are we now and what can we achieve?



This chart shows how our primary energy consumption could change in one possible scenario. Primary energy refers to energy in its raw form before being converted to other forms, for example natural gas or biomass before they are converted to electricity. Note that hydropower, PV, wave and wind energy have all been converted to the equivalent amount of primary natural gas energy that they displace. The ***peak*** scenario includes 100 MW of new wind capacity, 50 MW of new wave capacity, 25 MW of new small hydro capacity and 4 MW of new solar electric capacity, in addition to 100 MW of new biomass capacity. Nonetheless, biomass dominates the ***peak*** primary energy pie compared to the other renewable energy sources because it historically has played a big role (it accounted for 30% of the primary energy pie in 2010), it typically runs at full output for many hours of the year (two to five times as many as wind, wave or solar electric), and conventional biomass power plants are not very efficient (typically 20%), so they require a lot of biomass fuel (primary energy) to operate. See Figures 2 and 3 on page 21 for a view of how the various renewable energy resources compare with each other in terms of installed capacity and electricity generation in the ***peak*** and other scenarios.

- Electric heat pumps
- Electric vehicles
- Energy efficiency and conservation
- Small hydro
- Solar
- Wave
- Wind

Using these resources and technologies, a wide range of scenarios was examined. Results show that by the year 2030 and with only a 5 percent increase in overall energy costs, the county can meet over 70 percent of its electricity demand, displace 25 percent of its heating load, and supply 10 percent of its transportation energy needs with local renewable energy. At a cost increase of about 15 percent, those fractions increase to 98 percent of electricity demand, 33 percent of heating load, and 13 percent of transportation energy needs.

> *By the year 2030 and with only a 15 percent increase in overall energy costs, the county can meet over 98 percent of its electricity demand, displace 33 percent of its heating load, and supply 13 percent of its transportation energy needs with local renewable energy.*

Tremendous community benefits will be realized due to the switch to local renewable energy. Hundreds of new jobs will be created and tens of millions of dollars will be injected into the local economy. Simultaneously, greenhouse gas emissions will be reduced by 33% to 45%. In addition, the county will be more energy secure because it won't rely substantially on imports. It will have more control over its local energy resources and prices will stabilize.

In summary, key findings from the RePower Humboldt study include:

- A renewable energy future is feasible.
- A RePower Humboldt future will have beneficial economic, security, and environmental impacts.
- Energy efficiency is our cheapest option and should be maximized.
- Biomass, wind and small hydro can play a significant supply side role.
- Fuel switching to electric vehicles should play a key role.
- Distributed generation can play an important role, but utility-scale generation continues to be necessary.
- A mix of power options is needed and all options have impacts, including the "do nothing" option.

- The PG&E Humboldt Bay Generating Station provides important energy services and is well suited to support local renewable energy development.
- Significant transmission and distribution system upgrades will be necessary to accommodate large-scale renewable energy development.

Community Engagement

The RePower Humboldt stakeholder group clearly identified "Local Acceptance, Participation, and Control" as a critical criterion for considering future energy projects. This suggests that to realize the RePower Humboldt vision, there will need to be significant community engagement. This should include a constructive dialog and an inclusive public process that builds consensus and prepares us to seize opportunities as they become available. We should also work to develop community-based energy projects wherever possible, along with the financing mechanisms that will enable local projects to proceed. County projects can include facilities that are owned and operated by the community and arrangements that allow community members to purchase local, renewably generated electricity.

> *Tremendous community benefits are realized due to the switch to local renewable energy. Hundreds of new jobs are created and tens of millions of dollars are injected into the local economy. Simultaneously, greenhouse gas emissions are reduced by 33% to 45%.*

Near-Term Actions

This plan describes both long- and near-term actions for moving the County toward the RePower Humboldt vision. The most important actions in the near term are:

- **Continue and expand energy efficiency efforts.** Energy efficiency measures are cost effective and efficiency gains should be considered before additional power generation. RCEA and PG&E are already active in this area; their work should be supported and expanded.
- **Support responsible wind energy development.** Wind power is commercially viable on-shore in the Cape Mendocino area and off-shore throughout the county. Wind can supply a large portion of local electricity and is unexploited at present.
- **Support and expand the responsible use of biomass for energy that is consistent with forest restoration needs and priorities.** Biomass from forestry operations is already used to generate about one third of our electricity. There is potential to expand use of this abundant, renewable resource using forest treatment residues.
- **Develop infrastructure for and encourage use of electric vehicles**. RCEA, SERC, and others are already planning for an EV infrastructure. EVs are the best way to reduce dependence on petroleum imports for transportation.
- **Encourage development of distributed energy installations**. Combined heat and power generation systems installed at the point of use are inherently much more efficient than our current technology.
- **Form an energy leadership group.** To be successful, the RePower Humboldt effort needs local champions. The county Board of Supervisors and area city councils should form a leadership group, possibly through RCEA, to move this effort forward.

A Pioneering Effort

Securing Humboldt County's sustainable energy future will be a challenging undertaking, but the combination of abundant resources and a modest energy load make it a real possibility. Once successful, the county's pioneering effort will provide a blueprint for other regions to follow our lead.

2 Introduction

What is RePower Humboldt?

RePower Humboldt is an effort to build a Renewable Energy Secure Community, or a RESCO. A RESCO is a concept defined by the California Energy Commission. It refers to a community that has developed its local renewable energy resources, including energy efficiency and conservation, to meet its local energy needs and to secure its sustainable energy future at minimal costs to energy consumers. Developing local renewable energy resources as the primary means of meeting local energy needs will provide energy, environmental and economic security to our community, including:

- Greater availability of local energy sources.
- Less reliance on energy sources from outside the area.
- More predictable, less volatile energy prices.
- Less reliance on fossil fuels and thus less susceptibility to the impacts of "peak oil."
- Less reliance on foreign energy sources; greater national security.
- Reduced greenhouse gas emissions.
- Reduced air and water pollution.
- Creation of local jobs and local economic stimulus.
- More money circulating in the local economy.

Because of these benefits, communities throughout the country are looking for ways to develop local energy resources and achieve a clean energy future.

How can Humboldt County Secure its Sustainable Energy Future?

Humboldt County has the ability to lead the way toward a sustainable energy future by using local renewable resources to meet the majority of its electricity needs and a large portion of its heating and transportation energy needs. However, to accomplish this task effectively, efficiently, and economically will require comprehensive planning. Such a planning effort will look ahead beyond the next one or two proposed energy projects, and instead will consider long-term implications. It will look to identify optimal mixes of available resources. It will answer key questions, such as:

Which resources can be developed most cost-effectively? Does one resource complement another? Can a combination of resources provide a more reliable and cost-effective solution than the development of just one resource? These types of questions must be considered in a comprehensive planning process.

That is the purpose of the RePower Humboldt study. The study is a collaborative effort of the Redwood Coast Energy Authority, the Schatz Energy Research Center at Humboldt State University, and the Pacific Gas & Electric Company. Principal funding came from the California Energy Commission, with match funding from each of the three participating organizations.

The RePower Humboldt study included a thorough analysis of the technical and economic implications of renewable energy development in Humboldt County and involved the following key tasks:

- Assess resource and technology options
- Conduct economic analysis
- Examine development, financing and ownership options
- Examine Regulatory and Political Issues
- Conduct Stakeholder Analysis

A complete list of RePower Humboldt project documents can be found in Appendix A. These documents can be accessed

RePower Humboldt is an effort to build a community that has developed its local renewable energy resources, including energy efficiency and conservation, to meet its local energy needs and to secure its sustainable energy future.

at the RePower Humboldt web page[1]. This strategic plan summarizes the key findings and recommendations of the RePower Humboldt study and charts a course for near- and long-term activities that can help Humboldt County realize its shared community vision for a sustainable energy future.

It is important to note that the RePower Humboldt study examined energy policy options, namely local renewable resource development and energy demand reduction, with the aim of reducing greenhouse gas emissions, increasing energy security and increasing local economic activity. However, there are other policy areas that should be considered when seeking to achieve these goals, including land use planning, transportation planning, waste reduction, public transit, non-motorized travel modes, and carbon sequestration through forest management, among others. The fact that these additional topic areas were beyond the scope of the RePower Humboldt project is in no way intended to minimize their importance. They deserve to be studied and pursued in their own right. Most, if not all, of these options would likely complement the alternatives examined in the RePower Humboldt study.

1 http://www.redwoodenergy.org/programs/repower

3 Strategic Planning Process

The RePower Humboldt project team conducted this strategic planning process over a 3-year period starting in November of 2009. We conducted analytical studies and determined the energy needs for Humboldt County (electricity, heating and transportation energy needs). We gathered information and determined the availability of local energy resources, their technical viability, and their cost. We developed an energy supply and demand model to simulate Humboldt County's energy characteristics and examined a full array of alternatives. For each alternative we assessed the costs, greenhouse gas emissions, and percentage of demand supplied by local renewable resources. In addition, we also assessed the local job creation and economic stimulus associated with local energy resource development. The methods and results of these analyses are fully described in two project technical reports (Zoellick et al. 2012, Hackett et al. 2012).

In addition to these technical and economic analyses, we assessed project development, financing, and ownership options. This included a review of options like municipalization and community choice aggregation, as well as other community models for renewable energy development. A summary of this work can be found in the *Humboldt RESCO Task 3 Memo, Renewable Energy Development, Ownership and Financing Options*[2]. We also assessed local government options for facilitating renewable energy development in their communities. These topics are addressed in a companion document entitled *Regulatory and Policy Guide on Renewable Energy and Energy Efficiency for Humboldt County Local and Tribal Governments*[2].

To support development of the strategic plan we conducted a stakeholder analysis. Eleven stakeholder categories were specified, and participants were recruited from each of these categories to participate in a stakeholder engagement process. A concerted effort was made to cast a wide net and recruit a broad cross section of the community. Stakeholder groups included environmental advocates and labor representatives, as well as economic development officials and representatives from the financial and business communities. Also represented were political leaders, regulatory bodies, and local Tribes, as well as energy and natural resource (e.g., forestry and fisheries) professionals. Two stakeholder meetings were held and a total of 87 community members were invited to participate.

Thirty-three people attended the first meeting where they worked to craft a vision statement for Humboldt County's energy future (see Section 5 on page 12) and developed a set of decision criteria to be used in the evaluation of proposed energy development projects and initiatives (see Section 6 on page 14). An additional 19 stakeholders provided input on the decision criteria via a web based survey. Weighted criteria developed by participating stakeholders were later used to inform the development of the RePower Humboldt strategic plan.

At the second stakeholder meeting, 27 participants broke into small groups to address various resource and technology areas. The areas included: biomass, wind, small hydro, electric vehicles, heat pumps[3] and energy efficiency, solar, and Humboldt Waste Management Authority's landfill gas to energy and food digester projects. Participants brainstormed near-term projects or activities; identified key stakeholders;

2 http://www.redwoodenergy.org/programs/repower

3 A heat pump is an electrically powered heating technology that functions like a refrigerator or an air conditioner. It uses electricity to move, or "pump" heat from a colder area to a warmer area. A refrigerator uses electrical energy to pull heat out of the cold refrigerator box and dump it (via coils on the back or underside of the unit) into the warmer kitchen area. Similarly, a heat pump pulls heat from the outdoor air (or from the ground in the case of a ground source or geothermal heat pump) and moves it into the warmer confines of the interior space it is trying to heat.

assessed strengths, weaknesses, opportunities and threats; and identified short and long-term goals and concerns.

In addition, we held a special youth stakeholder meeting that drew 35 students from local area high schools and engaged them in a renewable energy strategic planning process. Additional information about the RePower Humboldt stakeholder process can be found in Appendix B, and the process and results for all stakeholder activities are documented in a project memo entitled *Humboldt RESCO Task 6 Memo, Stakeholder Analysis*.

A draft version of the RePower Humboldt Strategic Plan was publicly released on September 18, 2012. A town hall meeting was held on September 26, 2012 at the Eureka Wharfinger Building. This meeting included small group discussion where participants expressed preferences for which strategies should be prioritized and identified perceived challenges and ways of addressing them. Public comment on the draft plan was received through October 26, 2012. A summary of the public comments received and how they were addressed is included in Appendix C and full documentation is available at the RePower Humboldt web page. The draft plan was modified based on the comments received.

The *RePower Humboldt Strategic Plan* is the ultimate product from the RePower Humboldt study. Informed by the analysis work and stakeholder process, the plan points Humboldt County toward a sustainable and secure energy future. While the plan uses three scenarios, ***business-as-usual***, ***bold*** and ***peak***[4], to illustrate what is possible, it does not choose one of these scenarios. Instead, it recommends a series of next steps that will lead us toward the ***bold***, or even ***peak*** scenario, depending on how aggressively the recommended actions are pursued. Both the ***bold*** and ***peak*** scenarios are consistent with the vision statement presented in Chapter 5 and the community values expressed in Chapter 6, though they differ in emphasis, with the ***peak*** scenario emphasizing

greater renewable energy development and reductions in greenhouse gas emissions rather than controlling costs. The community will need to decide how aggressive they want to be in pursuing the RePower Humboldt vision. This is a topic that should be further explored as the plan is discussed in the public arena. Note that some of the recommended strategies are "no regrets" opportunities where the benefits clearly outweigh the costs. Such is the case with energy efficiency. These opportunities should be ambitiously pursued.

It is important to note that the RePower Humboldt strategic plan is intended to be a "living document." The plan as it now stands should serve as a starting point to guide the community forward, but the plan will likely evolve over time. There are numerous challenges that will need to be overcome to achieve the RePower Humboldt vision. A set of key challenges is outlined in the *RePower Humboldt Task 5 Memo, Regulatory & Political Issues - Challenges to Implementation the RePower Humboldt Strategic Plan*.

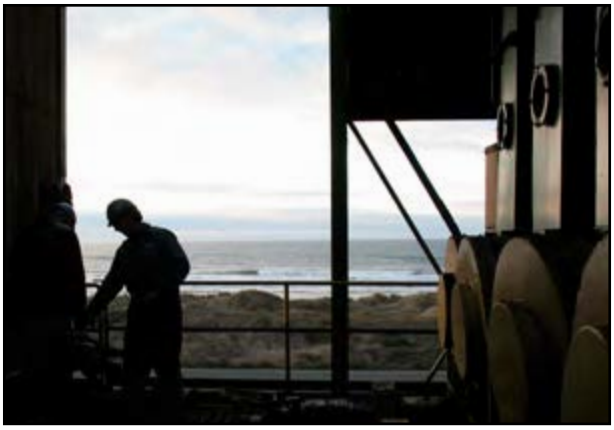
The RePower Humboldt strategic plan is a living document.

4 The business-as-usual, bold and peak scenarios are defined and discussed in Chapter 7.

4 Humboldt Energy Background

Where have we come from?

Humboldt County has a long history of developing its renewable energy resources. As far back as the 1930s biomass fired steam electric power was being developed in Humboldt, with additional plants coming on-line in the 1960s and 1980s. The 1980s were also an active period of small hydroelectric power development on local creeks, and Humboldt County boasted a huge concentration of off-grid solar electric systems. Also in the 1980s, the City of Arcata created a program to finance the installation of solar hot water systems on local residences, and the County sponsored a plan to accelerate economic development of local energy resources. In more recent years, Humboldt County residents have installed grid-connected solar electric systems at a per capita rate more than two times greater than the state of California as a whole.



Recently Humboldt County's sustainable energy planning efforts have been ramping up. In 2003, the Redwood Coast Energy Authority (RCEA) was formed to develop and implement sustainable energy initiatives that reduce energy demand, increase energy efficiency, and advance the use of clean, efficient and renewable resources available in the region. One of RCEA's first activities was working with the County to develop and implement an Energy Element for the County's General Plan Update. This work included preparation of a background technical report that documented the county's energy use characteristics and briefly explored opportunities for energy efficiency improvement and renewable energy development (Zoellick, 2005). The draft Energy Element, completed in 2005, laid out goals, policies, standards and implementation measures. As a natural follow-on to the Energy Element, in 2008 the RCEA applied for and

Redwood Coast Energy Authority

The Redwood Coast Energy Authority is a Joint Powers Authority whose members include the County of Humboldt; the Cities of Arcata, Blue Lake, Eureka, Ferndale, Fortuna, Rio Dell, and Trinidad; and the Humboldt Bay Municipal Water District. RCEA provides education, technical assistance, and direct installation services for the small commercial, public agency, and residential market sectors, as well as region-wide energy planning services. Since its inception RCEA has:

- brought approximately $5 million in funding to the North Coast for energy programs and services, resulting in a cumulative total projected savings to the community of over $9.8 million in reduced energy costs;
- provided energy-efficiency services to over 4,500 Humboldt County households; and
- coordinated over 875 small-business energy-project installations that generated over $1.4 million of economic activity for the local energy-retrofit sector.

In addition, RCEA has overseen a Million Solar Roofs program, helped develop an Energy Element for the County General Plan, and is currently administering regional energy planning grants for renewable energy development (the RePower Humboldt project) and electric vehicle infrastructure deployment. RCEA is a shining example of how a regional energy program can effectively serve a rural community.

received funding from the California Energy Commission's Renewable Energy Secure Community (RESCO) program to conduct the RePower Humboldt study.

Where are we now?

Humboldt County's energy system is geographically isolated from the larger California network, but remains reliant on imported energy. At the same time, Humboldt has a wealth of untapped local renewable energy resources, including biomass, wind, wave and hydropower. Combined, these resources could provide about three times more electricity each year than we currently consume. The surplus electricity is roughly equivalent to the energy that would be needed to satisfy all of Humboldt's heating and transportation demands, assuming we converted our heating appliances and vehicles to electric technologies. In other words, there is enough renewable energy potential in Humboldt County to meet all of our present energy needs with local renewable sources[5]. Although Humboldt has a tremendous potential supply of indigenous renewable energy sources, it currently imports two-thirds of its energy in the form of natural gas and petroleum products (See Figure 1 on page 12).

Humboldt's 2010 Energy Profile

In Humboldt County there are three primary types of demand for energy: electricity, fuel for heating, and fuel for transportation. Figure 1 presents a graphical depiction of Humboldt County's overall energy sources and uses in 2010, as well as the greenhouse gas emissions associated with energy consumption. The thickness of each band in the diagram is drawn in proportion to the amount of energy (or greenhouse gas emissions) produced, consumed, or converted each year. The bold boxes in the right half of Figure 1 represent the energy demands. In 2010 the total primary energy[6] consumed in Humboldt County was about 27 petajoules (10^{15} Joules; 1 petajoule is approximately equal to the annual consumption of 12,000 Humboldt households). Biomass, natural gas, and petroleum each contributed about a third of the total primary energy. Petroleum and the majority of natural gas are imported.

> *There is enough renewable energy potential in Humboldt County to meet all of our present energy needs with local renewable sources*

In 2010 Humboldt County spent approximately $460 million to meet local energy demand, the majority of which left the county. The greenhouse gas emissions associated with

Humboldt County General Plan Chapter 12 Energy Element - Goals

E-G1. Countywide Strategic Energy Planning. An effective energy strategy based on self-sufficiency, development of renewable energy resources and energy conservation that is actively implemented countywide through Climate Action Plans, General Plans and the Redwood Coast Energy Authority's Comprehensive Energy Action Plan.

E-G2. Increase Energy Efficiency and Conservation. Decrease energy consumption through increased energy conservation and efficiency in building, transportation, business, industry, government, water and waste management.

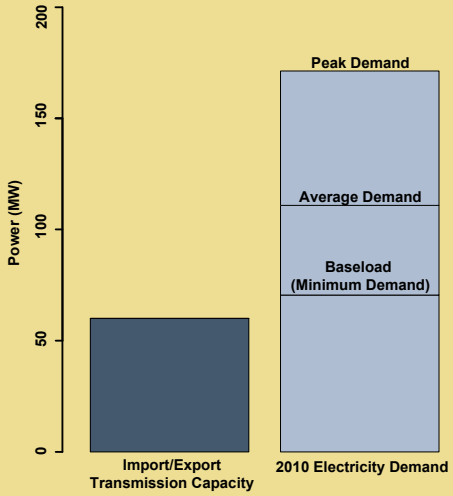
E-G3. Supply of Energy from Local Renewable Sources. Increased local energy supply from a distributed and diverse array of renewable energy sources and providers available for local purchase and export.

5 It's important to note that actually achieving a 100% renewable energy economy would require drastic and potentially impractical changes to energy infrastructure, appliances, and our vehicle fleet. In addition, a wide variety of barriers could limit development of our renewable energy resources. The comparison between renewable potential and our energy needs is only intended to illustrate that we are not limited by the availability of local resources.

6 Primary energy is an energy form found in nature that has not been subjected to any conversion or transformation process. It is energy contained in raw fuels (such as oil, coal, natural gas and biomass) and in other renewable forms (such as solar, wind and hydropower). Primary energy sources are often converted into secondary forms that are more convenient to use, such as electricity and refined fuels.

Energy Island

Humboldt County is geographically isolated and is almost an energy island. The majority of petroleum-based transportation fuels are imported to the county by barge. There is only one pipeline connecting us to the larger natural gas grid, and only two major connections to the larger electric grid. The electric transmission capacity (approximately 60-70 MW) that connects Humboldt County to the regional grid is less than half of the County's 170 MW peak electrical demand. For this reason Humboldt County generates much of its own electricity, mostly using natural gas and biomass fuels.

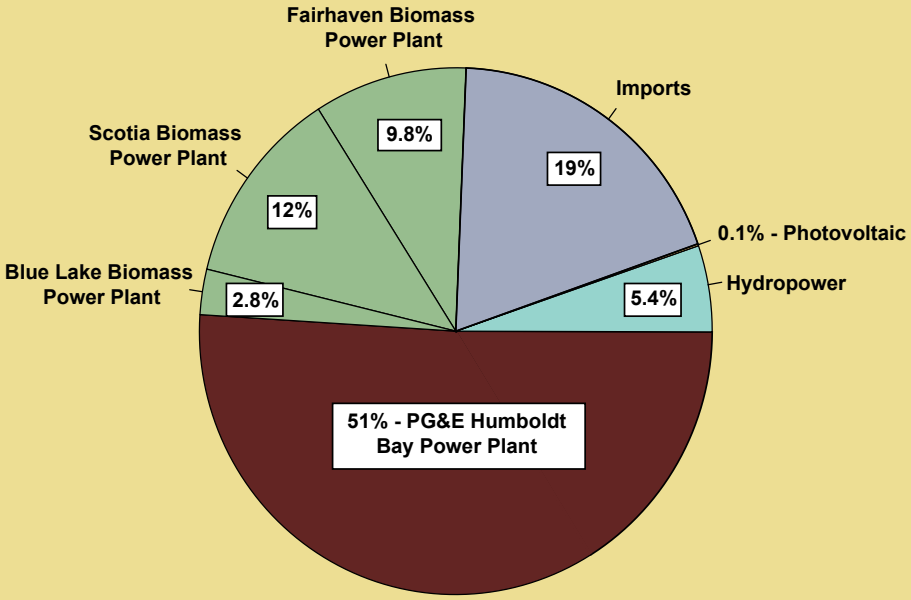


Where does electricity come from in Humboldt?

In 2010, local biomass fired generators and hydropower supported 30% of the local electricity demand. The remainder was provided by imports from outside the County as well as the Pacific Gas and Electric (PG&E) Humboldt Bay Power Plant, which is fueled by natural gas. The pie chart below illustrates our grid mix in 2010.

PG&E has recently built a new natural gas fired power plant located at King Salmon. The new plant is larger and more flexible than the previous plant. It now has the capability of supplying most of the electricity that previously came from imports. In addition, the new modular plant is ideally suited to following changes in the intermittent supply of renewable electricity. Without this plant, it would be challenging (if not impossible) to develop large amounts of wind and wave power in Humboldt.

