Recommendations towards Energy Independence for the City of Willits and Surrounding Community

Prepared for the City of Willits, California

by the

Willits Economic LocaLization (WELL)
and
Willits Ad-Hoc Energy Group

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Preface

The Willits Ad Hoc Energy Group was created by city councilman Ron Orenstein, out of members of the Willits Economic LocaLization (WELL) project -- brought together by Dr. Jason Bradford, in order to examine potential steps the city and surrounding community could begin to take towards lowering energy costs and dependence.

This paper is a draft working document that is intended to outline the recommendations of these two groups as well as steps the City of Willits can begin to take towards energy independence for the defined area (the 95490 zip code). Where possible, the cumbersome technical aspects of the discussion have been relegated to the appendices. The appendices also contain a list of definitions for the more obscure terms used in the main body, starting on page 12.

In creating this paper, every measure has been taken to ensure the accuracy of the information presented as well as the feasibility of the steps. Should errors or questions arise, we would appreciate them being brought to our attention so that they can be corrected or elaborated on.

The latest version of this document is available at:
http://www.willitseconomiclocalization.org/EnergyIndependencePlan.pdf

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1. Executive Summary

Willits is at a crossroads with the growing interest of those south of us for our relatively low home (and land) prices, the decline of local employment, and the increasing energy expenses we all face.

When the energy costs alone are examined, our area spends nearly $30 million a year[1] to firms outside of our area – monies that could be put to work right here in the community to stimulate the local economy and grow jobs.

Looking into the future, fossil fuels are in an undisputed decline and their costs have already begun a marked increase. Given that the average household in our area now spends over 20% of their take home income on energy products[2], one cannot foresee a recovering local economy and sustainable community unless we begin to take action now.

By taking steps now to change the way we assign fees to building permits (with respect to their energy saving considerations), the potential consideration of carbon taxes, the exploration and use of potential local energy sources, as well as simple conservation steps, Willits can become a leader for communities around the US in demonstrating economic localization and sustainability -- all while increasing local revenue streams & employment and reducing our vulnerability to political and economic turmoil.

2. Why is Energy Independence Important?

The Energy Information Agency of the US Government[3] states the total remaining reserves of petroleum at roughly 1 trillion barrels. Based on current consumption levels, with *moderate* annual increases of 2-4%, this will be fully depleted by the middle of the third decade of this century.

By most expert's calculations, world oil production will peak sometime around 2007[4]. Peak is defined as the point on the bell curve when production starts to decline and the cost of extracting oil starts to rise. As reserves decline, the quality of extracted fossil fuels also falls increasing the costs of refining as well as the potential for increasing pollution levels. Natural gas production's peak may shortly follow petroleum's since it has been historically considered a waste product and only in recent decades have markets, shipping and distribution facilities been developed[5]. Of special concern here is the fact that ***70% of California's electricity is generated by natural gas fueled plants***.

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[1] See the table on page 14 of the appendices.
[2] ibid.
[3] www.eia.doe.gov
[4] Deffeyes, K., Hubbert's Peak (New Jersey, Princeton University Press, 2001).
[5] Natural gas (and oil) production has already peaked and is in decline in North America. Strong opposition exists in this country over developing more extensive port facilities to import natural gas; and remaining global natural gas reserves may be fairly short lived as they are eyed to inject into oil fields to increase oil production (e.g. Iran) or to extract synthetic oil from tar sands and shales (e.g. Canada).

Petroleum and its related fossil fuels (natural gas, coal, etc.) are used extensively in everything we do and consume, including agriculture (fertilizers, pesticides, fuel), national defense (equipment and operations), healthcare (e.g. pharmaceuticals), plastics, lubricants, hydraulics, etc. As petroleum's decline is recognized, it is highly probable that some form of government-controlled rationing will be undertaken to ensure these applications receive preference over private (individual) transportation, recreation and home needs[6].

"The possibility for a significant, high technology future requires the springboard of a functioning, energy intensive society as we have today"[7].