2010 Electricity Production by Generator



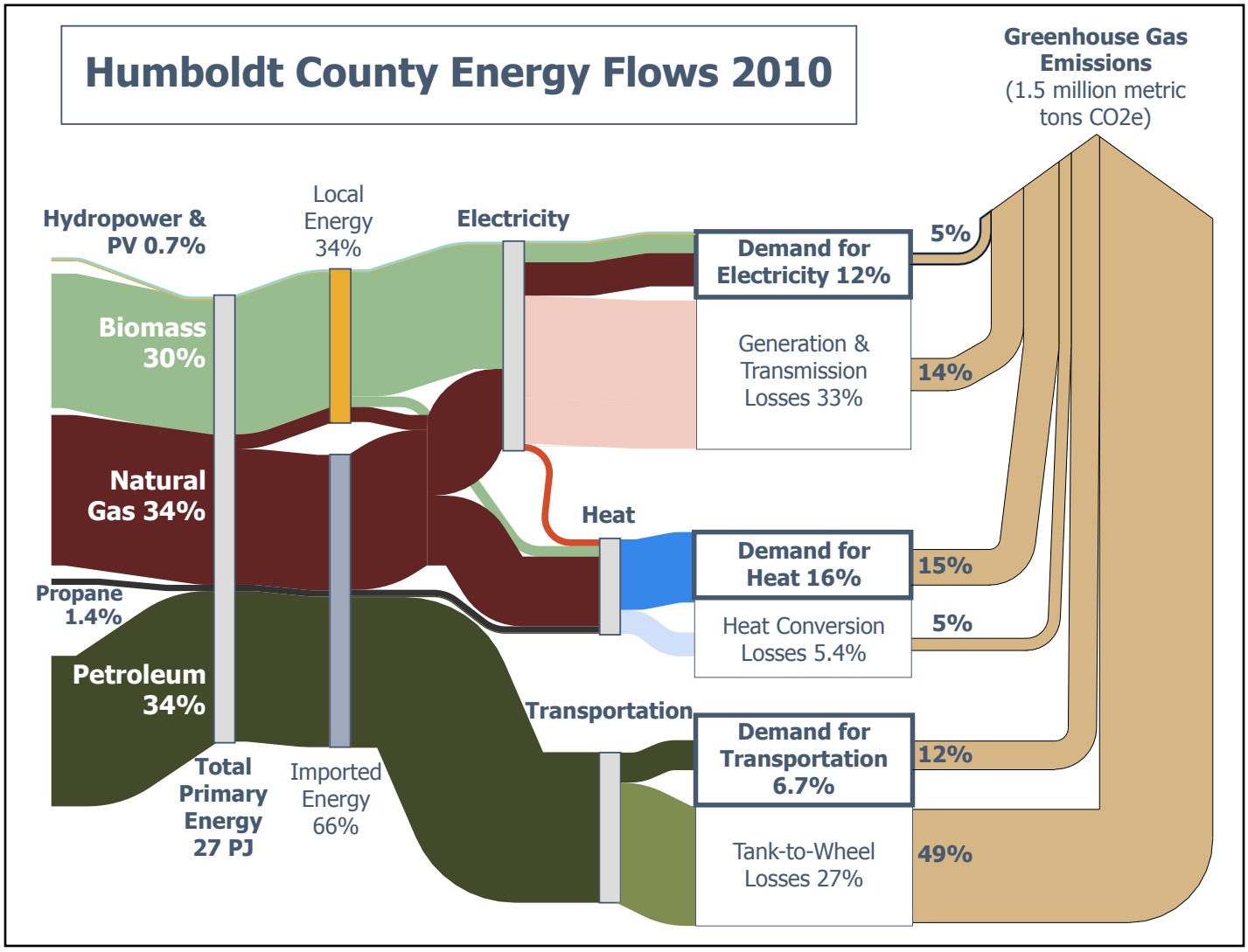


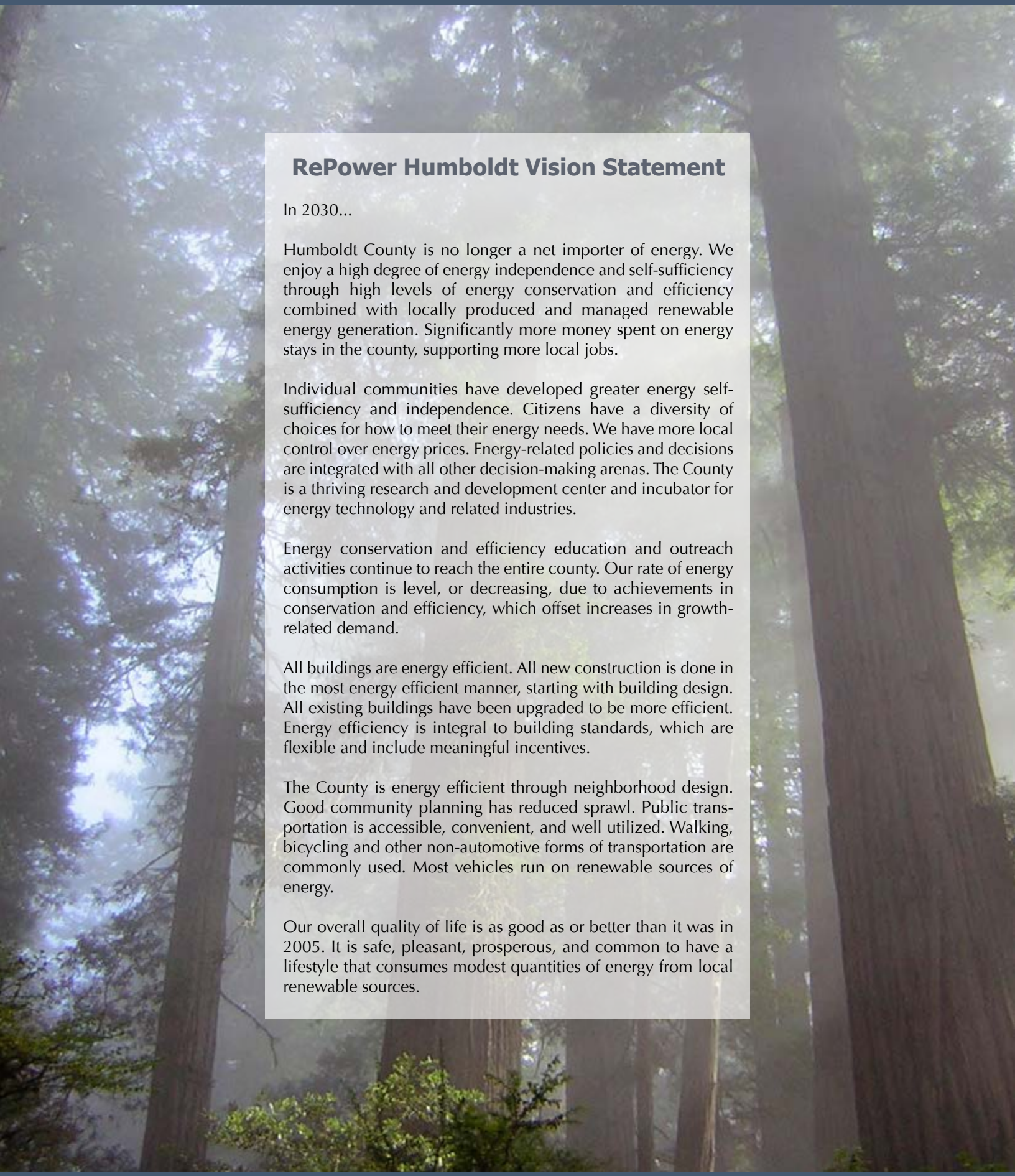
Figure 1: Energy flow diagram for Humboldt County in 2010. Energy units are in petajoules (PJ). The percentage labels on the yellow arrows represent percent of total emissions; all other percentage labels represent percent of total primary energy. The red line from electricity to heat represents electric space and water heating.

energy use in Humboldt total 1.5 million metric tons of CO_2 equivalent. About 60% of these emissions are associated with the transportation sector (through combustion of petroleum fuels) while the remaining 40% of emissions are split rather evenly between the electricity and heating sectors (through combustion of natural gas). This strategic plan addresses all three energy sectors in order to have the greatest impact on reducing emissions and other negative environmental consequences of fossil energy consumption.

5 Vision Statement

Where are we headed?

The RePower Humboldt vision statement has its roots in the 2005 public comment process for the Draft Energy Element prepared for the Humboldt County General Plan Update. The vision statement that came out of that process was reviewed and reinforced by the RePower Humboldt stakeholder group in 2010. It embodies the community qualities and characteristics that the RePower Humboldt strategic plan aspires to achieve, expressed as a hypothetical description of Humboldt County in 2030.



RePower Humboldt Vision Statement

In 2030...

Humboldt County is no longer a net importer of energy. We enjoy a high degree of energy independence and self-sufficiency through high levels of energy conservation and efficiency combined with locally produced and managed renewable energy generation. Significantly more money spent on energy stays in the county, supporting more local jobs.

Individual communities have developed greater energy self-sufficiency and independence. Citizens have a diversity of choices for how to meet their energy needs. We have more local control over energy prices. Energy-related policies and decisions are integrated with all other decision-making arenas. The County is a thriving research and development center and incubator for energy technology and related industries.

Energy conservation and efficiency education and outreach activities continue to reach the entire county. Our rate of energy consumption is level, or decreasing, due to achievements in conservation and efficiency, which offset increases in growth-related demand.

All buildings are energy efficient. All new construction is done in the most energy efficient manner, starting with building design. All existing buildings have been upgraded to be more efficient. Energy efficiency is integral to building standards, which are flexible and include meaningful incentives.

The County is energy efficient through neighborhood design. Good community planning has reduced sprawl. Public transportation is accessible, convenient, and well utilized. Walking, bicycling and other non-automotive forms of transportation are commonly used. Most vehicles run on renewable sources of energy.

Our overall quality of life is as good as or better than it was in 2005. It is safe, pleasant, prosperous, and common to have a lifestyle that consumes modest quantities of energy from local renewable sources.

6 Community Values for Energy Development

What path should we take? Guiding principles for pursuing our vision.

A renewable energy future for Humboldt County is possible and practical. As discussed in the next section, "Potential Energy Futures", we can make substantial progress toward achieving the 2030 vision described above.

The pathway forward, however, is multi-faceted and complex, requiring substantial participation and support from the community. No single policy or technology is capable of realizing our vision; rather a comprehensive portfolio of energy supply and demand-related programs and projects must be pursued. As a community, we must be prepared to review and evaluate a wide range of alternatives in a manner that maintains and honors the core values held in common by us all.

The RePower Humboldt community stakeholder process was, in part, an attempt to identify and document these core values. The stakeholder group produced and ranked a set of seven criteria to use in the evaluation of proposed energy development projects and initiatives. These criteria, and their relative ranking from the stakeholder group, reflect values held by our community and represent guiding principles to follow as we pursue our sustainable energy goals. These criteria helped guide the development of the RePower Humboldt Strategic Plan. Further information regarding the RePower Humboldt stakeholder process can be found in Appendix B.

RePower Humboldt Stakeholder Criteria for Energy Project Evaluation

Criteria are presented in order of importance to the community as ranked through the RePower Humboldt stakeholder process.

Criteria	Ranking
Environmental Quality	23%
Financial Viability / Affordability	22%
Local Acceptance, Participation, and Control	16%
Economic Impact (Jobs, Income)	13%
Appropriate Technology	13%
Social/Environmental Justice	8%
Other Community Benefits	4%

1. Environmental Quality/Impacts

The development, production, transportation, transmission and use of a renewable energy resource with high environmental quality would…

- Have little or no immediate impact on the local landscape and ecosystems;
- Have little or no global or regional environmental impacts (e.g., the carbon footprint, impacts on habitat corridors, downstream impacts on water quality);
- Have little or no impacts from "the cradle to grave" (i.e., from the development of the resource to the disposal of any waste or by-products produced).

Note: Impacts may be direct or indirect. An example of an indirect impact is pollution emitted by a truck that is transporting a fuel for running a power plant.

2. Financial Viability and Affordability

The development, production, transportation, transmission and use of a renewable energy resource with high financial viability and affordability of use would…

- Be supported by the business community;
- Not be prohibitively expensive to construct or use;
- Have diverse and sustainable funding sources for construction (private and public; local, state and federal monies);
- Be affordable for low-income consumers.

3. Local Acceptance, Participation, and Control

The development, production, transportation, transmission and use of a renewable energy resource with high local acceptance, participation, and control would….

- Have evidence of high local support for and participation in the planning process for its development;
- Have evidence of broad acceptance by and support from key sectors (i.e., environmental, business, and agricultural communities).

4. Economic Impact on Jobs and Income

The development, production, transportation, transmission and use of a renewable energy resource with highly favorable economic impacts on jobs and income would…

- Stimulate the number of living wage jobs and raise income levels within the county through local manufacture, installation, operation, maintenance, and service of the renewable energy systems.
- Stimulate the local economy by increasing tax revenues and injecting money into the local economy that indirectly stimulates non-energy related economic sectors.

5. Appropriate Technology

A renewable energy resource portfolio with appropriate technology would have options that….

- Locate energy supplies close to demand, reducing the need for long transmission lines
- Are efficient and reliable
- Are diverse in scale and type
- Are sustainable
- Offer flexibility to respond to future changes in demand

6. Social and Environmental Justice

The development, production, transportation, transmission and use of a renewable energy resource portfolio that is socially and environmentally just would…

- Be accessible and affordable to people of all income levels;
- Be placed throughout the county so that both positive and negative impacts that may arise from renewable energy projects are distributed equitably.

7. Meets Other Community Goals and Creates Positive Externalities

Value-added renewable energy options meet community goals and create positive externalities by providing benefits beyond just meeting the energy needs of the communities in which they operate. Examples of such externalities include an increase in local jobs, improved public health, and a decrease in waste.

7 Potential Energy Futures

7.1 What are Humboldt County's Energy Options?

The RePower Humboldt study team conducted a comprehensive examination of Humboldt County's potential for achieving renewable energy security and prosperity. The key energy resources and technologies that were identified and assessed are briefly described below, and a list of the maximum capacities analyzed can be found in Appendix D. Further information on these resources, as well as additional resources and technologies that were considered but were found not likely to play a significant role in furthering the RePower Humboldt vision can be found in the report entitled *Humboldt County Renewable Energy Secure Community: Resource and Technology Assessment Report*[7], March 2012.

Energy Efficiency

Improvements in energy efficiency can substantially reduce energy demand in Humboldt County. Our best estimates based on a statewide energy efficiency potential study (Itron, 2008) indicate that the total electric demand could be decreased by 5% to 25% with aggressive energy efficiency retrofits. These estimates consider only proven, cost-effective efficiency measures. Technological advances that are yet to come will almost certainly increase this energy savings potential. Energy efficiency is typically the cheapest available "resource" and should be the top priority.

7 http://www.redwoodenergy.org/programs/repower

Wind

Good wind resource areas are very site specific. To help identify prime wind energy locations the California Energy Commission contracted with AWS TrueWind Solutions to develop wind resource maps for all of California (California Energy Commission, 2006). Wind resources are characterized by average wind speed, ranging from class 1 (the lowest) to class 7 (the highest). A rating of at least class 4 designates sites with good potential for commercial development. The best wind resource in Humboldt County is in the Cape Mendocino area, where much of the onshore resource is rated at class 5 or better. It has been estimated that there is greater than 400 MW of onshore resource in this area (California Department of Water Resources, 1985). Bear River Ridge, the most accessible ridge in the area, was recently studied by Shell WindEnergy. They had proposed a 50 MW wind farm on the ridge, but chose not to pursue the project due to "unfavorable market conditions and issues pertaining to the transportation logistics." The maximum wind power potential considered in the RePower Humboldt study was 250 MW.

One conflict regarding wind energy development in most of the Cape Mendocino area is that the National Audubon Society has designated a large fraction of the area (known as the Cape Mendocino Grasslands) as an Important Bird Area. While the Audubon Society "strongly supports properly-sited wind power as a clean alternative energy source that reduces

the threat of global warming," they typically do not support wind energy development in areas designated as Important Bird Areas. Bear River Ridge is on the northern border of the Cape Mendocino Grassland Important Bird Area.

Other possibilities for wind energy development in Humboldt County include offshore resources, though these are more expensive to develop, and the offshore wind industry is not well developed in the United States. Much of the wind resource offshore of Cape Mendocino is rated as Class 7; however, this area is not readily accessible and is in deep water. Offshore of Humboldt Bay, where electrical grid infrastructure is more readily accessible, the wind resource reaches Class 5 and higher at about 10 to 15 miles offshore. There are also a few sites on the ridge lines above Highway 36 and Highway 299 that appear they might marginally support commercial wind development.

Small Hydro

There are currently six small hydroelectric facilities that serve Humboldt County (SERC, 2005). These facilities have a combined rated capacity of 11.5 MW. All but one of these, the Mathews Dam facility at Ruth Lake, are run-of-the-river systems that do not require significant water impoundments. All of these systems are 5 MW or less in capacity and all sell power to Pacific Gas and Electric Company via long-term contracts. Although numerous other sites totaling about 60 MW in capacity have been identified for potential development of small, run-of-the-river hydroelectric power (Oscar Larson & Associates, 1982), very few sites have been developed. Likely barriers to small hydropower development include rigorous permitting requirements, remote site locations, and lack of economic viability. The maximum hydropower capacity examined in the RePower Humboldt study was 35 MW.

Biomass

Humboldt County has a tremendous woody biomass resource that is already used to meet 25%-35% of our local electricity demand, and there is potential to expand this use of biomass for energy production. The potential for growth is primarily from sources of biomass waste that are not currently being utilized. This includes slash left behind after timber harvest operations, waste material generated when understory brush is removed to reduce fire hazards (known as fuel reduction treatments), and small diameter logs generated during forest management thinning operations. These materials typically are not marketable as timber products and are largely left in the woods or are piled and burned. However, burning can create air quality and fire hazards. Also, it is expensive to perform fuel treatments to reduce the fire loading in the forest, and this significantly reduces the amount of area that can be treated.

If these waste materials could be utilized as an energy resource there could be many derived benefits. Fire hazards and air quality hazards could be reduced. A local renewable energy resource could be utilized to meet local energy demand. By adding value to the biomass waste, revenue could be generated that could partially offset the cost of the fuel treatments, thereby allowing a larger area to be treated.

The magnitude of the available resource has been estimated to be enough to support 220 MW of electricity generating

capacity (Williams, 2008). However, to successfully and sustainably utilize this additional biomass resource a number of key issues need to be addressed. First, the cost to process and transport this woody biomass waste to a local power plant is a seriously limiting factor. This problem could be mitigated if we can find ways to increase the density of the material before transporting it. Second, there are concerns that expanding biomass energy generation could place unsustainable pressures on our local forests. This issue would need to be assessed and a consensus developed regarding what levels of biomass waste could be removed in a sustainable fashion. Proper disposal of the waste ash from biomass power plants has also been identified as a potential issue. Finally, there is some controversy regarding the greenhouse gas emissions associated with biomass energy. In general, biomass has been treated as a carbon neutral resource as long as the harvest rate does not exceed the rate of new growth. However, this premise is currently being scrutinized and regulatory treatment of biomass could change. In addition, there are greenhouse gas emissions associated with the harvest and transport of the fuel. These emissions can be assessed in a life cycle analysis. This study treated biomass as a carbon neutral resource. It is recommended that this assumption be further evaluated as a topic of future research. The maximum biomass capacity examined in the RePower Humboldt study was 225 MW.

Wave

Currently wave energy technologies are relatively immature. Nonetheless, there is tremendous wave energy potential worldwide and great interest in the technology. One study (California Energy Commission, 2003) estimated the wave energy potential offshore from Humboldt County. Primary sites for the Humboldt County coastline north of Cape Mendocino (a 72-mile stretch) were estimated to have a total potential capacity of 3,900 MW. Primary sites for the southern Humboldt and northern Mendocino coastlines (an 81 mile stretch) were estimated to have a total potential capacity of 3,700 MW, approximately half of which falls within Humboldt County's coastline. A rough estimate is that as much as 1,000 MW of this potential capacity in Humboldt County could be developed (Zoellick, 2005). PG&E recently considered development of a 5 MW wave energy pilot project directly west of Humboldt Bay (PG&E, 2010). Although this project was suspended due to significant challenges and high costs, future development of wave energy potential on the Humboldt County coastline continues to be a real possibility. The maximum wave power capacity examined in the study was 100 MW.

Solar

Humboldt County is not well suited for large, utility-scale, photovoltaic or concentrating thermal electric solar energy installations. The solar resource is not adequate to make such an installation economically viable, and there are few areas with large expanses of flat, available terrain. Most of the flat areas are in the foggy coastal parts of the county (near the Humboldt Bay and Eel River deltas), which are the population centers and important agricultural zones. However, rooftop solar electric and solar hot water systems that serve individual facilities can be very appropriate in Humboldt County. In fact, there are already many roof-top solar energy systems installed in on-grid and off-grid applications. Since 1998, the residents of Humboldt County have installed over twice as many grid-connected solar electric systems per capita as the State of California as a whole. The

total grid-connected capacity in 2010 was 1.44 MW for 428 systems (California Energy Commission, 2010). This could be substantially increased as a part of the RePower Humboldt plan. The maximum solar electric capacity examined in the study was 10 MW.

Distributed Generation

Distributed generation has been defined by the California Energy Commission as electricity production at a capacity of 20 MW or less that is on-site or close to a load center and is interconnected to the utility distribution system (Rawson, 2007). Typical distributed generation technologies include photovoltaics, small wind, small biomass, and small combined heat and power (CHP). Prime opportunities for CHP include commercial and industrial applications where substantial thermal energy is required. These include hospitals, jails, colleges, large office buildings, casinos, supermarkets, and commercial and industrial processes. CHP systems are typically sized to meet the heating load. Because our solar resource is marginal and viable small wind, biomass and CHP opportunities are limited, we expect distributed generation to provide only a modest contribution to our local power needs. However, we think it should play an important role in the RePower Humboldt plan because small, distributed projects are one key way that local residents and businesses can directly participate in implementing the RePower Humboldt vision.

Plug-in Electric Vehicles

Electric drive vehicles have the potential to substantially displace gasoline and diesel demand with the use of cleaner, locally generated electricity. Compared to conventional gasoline and diesel, which are entirely imported, the majority of electricity consumed in Humboldt County is generated by local natural gas- and biomass-fired power plants. Studies indicate that electricity generation from fossil fuels such as natural gas and even coal is cleaner than the combustion of gasoline and diesel (EPRI, 2007). Moreover, electricity generated from local renewable sources can further reduce greenhouse gas emissions. Electric drive vehicles represent a fuel switching option that can reduce emissions and allow greater use of local renewable energy resources. The maximum penetration of electric vehicles that was considered in the study was 38% of registered light duty vehicles.

Electric Heat Pumps

Currently over 80 percent of energy used for space heating in Humboldt County comes from natural gas (Zoellick, 2005). A smaller portion comes from propane (approximately 9 percent), with the remainder coming from firewood. With large-scale renewable electricity development in Humboldt County, a portion of this heating energy demand could be served using renewable electricity and electric heat pumps. Heat pumps are devices that utilize an electrically driven vapor-compression refrigeration cycle (like a refrigerator or air-conditioner) to move heat from a colder reservoir to a warmer reservoir. When using heat pumps for space heating applications heat is either moved from the outside air (an air source heat pump) or from the ground (a ground source heat pump) to the interior conditioned space. The maximum penetration of electric heat pumps considered in the RePower Humboldt project was 38% of natural gas furnaces and water heaters.