What this is reminding us is that <u>if we want to be able to develop alternative sources of energy in order to maintain some semblance of our society today, we need to do so now while energy is still cheap and plentiful</u>. We cannot afford to wait until fossil fuels decline to the point of severe economic impact – the changes to ensure our survival need to begin today. Those same fossil fuels we save by striving for energy independence today will provide the basis for sustaining agriculture and healthcare tomorrow.

*The goal we feel is necessary for this endeavor is energy independence by the year **2010**.*

3. How Much Energy does the Willits Area Consume?

The WELL (Willits Economic LocaLization) energy sub-group conducted a survey on the current energy consumption by the defined Willits area (see page 11). This survey concluded that over ***$30 million dollars*** are spent by the local economy on energy from outside our area (***~24% of per-household after-tax income***). This includes energy used to drive our vehicles, run our business and to heat and light our homes (it does not include the embodied energy of products we purchase such as plastics, fertilizers, pesticides, pharmaceuticals, etc.). When converted to common units of MegaWattHours (MWhr), the total is over ***1000 MWHr/day***. The inventory chart they prepared can be found in the appendices of this document, starting on page 14, with a proportional breakdown illustrated in Figure 1 below.

[6] Many economists have written of far more dire circumstances, to the extreme of world trade and social collapse. One of the primary goals of this group is to mitigate this possibility by creating a strong, self-sustaining local community.

[7] John Howe, <u>The End of Fossil Energy and a Plan for Sustainability</u> (www.mcintirepublishing.com, 2002).

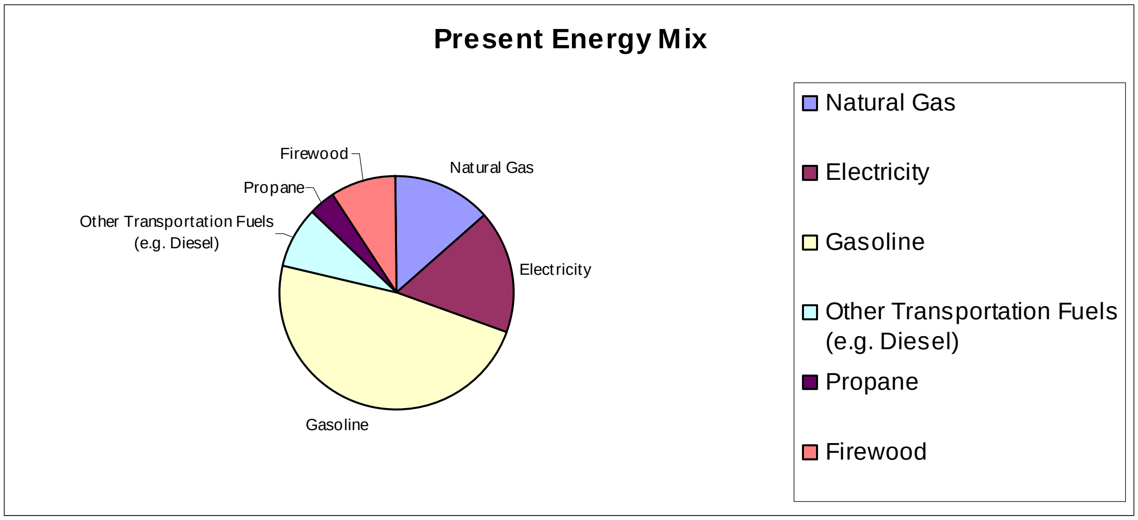

Figure 1. Present Energy Consumption for the Willits Community (95490 zip code).

4. A Plan towards Energy Independence

In recommending approaches to energy independence, let us first state *that there is no single solution that will achieve this goal*. On the other hand, presenting high-tech theoretical solutions will not gain us anything either. What we want are established *technologies that work and are readily obtainable*[8]. We say this both with respect to cost as well as to maintenance issues. In addition, any actions taken will require funds so we have made every attempt to show that there are not only grant and revenue sources available, but that with an incremental approach, we should be able to develop viable revenue streams from these actions for the city and community[9].

In the following paragraphs we will first explain, as a narrative, the steps we recommend; and we will follow this by bulleted points further itemizing the steps such that the list can be extracted and used by itself. In the appendices, page 40 is a flow chart of this process in abbreviated form.

4.1. Start with Conservation

Any good energy plan will start with conservation, and given that over 1000 MWhr[10] is consumed daily by the Willits area in all forms of (imported and directly-used) energy,

[8] This is not meant to preclude private ventures developing and implementing such technologies. We simply see the best value and use of time and resources by the public in established technologies.
[9] Note that even if you do not believe that oil is in decline, taking the steps outlined will also help reduce greenhouse gasses and the commiserate global warming.
[10] 1000 MWHr represents the generation capacity of ~42 MW, which at nominal industry figures would cost roughly $1 million / MW to develop. In the case of the Community of Willits, 25MW of this is for transportation, 15MW is for electricity, natural gas and propane while the remainder is for wood (heating).

conservation steps are a necessity. Ron Orenstein has initiated an energy audit of city buildings by PG&E but there is much more that can be done, albeit in little steps. In the appendices is a table of additional actions that can be taken on both the individual and the city/community-wide level (see page 16).

For every MegaWatt saved by conservation an estimated $1 million is saved in developing power generation facilities.

Due to the multiple levels of consideration (i.e. ranging from conservation efforts to grants to system implementation, let alone the range of energy sources), we would highly recommend the appointment of an 'energy czar'. This position can remain unfunded for now but should have some promise of remuneration over the long term based on their success. You will find that having one person who can track and follow through with all of the issues, as well as to provide updates to the city (council) will be worth their weight in gold.

This person's (or whoever is put in charge of this endeavor) first goal should be to establish a relationship with the Willits Press so that stories on progress as well as conservation and news of grants or rebates can be made available to the community at large. The goals should be stated clearly to the community (of energy independence) as well as the underlying need (increasing cost of and decline in supplies of fossil fuels).

*Our long-term objective should be a **50% (or greater) reduction** in the current energy usage (all forms) as a result of this plan.*

- Appoint an 'energy czar.' Position funded (or rewarded) by cost savings generated?
- PG&E energy audit of city-run facilities. [no-cost]. Examine upgrade of lighting, pumps[11], etc. per PG&E recommendations. Convert streetlights to LED-based as replacement is needed[12].
- Publishing and encouragement of individual/household conservation through city and privately held media, e.g. *'Energy Tips' in the Willits News* (see page 16 for a possible list to publish and expand upon).
- Promote PG&E involvement in individual/household audits

4.2. Encourage Energy Consciousness in New Projects and Facility Upgrades

The next step should be a review of the city planning office, specifically the permit fees. Permit fees, albeit small, are valuable sources of revenue to continue this endeavor and should reflect a high no-energy-savings default fee for a building, with the rate declining depending on the amount of energy savings and/or alternative energy additions incorporated. The city of Sebastopol has just such a fee structure and it would only take a

[11] Going to the next voltage increment of a pump (e.g. 480VAC from 240VAC) reduces the energy the pump uses.
[12] http://www.mooncellusa.com/ offers a selection of direct-replacement LED streetlights.

few minutes to get them to fax you a copy for review. In addition, the city council should be briefed on the goals and encouraged to inquire, on any proposed project, as to the energy saving features being incorporated.

The city council should also keep these same goals in mind whenever considering new equipment for city facilities – whether they be pumps for the water plant[13] to new vehicles for city employees (including police cars). In the case of vehicles, the city of Sebastopol went through this recently and ended up getting Toyota Prius hybrid vehicles for all except the police pursuit car (ideally though, our long-term goal should be electric vehicles for both public and private interests). The savings add up, as do the reduction of fuels – our primary goal.

- Restructure building permit fees to a tiered approach based on the energy savings measures incorporated, including alternative energy with grid-tie.
- As city vehicles need to be replaced, consider hybrid or pure electric vehicles first.
- Encourage industrial *co-location* so that one's waste is another's feedstock as much as possible.