7.2 What's possible? Results from the RePower Humboldt Study

The following conclusions and lessons learned summarize the most important outcomes of the RePower Humboldt study. To facilitate presentation of results, we refer to three future energy scenarios: ***business-as-usual***, ***bold***, and ***peak***[8]. These scenarios are intended to illustrate a range of possibilities. ***Business-as-usual*** (BAU) is the baseline projection for energy use in Humboldt in 2030 and assumes continued use of already existing infrastructure and technologies. The ***bold*** scenario indicates the extent to which the RePower Humboldt vision can be achieved if we cap overall cost increases to 5% above ***business-as-usual*** and choose a mix of resources that maximizes reductions in greenhouse gas emissions. Finally, the ***peak*** scenario features a resource mix that maximizes greenhouse gas reductions while allowing a 15% increase in cost over ***business-as-usual***[9].

The ***bold*** scenario includes development of 124 MW of new renewable energy capacity with an estimated overnight capital cost of about $360 million. The ***peak*** scenario calls for 280 MW of new renewables at an estimated overnight capital cost of $820 million.

The portfolios associated with these scenarios are presented in Figure 2 (with additional information presented in Appendix D). Within this figure, the left bar graph contains the installed capacity of each electricity generation technology: biomass, wind, hydropower, wave, solar PV, and natural gas. The right bar graph shows the adoption rate of each demand-side activity: efficiency, plug-in electric vehicles, and electric heat pumps.

An adoption rate of 100% for efficiency means complete participation in a two-tiered program. This level of participation would achieve a countywide electricity savings of about 24%. The two efficiency tiers are "Market Efficiency," meaning the potential to expand existing efficiency programs through increased incentives to overcome market barriers, and "Economic Efficiency," which means expanding existing programs to capture all cost-effective efficiency opportunities (i.e., all projects that save money over their lifetime) (Itron, 2008).

Percent adoption for heat pumps represents the penetration of this technology into the residential and commercial space heating market as a technology replacement for natural gas furnaces. Finally, for plug-in electric vehicles, percent adoption represents the number of conventional light duty vehicles replaced by either plug-in hybrid electric or battery electric vehicles[10].

Figure 3 shows the percentage of electrical energy that comes from each generation technology under each scenario. This figure demonstrates how the use of wind, biomass, hydro and wave energy technologies can substantially decrease the amount of electricity that needs to be generated by PG&E's natural gas fired power plant. In the peak scenario, although there is still 163 MW of electrical capacity available from the PG&E Humboldt Bay Power Plant, it only provides a few percent of the total electrical energy required by the county.

8 See the *Humboldt County Renewable Energy Secure Community: Resource and Technology Assessment Report*, March 2012 for a discussion of the methodology used to arrive at these scenarios.

9 The peak scenario should not be confused with technical potential. Technical potential represents all of the renewable energy that could be harnessed in the county and all of the energy savings that could be achieved through exhaustive efficiency measures. By contrast, the peak scenario is based on a set of assumptions about what could realistically come to pass in 20 years given the availability of local resources and the technological and economic barriers to development. The authors used their best judgment in setting these limits, including an analysis of the impact that renewable energy development would have on the local electricity grid.

10 Plug-in hybrid electric vehicles use both a gasoline powered internal combustion engine and a battery powered electric motor to propel the car; the battery is recharged by plugging it into the electric grid. A plug-in hybrid electric vehicle can typically drive 10 to 40 miles on electricity only, but for longer distances or at higher speeds and on hills the gasoline powered internal combustion engine is needed. Battery electric vehicles can achieve driving ranges of up to about 100 miles, then they need to be plugged in and recharged.

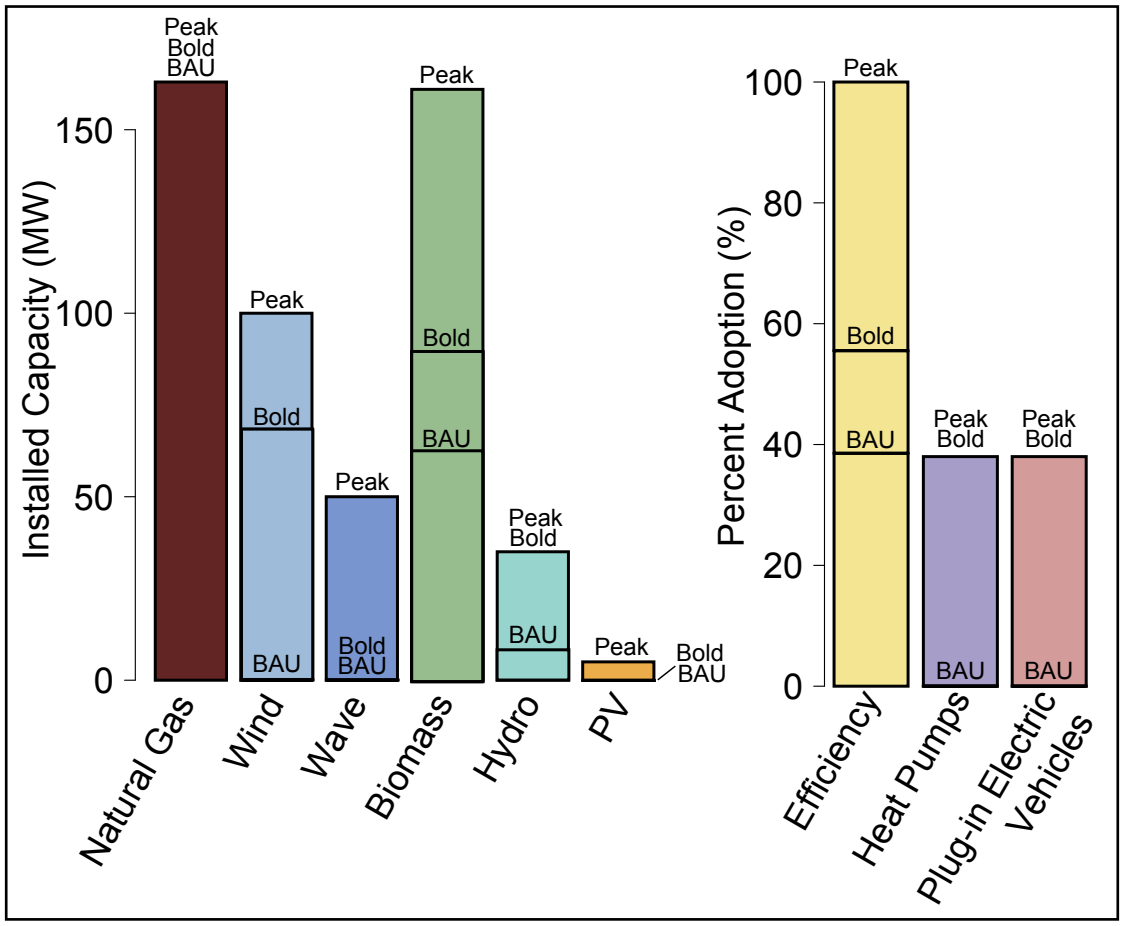


Figure 2: Installed capacity for ***business-as-usual (BAU)***, ***bold***, and ***peak*** scenarios. ***BAU:*** Humboldt's 2030 energy portfolio if no new generation is developed and no new demand technologies are adopted; ***bold***: what can be achieved by 2030 with only a 5% increase in cost over ***BAU***; ***peak***: the practical maximum development achievable in 20 years with high motivation and low regard for cost increases.

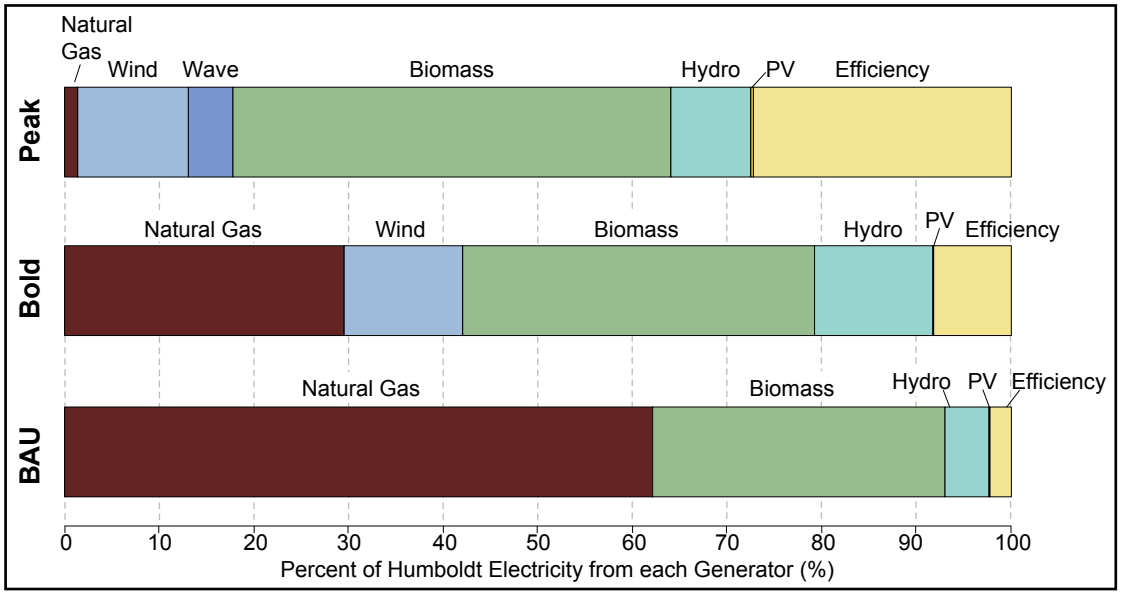


Figure 3: Energy production from each generator type as a fraction of total county demand for electricity under each scenario.

7.3 Key Findings

A renewable energy future is feasible!

There is great potential in Humboldt County for renewable energy development. At only a 5 percent increase in costs, the ***bold*** scenario shows that in 20 years the County can realistically meet over 70 percent of electricity demand with local renewable energy while simultaneously displacing 25 percent of heating and 10 percent of transportation energy needs (Figures 6 and 7 on page 24). The ***peak*** scenario goes even further. At a cost increase of about 15 percent it will meet 98 percent of our electricity needs and about 33 percent of heating and 13 percent of transportation energy demand with local renewable energy resources.

A renewable future will have beneficial economic, security, and environmental impacts.

The RePower Humboldt study estimated the local economic impacts (job creation and economic output[11]) associated with the construction and operation of local renewable energy and energy efficiency projects. In the ***bold*** scenario there is a potential for 120 new jobs and $17 million in new economic output, while the ***peak*** scenario offers 300 new jobs and $50 million in additional economic output (Figures 8 and 9 on page 25). These local job estimates represent a combination of construction and operation phase jobs. For ease of comparison, the construction phase impacts are assumed to be spread out over the lifetime of each technology.

The large increase in the share of locally generated renewable electricity (Figure 5 on page 24) will result in a significant increase in the security of our local electricity supply. Generation of local renewable electricity will reduce the need to import electrical power over the limited transmission lines that serve our isolated area and will reduce reliance on the PG&E Humboldt Bay Power Plant that utilizes imported natural gas. The natural gas comes into the county via a single natural gas transmission pipeline. Perhaps even more important, the use of local renewable energy to provide for substantial portions of our heating and transportation needs (Figures 6 and 7 on page 24) will further reduce our reliance on imported natural gas and on imported petroleum fuels (gasoline and diesel), which are primarily shipped to Humboldt Bay by barge from the San Francisco Bay Area. Overall, the ***bold*** potential for the share of total energy sourced inside Humboldt County is 53% and the ***peak*** potential is 67%, nearly double the ***business-as-usual*** level (Figure 10 on page 25).

Finally, the environmental benefits associated with renewable energy security will be substantial. The ***bold*** scenario will achieve a 33% reduction in greenhouse gas emissions[12] and the ***peak*** scenario will reduce these emissions by 45% (Figure 11 on page 25). Note that these RePower

RePower Humboldt Key Findings

- A renewable energy future is feasible.
- It will have beneficial economic, security, and environmental impacts.
- Energy efficiency is our cheapest option and should be maximized.
- Biomass, wind and small hydro can play a significant supply side role.
- Fuel switching, like electric vehicles, can play a key role.
- Distributed generation can play an important role, but utility-scale generation is also needed.
- A mix of power options is needed.
- Multiple power options are available and they offer trade-offs.
- All power supply options have impacts, including the "do nothing" option.
- The PG&E Humboldt Bay Generating Station provides important energy services and is well suited to support local renewable energy development.
- Significant transmission and distribution system upgrades will be necessary to accommodate large-scale renewable energy development.

11 Economic output represents the value (in dollars) of all economic activity resulting from the development of a resource. For example, all of the following are included in the metric: taxes paid to local jurisdictions; wages paid to workers; materials, products, and services purchased during construction and operation of the facility; and all "induced" economic effects resulting from the project (e.g. increased patronage of local businesses by workers and their families, etc.).

12 All renewable energy technologies were considered carbon neutral during operation, and life cycle emissions associated with upstream and/or decommissioning activities were not considered. Upstream activities include the production, transportation and installation of renewable energy equipment. Total associated greenhouse gas (GHG) emissions should be examined in a full life-cycle assessment. It is likely that the life-cycle GHG emissions for most renewable technologies will be negligible. The one exception may be for biomass power. The source of biomass fuel, how it is obtained, and related land-use issues can create significant life-cycle GHG emissions associated with some biomass energy alternatives. We expect that utilization of local biomass waste materials associated with timber operations will result in very low life-cycle GHG emissions, but this should be verified through further study.

Humboldt greenhouse gas reduction estimates are highly dependent on the aggressive adoption of plug-in electric vehicles and heat pumps. The 38% adoption rate for these technologies used in both the ***bold*** and ***peak*** scenarios is likely a significant overestimate of what can reasonably be achieved. More reasonable optimistic estimates are likely in the 10% to 20% range. These lower adoption rates would likely result in greenhouse gas reduction levels in the peak scenario of only about 30% to 35%. For comparison, the State of California's greenhouse gas reduction goals call for a 53% reduction compared to business-as-usual in 2030.

Energy efficiency is our cheapest option and should be maximized.

Energy efficiency is the cheapest and most environmentally friendly way to meet a portion of our energy needs. Up-front capital costs are relatively low and lead times for technology implementation are short. Cost-effective energy efficiency opportunities should be aggressively pursued. However, efficiency gains have technical and economic limits, thereby leaving room for the cost-effective development of renewable resources.

Biomass, wind and small hydro can play a significant supply side role.

On the supply side, biomass, wind and small hydro offer substantial opportunity for expanded renewable resource development. These renewable resource options likely offer the most cost-effective approaches. However, environmental impacts associated with these types of projects will need to be considered on a case-by-case basis, and appropriate mitigations will need to be employed when projects are developed. Wave energy might also play a role as the industry develops.

Fuel switching can play a key role in our renewable energy future.

In this study, fuel switching refers to the use of electricity as a "fuel" for vehicles and heating systems instead of gasoline and natural gas. Combining electrification of the transportation and heating sectors with increased renewables on the electric grid results in a more cost-effective strategy for reducing overall greenhouse gas emissions in the energy sector. Demand response technologies may be important to lessen peak demand impacts and better match intermittent renewables to these new electric loads.

Distributed generation can play an important role, but utility-scale generation is also necessary.

Distributed generation, such as rooftop solar, small scale wind power, small biomass, and combined heat and power systems, can play an important role. Distributed power systems typically have little to no land use impacts and provide power close to where it is needed, which can improve overall system efficiencies and reduce strain on transmission and distribution infrastructure. Distributed generation technologies can also provide direct economic benefits to retail customers. In addition, they empower members of the community by providing an active way for individuals and businesses to participate in the implementation of the RePower Humboldt vision. Appropriate levels of support for these technologies can help cultivate broad backing for the overall strategic plan.

However, distributed generation cannot reliably, efficiently and cost-effectively meet all of our energy needs. For example, if it were feasible (and it's not) to install 2-kW solar electric systems on all 61,000 housing units in Humboldt County (122 MW of capacity), the total energy output would only meet about 16% of our electricity needs. Without energy storage, the power would only be available when the sun was shining. The cost for this solar rooftop option would be very high, likely well over $600 million. In contrast, a 50 MW wind farm in a viable location would provide the same quantity of electrical energy for about 20% of the cost. Or, at a cost only slightly higher than the 50 MW wind farm, a 20 MW biomass fired power plant could provide the same amount of electrical energy and it could generate power whenever it was needed, day or night, rain or shine, windy or still. Wise integration of distributed generation and deployment of utility-scale generation are both necessary to reliably, efficiently and cost-effectively meet our energy needs.

A mix of power options is desirable.

Our electric power supply must keep up with a constantly changing demand for electricity. In addition, it should be economical to operate and meet reliability and environmental objectives. This requires generating technologies with a variety of characteristics and attributes. Baseload power plants are run continuously and are typically the cheapest to operate. In Humboldt County biomass and small hydro power plants generally serve baseload. Plants that serve intermediate load must follow demand throughout the day, and peaking power plants must be able to ramp up and down quickly to meet peak demands and adjust to rapid changes in demand. The PG&E Humboldt Bay Generating Station serves both these functions, though gasifier biomass power plants could potentially serve this function as well. Renewable power sources that are cheap to operate and have minimal environmental impact, such as solar photovoltaic and wind energy, are also desirable. However, these resources must be used when they are available (referred to as "must-take" resources). In addition, power plants of various sizes can also help meet various objectives. Small, distributed systems

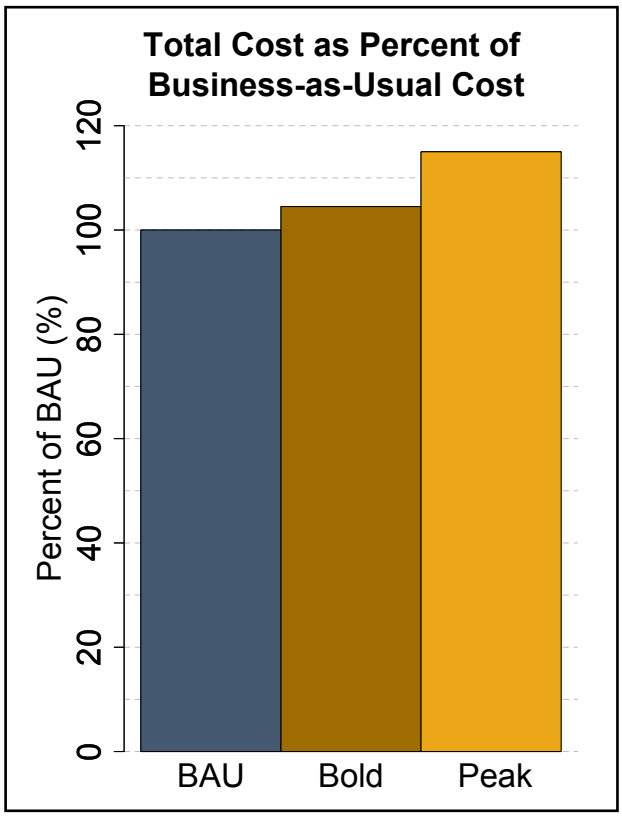


Figure 4

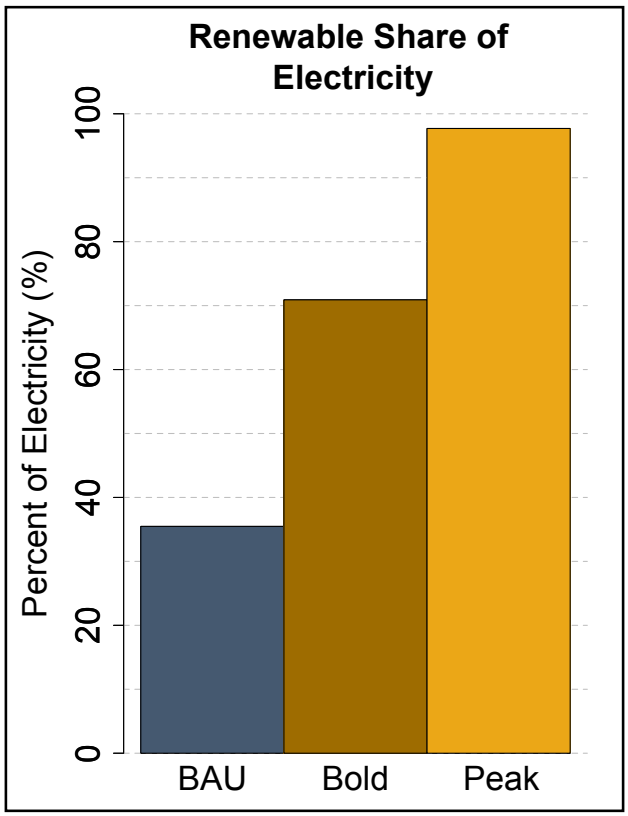


Figure 5

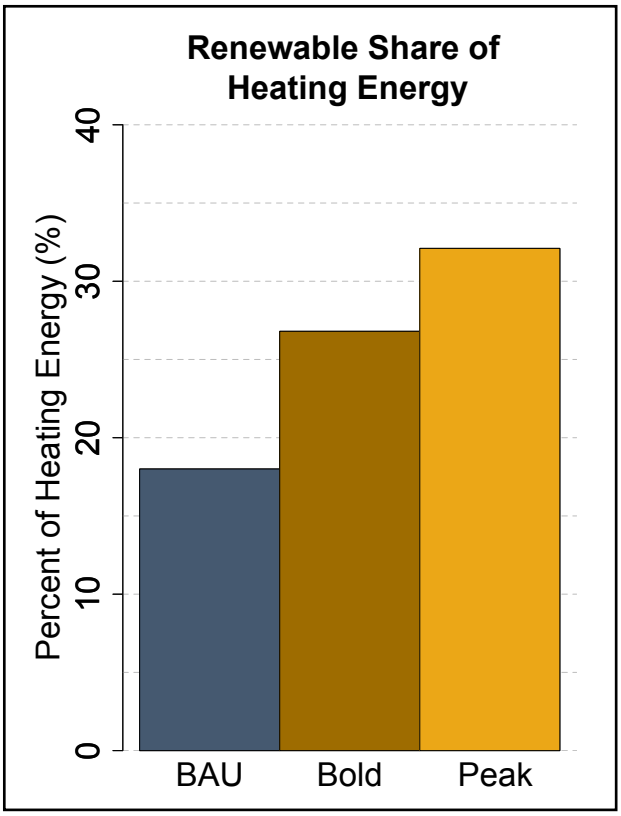


Figure 6 - Based on heat energy delivered to the end user.

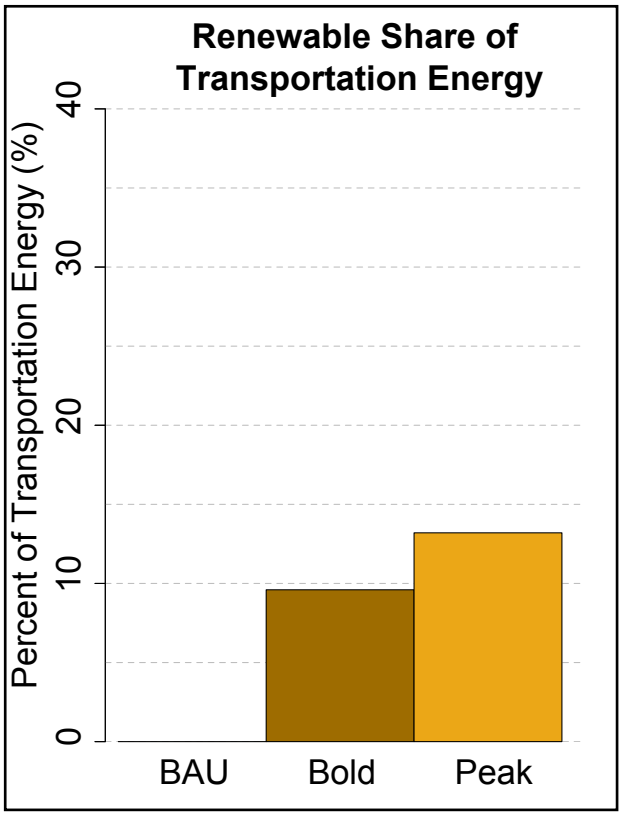


Figure 7 - Based on kinetic energy delivered to wheels.

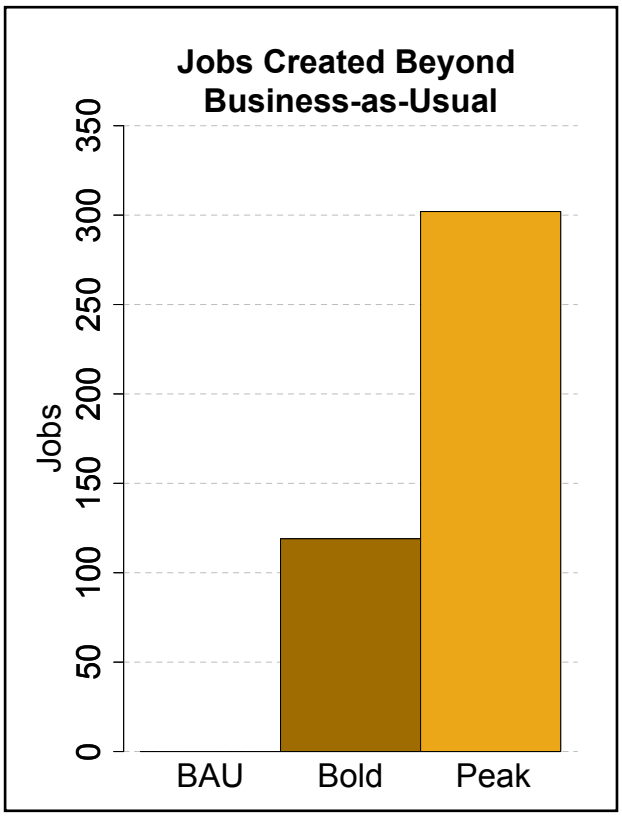


Figure 8

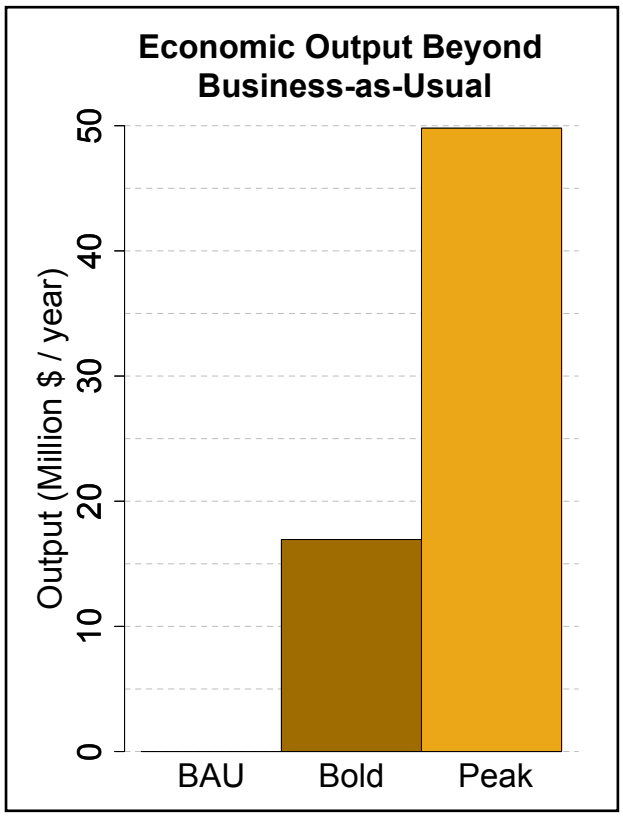


Figure 9

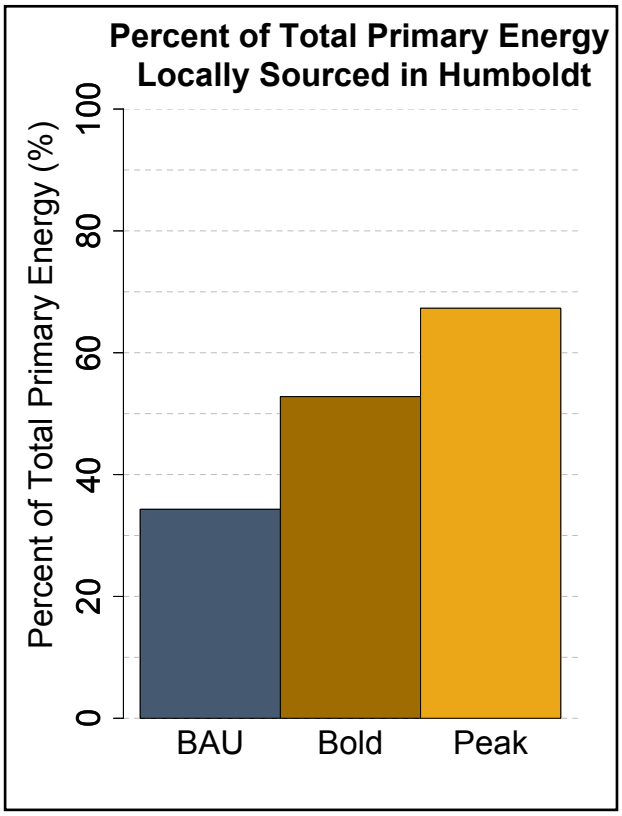


Figure 10

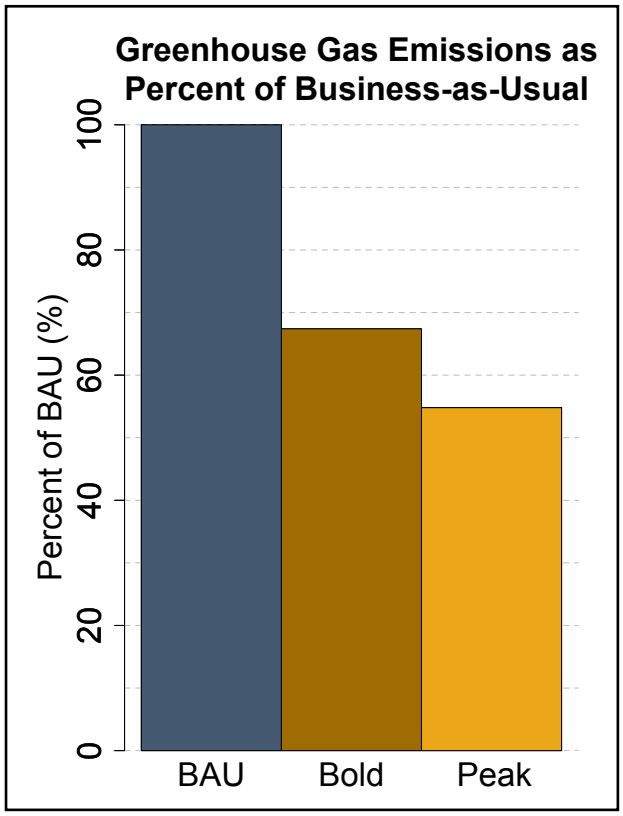


Figure 11

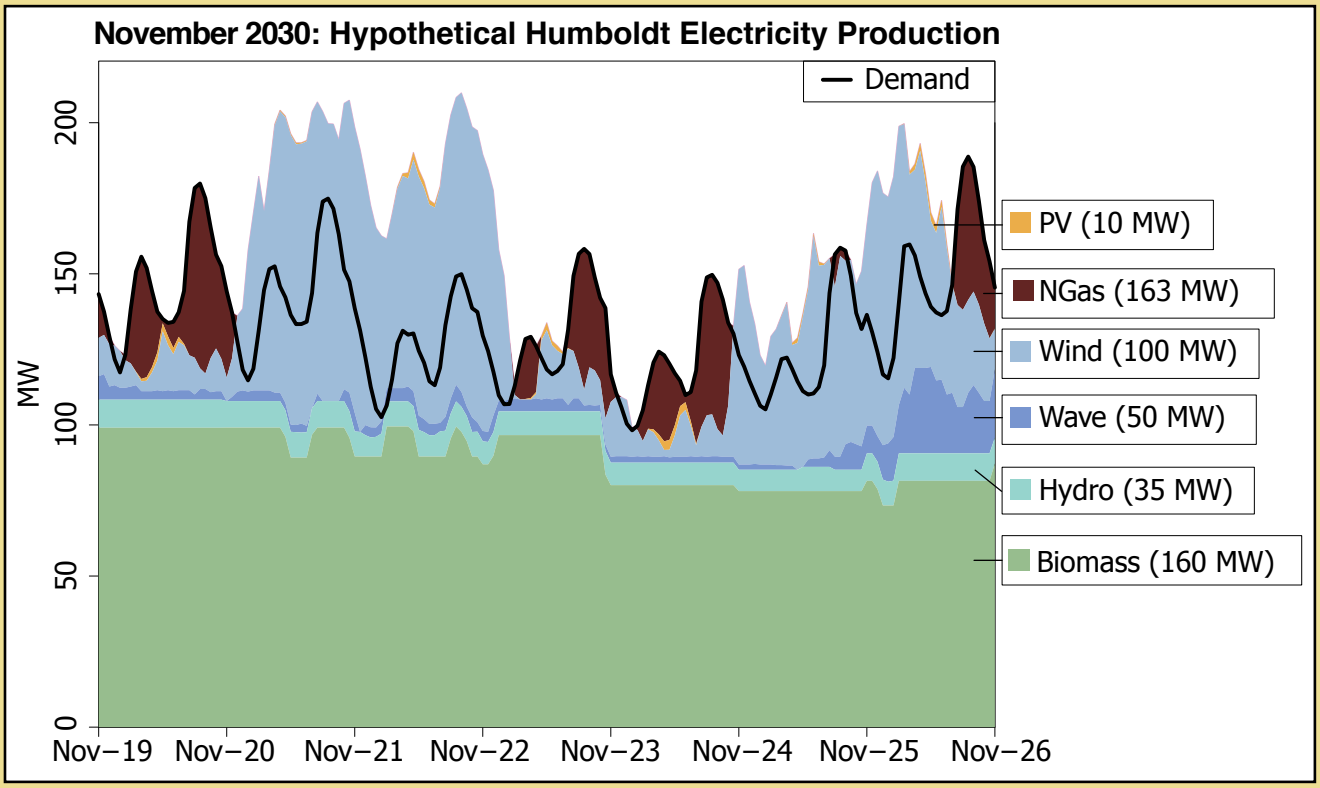
can minimize environmental impacts and efficiently serve customers close to the load, while centralized power plants can provide the reliability, readiness and cost-effectiveness that we require. Employing a combination of energy efficiency and renewable energy resources of various types and scales - including biomass, wind, small hydro, solar and wave energy – can reduce fossil fuel consumption and minimize environmental impacts while maintaining system reliability and affordability. Like in natural ecosystems, diversity in our energy supply system can promote strength, resilience and stability.

Multiple power options are available and offer trade-offs.

There is no single option that can unilaterally achieve the goal of renewable energy security in Humboldt County. In fact, there are interactive benefits when pursuing multiple options simultaneously; that is, some options such as fuel switching actually increase the beneficial impacts of other options such as renewable energy development. Only through a combination of measures can effective progress be achieved.

Hypothetical electricity supply and demand profile, peak scenario

This plot shows a simulation of the hourly electrical demand (solid black line) as it varies over a week long time period. The colored bands show the portion of the electrical demand that is supplied by each resource. At times when available renewable power is insufficient to meet demand, the deficit is filled by the natural gas plant; when renewable power exceeds demand, export occurs. Biomass and hydro power are supplied at a relatively steady rate and act as baseload power. Wind, wave, and solar vary intermittently (note that solar contribution is very small and difficult to see in the plot). This graphic illustrates the importance of having a diverse resource mix and shows the attributes and constraints associated with various resources.



There are, however, important differences among the available options that should be assessed by community stakeholders before any specific course of action is adopted. In particular, some resources are more favorable than others in terms of energy production potential, cost, economic growth, and environmental impact. Some of these trade-offs between various technology options are examined below.

All options have impacts, including the "do nothing" option.

It is important to realize that all energy supply options, even renewable energy alternatives, present environmental and community impacts. Communities may be affected during construction. Land use might be altered. Wildlife may suffer impacts. View sheds might be disturbed. Because of these impacts local community members might be opposed to some projects, and their concerns must be acknowledged and addressed. However, we must also remember that when we say no to a local renewable energy project, we are essentially saying yes to our current fossil fuel dominated energy system and the problems that come with it. The "do nothing" option also has serious environmental and community impacts, even if they aren't as immediately evident.

The PG&E Humboldt Bay Generating Station provides important energy services and is well suited to support local renewable energy development.

In 2010, Pacific Gas and Electric Company installed a new power plant at their King Salmon location on Humboldt Bay. The new plant consists of ten 16 MW engine generators that operate on natural gas fuel. The plant replaces a 50 year old natural gas steam power plant at the same location, and it offers several advantages compared to the old plant. The new power plant is 33% more efficient and features a closed-loop cooling system that eliminates the use of water from Humboldt Bay for once through cooling. In addition, the new plant is well suited to provide reliable back-up power for intermittent renewable resources such as wind, wave and solar power. Anywhere from one to all ten generators can be operated at any given time, and each generator can be quickly ramped up and down to follow changes in demand or changes in supply from local renewables. This plant provides critical reserve capacity and reliability benefits to our area and serves an important function even if it doesn't run very often, as simulated in the ***peak*** scenario.

Significant transmission and distribution system upgrades will be necessary to accommodate large-scale renewable energy development.

Any time a large new generation facility is connected to the grid, an assessment must be made to determine what impact it will have on grid operation and reliability. As part of the RePower Humboldt study, PG&E conducted an analysis to assess the impact of large-scale renewable power development on the local Humboldt grid. At our request, their analysis considered the aggregate installation of 8 new power plants scattered throughout the county, including 125 MW of wind, 70 MW of biomass, 30 MW of wave, and 13 MW of small hydroelectric power. Their findings indicate that substantial upgrades to the local transmission and distribution system will be required to support such large-scale development. These upgrades could cost as much as $260 million or more[13], and could increase the cost of the peak scenario a few percentage points further above the ***business-as-usual*** scenario.

7.4 What are the trade-offs? Costs and Benefits of Specific Options

The RePower Humboldt study took a critical look at several options for renewable energy generation and demand-side activities (efficiency and fuel switching). The following provides an overview of the costs and benefits associated with the options that were explored.

Cost of Energy

Cost is a critical determinant of the success or failure of any energy development project. One standard way to make an "apples-to-apples" comparison of alternative development options is to estimate the levelized cost of energy (LCOE) for each project. LCOE is a lifecycle assessment tool that sums all project related costs and divides by the total energy produced over the economic lifetime of the project.

13 The study that PG&E conducted is a preliminary assessment. If project developers proceed with requests for interconnection to the transmission system, the official process is through the CAISO Generation Interconnection Procedures (CAISO Tariff Appendix Y). The CAISO studies could identify upgrades that are higher or lower in cost.

Figure 12 presents the results of applying this methodology to renewable energy generation and efficiency program options in Humboldt County. Wherever possible, cost and energy production estimates were based on Humboldt-specific information. The vertical axis indicates the LCOE in units of cents per kilowatt-hour, while the horizontal axis represents the ***peak*** energy potential of each option. In other words, the height of each bar represents the cost while the width of each bar indicates the percentage of electrical energy that could be supplied by each option if it were developed to its ***peak*** scenario level.

Based on this figure it is clear that the cost per kilowatt-hour to save energy through market efficiency programs (and potentially from economic efficiency as well) is less than the cost to produce energy from the generation technologies investigated. This underscores a central mantra in the clean energy industry: "efficiency first." Additionally, it is notable that wind and hydropower both produce electricity at a lower cost than biomass (this is mostly due to the additional fuel costs that biomass power plants must bear). However, because biomass can operate as a baseload source of electricity, it can command a higher price for its energy than intermittent sources like wind and run of the river hydropower. Finally, substantial cost reductions would be necessary to make solar PV in Humboldt County a competitive source of energy compared to any of the other technologies analyzed.

All together, the combined ***peak*** energy potential from these energy sources represents the equivalent of 1,700 GWh per year of electricity, or 180% of present day electricity demand. Even with very high levels of fuel switching in the transportation and heating sectors, there is still enough energy potential to meet all of our electricity demand with local renewable sources.

All other things being equal, it would make sense for us to pursue the cheapest sources of energy first. However, there are other criteria that must be weighed, including environmental impacts, job creation, and community acceptance. In addition, when viable project opportunities present

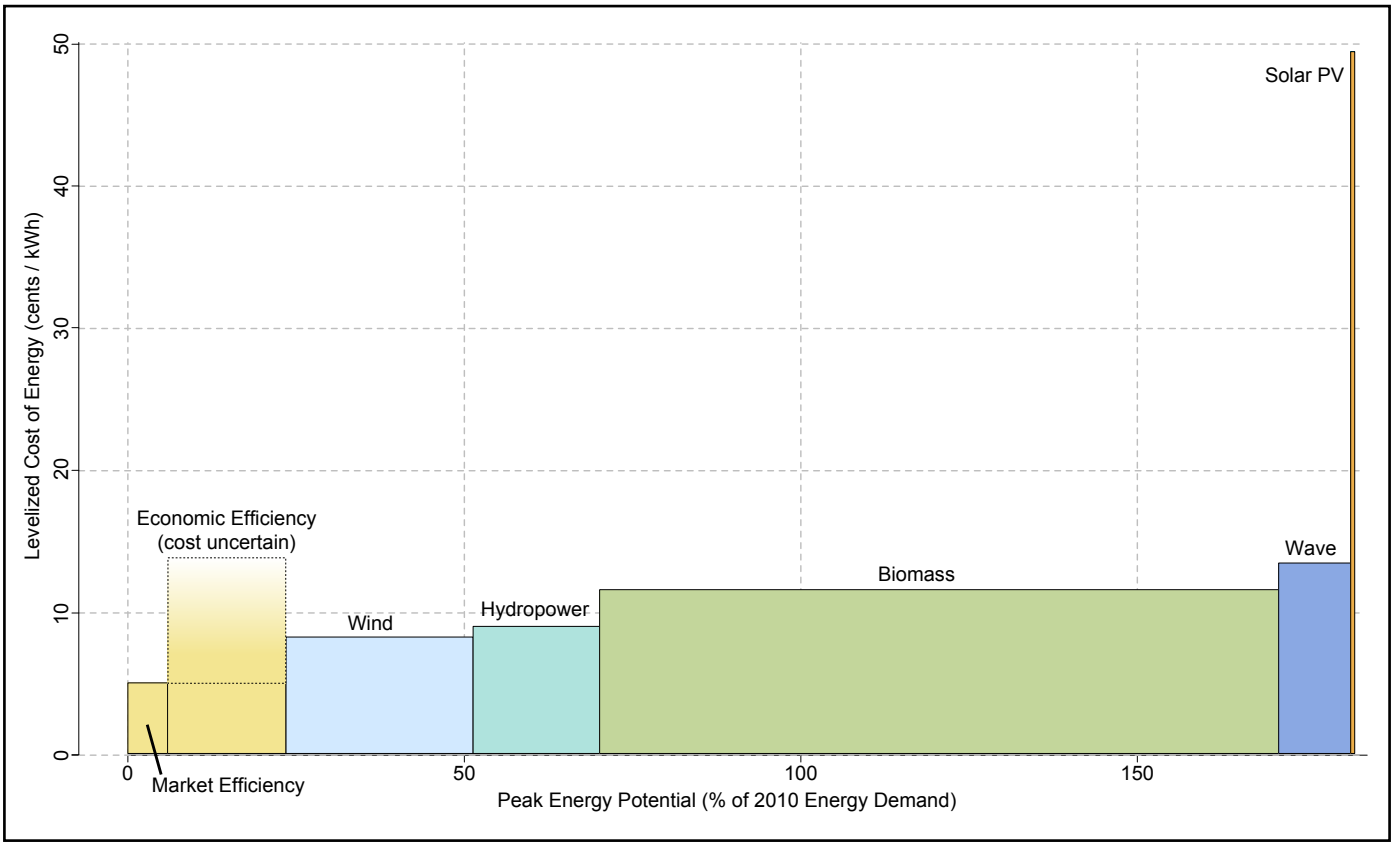


Figure 12: Levelized cost of energy (vertical axis) and peak energy potential (horizontal axis) of developing renewables and adopting efficiency measures in Humboldt County. Due to a lack of data, the cost estimates for "economic efficiency" can only be expressed as a range, which is indicated by the dotted region in the bar. See page 20 for definitions of market and economic efficiency. Note that solar PV prices have dropped dramatically in recent years; this analysis assumes an installed cost of $5/Watt. Solar PV also assumes distributed, net metered systems. The power from these systems would be valued at the retail rate, whereas power from the other sources would be valued at wholesale. This means solar PV could cost up to 7 cents / kWh more than a competing technology and still be cost competitive.

themselves it will often be prudent to seize the moment and capitalize on the opportunity at hand rather than waiting for a cheaper alternative at some future time that might not ever arrive. The projects that should be developed first are the ones that *can* be developed first. That is, achieving a RePower Humboldt future will require substantial progress in all of these technology areas and whatever can be done to promote each option should be done as soon as possible.

Economic Impact

Renewable energy development will have positive impacts on the local economy. As demonstrated in Figure 13, which shows the economic impacts associated with the ***peak*** scenario, the major potential for economic benefit resides in biomass power production. Biomass is relatively labor intensive due to the upstream activities necessary to collect, transport, and pre-process the feedstock. That intensity is magnified by the relatively large resource potential of biomass over the other technologies, and by the fact that we have a trained labor force and the required infrastructure needed to support this industry, so nearly all jobs created would be filled by local workers. The economic impacts associated with hydropower, wind, and efficiency are more comparable in magnitude and reflect the fact that the ***peak*** scenario involves pursuit of a broad portfolio of options, all of which will result in local economic development.

Environmental Impacts

All power supply options have environmental impacts. The modeling analysis considered greenhouse gas emissions associated with each of the energy supply scenarios. However, greenhouse gas emissions are only one measure of environmental impact. Other impacts can affect view sheds, water quality, air quality, biological resources, cultural resources, public health and safety, and other quality of life indicators. Every proposed project needs to be evaluated for its own impacts. A brief overview of typical environmental impacts that can be associated with new renewable power plants, including wind, biomass, small hydro and solar electric is provided in the California Energy Commission's *Energy Aware Facility Siting and Permitting Guide*[14].