4.3. Make it Easy for Individuals to Add Renewable Energy

Since the community (individual and business) use is far higher than the city's, we need to encourage individuals, households and businesses to install their share of renewable energy. One way to do this is to declare a public goal of say 1 MegaWatt of renewable energy installed each year, and to create a co-op which people can come to for advice, co-op discounts on equipment, etc. Specifically, an entity that has no ties to commercial concerns and to which people feel no obligation when asking for advice. Solar electric (and wind, where applicable) are the best bets for renewable energy generation that mitigates global warming concerns while providing good long-term value and should be strongly encouraged.

Sebastopol, California has a program called 'Solar Sebastopol' with a stated goal of 1 MegaWatt installed on roofs within their community this year and they created a SolarFestival to demonstrate the technology to the community and invited CC Energy to run the program and put on the fest. The resultant co-op has provided well for the community and we would do well to follow, especially since the experience is already established (more about Solar Sebastopol can be found in the appendices beginning on page 66).

Encouraging community participation in an annual energy fair, to learn more as well as to show what they have done, is good for the community and for business!

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[13] PG&E can conduct an audit and recommend whether a conventional pump motor upgrade (complete or higher voltage operation) would result in energy savings. <u>World Water</u>, based in New Jersey has developed very high efficiency water pumps coupled with solar and offers full financing based on paying the equivalent of your current electric bill for a 5-7 year period (http://www.worldwater.com/).

A quick statistical approximation of the Willits area roof potential (city, commercial and residential) ***shows the potential for over 25 MWhr/day production from solar alone*** *(see the solar electric appendix section beginning on page 25). This represents nearly a third of the post-conservation electricity consumption, putting us well on our way of meeting our goals!*

- Creation of a Community Alternative Energy Co-op to support individual/household quests for alternative energy (and accompanying grants/rebates), as well as to help offset costs of equipment for city installations. [none-to-minimal cost, use CCEnergy who manages Solar Sebastopol].

One final note before moving on. As energy becomes more expensive, the lower income families will be the most vulnerable. Having a community co-op to help advise and head programs that target this group, potentially in conjunction with city, state and federal programs, will benefit the community at large.

4.4. Tax Non-Renewable Fuels Sold Locally

Now for the nasty stuff; taxes are a necessary evil used by cities to shape behavior, not simply to generate revenues. We propose the addition of a half cent (perhaps higher should the city feel so inclined) 'carbon tax' on all fuels sold within the city[14]. A possible exemption would be for established vegetable farms (not any agricultural activity but only ones that provide food products). The money raised from this tax should be directed into programs that fund Alternative Energy installations on community buildings, and eventually on distributive generating facilities.

- Consider a carbon tax on fuels and associated energies sold in the area to finance on-going programs.
- Examine and plan for solar (photovoltaic/PV) upgrades to city buildings. Fund through PUC, PG&E and Homeland Security grants as well as the 'carbon tax'. See the appendices, starting on page 41 for a list of possible grant and funding sources.

4.5. Build Distributive Generation Facilities and Form a Local Public Utility

We now move into the realm of generating energy by both public (community) and private interests. This will be very important as we move towards foreign energy independence. It is important not only for the independence from extreme price swings, but also for the revenue streams that will funnel through the city and for the local jobs it will begin to create. Some energy sources are dependent on an industrial waste product

[14] The legality of such a tax should be researched, not specifically to see if it can be done but how and on what products.

(i.e. wood waste[15]) and the funding of that energy facility should be done collaborative with that private concern. Through lease arrangements and similar instruments, the city can structure the arrangements for the long-term community benefit. A list of locally-developable energy sources starts on page 17.

*Using a modular gassifier plant as described in the appendices, and given 10 tons of material/day available, an additional **~6.5 MWhr/day** can be produced from wood waste alone in a public-private joint venture. This does not take into account the use of the heat co-generated that could be used to heat surrounding buildings.*

Concurrent, or following these endeavors, is the creation of a community-owned utility company. Why would we want to maintain power lines, poles, transformers and the like you ask? Well for one, jobs. A community owned utility most importantly allows us to buy blocks of power from PG&E (or the NCPA) at a discount, allowing some of the profit to stay local. In addition, as you develop local energy production (*distributive generation* is the technical name), we need a way to ensure the local community ultimately gains the benefit and that revenues generated are controlled and put to work back in the community. Buying or generating power at a discount also provides another means of helping those impacted hardest, whether it be the impoverished or a critical area employer.