14 http://www.energy.ca.gov/2010publications/CEC-600-2010-007/CEC-600-2010-007.pdf

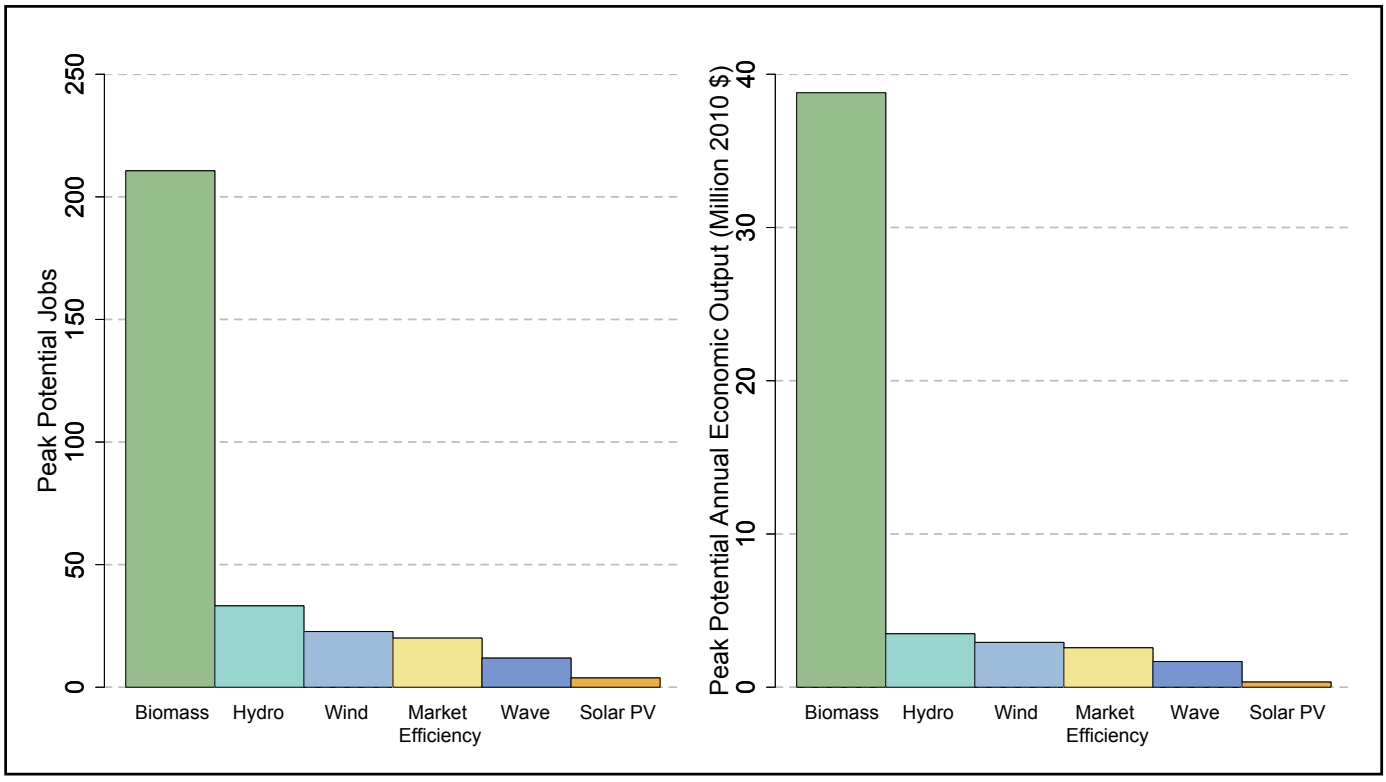


Figure 13: Jobs and economic output beyond business-as-usual from electricity production and market efficiency programs associated with the peak scenario. The data represent a combination of the construction and operation phases of each technology. The construction phase impacts are assumed to be dispersed throughout the lifetime of each technology, which implicitly assumes that each technology will be developed incrementally over a period of decades.

8 Community Empowerment

How can we engage and empower our community?

The RePower Humboldt stakeholder group clearly identified "Local Acceptance, Participation, and Control" as important criteria for considering future energy projects. In order for Humboldt County to successfully realize the RePower Humboldt vision of a sustainable energy future, there will need to be significant community engagement and participation. Some people may choose to drive less and instead walk, ride the bus, or ride a bike. Some people may choose to buy renewable energy when given the chance. Others may choose to buy energy efficient appliances and to upgrade their homes and businesses to be more energy efficient. All of these individual actions will be important and even necessary to our success, but they won't be sufficient. We will also need to agree on some new, larger-scale renewable energy projects that can provide our community with the energy resources we need.

In order to achieve the RePower Humboldt vision our community will need to engage in a discussion about energy. We will need to educate ourselves about the various alternatives and their associated trade-offs. We will need to become informed about potential project impacts and possible mitigations for addressing those impacts, as well as about project benefits. Hopefully we will be able to approach these issues with an open mind and can engage in constructive dialog, listen to each others concerns, and consider the costs and benefits of various alternatives from personal, local and global perspectives. By engaging in a public dialog, working to identify common ground across diverse stakeholder groups, and building consensus, we will place ourselves in a position where we can respond quickly and effectively when new project opportunities present themselves.

- **We need community dialog, engagement and education.**
- **We need proactive planning via an inclusive public process.**
- **We need to build consensus so that we can seize opportunities.**

How can we develop projects that include community ownership, control and participation?

Based on the stakeholder input that has been gathered as part of the RePower Humboldt project, it is clear that there is a preference for community owned and operated renewable energy facilities. However, the regulatory framework that governs our electric utility industry dictates the opportunities for community involvement in renewable power projects. This framework defines who the key players are and how they interact. It has evolved over the last 125 years or so, and it continues to change today. Most recently there have been changes that support the development of renewable energy, encourage distributed generation, and empower communities and individuals to take an active role in their energy choices. In Table 1 we summarize a list of options that can allow community members to take an active role in pursuing a sustainable energy future. More information on these options can be found in Appendix E and in the *Humboldt RESCO Task 3 Memo, Renewable Energy Development, Ownership and Financing Options.*[15]

How can we finance community-based projects?

Project financing is critical to the successful development of renewable energy projects. The types of financing mechanisms used can vary depending on the size of the project and the type of project developer or owner. For example, some financing mechanisms are suited to private entities, whereas others are applicable only to public entities. Below we list a few financing tools. More information on this topic can be found in Appendix F and in the *Humboldt RESCO Task 3 Memo, Renewable Energy Development, Ownership and Financing Options*[15].

15 http://www.redwoodenergy.org/programs/repower

Table 1: Utility Industry Mechanisms that Can Allow Community Participation in Local Renewable Energy Projects

Option	Description	Benefit	Local Viability
Municipal Utility	Publicly owned utility	Local control of energy policy	Very unlikely due to high cost and legal/political hurdles associated with taking over local electric grid
Electric Cooperative	Cooperatively owned utility	Local control of energy policy	Very unlikely due to high cost and legal/political hurdles associated with taking over local electric grid
Community Choice Aggregation (CCA)	Joint Powers Authority purchases power for community	Greater choice regarding energy sources	Substantial up front cost and effort, but much easier than municipal utility or cooperative. CCA does not take over local electric grid.
Direct Access	Allows non-residential customers to buy electricity from competitive energy service provider	Greater choice regarding energy sources	Already available on a limited basis, but fully subscribed. Expansion will require state legislation; SB 855 (Kehoe, 2011) would have accomplished this.
Net Metering	Customer installs on-site generation (e.g., rooftop solar)	Ownership of on-site system, offset retail cost of electricity	Already common practice, limits on size of system, site must be suitable
Community Renewable Energy	Establishment of a community based renewable energy system that provides power to local subscribers	Ability to purchase locally generated renewable energy	Will require state legislation, SB 43 (Wolk, 2013) is currently pending.
Utility "Green Pricing" program	PG&E provides an option for customers to purchase "green power" at a premium price	Greater choice regarding energy sources	Will require approval from Public Utilities Commission. PG&E currently has a proposal before the PUC. Won't likely encourage development of local renewable resources.

Equity financing

- Flip structure - hybrid public and private ownership model designed to capitalize on the tax liability of a private equity investor and provide eventual full ownership to the community entity.

Debt financing

- Government loan guarantees - lowers the risk on a loan and therefore lowers the interest rate.
- Public bonds - typically have a lower interest rate because they are often less risky than corporate bonds and because bondholder interest is often exempt from state and federal taxes.
- Specialty public bonds (like Qualified Energy Conservation Bonds) – energy specific "tax-credit bonds" where the bond purchaser receives a federal tax credit in exchange for a lower interest rate.

Government grants, rebates and tax credits

- Cash grants and tax liability incentives can help reduce up-front project costs.

Financing of small, facility-scale energy projects

- Property Assessed Clean Energy - participants receive financing that is repaid through an assessment on their property taxes for up to 20 years.
- Power purchase agreements - third party provider installs, owns and operates a system and customer pays a negotiated price for the energy.

- Lease-to-own arrangements - third party provider installs, owns and operates a system and customer leases it leading to eventual ownership.
- Performance contracting - third party installs the upgrades and is compensated over time based on the actual energy savings that are realized.
- Utility on-bill financing – PG&E provides customer with unsecured loan and customers re-pays loan via monthly on-bill surcharges.
- Energy efficient mortgage - the buyer rolls the cost of energy efficiency upgrades into his or her mortgage at the time of sale, thereby financing the upgrades over the life of the loan.

9 Long-term Strategies

How do we get there?

As detailed above, there is tremendous potential for a renewable energy future in Humboldt County. Realizing this potential will require sustained, widespread action by municipalities, businesses, community organizations and individual citizens throughout the county. The following is an unprioritized list of recommended policies and activities that should be central to the long-term plan for achieving a RePower Humboldt vision. The long-term plan looks out over the next 10 to 20 years.

The County of Humboldt should….

LTS1. Engage the community in the adoption and implementation of the RePower Humboldt vision and plan.
Successful implementation of the RePower Humboldt strategic plan will require strong local leadership, broad public support, participation and commitment. To accomplish this, RePower Humboldt planners should first secure the support of local municipalities, Tribes, agencies and community organizations. Then, on-going education and outreach efforts should be conducted to engage the participation of the broader community.

LTS2. Aggressively pursue cost-effective energy efficiency and demand response opportunities
The number one RePower Humboldt priority should be to increase energy efficiency. This is consistent with state energy policy, which lists efficiency as the first choice in meeting energy needs and has set aggressive goals for energy efficiency improvement (see State policy goals in table below). Energy efficiency simultaneously saves money for consumers, reduces negative environmental impacts, increases energy security, creates jobs, and increases local economic activity. We should expand existing energy efficiency programs in the county, including increased incentives and other strategies to overcome market barriers, across multiple customer segments including residential single family, residential multifamily, small and large commercial, municipal, institutional, and industrial. Efforts should be made for both existing and new construction applications. Demand response measures that can reduce peak demand and match demand to intermittent renewable resources should also be pursued.

LTS3. Develop local renewable energy resources
Central to enhancing energy security in Humboldt County is increasing the fraction of local renewable resources on the electricity grid. The community should promote and support development of distributed and utility-scale renewable energy resources, especially run-of-the-river hydropower, wind, wave and biomass.

LTS4. Adopt plug-in electric vehicles (plug-in hybrid and battery electric vehicles)
Combining fuel switching in the transportation sector with renewable electricity is critical to cost-effectively reducing overall greenhouse gas emissions. The community should strongly promote plug-in electric vehicles through education, incentives, planning, adoption of electric fleet vehicles, and development of charging infrastructure.

LTS5. Adopt electric heat pumps for water, space, and other appropriate heating needs
Substantial environmental benefits can be realized by fuel switching in the heating sector combined with renewable electricity. The community should promote electric heat pumps through education, incentives, modified building codes, and streamlined permitting.

LTS6. Develop distributed generation projects
Distributed generation, such as solar electric and solar thermal at the residential and commercial scales, can play an important role in achieving our community vision with respect to promoting locally owned, renewable energy projects with minimal environmental impacts. The State of California is calling for the installation of 12,000 MW of distributed generation by 2020. Humboldt County should promote and support the adoption of facility-scale, distributed generation technologies, including combined heat and power projects that make more efficient use of fuel sources.

LTS7. Pursue sustainable means to access forest management residues for biomass energy applications
Substantial biomass resources go to waste every year (i.e., logging slash and material from thinning and fuel reduction treatments) in remote areas where it is not currently cost-effective to process and transport the biomass for energy or other purposes. The community should support an assessment of resource sustainability and a life cycle analysis of greenhouse gas emissions to confirm the viability of this resource. Biomass energy plans that are consistent with forest restoration needs and priorities as well as accepted forest management practices should be developed, and technologies and processes that can potentially expand the range of sustainable biomass to energy opportunities should be researched and developed.

LTS8. Work to develop Humboldt as a center for marine and offshore wind energy research and demonstration

Humboldt County is uniquely positioned to play a critical role in the early adoption of wave energy and offshore wind energy resources in California. In addition to vast offshore wind and wave resources, the county has electrical grid and marine infrastructure that can support development of these technologies. Another research and development opportunity is an emerging technology called osmotic power. This technology exploits the energy available when fresh water mixes with salt water, both of which are abundant on the North Coast. The community should promote and support marine and offshore wind energy research, assessment and demonstration projects.

LTS9. Work with PG&E to plan for long-term electric grid infrastructure upgrades

The RePower Humboldt technical analysis found that large-scale development of renewable energy resources in Humboldt County will require significant upgrades to the electrical transmission and distribution infrastructure. In addition, the cost and nature of these upgrades could be substantially different if they were developed based on a long-term plan as opposed to specific upgrades being made on a project-by-project basis. For this reason, RePower Humboldt representatives should work with PG&E, the California Independent System Operator and others to explore the options for electric grid upgrades and determine the most appropriate approach given short-term and long-term needs and resources.

LTS10. Work with regulatory agencies to assess and reduce permitting barriers to renewable energy project development

Renewable energy projects must meet environmental standards. However, permitting can be challenging when developing renewable energy resources (e.g. small hydropower, wind, wave, distributed generation, etc.). Conducting a constraints and opportunities analysis that identifies preferred areas for development followed by program level environmental reviews can partially mitigate this barrier. This would enable accelerated adoption and development of projects while still meeting environmental compliance standards.

LTS11. Develop options for local development and ownership of renewable energy projects

Local participation and control over renewable energy resource development is a key guiding principle identified in the RePower Humboldt stakeholder process. We can achieve local control and ownership of energy projects through private development that involves local entities, public development by municipal actors, and development by local Tribes. The community should promote and support policies that achieve local ownership of renewable energy projects, as well as local involvement in projects that are developed and owned by out-of-county entities.

LTS12. Develop options for local consumers to purchase local renewable energy

The development of local renewable resources can also be driven by increased demand. However, consumers generally have little choice in where their electricity comes from or how it is generated. The community should explore policy, regulatory and financial mechanisms that enhance the ability of customers to preferentially consume locally sourced renewable energy, like with a community renewable energy program.

LTS13. Develop options to finance local renewable energy projects

Development of local renewable resources will require capital investment. Access to required capital can be a barrier to successful project development. The community should seek to develop mechanisms that can make financing available for the development of both small-scale and large-scale local renewable energy projects. This should include raising local capital and attracting outside capital.

LTS14. Evaluate and adapt RePower Humboldt plan

The RePower Humboldt Strategic Plan is intended to be a living document. An evaluation plan should be developed and implemented to track progress and make changes as warranted.

How does RePower Humboldt compare with state energy policy?

The RePower Humboldt Strategic Plan long-term strategies are consistent with California's current energy policy goals. These include policies to reduce greenhouse gas emissions, increase the use of renewable energy resources, increase the use of distributed generation, increase energy efficiency efforts, and promote the use of low emission and low carbon fuels for transportation. A few key state policy directives are listed in Table 2 along with information on how they are supported by the RePower Humboldt Strategic Plan.

Table 2: Match between RePower Humboldt Strategies and State Energy Policy

State Policy	State Goals	RePower Humboldt Strategies
Renewable Portfolio Standard	Achieve 33% renewable electricity by 2020	***Bold*** scenario achieves 71% and ***peak*** scenario achieves 97% renewable electricity by 2030
Alternative Fuel Vehicle Rule Making, ZEV Action Plan	Ready electric infrastructure for light-duty passenger battery electric and plug-in hybrid electric vehicles	RePower Humboldt plan calls for strong promotion of plug-in electric vehicles through education, incentives, planning, adoption of electric fleet vehicles, and development of charging infrastructure
Governor's Clean Energy Jobs Program	Develop 20,000 MW of renewable electricity, accelerate the development of energy storage, and take bold steps to increase energy efficiency resulting in a half a million new jobs	***Peak*** scenario calls for 279 MW of renewable energy development and substantial increases in energy efficiency with an estimate of 300 new, permanent, full-time local jobs
BioEnergy Action Plan for California	Maximize the contributions of bioenergy toward achieving the state's petroleum reduction, climate change, renewable energy, and environmental goals	***Peak*** scenario calls for 100 MW of new biomass energy utilizing forest treatment residues that are consistent with forest restoration needs and priorities
Energy Action Plan	Loading order for electricity resources: 1) energy efficiency and demand response, 2) new generation from renewable energy and distributed generation resources, 3) clean fossil-fueled generation and infrastructure improvements	RePower Humboldt loading order follows State Energy Action Plan loading order: 1) efficiency, 2) new renewable and distributed generation, 3) natural gas fueled generation and infrastructure upgrades
California Long-Term Energy Efficiency Strategic Plan	All new residential construction zero net energy by 2020, all new commercial construction zero net energy by 2030, energy consumption in existing homes reduced by 40% by 2020, 50% of existing commercial buildings retrofit to zero net energy by 2030	RePower Humboldt plan calls for aggressive pursuit of cost-effective energy efficiency opportunities across all sectors, including existing and new construction.
AB 32 Greenhouse Gas Reduction Plan	Reduce greenhouse gas emissions via increases in energy efficiency, renewable electricity generation, combined heat and power and distributed generation, as well as via other non-energy related measures. The State's goal for 2030 is about a 53% reduction compared to business-as-usual.	***Bold*** scenario achieves 32% decrease and ***peak*** scenario achieves 45% decrease in greenhouse gas emissions by 2030

10 Near-term Next Steps

What next?

The following discussion recommends specific programs, studies, and actions that are aligned with the long-term strategies listed above and that the community can immediately act upon in order to move the RePower Humboldt vision forward. Note that the long-term strategy (LTS) associated with each implementation measure (IM) is listed in parentheses following the title of the implementation measure. Following the discussion, a summary table is provided that lists each implementation measure, along with key players who are likely to be involved, milestones and timeline for implementation, and potential funding and resources that might be important for success.

Implementation Measures

IM1. Secure endorsement from key constituencies and form leadership group (LTS1)

Successful implementation of the RePower Humboldt Strategic Plan will require strong public support and participation. The first step in generating public support should be to seek endorsement from key local constituencies, including local municipalities, Tribes, agencies and community organizations. In addition, a leadership group should be formed to move the plan forward.

IM2. Coordinate with local Tribes (LTS1)

Local Tribal Governments and non-tribal entities should coordinate in the areas of energy policy and planning, energy program design and implementation, renewable energy development, energy efficiency implementation, climate action planning, and other areas of mutual interest. Government-to-government consultations, both formal and informal, are a productive way to increase stakeholder involvement and investment.

IM3. Work to integrate RePower Humboldt activities into local climate action plans (LTS1)

The RePower Humboldt vision is highly consistent with the goals of climate change mitigation. The community should seek to integrate the recommendations of this strategic plan with local climate action plans wherever possible.

IM4. Implement a RePower Humboldt education and outreach program (LTS1)

Once endorsements from key constituencies have been secured, a coordinated education and outreach campaign should be developed and implemented. This campaign should seek to communicate the findings and recommendations of the RePower Humboldt Strategic Plan, to solicit additional public input, to work to build consensus for the plan, and to mobilize public action on the implementation strategies.

IM5. Expand RCEA's energy efficiency services and increase funding levels and incentives (LTS2)

Energy efficiency services provided by the Redwood Coast Energy Authority (RCEA) should be greatly expanded so that they cover more measures across more end uses and more customer sectors. In addition, incentive levels should be increased where warranted to overcome first cost barriers.

IM6. Implement existing Title 24 code and consider adopting stricter energy efficiency standards for new construction (LTS2)

The State of California's Zero Net Energy Building Policy states that new homes should be zero net energy by 2020 and new commercial buildings by 2030. Humboldt County should strengthen its green building program and consider adopting stricter energy efficiency standards for new construction that moves us toward zero net energy buildings. Better implementation of existing Title 24 code should also be pursued.

IM7. Promote responsible run-of-the-river hydroelectric power development (LTS3)

There is substantial potential for run-of-the-river hydropower to supply cost-effective renewable energy to the county. However, there has not been any new development of megawatt scale hydropower in the county in nearly two decades. Permitting is one key burden that has increased in the last twenty years and may be partially responsible for stalled development. The process of obtaining the necessary permits, licenses, or exemptions necessary to build and operate a hydroelectric power system is complex, involves multiple agencies, and can take years to complete. It is therefore difficult to know in advance the ultimate cost of development, which can make securing capital a formidable challenge.

In light of these challenges, there is a lot the local community can do to assist in the development of small hydroelectric generation in Humboldt County. In particular, preliminary assessment work can be done to identify optimal locations throughout the county for development. This should include updating the resource assessment report prepared by Oscar Larson, and Associates in 1982. Site characteristics assessed should include: hydropower resource, proximity to electrical substation, ability to develop project without significant environmental impact (e.g., well upstream of sections of creeks where salmon are found). In addition, efforts should be made to reduce the burden and cost of permitting (see IM23), and to make it clear that we are interested to work with developers to facilitate the responsible development of additional hydropower installations.

IM8. Support responsible wind energy development (LTS3)

The Cape Mendocino area is home to one of the top wind resources in California and is located within 10 miles of the Humboldt County transmission network. This makes it Humboldt County's prime wind resource area. However, the Audubon Society designates much of the area as an Important Bird Area (IBA), and development of this area would likely raise concerns. The one ridge that straddles the northern edge of the Cape Mendocino Grasslands IBA is Bear River Ridge.

Until recently, Shell WindEnergy had been pursuing a conditional-use permit for development of a 50 MW wind farm on Bear River Ridge. Now that Shell has dropped their project proposal, the community should examine alternate models for developing this wind site. Note, however, that the proposed Shell wind project had generated a fair amount of opposition, and many of the same issues that plagued the Shell project will still need to be overcome. The proposed Shell wind project serves as an excellent example of the tension between the RePower Humboldt vision and the complexities of implementation. Any successful renewable energy project must be acceptable to the community in terms of the tradeoff between the project's benefits and impacts.

In addition, it is recommended that other areas in Humboldt County that might support commercial wind energy development should be examined. This might include ridges adjacent to Highways 36 and 299, as well as offshore areas.

IM9. Consider designating "Renewable Energy Parks" in Humboldt County (LTS3)

Humboldt County has a wealth of renewable energy resources, including wind, small hydro, biomass and wave. However, substantial development of any of these resources is likely to incur some negative impacts. When a new project is proposed, those who feel negatively affected often step forward to oppose the project. One approach to this dilemma is to proactively assess areas throughout the county that offer prime opportunities for renewable energy development. These areas would be screened for their preliminary feasibility, and key issues would be identified. A broad group of stakeholders would review the proposed sites and then work to come to consensus on preferred locations. The preferred locations would be designated as "renewable energy parks" and preparations could be made for development, including assessment of the maximum power capability of the local grid, identification of an appropriate land area, development of land purchase or lease arrangements, zoning changes, permitting assessment and initial environmental assessment. This concept has been proposed in San Diego County in an attempt to site utility scale solar, wind and geothermal power parks. Once the energy parks have been identified they can potentially be used to attract investors and/or project developers. They can also help ensure that proposed projects are acceptable to the local community.

IM10. Develop Plug-in Electric Vehicle (PEV) Readiness Plan (LTS4)

Humboldt County residents have been enthusiastic in adopting solar electric systems and hybrid gasoline-electric vehicles, and we expect they will also be early adopters of plug-in electric vehicles (PEVs). However, there is a set of challenges we will face while trying to achieve substantial penetrations of PEVs in Humboldt County. Our rural geography and modest-sized electricity distribution system may hinder adoption of PEVs. Overcoming these challenges will require research, analysis, planning, policy work and funding.