We have included an appendix on "Creating a Community Owned Utility" beginning on page 57. The appendix goes into more detail on this subject, discussing several approaches and levels to achieving a community-owned utility though it is beyond the present scope of this paper to advise on the best one.

- Negotiate private funding of gassifier plant co-located with millwaste. Plant can be privately held on a long-term lease (city held) with electricity provided to utility at discounted block rates and heat/cooling provided by pipes to local schools and other public facilities
- Examine potential of using water reservoir to generate electricity (pumped/stored hydro, rate differential)
- Create a community owned utility company to ensure power generated stays local and creates local revenue streams.

4.6. Strive to Ensure Localized Employment

The last stage we offer today is the goal of localizing 80% (or greater) of our community's employment. Localized employment means fewer hours commuting, less spent on transportation fuels, and the higher likelihood of earned income staying local and thus further stimulating the local economy. In addition, it broadens the worker base and skill levels and provides ready examples to our children of a good work ethic (i.e. one that is close at hand, with direct community impacts).

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[15] Wood waste may also be available from on-going community projects such as the Brooktrails fire suppression project.

In order to effect the transition to in-community jobs, we need to see that although many of these suggestions have a cost in implementation (e.g. a distributive generation plant or a community-owned utility), they also create jobs that keep revenues local and decrease the need for commuting outside the area. As these facilities are created, the potential for related entrepreneurial developments occur. It is here the city needs to be proactive in recognizing the need, searching out available space for such businesses, while ensuring *co-location*. One final tool is <u>local vendor preference</u> – a practice that is becoming more and more prevalent. Specifically with city bids, local vendors are given preference in the form of a 5 to 15% contract bid differential. Keeping your products and services local, even at slightly higher costs, ensures local businesses survive and that people within the community have jobs.

- Goal of **80%** local employment reduces travel-related energy consumption since *over **50%** of our present energy appetite is for transportation fuels.*

4.7. Solving the Last Pieces

This proposal seems insurmountable yet it only begins to touch upon the task at hand – that of imported energy independence. What hasn't been elaborated on is the need to transition conventional gasoline (and diesel) vehicles to electric, while providing fuel in the interim. The plan also hasn't addressed replacements for natural gas or propane, commonly used for home or business heating.

*Both biodiesel and ethanol (a gasoline substitute) can be produced locally but at the expense of arable food-production lands[16]. As such, **the production of these fuels must be limited to transitional status** (i.e. only until the need for food production supersedes).*

The reason both of these fuels (heating gas and transportation) were left until now is that, following the recommendations, we have now created a viable community of local employment and economy. As such, we also now have the talent at hand to create businesses that can solve these problems in ways we may not yet be able to envision. Whether it is bio-fuel production, electric car conversions, low cost geothermal or solar thermal home and business heating or the like, the core population that now spends 2 or more hours each day commuting can dedicate at least that much time to solving the problems of their immediate community. This is something our current society has lost – the entrepreneurial spirit that comes from knowing a problem exists and being able to help those around you in solving it. A community with a localized economy can do just that. For additional business ideas, refer to the appendix regarding entrepreneurial opportunities beginning on page 48. For thoughts on what future transportation in our community might resemble, see the appendix on transportation beginning on page 50.

[16] Bio fuels can also be produced with wood or crop waste (e.g. cellulose fermentation conversion or through wood distillation processes); but these processes have not been developed to large scale.

5. Funding the Plan

In the last section, as possible means to meet the energy independence goal was presented, some discussion was also provided on how each step could be funded. Wherever possible, where owner inducements and self-funding can be negotiated, this should be pursued since the reduction of necessary remaining production capacities (and cost) is reduced. In the appendices is a list of potential grant, funding and revenue sources compiled for quick reference, starting on page 41. In the case of grants, although specific grants were not identified, a grant coordinator / writer should be able to readily identify applicable offerings.