Fortunately, the Redwood Coast Energy Authority in partnership with the Schatz Energy Research Center and GHD[16] have already been awarded a research grant from the California Energy Commission to conduct PEV planning work . The key topic areas of the study will include identification of public charging infrastructure needs, a plan for streamlining the permitting process of PEV charging facilities, and a plan to promote the adoption of PEVs.

IM11. Promote PEV adoption (LTS4)

Based in part on the results and recommendations of the PEV Readiness Plan (IM10), the community should engage in efforts to promote consumer adoption of PEV technologies. These efforts may include public outreach and education, technical support, incentives and a fleet vehicle adoption program.

IM12. Streamline permitting for PEV charging infrastructure (LTS4)

One key outcome of the PEV Readiness Plan will be recommendations for reducing the permitting burden associated with the installation of PEV charging infrastructure. Municipalities should adopt and implement these recommendations where possible to better facilitate PEV adoption.

IM13. Install PEV charging infrastructure (LTS4)

Adequate availability of charging facilities throughout the county will likely be critical to the successful promotion of PEVs. Both public and private entities will need to engage in the development of charging infrastructure. To ensure efficient use of limited resources, decisions about siting and capacities of charging infrastructure should be informed by the findings and recommendations of the PEV Readiness Plan. Development of the PEV Readiness Plan should place Humboldt County in prime position to access state funding for installing charging infrastructure.

IM14. Conduct a heat pump pilot study (LTS5)

Heat pumps show substantial promise as a cost-effective means to satisfy demand for heat with renewable energy. However, heat pumps are still rare in Humboldt County. It would be prudent to study the technology in further detail to more comprehensively assess the economic and energy implications of promoting heat pumps on a large scale.

Such a study would involve monitoring and analysis of multiple demonstration systems in the Humboldt climate. Based on the performance of the systems, a rigorous economic analysis would be developed and used as the basis for a promotional program. Also, first-hand experience gained in permitting and other installation issues could be used in subsequent efforts to ease the regulatory burden for customers who chose to replace conventional furnaces with heat pumps. Finally, the study could include a market survey to assess the turnover rate of heating systems in Humboldt County, understand the primary factors that influence consumer choice and assess opportunities for early replacement of existing heating systems with heat pump units.

16 GHD, formerly Winzler and Kelly, is an international engineering consulting firm with an office in Eureka.

IM15. Develop a heat pump promotion program (LTS5)
Based on the results and recommendations of the heat pump pilot study (IM14), a promotional program could be developed to actively encourage Humboldt County residents and business owners to select heat pumps when purchasing a heating system.

IM16. Promote distributed generation projects (LTS6)
Distributed generation (DG) refers to small- to medium scale electricity generation located close to the point of use. Key benefits of DG include local ownership and control and the fact that the energy generated is valued at the retail price when it offsets on-site loads. Early adopters, renewable energy enthusiasts, and concerned citizens can take immediate action to install DG. Due to its smaller scale, DG tends to be more expensive on a per-kW basis than centralized power production. Nevertheless, the community should support DG as a measure with important benefits that can be immediately implemented. Key DG opportunities should be identified and assessed. Examples for potential near-term DG projects in Humboldt County include:

- The Humboldt Waste Management Authority's (HWMA) food waste digester project
- The HWMA landfill gas to energy project
- Humboldt State University's cogeneration upgrade
- Commercial and industrial combined heat and power applications
- Biomass energy systems for institutional facilities (schools, hospitals, etc.)
- Tribal energy projects
- Residential and small-commercial scale solar electric and solar heating
- Residential and small-commercial scale wind energy
- Residential and small-commercial scale micro-hydropower

IM17. Conduct research on woody biomass to energy in Humboldt County (LTS7)
For decades, wood residues from the Humboldt lumber and pulp industries have been used as a feedstock for electricity generation. Local biomass power plants have enjoyed reliable, low-cost access to these fuels. However, due to a variety of economic pressures in the last decade, the forest products industry has gone through a state of decline and transition, putting the future availability of this feedstock in jeopardy.

At the same time, a broad consensus has formed around the need for increased thinning of forests to help prevent fires, reduce fire severity and improve forest ecosystem health and productivity. Generally the biomass from thinning projects and fuel reduction treatments is non-merchantable as lumber, but it can be marginally cost-effective as fuel for electricity generation. Innovative process technologies, such as torrefaction, can be used to densify and upgrade these fuels and increase the economic viability of biomass energy from forest thinning efforts.

These factors make increased biomass energy development in Humboldt County potentially desirable yet uncertain. In addition, the greenhouse gas implications of bioenergy production are also uncertain and remain the center of vigorous debate in the academic and policy arenas. We need to conduct a study of bioenergy in Humboldt County to better understand the availability, cost, and greenhouse gas impacts of this resource. This will be vital to making well-informed, responsible decisions regarding the further development of local biomass energy resources.

IM18. Form biomass energy working group (LTS3, LTS7)
Develop a biomass energy working group to support the research identified in IM17 and to help move biomass energy projects forward in the region. In addition, the working group should develop education and outreach materials that can be used to maintain the community's support of existing biomass energy projects, as well as secure support for the development of new technologies and processes that could be key to an economically and environmentally sustainable bioenergy industry.

IM19. Try to attract wave energy research, development, and demonstration projects (LTS8)

The Pacific Northwest has become the center for research and development of hydrokinetic technologies (including wave energy and tidal energy conversion) in North America. Significant funding and support for hydrokinetic research has been secured at Oregon State University (OSU) and Washington State University (WSU), which have become the lead research arms of the U.S. Department of Energy National Marine Renewable Energy Center.

Although wave energy research in California has been very modest to date, Humboldt County will likely be among the first regions in California where commercial scale development occurs. Humboldt County has a huge wave resource, as well as a deep-water port and an electrical grid infrastructure that can support wave energy development. For these reasons it would be prudent for Humboldt County to position itself early as California's center for research, development and demonstration.

PG&E's recently suspended Humboldt WaveConnect Project was a good example of the type of pilot scale project that could be developed here in Humboldt. In addition, The Humboldt State University Oceanography and Environmental Resources Engineering Departments would be a natural fit for this topic area and should consider incorporating ocean energy into their curriculum, conducting research, and forging professional bonds with OSU and WSU. A working group should be formed to promote Humboldt County as a prime location for wave energy research, development and demonstration.

IM20. Pursue opportunities for off-shore wind energy research, development and demonstration (LTS8)

The county has already been approached by two developers of emerging offshore wind technologies interested in siting demonstration projects offshore of Humboldt Bay. Form a working group to explore the opportunities for off-shore wind development and to promote Humboldt County as a prime location for off-shore wind energy research, development and demonstration.

IM21. Pursue opportunities for osmotic power and other energy research at the newly proposed National Marine Research & Innovation Park (LTS8)

Humboldt County has vast fresh water resources and the Humboldt Bay Municipal Water District is looking for more beneficial uses of the resource. Osmotic power exploits the energy available when salt water mixes with

fresh water. The technology is still in the research and development phase, and one of the leading researchers is a professor of Environmental Resources Engineering at Humboldt State University. In addition, the Humboldt Bay Harbor, Recreation and Conservation District is considering purchase of the old Samoa pulp mill facility. This site, with its water and power infrastructure would be an ideal location for an osmotic power research center. It could also serve as a research location for offshore wind, wave and even biomass energy. A working group should explore and pursue this opportunity.

IM22. Assess the needs and opportunities for transmission and distribution system upgrades (LTS9)

Form a working group to assess the needs and opportunities for upgrades to Humboldt County's electrical transmission and distribution systems. Special focus should be given to the trade-offs between a series of individual project level upgrades versus an integrated upgrade that would support a large-scale build out of local renewable energy resources.

IM23. Form a renewable energy permitting working group (LTS10)

Permitting can be a substantial hurdle to the development of renewable energy, especially for small projects. The community can help alleviate this burden by organizing a renewable energy permitting working group. This group could include local energy and permitting experts in the community. Their mission would include:

- Consolidate and centralize their expertise in permitting
- Identify opportunities for streamlining the permitting process for specific renewable generation opportunities
- Act as consultants and a resource for renewable energy developers

IM24. Develop a turn-key purchase program (LTS11)

One strategy for overcoming the diseconomies of small scale distributed generation projects (e.g. solar PV and solar water heating) as well as demand-related measures (e.g. heat pumps and electric vehicles), is to organize a purchasing program. By leveraging the purchasing power of a multitude of customers, the overall costs of equipment can be reduced. In addition, a uniform set of equipment purchases can also decrease the installation costs through standardization and cooperation among installers. A bulk purchase program can also be coordinated with a financing program and can include assistance with project management, project development, interconnection, incentives, and permitting (see IM27).

IM25. Form a working group for the local development and ownership of renewable energy projects as well as consumer access to the resulting energy (LTS11, LTS12)

From direct access contracting, to community choice aggregation, to municipal and Tribal utilities, to private ownership, to public-private partnerships in energy development, to community renewable energy systems, there are a number of ownership and financing options available that may allow the local community to take a more active role in the development and purchase of local renewable energy. The benefits and drawbacks of each option should be evaluated, a sufficient consensus arrived at, and a pathway forward planned and then implemented. To tackle this issue, the community should organize and support a working group to assess options for the local development and ownership of renewable energy projects, as well as opportunities for local purchase of the generated electricity. Since the regulatory framework related to community energy systems is continually evolving, this working group should also provide input at the state level to promote opportunities for community based renewable energy systems (e.g., supporting SB 43, which would establish a shared renewable energy self-generation program).

IM26. Purchase local renewable energy via Direct Access Agreement (LTS12)

Direct access is the purchase of electricity from a different retailer than one's regional utility. Possible advantages of direct access contracts include potential cost savings and the freedom to choose your energy provider based on criteria such as the renewable content of the electricity. Large electricity customers could potentially use direct access as an avenue to support the development of local renewable energy. The community should investigate the possibility for individual customers (or groups of customers) to leverage their purchasing power to promote the RePower Humboldt vision in Humboldt County through direct access. This could involve identification of eligible customers and a coordinated effort to contact and negotiate with direct access service providers.

IM27. Form a working group to create financing options for renewable energy projects (LTS13)

Adequate financing is necessary to successfully develop renewable energy projects, and a lack of access to adequate financing can pose a barrier to project development. In order to address this issue, a working group should be convened. The group should work to identify and develop options for financing local renewable energy projects of various scales. This should include financing for residential and small commercial sized projects, as well as for larger utility scale projects. Key players to be included in this working group should include representatives from local banks and financial institutions, economic development professionals, and local political leaders.

IM28. Develop and implement an evaluation plan (LTS14)

Develop an evaluation plan to track the progress being made in implementing the RePower Humboldt plan. Adjustments to the RePower Humboldt plan should be made where warranted. A draft set of metrics to be used for evaluation is presented in Chapter 11.

Table 3: Summary of Near-term RePower Humboldt Implementation Measures

Measure #	Associated Long-Term Strategy	Implementation Measure	Responsible Parties & Partners	Key Milestones / Time frame	Potential Funding Resources	Related Resources
IM1	LTS1	Secure endorsement of RePower Humboldt Strategic Plan from key constituencies, form leadership group	Municipalities, RCEA, SERC	Complete in 2013		
IM2	LTS1	Coordinate with local Tribes	Tribal Governments, municipalities, RCEA	Ongoing		
IM3	LTS1	Work to integrate RePower Humboldt activities into local climate action plans	Municipalities, RCEA	2013 program initiation		Existing climate action plans
IM4	LTS1	Implement a RePower Humboldt education and outreach program	RCEA, SERC, HSU, PG&E, municipalities, Tribes	2013-2014		RePower Humboldt Education & Outreach Plan
IM5	LTS2	Expand RCEA's energy efficiency efforts	RCEA, PG&E, municipalities	2012 program initiation, ongoing	Utility & state funding, cap & trade revenues	
IM6	LTS2	Implement existing Title 24 code & consider adopting stricter energy efficiency standards for new construction	RCEA, municipalities	Initiate in 2015	Utility & state funding	
IM7	LTS3	Promote development of run-of-river hydroelectric power	Municipalities, RCEA, SERC, PG&E, economic development, Tribes	Initiate in 2013	State & federal funding	1982 Oscar Larson report, FERC
IM8	LTS3	Support responsible wind energy development	RCEA, municipalities, SERC, PG&E, economic development, land owners	Ongoing		
IM9	LTS3	Designate "Renewable Energy Parks"	RCEA, SERC, PG&E, municipalities, economic development, Harbor District	Initiate in 2013	State & federal funding	RePower Humboldt Regulatory & Policy Guide
IM10	LTS4	Develop Plug-in Electric Vehicle (PEV) Readiness Plan	RCEA, SERC, PG&E, municipalities, GHD, Tribes	Underway, study complete in 2014	Already funded by CEC	
IM11	LTS4	Promote PEV adoption	RCEA, SERC, PG&E, municipalities, GHD, Tribes	2013 program initiation, ongoing	Local, state, federal, private grants.	PEV Readiness Plan (IM10)

Table 3 (continued): Summary of Near-term RePower Humboldt Implementation Measures

Measure #	Associated Long-Term Strategy	Implementation Measure	Responsible Parties & Partners	Key Milestones / Time Frame	Potential Funding Resources	Related Resources
IM12	LTS4	Streamline permitting for PEV charging infrastructure	RCEA, municipalities, GHD	2013-2015		PEV Readiness Plan (IM10)
IM13	LTS4	Install PEV charging infrastructure	Municipalities, HSU, businesses, Tribes	Ongoing	Local, state, federal grants. Private investment.	PEV Readiness Plan (IM10)
IM14	LTS5	Conduct a heat pump pilot study to demonstrate heat pumps and assess heat pump impacts	RCEA, SERC, PG&E, businesses	Initiate study in 2013	State & federal grants	
IM15	LTS5	Develop a heat pump promotion program	RCEA, municipalities, SERC, PG&E, businesses	2015 program initiation, ongoing	Local, state, federal and private grants.	
IM16	LTS6	Promote distributed generation projects	HWMA, municipalities, RCEA, SERC, HSU, Tribes	Ongoing	State & federal grants	
IM17	LTS7	Conduct research on woody biomass to energy in Humboldt County	RCEA, SERC, local forest products industry, forest restoration community, HSU Forestry department	Initiate study in 2013	Local, state, federal grants. Private grants from industry.	
IM18	LTS3, LTS7	Form a biomass energy working group	RCEA, SERC, forest products industry, Forest Service, sustainable forestry/environmental groups, Tribes	Initiate in 2013		CA Biomass Collaborative, UC Berkeley Woody Biomass Utilization Group
IM19	LTS8	Attract wave energy research, development, and demonstration projects	SERC, HSU, RCEA, economic development, Harbor District	Initiate in 2013, ongoing	State & federal grants	Oregon State Univ.
IM20	LTS8	Pursue opportunities for off-shore wind energy research, development and demonstration	SERC, HSU, RCEA, economic development, Harbor District	Initiated in 2012, ongoing	USDOE, state & federal grants	

Table 3 (continued): Summary of Near-term RePower Humboldt Implementation Measures

Measure #	Associated Long-Term Strategy	Implementation Measure	Responsible Parties & Partners	Key Milestones / Time Frame	Potential Fund-ing Resources	Related Resources
IM21	LTS8	Pursue opportunities for osmotic power research and other energy research at National Marine Research & Innovation Park	SERC, HSU, RCEA, economic development, Harbor District, HBWMD	Initiated in 2013, ongoing	USDOE, state & federal grants	
IM22	LTS9	Assess needs and opportunities for transmission and distribution system upgrades	SERC, RCEA, PG&E, municipalities, CAISO	Initiate in 2014	State & federal grants, utility funds	
IM23	LTS10	Form a renewable energy permitting working group	Municipalities, RCEA, SERC, PG&E, regulatory agencies & consultants	2013 program initiation, ongoing		RePower Humboldt Regulatory & Policy Guide, CEC Local Government Planning Resources
IM24	LTS11	Develop a turn-key purchase program	RCEA, installers, distributors	2013 program initiation		Existing RCEA Energy Watch Program
IM25	LTS11, LTS12	Form a working group for the local development and ownership of renewable energy projects and consumer access to resulting energy	Municipalities, RCEA, SERC	2013 program initiation		RePower Humboldt Regulatory & Policy Guide, other regional jurisdic-tions like Marin & Sonoma
IM26	LTS12	Purchase local renewable energy via Direct Access agreement	HSU, businesses		Humboldt Energy Independence Fund	
IM27	LTS13	Form a working group to create financing options for renewable energy project development	Municipalities, RCEA, banks, Headwaters Fund, Humboldt Area Foundation	2013 program initiation	Cap & trade auction revenues, local capital	RePower Humboldt Regulatory & Policy Guide, Sonoma County financing program
IM28	LTS14	Develop and implement an evaluation plan	RCEA, RePower Humboldt leader-ship group	2013-2014 initiation		Draft Evaluation Metrics (Ch. 11)

11 Evaluation Plan

How do we measure our progress and make adjustments as needed?

The RePower Humboldt Strategic Plan is intended to be a dynamic document that will be periodically updated to reflect past successes, failures and lessons learned. A set of metrics should be developed to gauge overall program success as well as individual measure success, and the program should be monitored and periodically evaluated (e.g., every 3-5 years) based on these metrics. In addition, input should be solicited from project stakeholders regarding program successes and failures, desired changes, etc.

The following is a set of possible metrics for program evaluation. These metrics will need to be further developed, data sources identified, a tracking system developed, methods of interpretation agreed upon, baseline levels established, and a responsible party identified.

Energy and Infrastructure Metrics

- Percentage of local renewable energy serving our electrical load (contractual vs. physical)
- Percentage of local renewable energy serving transportation and heating energy demand
- Reduction in imported energy (natural gas, petroleum, electricity)
- MWh generated by renewable resources
- Capacity of renewable energy installed (MW)
- Number/capacity/estimated savings from energy efficiency implementation projects
- Number of energy audits
- Number of heat pump installations, installed capacity
- DG installations (capacity, kWh generated)
- Installation of PEV charging infrastructure
- Total kWh of locally generated and purchased renewable energy
- Improvements in local transmission and distribution infrastructure

Environmental Metrics

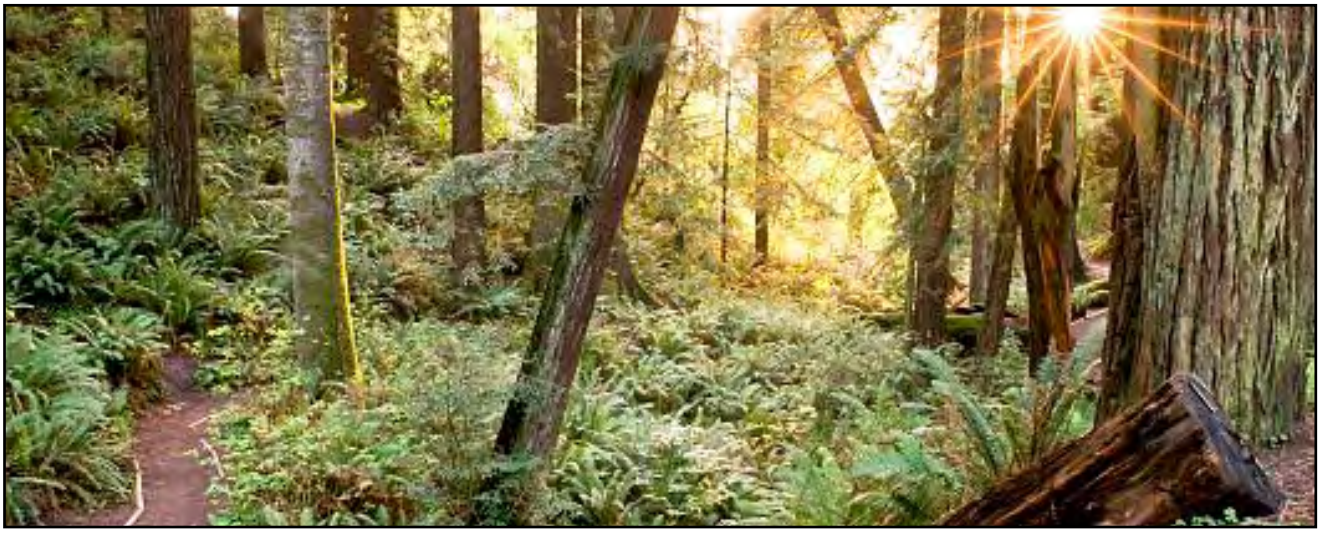
- Greenhouse gas emission reductions
- Other environmental impacts (improvements, degradation)

Economic Metrics

- Economic impacts (job creation, local economic stimulus)
- Cost of energy ($ spent), economic leakage
- Sales/registration of PEVs
- Economic activity in energy efficiency and renewable energy industries (sales, revenues, etc.)
- Number of energy efficiency and renewable energy businesses and employees

Local Participation Metrics

- Local control and involvement in energy decision making (qualitative assessment)
- Adoption of RePower Humboldt plan by local municipalities,
- Integration of RePower Humboldt plan into local climate action plans
- Capacity of locally owned renewable energy projects
- Tracking of incentives, programs, program participation



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13 Appendices

Appendix A - RePower Humboldt Project Documents

The following documents were produced as part of the Humboldt County RePower Humboldt Study. They are available on the RePower Humboldt web page at http://www.redwoodenergy.org/programs/repower.

RePower Humboldt Strategic Plan Documents

- RePower Humboldt: A Strategic Plan for Renewable Energy Security and Prosperity
- Public comment received on RePower Humboldt DRAFT Strategic Plan September/October 2012
- RePower Humboldt Town Hall Meeting September 26, 2012, Results from Small Group Discussions
- Humboldt RESCO Task 6 Memo: Stakeholder Analysis
- RePower Humboldt Task 5 Memo: Regulatory and Political Issues – Challenges to Implementing the RePower Humboldt Strategic Plan

RePower Humboldt Analysis Documents

- Humboldt County Renewable Energy Secure Community: Resource and Technology Assessment Report. Zoellick, Jim, Colin Sheppard and Peter Alstone. (Schatz Energy Research Center, Humboldt State University). 2012. California Energy Commission.
- Humboldt County as a Renewable Energy Secure Community: Economic Analysis Report. Hackett, Dr. Steven C., Luke Scheidler, and Ruben Garcia Jr. (Schatz Energy Research Center). 2012. California Energy Commission.

RePower Humboldt Supporting Documents

- Humboldt RESCO Task 3 Memo: Renewable Energy Development, Ownership and Financing Options
- Regulatory and Policy Guide on Renewable Energy and Energy Efficiency for Humboldt County Local and Tribal Governments
- RePower Humboldt Community Outreach Plan

Appendix B - Stakeholder Process

Table B.1: List of RePower Humboldt Stakeholder Group Members

Stakeholder Group	Last Name	First Name	Organization/Affiliation
Business Community	Blodgett	Vanessa	Planwest Partners, Inc.
Business Community	Collier	Kevin	Anderson, Lucas, Somerville and Borges, CPA
Business Community	Hockaday	J. Warren	Eureka Chamber of Commerce
Business Community	Williamson	George	Planwest Partners, Inc.
Business Community	Ziemer	Katherine	Farm Bureau
Econ. Dev./Financial	Dalby	John	Redwood Capital Bank
Econ. Dev./Financial	Dyer	Jackie	County Economic Development
Econ. Dev./Financial	Elsbree	Dawn	Headwaters Fund
Econ. Dev./Financial	Foster	Greg	Redwood Region Economic Development Comm.
Econ. Dev./Financial	Kraft	Michael	Small Business Development Council
Econ. Dev./Financial	Lorenzo	Connie	The Job Market

Table B.1 (continued): List of RePower Humboldt Stakeholder Group Members

Stakeholder Group	Last Name	First Name	Organization/Affiliation
Econ. Dev./Financial	Rudebock	Ron	Coast Central Credit Union
Econ. Dev./Financial	Salzman	Steve	Plan It Green
Education/Policy	Lehman	Peter	Humboldt State, Schatz Energy Research Center
Education/Policy	Marsee	Jeff	College of the Redwoods
Education/Policy	Moxon	Kathy	Redwood Coast Rural Action
Education/Policy	Peterson	Mike	College of the Redwoods
Education/Policy	Richmond	Rollin	Humboldt State University
Education/Policy	Stewart	Connie	CA Center for Rural Policy
Energy Industry	Katz	David	Founder of Alternative Energy Engineering
Energy Industry	Leary	Kevin	Renewable Energy Providers (Blue Lake Power)
Energy Industry	Marino	Bob	Fairhaven Power Plant
Energy Industry	McClelland	Marty	Representing Shell WindEnergy
Energy Industry	McKeever	Nate	McKeever Energy and Electric
Energy Industry	Ratana	Pana	Shell Wind Energy
Energy Industry	Scurfiled	Jan	Scurfield Solar
Energy Industry	Talbot	Alison	Pacific Gas and Electric Company
Energy Industry	Tittman	Daniel	Greenwired
Environment/Energy	Berman	Jennifer	Redwood Alliance Climate Action
Environment/Energy	Clark	Jim	Redwood Region Audubon Society
Environment/Energy	Flynn	Laura	Redwood Community Action Agency
Environment/Energy	Gold	Gregg	Sierra Club
Environment/Energy	Johnson	Kevin	Humboldt Electric Vehicle Association
Environment/Energy	Martinez	Val	Redwood Community Action Agency
Environment/Energy	Nichols	Peter	Humboldt Baykeeper
Environment/Energy	Ross	Kerry	Audobon Society
Forestry/Fisheries	Bitts	Dave	Pacific Coast Federation of Fishermen's Assoc.
Forestry/Fisheries	Blomstrom	Greg	Baldwin, Blomstrom, Wilkinson, and Associates
Forestry/Fisheries	Compton	Craig	Green Diamond Resource Company
Forestry/Fisheries	Dellinger	Adam	Northwest California RC&D Council
Forestry/Fisheries	Elsbree	Andy	Green Diamond Resource Company
Forestry/Fisheries	Fry	Tova	Humboldt Redwood Company
Forestry/Fisheries	Hansis	Dick	Institute for Sustainable Forestry
Forestry/Fisheries	Newman	Aaron	Humboldt Fishermen's Marketing Association
Forestry/Fisheries	Rogers	John	Institute for Sustainable Forestry

Table B.1 (continued): List of RePower Humboldt Stakeholder Group Members

Stakeholder Group	Last Name	First Name	Organization/Affiliation
Forestry/Fisheries	Valachovic	Yana	Humboldt County Forest Advisor
Forestry/Fisheries	Wooden	Dan	Six Rivers National Forest
Labor	Berg	Sid	Plumbers and Steamfitters Local 290
Labor	Borgeson	David	Building Trades Council
Labor	Borck	Bob	Building and Construction Trades Council
Labor	Cochran	Ron	International Brotherhood of Electrical Workers
Labor	Hassler	Mariann	Carpenters Local Union #751/Eureka
Political Leaders	Bohn	Juliet	Humboldt Waste Management Authority
Political Leaders	Clendenen	Cliff	Board of Supervisors District 2
Political Leaders	Fregoso	Neleen	Humboldt Transit Authority
Political Leaders	Fulkerson	Julie	Trinidad City Council
Political Leaders	Goosby	Zuretti	State Senator Pat Wiggins
Political Leaders	Lovelace	Mark	Humboldt County Supervisor
Political Leaders	Murguia	Liz	Congressman Mike Thompson's Office
Political Leaders	Pardi	Larry	Humboldt Transit Authority
Political Leaders	Parrish	Jay	Redwood Coast Energy Authority
Political Leaders	Rische	Carol	Humboldt Bay Municipal Water District
Political Leaders	Schneider	Sarah	City of Arcata
Political Leaders	Smith	Jimmy	Board of Supervisors, District 1
Political Leaders	Test	Jim	Humboldt Waste Management Authority
Political Leaders	Wilson	Mike	Harbor Commission
Political Leaders	Winkler	Michael	Arcata City Hall
Political Leaders	Woo	Sheri	Humboldt Bay Municipal Water District
Political Leaders	Woolley	John	Assembly Member Wesley Chesboro
Regulatory	Ashton	Diane	National Marine Fisheries Service
Regulatory	Bond	James	U.S. Fish and Wildlife Service
Regulatory	Dolf	Jeff	Ag Commissioner
Regulatory	Frey	Vicki	CA Department of Fish and Game
Regulatory	Hattem	Michael	CA Dept of Fish and Game
Regulatory	Kraemer	Melissa	CA Coastal Commission, North Coast District Office
Regulatory	Martin	Rick	North Coast Unified Air Quality Management District
Regulatory	McIver	Bill	U.S. Fish and Wildlife Service
Regulatory	Merrill	Bob	CA Coastal Commission, North Coast District Office
Tribes	Cozens	Rob	Resighini Rancheria

Table B.1 (continued): List of RePower Humboldt Stakeholder Group Members

Stakeholder Group	Last Name	First Name	Organization/Affiliation
Tribes	Hernandez	Ted	Wiyot Tribe
Tribes	Kullman	Stephen	Wiyot Tribe
Tribes	Masten, Jr.	Leonard	Hoopa Tribe
Tribes	O'Rourke, Sr.	Thomas P.	Yurok Tribe
Tribes	Savage	Jonas	Trinidad Rancheria
Tribes	Smith	Edwin	Bear River Band of the Rohnerville Rancheria
Tribes	Supahan	Terry	Supahan Consulting Group
Youth	Ludtke	Jordan	Eureka High School
Youth	Ludtke	Page	Parent

Note: An additional 34 youth participated in a Humboldt RePower Humboldt youth stakeholder meeting.

Table B.2: Humboldt RESCO Stakeholder Participation

Stakeholder Group	# Invited	Meeting 1 Attendees	Meeting 2 Attendees
Business Community	5	3	2
Economic Development / Financial Organizations	8	3	2
Education / Policy Groups	6	2	2
Energy Industry	9	8	4
Environmental / Energy Groups	8	2	2
Private / Non-Profit Forestry and Fisheries Organization	11	4	2
Labor Groups	5	0	3
Political Leaders	17	6	6
Regulatory Bodies	9	3	1
Tribes	8	0	1
Youth	2	2	2
Total	88	33	27

How were the RePower Humboldt stakeholder criteria rankings determined?

The RePower Humboldt stakeholder criteria rankings were determined based on stakeholder input from in-person meetings and a web-based survey. The criteria rankings were determined as follows. During the stakeholder meetings participants were given the opportunity to cast six votes for whichever criteria they deemed most important; each vote was worth one point. In the web-based, survey participants were asked to pick a first, second and third choice for the criteria they thought were most important; first place votes were worth 3 points, second place votes 2 points, and third place votes 1 point. Based on these stakeholder votes a weighted score was determined for each criterion.

Appendix C - Public Comments and Associated Responses & Revisions to the RePower Humboldt Strategic Plan

Table C.1: Summary of Public Comment on RePower Humboldt Strategic Plan Draft

Note: see http://www.redwoodenergy.org/programs/repower for a complete record of public comment.

Commenter	Organization	Medium	Date	Summary of Comments	Response and Changes to Strategic Plan Document
Cecil, Ruthann	N/A	written comments	26-Oct-12	Further research is needed before seeking municipal endorsements. Environmental impact assessment and public hearings will be needed prior to government action to implement the plan. Energy efficiency should be top priority. Biomass is not a carbon neutral resource. A local study for our bioregion should be conducted as recommended in IM15 and should include complex carbon accounting methods. The terms "renewable" and "sustainable" are questionable. Perhaps a set of criteria for true sustainability can be reached locally if it involves a high quality community discussion that looks at complex issues. The threat of forest fires should not be used as a justification for over-cutting trees to supply biomass power plants. The active forest restoration industry and fire councils in this region should be consulted.	Made it clear we treated biomass as carbon neutral in our study (clarified in Section 7.1, Biomass). The concerns expressed regarding biomass energy are already noted in the plan (LTS7, IM15, IM16). It is clearly stated that further research is needed to assess the economic and environmental sustainability, and the greenhouse gas implications of using local biomass resources for energy production.
Drake, Jake	N/A	email	12-Oct-12	Strongly support overall plan. Hanging clothes on clotheslines to dry is a simple measure we can all take to reduce carbon emissions.	While using clotheslines is not specifically noted in the plan, it could be included under the energy efficiency category (LTS2, IM2, IM3).
Faust, Melanie	N/A	oral comments	15-Oct-12	A summary of potential environmental impacts associated with each of the proposed renewable energy technologies would be a useful addition to the Strategic Plan. The plan should consider the potential issues and environmental impacts associated with ash generation from biomass power plants and its disposal.	Added a link to the CEC's Energy Aware Siting Guide, Appendix E, Environmental Impacts of New Landslide Utility-Scale Facilities. Added a note in Section 7.1, Biomass that acknowledges the ash disposal issue could be a potential barrier. Depending on ash characteristics it can potentially be used as a soil amendment or for other uses (e.g., an additive to concrete). Ash composition should be assessed to ensure there are not significant levels of heavy metals or other hazardous contaminants. Contamination is a more serious issue with urban sources of treated wood waste. Also, fly ash typically has higher levels of heavy metals, so it is best if fly ash and bottom ash are kept separate.
Kalt, Jennifer	N/A	email	27-Sep-12	Consider the potential issues and environmental impacts associated with ash generation and disposal from biomass power plants.	Added a note in Section 7.1, Biomass that acknowledges the ash disposal issue as a potential barrier.

Table C.1 (continued): Summary of Public Comment on RePower Humboldt Strategic Plan Draft

Commenter	Organization	Medium	Date	Summary of Comments	Response and Changes to Strategic Plan Document
McNamee, Kerry	N/A	email	23-Sep-12	In full support of the plan. Hope the peak scenario is achieved. Excited to see wind and wave power developed.	No changes required.
Nesbitt, Gregory	N/A	email	14-Oct-12	Not enough information on the expected cost of recommended options.	Responded via email and pointed him to the Resource and Technology Assessment Report and the Economic Analysis Report. These reports contain a lot more information regarding the estimated cost of various scenarios and provide documentation regarding how the cost estimates were derived and where various cost data came from. Added information in Section 7.3 describing how the cost of T&D infrastructure upgrades could affect the cost of the peak scenario.
Nesbitt, Gregory	N/A	email	29-Oct-12	Examine uncertainties that accompany any suggested course of action and try to quantify those uncertainties wherever you can. Try to understand under what conditions going local is a good thing and under what conditions it could prove to be a big mistake.	In the Technology Assessment Report, Section 3.1, we discuss the Monte Carlo sensitivity analysis that was performed. It was used to assess how sensitive our Regional Energy Planning Optimization Model was to changes in various model parameters. Sixty parameters were varied by ±10% and the resulting change in model outputs (cost and greenhouse gas emissions) ranged by about ±3% to ±5%. While this sensitivity analysis did not explore all uncertainties, it did indicate that the model was rather robust in finding an optimal solution.
Orahoske, Andrew	Environmental Protection Information Center	written comments	26-Oct-12	RePower Humboldt plan is a valuable working document. Support plan to emphasize efficiency first. Ask that further efficiency opportunities be addressed before additional generation is considered. Should consider local energy authority/public utility that could better serve the community and promote renewables. Have serious concerns regarding the operation of industry-standard wind turbines in the Cape Mendocino area, which is identified as an Important Bird Area by the National Audubon Society. There are risks to birds and bats, including endangered Marbled Murrelets. Recommend that the American Bird Conservancy's Smart Bird Guidelines be incorporated into the RePower Humboldt plan. Questions the emphasis on biomass energy in the plan; recent literature claims that burning biomass is as bad or possibly worse than burning fossil fuels in terms of climate change. Concerned that deforestation and forest degradation due to timber harvest can impair the ability of forests in our region to sequester carbon.	The RePower Humboldt plan emphasizes energy efficiency first. It recommends examination of community energy models, like Community Choice Aggregation, that can provide for greater local control of energy decisions. The plan identifies Cape Mendocino as a prime wind energy location and recommends that the community continue to consider Bear River Ridge for wind energy development. The plan acknowledges there are potential conflicts due to the designation of this area as an Important Bird Area. Ultimately these potential environmental impacts would need to be assessed in a project specific environmental review. Biomass is identified as a key resource that could be expanded. Plan acknowledges that biomass energy development must be further examined to assess if it's sustainable and can provide carbon emission benefits. Recommends that biomass energy plans should be consistent with local forest restoration needs and priorities. The debate regarding the carbon emission benefits and impacts of biomass power is ongoing and should be followed.

Table C.1 (continued): Summary of Public Comment on RePower Humboldt Strategic Plan Draft

Commenter	Organization	Medium	Date	Summary of Comments	Response and Changes to Strategic Plan Document
Rische, Carol	Humboldt Bay Municipal Water Dist.	phone conversation	24-Sep-12	Include pressure retarded osmosis (PRO) power generation as a potential renewable energy source for Humboldt County, particularly at the site of the old Samoa Pulp Mill.	Added PRO power to LTS8 and added an Implementation Measure in Chapter 10 for an Osmotic Power Research Center in Humboldt.
Willis, Roy	N/A	email	27-Sep-12	Proposed local energy generation projects often face many challenges, including economic hurdles and public concerns/opposition. In the Town Hall Meeting small group session his group agreed that energy efficiency should be the first priority, followed by distributed generation, biomass and wind. Notes that current biomass electricity generation only meets about 10-15% of local demand, not 30%. Notes that NOx and particulate matter emissions from biomass plants can be a concern. Cost of bold and peak scenarios should not be underestimated, should include cost of transmission and distribution system upgrades. No new hydro facilities have been permitted in CA in last 2 decades. The 60 kV transmission lines that run south to Willits are for distribution only and are not capable of importing or exporting power. Exporting power from Humboldt is very rare and not normal operation.	CEC data show biomass provided about 27% of local electricity supply in 2010. Cost estimates for bold and peak scenarios were based on the best information available at the time of the study and were obtained from reputable industry sources. See the Economic Analysis Report, Appendix B for details on the cost analysis methodology and data sources. Added information to Section 7.3 about the cost of T&D upgrades and their impact on the cost of the Peak scenario. Changed discussion about transmission lines to indicate there are only 2 major connections (115 kV) to the larger electrical grid.
Wilson, Mike	Humboldt Bay Harbor District	email, oral comments	28-Sep-12	Would like to see a wave power research facility located on the Samoa Peninsula at the site of the old pulp mill (Freshwater Tissue site). Later conversations noted that the research facility could also include offshore wind, biomass and pressure retarded osmosis power.	Added PRO power to LTS8 and add an Implementation Measure in Chapter 10 for an Osmotic Power Research Center in Humboldt. Identified old pulp mill site as an ideal location for an energy research center that covers wind, wave, biomass and PRO power.
Informal walk-in commenters	N/A	oral comments	misc	Plan is interesting. Would like to see financing program that will cover energy efficiency and renewable energy projects for residential applications.	No changes required.

Table C.1 (continued): Summary of Public Comment on RePower Humboldt Strategic Plan Draft

Commenter	Organization	Medium	Date	Summary of Comments	Response and Changes to Strategic Plan Document
Winkler, Michael	Redwood Energy	email	23-Sep-12	Suggested additions to the report include: examples to illustrate recommendations, links to outside information sources, discussion of smart grid and time varying pricing, importance of PG&E power plant even if it doesn't run very much (e.g., in Peak scenario), information on how grid upgrades would be financed and paid for, explain demand response, add heat pump clothes dryers and process heating to LTS5, discussion of electric vehicle charging issues, add possibility of new biomass plants running in load following mode. Asks for clarification regarding percentage of heat and transportation from renewables.	Examples to illustrate recommendations and links to outside information sources are beyond the scope of the strategic plan document, but are included in a companion document called the RePower Humboldt Regulatory and Policy Guide on Renewable Energy and Energy Efficiency for Humboldt County Local and Tribal Governments. Time varying pricing is also covered in the Regulatory and Policy Guide. Added note to Section 7.3 regarding what an important role the PG&E power plant plays even if it doesn't run very much. Added demand response to LTS2; note also that demand response is covered in the Resource Technology and Assessment Report. Revised LTS5 to cover more than just water and space heating. Added brief comment about potential peak demand issues with electric vehicle charging; this will be covered in more detail in the North Coast Plug-in Electric Vehicle Readiness Plan being prepared by RCEA, SERC and GHD. Added mention of new biomass plants running in load following mode. Section 7.2 explains that the percent adoption for electric vehicles and heat pumps refers to the penetration of these technologies into the market place. This is further explained in the Technology Assessment Report. This is not the same as the percent of heating or transportation energy that comes from renewable resources.
Bryan Jungers	RePower Humboldt Professional Advisory Committee	marked up draft document	21-Sep-12	Forming a leadership group to move plan forward is very important; need specific IM for this. Living document should be reflected in planning process. Include distributed generation biomass. Near-term next steps should be action oriented and detailed enough to be useful. Evaluation plan is too brief. Consider a definitions section for the appendix.	Add leadership group to implementation measures. Add biomass distributed generation. Make near-term next steps more action oriented where possible.

Table C.1 (continued): Summary of Public Comment on RePower Humboldt Strategic Plan Draft

Commenter	Organization	Medium	Date	Summary of Comments	Response and Changes to Strategic Plan Document
RePower Humboldt Professional Advisory Committee (phone/in-person meeting)	RePower Humboldt Professional Advisory Committee	in-person/ phone meeting	21-Sep-12	Include distributed biomass as an option. Provide more examples of hourly load and supply plots (pp. 26) on website. Consider allowing biomass to be used in load following mode. Consider smart charging for PEVs (demand response). Fuel switching assumptions in model scenarios (38% PEV and heat pump penetration) are too optimistic. Note how this affects results, especially greenhouse gas emission reduction estimates. Explore this further in future research. Note that in the peak scenario the PG&E power plant is still very important. It doesn't run very many hours, but it is a strategic asset that provides critical reserve capacity and reliability benefits. It enables the high percentage of intermittent renewables in the peak scenario. Need a conceptual timeline for the renewable energy build-out -- which projects? how much capacity? in what time frame? Key lesson learned is that increasing renewable electricity and reducing greenhouse gas emissions are distinct objectives; pursuing one does not ensure the other. The energy efficiency estimates are based on an analysis that only considers existing, cost-effective measures. Greater potential should be considered. Also, utilities are mandated to pursue all cost effective efficiency, so we should consider including 100% efficiency penetration in the bold scenario. The strong focus on biomass energy may not be well received in our region. Need to determine what is acceptable to the community. Need to assess potential environmental impacts and carbon neutrality assumption. Regulatory restrictions on how biomass is treated as a renewable fuel could impact it's cost effectiveness. The peak scenario barely reaches the state's greenhouse gas reduction goals; we should keep the peak scenario as an option. We should pursue a "no regrets" approach for near-term next steps that preserves flexibility and allows for needed adjustments without great sacrifice. Major transmission upgrades would be expensive and challenging to pursue.	Added biomass to distributed generation. Noted that fuel switching assumptions in model scenarios (38% PEV and heat pump penetration) are too optimistic; noted how this affects results, especially greenhouse gas emission reduction estimates. Noted that in the peak scenario the PG&E power plant is still very important as a strategic asset that provides critical reserve capacity and reliability benefits. Noted that energy efficiency estimates are based on an analysis that considers existing, cost-effective measures only, and greater potential is possible. Noted that regulatory restrictions on how biomass is treated as a renewable fuel could change. Added a "least regrets" exercise for near-term next steps that identifies low risk measures that can be pursued.

Table C.2: RePower Humboldt Townhall Meeting - Small Group Discussion Results

Note: see http://www.redwoodenergy.org/programs/repower for a complete record of townhall meeting feedback.

Group	Which scenario - BAU, Bold or Peak - should be the goal?	Which 3 of these "key strategies" do you think should be prioritized?	What specific near-term next steps or projects should be pursued?	What do you think are the top three challenges?	How might those challenges be addressed?
1	Peak	7. Local energy-project ownership 2. Biomass 3. Utility-scale wind development	1. Communication / media blitz 2. make sure energy element is kept in General plan 3. high energy use tax with revenues going to RE	1. Cheap natural gas 2. biomass haul costs 3. inadequate capacity in key places to put RE on grid	1. cap & trade support 2. community education to correct misconceptions, more BTUs per truckload through torrefaction, gasifiers, biofuel powered chip vans 3. transmission upgrades
2	Peak	7. Local energy-project ownership 6. Fuel switching 1. Distributed generation	1. PV lease programs	1. economic / lack of subsidies for RE 2. environmental impacts of renewables 3. siting issues	1. lobby for more subsidies 2. be sure to address / study them early in the process 3. develop criteria for appropriate siting with wide public input / support
3	Peak	2. Biomass 3. Utility-scale wind development 7. Local energy-project ownership	1. local ownership (CCA, Investment Fund) 2. public engagement and outreach (NEC, Solarize) 3. community advocacy	1. cheap fossil fuels 2. car culture, energy inefficiency 3. regulatory barriers, social acceptance, funding/financing, technology development	1. carbon tax, end subsidies, internalize external costs 2. better bike/ped/transit infrastructure, municipal financing, high energy use tax 3. high energy use tax, local clean energy bonds, collectives/cooperatives
4	Peak	3. Utility-scale wind development 6. Fuel switching 7. Local energy-project ownership	1. decrease vehicle miles traveled 2. land-use strategies 3. environmental inputs / community dialogue on specifics 4. wind via local community developer 5. efficiency 6. CCA/local ownership	1. low cost fuel 2. inertia in behavior 3. car culture 4. home energy	1. Support state /national price on carbon, end subsidies on FF 2. Pickup trucks (?) 3. municipal financing/ support imagine Humboldt
5	Peak	2. Biomass 3. Utility-scale wind development 7. Local energy-project ownership	1. SB843 support/alternate financing mechanisms for local ownership 2. community engagement/ outreach 3. community advocacy 4. efficiency	1. social acceptance 2. financing (stable, long-term, local bonds) 3. existing fuels are hard compete with 4. local grid reliability	1. Education/ownership (CCA)/internalize external costs 2. Local participation, collectives & cooperatives, better county & state policies 3. Internalize external costs

Table C.2: RePower Humboldt Townhall Meeting - Small Group Discussion Results

Group	Which scenario - BAU, Bold or Peak - should be the goal?	Which 3 of these "key strategies" do you think should be prioritized?	What specific near-term next steps or projects should be pursued?	What do you think are the top three challenges?	How might those challenges be addressed?
6	Peak	Have to address transportation 2. Biomass 5. Offshore wind/wave 7. Local energy-project ownership	1. support SB843 2. seek other funding (e.g. PACE) 3. RE community advocacy 4. transportation - multimode 5. EE/conservation 6. high usage tax	1. social awareness and acceptance/ behavior change/inertia 2. financing 3. gas is artificially low 4. inertia and resilience/siting of projects	1. Address external costs, education, ownership, community group 2. Stable long-term funding, local participation, policy, cooperatives 3. carbon has a cost 4. more incentive
7	Peak	2. Biomass 3. Utility-scale wind development 7. Local energy-project ownership	1. support SB843 2. alternative funding mechanisms 3. citizen awareness and training 4. community advocacy 5. transportation	1. social acceptance 2. financing - alternatives needed 3. natural gas too cheap & hard to compete [with]	1. carbon tax- internalize externalities, empower people - smart meters, education 2. long-term funding (government bonds) 3. carbon tax
8	Peak	7. Local energy-project ownership 9. Local energy-project financing programs (public utility model is much preferred) 10. Conservation-reduction of total energy consumption	1. identify local resources that are underutilized 2. identify funding opportunities on a local level 3. public awareness campaign on unsustainable energy usage	1. upfront costs of large projects 2. community awareness (lack therof) 3. diminishing utility of technical solutions to technical problems	1. State and federal programs to redistribute available resources 2. promote "paradigm shift" in thinking similar to smoking cigarettes 3. prefer simple to complex
9	Bold / Peak	1. Distributed generation 2. Biomass 5. Offshore wind/wave (esp. wind) Efficiency, conservation and culture are key	1. focus on conservation and efficiency 2. considering developing and building network of local energy councils	1. funding (we need big $) 2. achievable misses the mark 3. ideal is not achievable	1. not sure 2. not sure 3. not sure
10	Peak	7. Local energy-project ownership 8. Options to purchase local RE 9. Local financing programs Increase efficiency	1. community involvement 2. small distributed generation	1. resistance to change, individual & group social acceptance 2. financing 3. technology development	1. education, involvement, create incentives - pay less/profit 2. county policies, collectives/cooperatives 3. research centers, grants- financing
11	Peak	7. Local energy-project ownership 8. Options to purchase local RE 9. Local energy-project financing programs	1. community involvement, community based projects 2. distributed energy projects, small scale 3. getting local investors	1. resistance to change, individual rights 2. financing 3. technology development	1. incentives (tangible), education/outreach, organization, communication, involvement 2. county policies that encourage investment, regulatory issues?, collective/cooperative orgs., package/known cost 3. research centers/grants

Appendix D - RePower Humboldt Energy Analysis Parameters

Table D.1: Existing and Maximum Capacities Considered in RePower Humboldt Analysis

Resource / Technology	Existing Capacity	Max Capacity Considered	Notes
Wind	0 MW	250 MW	Onshore only, estimated 400 MW available
Wave	0 MW	100 MW	Estimate 1000 MW available
Biomass	61 MW	225 MW	Fuel from slash, fuel reduction and thinning per CDF
Small Hydro	10 MW	35 MW	Run-of-river only, estimate 60 MW available
Solar	1 MW	10 MW	Distributed rooftop photovoltaic systems for residential, commercial and industrial applications; no utility scale installations
Transmission	60 MW	250 MW	Import/export transmission capacity to east
Storage	0 MW	25 MW	Hypothetical site near Ruth Lake
Efficiency	0%	100%	% of energy efficiency potential, 100% = 20% energy savings
PEVs	0%	38%	% of registered vehicles
Heat Pumps	0%	38%	% of natural gas furnaces
Demand Response	0%	12%	% of peak load

Table D.2: Energy System Capacities Modeled in RePower Humboldt Scenarios

Resource / Technology	BAU (MW)	Bold (MW)	Peak (MW)
Natural Gas	163	163	163
Wind	0	68	100
Wave	0	0	50
Biomass	60	90	160
Small Hydro	10	35	35
Solar	1	1	5
Food Waste Digester	0	1	1
Technology / Resource	**BAU (% adoption)**	**Bold (% adoption)**	**Peak (% adoption)**
Energy Efficiency	38	56	100
Heat Pumps	0	38	38
Plug-in Electric Vehicles	0	38	38

Appendix E - Options for Community Ownership, Choice and Control

The Electric Power System - A Regulated Monopoly

Only one entity in a given geographic region can realistically own and operate the electric infrastructure necessary to serve customers. In some regions the system is owned and operated by a public or non-profit entity (a municipal utility or cooperative, respectively), and in other areas it is owned and operated by an investor owned utility (IOU), such as PG&E. Under this model electricity customers typically have very little choice. With publicly owned utilities and cooperatives, customers do get to elect the boards that govern these entities, and therefore they do have a say in how things are managed. However, with privately held utilities the companies' shareholders have this voting power, but the IOU's customers do not. To ensure that customers pay a fair price for electricity services in this monopolistic environment, the industry is regulated according to a "cost-of-service" model. Retail rates are set to recover expenses and to allow IOUs a "fair" return on their capital investments. In California the regulatory agency that sets rates is the California Public Utilities Commission.

Within this regulated monopolistic system customers have traditionally had very little choice. They haven't had the ability to "shop around" or to choose among different products at different prices from different vendors. In addition, very little decision making in the electricity industry has taken place at the local level. However, in recent years there have been efforts to create competition in the electricity industry, to give consumers more choice, and to better involve local communities in the decision making process. The RePower Humboldt project is part of these efforts.

Municipal Utilities

A municipal electric utility is a publicly owned, full service electric utility. They provide electricity generation/acquisition, transmission, distribution, metering, billing, and operations and maintenance services to their customers. They are managed by a publicly elected board. Benefits of municipal utilities include local control of energy policy and rate setting, direct public accountability to voters, and transparent business practices that must follow public protocols. However, forming a municipal electric utility is a huge task that requires tremendous political will and staying power, deep financial pockets, and a committed voting citizenry.

Rural Electric Cooperatives

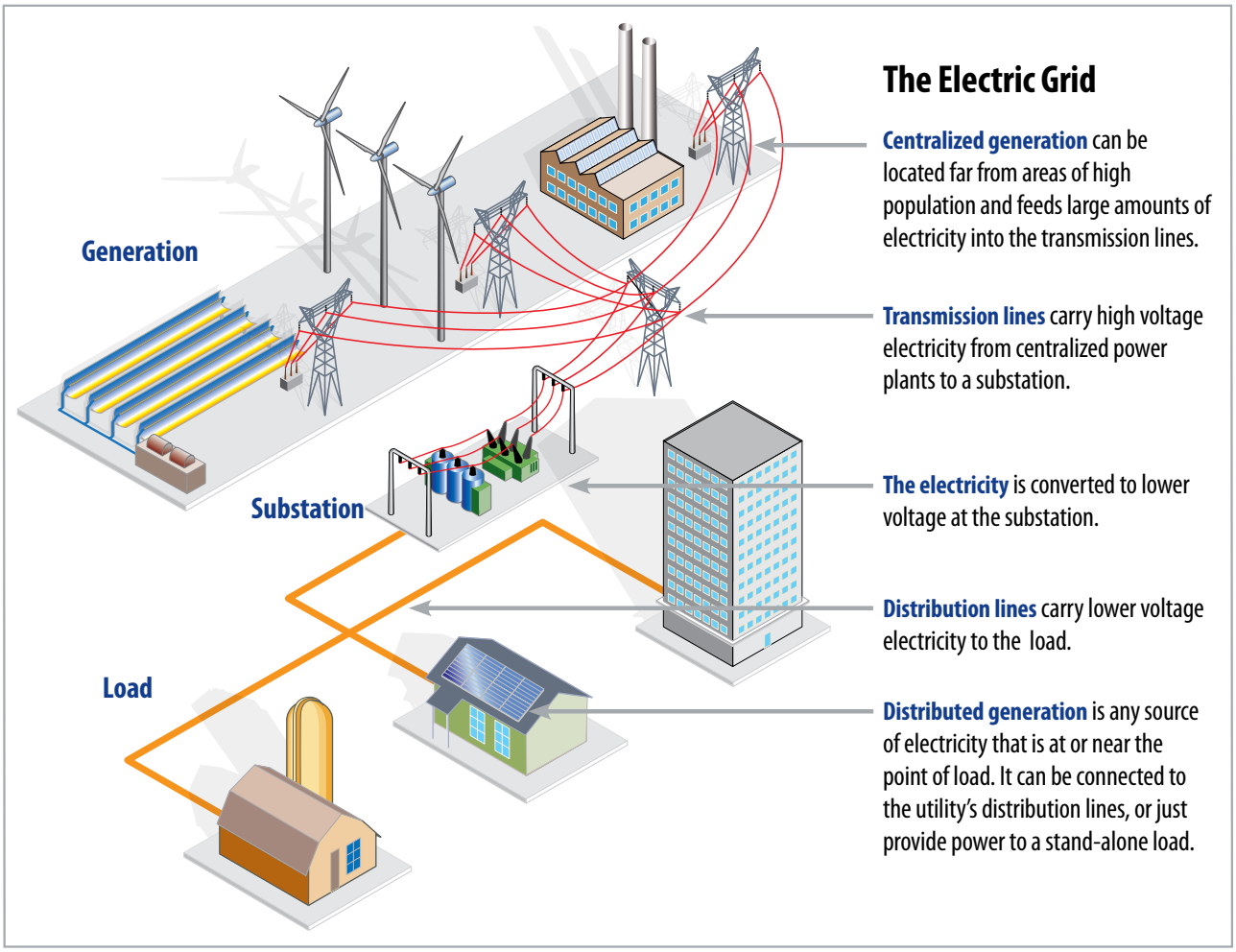
Electric cooperatives are private, not-for-profit businesses governed by their consumers (known as "consumer-members"). Co-ops are required to have democratic governance and every consumer-member can vote to choose the board that oversees the co-op. Co-ops must charge customers based on the cost of service and, with few exceptions, return to consumer-members any revenue above what is needed for operation. Like municipal utilities, co-ops own the distribution lines that serve their customers, and sometimes own transmission and generation facilities as well. Similar to a municipal utility, a rural electric cooperative must acquire or build distribution lines to serve their customers. This presents many of the same hurdles that are faced when establishing a new municipal utility, namely acquiring the distribution infrastructure from the incumbent utility.

Community Choice Aggregation

Community choice aggregation (CCA) enables cities, counties, and groups of cities and counties to supply electricity to customers within their borders. However, unlike a municipal utility or a cooperative, a CCA does not own transmission or distribution infrastructure. Instead, customers continue to receive transmission, distribution, metering, billing and operation and maintenance services from their incumbent utility. The CCA only provides the generation component of the electricity service. CCAs choose their electricity supplier, and with that choice determine what type of power they will use and what price they will pay. However, establishing a CCA is not without risk (e.g. energy costs could be higher than expected). It is important for a community to be well informed and to carefully weigh potential risks and benefits before choosing to form a CCA. Currently some Humboldt County municipalities are considering the CCA option, including the possibility of joining an existing CCA.

Direct Access Service

Direct access is an optional service that allows electricity customers of investor owned utilities (IOUs) to purchase electricity from a competitive Energy Service Provider (ESP), rather than from the IOU. Like with a CCA, the ESP only provides the generation component of the electric service, and the incumbent IOU still provides transmission and distribution. In California, direct access service was made widely available in the 1990s as an early step in electric utility deregulation. However, direct access was curtailed in the wake of the 2000-2001 California electric market crisis. It has been reintroduced over the last four years on a limited basis to a relatively small number of non-residential customers, and it is fully subscribed. It will require additional state legislation to further expand direct access opportunities. Currently SB 855 (Kehoe) is pending in the California Senate; if passed it would essentially double the availability of energy for direct access contracts. It is possible that local renewable energy projects, under the auspices of an ESP, could sell power to local direct access customers.



Source: Solar Power and the Electric Grid, National Renewable Energy Laboratory, March 2010.

Net Metering and Self-Generation

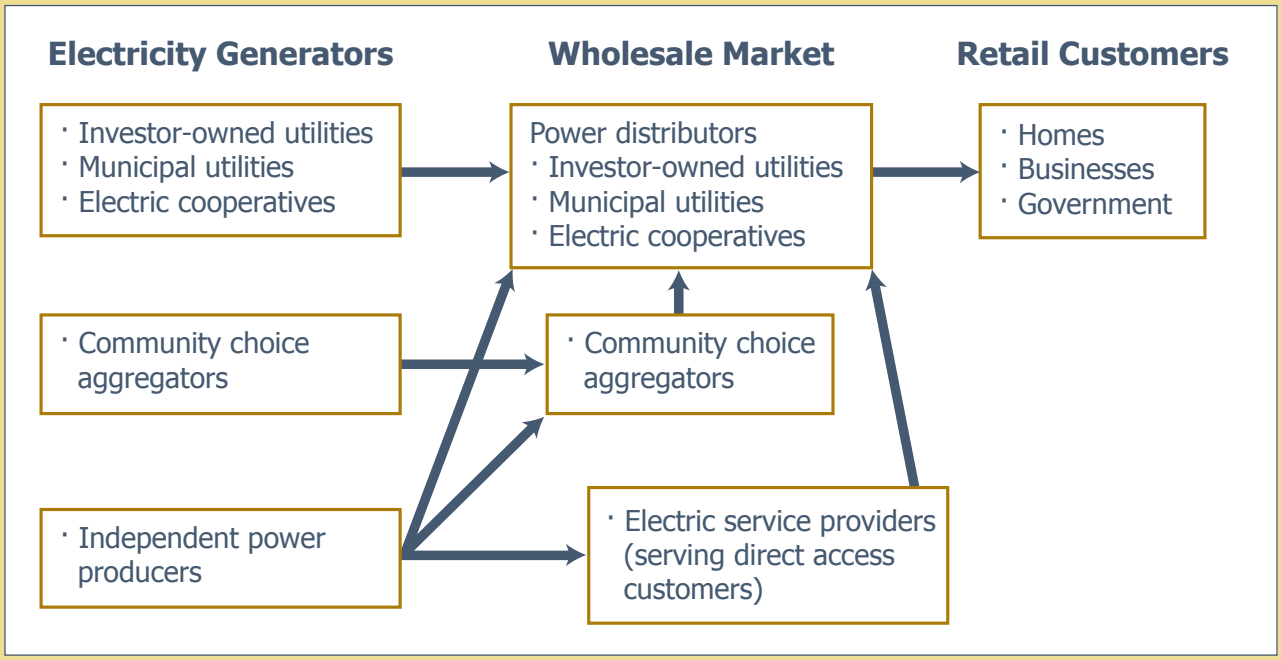
A self-generator is an electric customer who installs their own electricity generation equipment at their facility on the customer side of their electric meter in order to displace power purchased from the utility. This is commonly done with rooftop solar electric systems, but it can also be accomplished using other types of modular electrical generators (e.g., wind turbines, engine generators, microturbines, fuel cells, etc.). A self-generator may provide some or all of their own electricity needs, with any needed additional electricity being purchased from their utility. The self-generation approach that currently benefits the customer most is net metering. With net metering, excess generation is credited at the customer's full retail electric rate at the time it is generated and can be credited to the bill for up to one year. The customer can net their annual bill to a modest minimum monthly charge.

Community Renewable Energy Programs

While net metering is a great opportunity, it is not a practical option for many customers who want to purchase renewable energy, such as those who rent or lease their facilities, those who lack adequate and appropriate space, and those who lack sufficient credit to purchase a renewable energy system. There are other models that can better serve these customers. Over the last several years many states have instituted policies that encourage innovative community renewable energy programs. One such community renewable energy program is the Solar*Rewards Community Program offered by Xcel Energy in Colorado. This program provides residential and business customers with the opportunity to purchase renewable energy from a community-based photovoltaic project. Subscribing customers purchase or lease interest in a shared solar electric system and then receive credit on their bills for the energy produced by the system. The Sacramento Municipal Utility District also has a similar program called

Who are the key players in the electric power market?

Electric power is typically generated at large central station power plants by electric utility companies (private or public), electric cooperatives or independent power producers. Community Choice Aggregators, a new player in the California market, can also generate their own power. This power is then sent through the transmission and distribution system to retail customers. The transmission and distribution infrastructure is typically owned by utility companies or electric cooperatives, though they are required to provide open access to others who want to transfer electric power through the system. Once power is generated, it is often sold on the wholesale market before it makes its way to retail customers.



SolarShares. Currently, Senator Wolk has proposed a similar statewide program in the California State Legislature (SB 843). If passed, this legislation would provide households and businesses the ability to voluntarily buy up to 100% renewable power from a shared facility (20 MW maximum) in their utility's service territory and receive a credit on their utility bill. Such a program would allow Humboldt County electric customers to support local renewable energy projects and could be a boon for local renewable energy development.

Utility "Green Pricing " Programs

Another model that is being extensively employed is the green pricing option, where customers voluntarily sign up to pay a premium charge on their monthly bill in exchange for the purchase of renewable power. Most programs charge a premium, ranging from less than 1¢/kWh up to as much as 5¢/kWh. Programs are structured so that the renewable power that is being purchased is above and beyond what the utility otherwise would have purchased. There are hundreds of green pricing programs being offered around the country, with the most successful programs serving large numbers of participants. For example, the Portland General Electric green pricing programs are serving more than 75,000 customers and account for over 8% of the utility's total retail sales. Pacific Gas and Electric Company recently submitted a proposal to the California Public Utilities Commission for a green pricing program. Their program would cost the average residential customer a $6/month premium in exchange for Renewable Energy Certificates (RECs) that would cover the customer's usage. RECs represent the environmental attributes of renewable energy, but not the energy itself. The proposed PG&E program would not likely do anything to promote local renewable energy projects.

Appendix F - Financing

Financing can primarily be categorized into two different types: equity financing and debt financing. Equity financing involves an exchange of money from an investor in return for a piece of ownership in a business. Debt financing is a loan that is given in exchange for repayment with interest at some future date. Financing of large, capital intense projects will typically involve a mix of debt and equity, with the required equity portion usually amounting to at least 20% of the total financing.

Equity Financing

When a renewable energy project is funded through equity financing, investors make an investment in that project in exchange for partial ownership interests (stock). As such, they have a vested interest in the operations, management, and ultimate success of the venture. Involving equity investors in a project results in diluted ownership for the project developers and may require them to share management control.

One option that has been used to secure equity for community renewable energy projects and eventually provide full control to the community owners is called a flip structure. A flip structure is generally a hybrid public and private ownership model designed to capitalize on the tax liability of the private equity investor. During the initial phase of the project the private investor owns the majority of the project (e.g., 99% private ownership). This phase typically lasts 6 to 10 years during which time the private investor takes full advantage of available tax benefits. After this period the ownership structure flips so that the community owner acquires the majority ownership.

Debt Financing

Debt financing can be structured as either project based or corporate financing. With project financing, lenders look primarily to the cash flow and assets of a specific project for repayment rather than to the assets or credit of the project developer. Because project financing relies on the cash flow and assets of the project, long-term power purchase agreements that guarantee a revenue stream are critical. Project financing is most typical for renewable energy projects, with the exception of projects financed by electric utility companies.

Debt financing options include both loan and bond financing. Loans are typically secured from a bank or other private entity. The borrower receives a principal amount of money and is obligated to repay it over time with interest. Government loan guarantees might also be secured, which can lower the risk on the loan and therefore lowers the interest rate.

Bond financing is similar to loan financing except that with bond financing the capital is sourced from a group of investors (the bondholders) rather than a central institution (i.e., a bank). A bond company underwrites the loan and the borrower makes principal and interest payments to the bondholders through a corporate trustee. At the end of a set term the full value of the principal is repaid to the bondholder. Bonds can be issued by either corporate or public sources. Public bonds typically have a lower interest rate because they are often less risky than corporate bonds and because bondholder interest is often exempt from state and federal taxes. Public bonds can be structured as general obligation bonds, which will impact a municipality's general fund, or as revenue bonds that are tied to income producing projects, like renewable energy projects. Specialty public bonds that are specific to energy projects may also be available, such as Qualified Energy Conservation Bonds (QECBs). QECBs are "tax-credit bonds" where the bond purchaser receives a federal tax credit in exchange for a lower interest rate.

Grants, Rebates and Tax Credits

State and federal grants, rebates and tax credits are often available for renewable energy projects. State and federal grants are available from many agencies, including the U.S. Department of Energy, the U.S. Department of Agriculture and the California Energy Commission, among others. Federal tax credits include the Investment Tax Credit (available through 2016) and the Production Tax Credit (available through 2013), which are mutually exclusive, as well as accelerated depreciation benefits. All of these tax credits are limited to eligible systems and equipment. State rebates are also available from the California Solar Initiative (though these funds are nearly gone), the Emerging Renewables Program (small wind systems only), and the Self-Generation Incentive Program. More information on these programs can be obtained from RCEA, PG&E, the California Energy Commission, and/or the California Public Utilities Commission.

Value of Environmental Attributes

Environmental attributes associated with renewable energy projects (e.g., avoided carbon emissions) provide value above and beyond the generated energy. These attributes can be sold in combination with the energy commodity, or they can be sold separately in the form of Renewable Energy Certificates (RECs) or carbon offsets. If the environmental attributes are sold separately, they can be sold up-front and used as a means of raising capital to help finance the project.

Financing Residential and Small Commercial Projects

A number of financing mechanisms for energy efficiency and facility scale distributed generation projects in the residential and small commercial sectors are now being utilized. These include *Property Assessed Clean Energy* (PACE) programs that help property owners finance energy efficiency and renewable energy projects for their homes and businesses. Participants receive financing that is repaid through an assessment on their property taxes for up to 20 years. PACE financing spreads the cost of energy projects over the expected life of the measures and allows the loan to automatically transfer to the next property owner if the property is sold. Currently many jurisdictions are offering PACE type programs in the commercial sector, but programs for the residential sector are largely on hold because of concerns expressed by the Federal Housing Finance Agency about how PACE loans are typically structured to assign energy improvement-related debt a priority lien over existing mortgages. Efforts are being made to resolve these issues. In one case the State of Vermont passed legislation moving PACE assessments behind mortgages in payment priority and federal authorities have approved the change. This has allowed Vermont to establish an active PACE program for the residential sector.

The high first cost of distributed energy systems, even though the life-cycle economics are favorable, often presents a barrier to customer adoption. A number of arrangements have been developed to overcome this barrier, where the customer allows a third party provider to install, own and operate a system on their premises. The customer either leases the system from the third party, or pays a negotiated price for the energy generated by the system according to a *power purchase agreement*. *Lease-to-own arrangements* are also possible. Similar arrangements have been used to finance the installation of energy efficiency upgrades, where a third party installs the upgrades and is compensated over time based on the actual energy savings that are realized. This is referred to as *performance contracting*. In all these cases the third party vendor assumes the risk if the renewable energy system or energy efficiency upgrades do not perform as advertised.

On-bill financing is a new financing model that is being implemented via utility companies in California. The utility provides customers with unsecured loans that cover 100% of the energy efficiency equipment and installation costs (net of rebates and incentives) at zero percent interest. Customers re-pay the loans via on-bill surcharges that are added to their monthly utility bills. This program is currently limited to non-residential customers of the state's four large investor-owned utilities.

Another financing tool available to home buyers is the *energy efficient mortgage* (EEM). With an EEM the buyer rolls the cost of energy efficiency upgrades into his or her mortgage at the time of sale, thereby financing the upgrades over the life of the loan. The small increase in the monthly mortgage payment is typically more than offset by the money saved in monthly energy bills.

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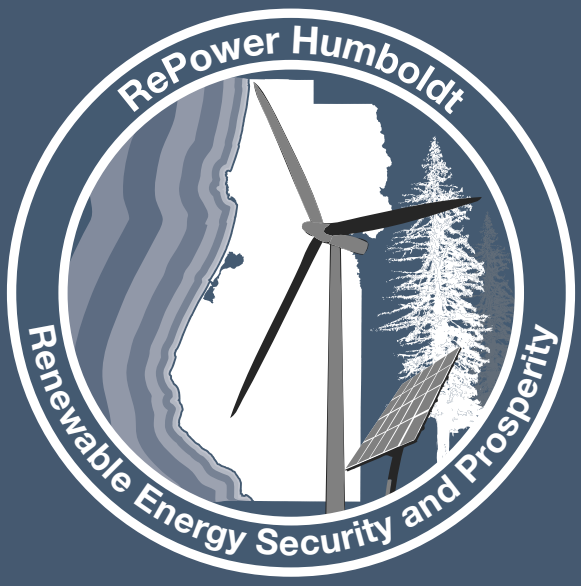
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