6. Closing Thoughts

So how did we do? The table on page 39 illustrates the potential energy we can generate from the steps outlined to this point, as well as the amount of energy we must produce to achieve 50% of present day use (with respect to conservation steps). This is further illustrated by the pie chart in Figure 2 below. As one will note, we aren't quite there but the steps we have outlined are conservative estimates and goals. As the process gets started, the community's contributions will be far greater, especially with creative incentives.

Achieving energy independence is a multi-stage, several year process; but one that *can be* achieved. However, if we recognize the need for independence too late, we will not have the luxury of (relatively) cheap fossil fuels to facilitate the transition. Given the northward migration of the bay area, ever in search of cheaper homes and land, we also cannot afford to wait until we have become a bedroom community with little open space (and foresight) remaining to implement these concepts.

In presenting these potential steps the city of Willits can take, every effort has been made to find ways that the transition results in revenue streams to the city and community, with the long-term objective being a stronger self-sustaining economy. Think of it, energy independence and a thriving, productive community? What more could a community wish for in the face of growing world instability!

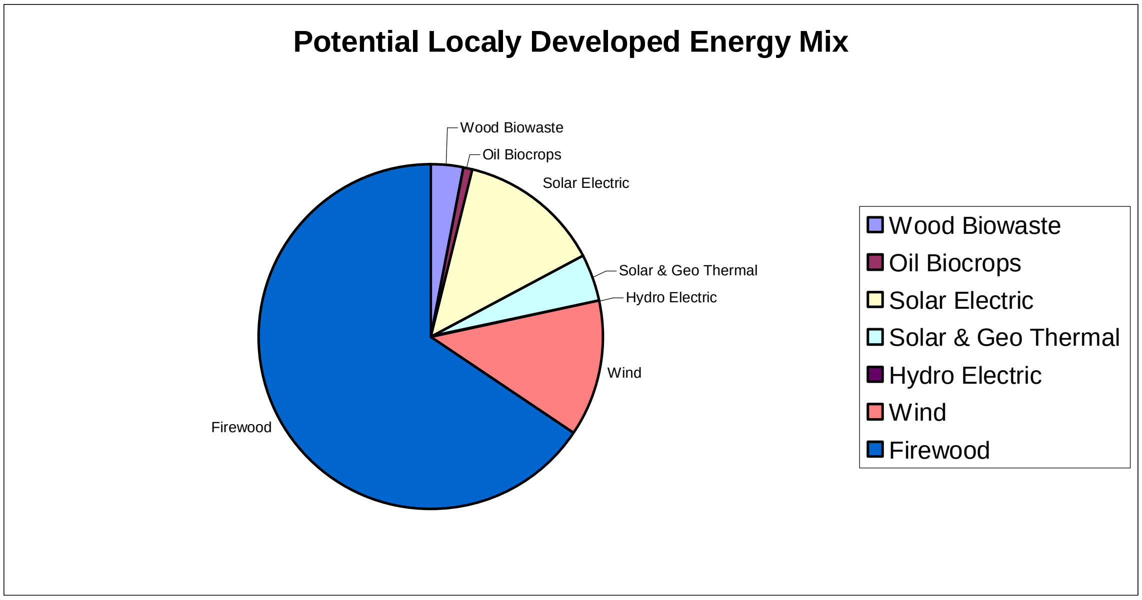

Figure 2. Potential Local Energy Mix Possible if Recommended Steps are Undertaken.

Appendix A. Definition and Demographics of Area Discussed

Essentially the 95490 US Postal Zip Code

Population:	13302	
Households:	5105	
Pop. / Household:	2.6	
Median Household Income:	$36,000	$25,200 (after tax liability of ~30%)
Approximate size	321 $miles^2$	206,000 acres

Source: US Census Figures, 2000 [http://www.census.gov/main/www/cen2000.html][17]

[17] Note that there has been little population growth since the 2000 census figures were taken per Mendocino County statistics.

Appendix B. General Definitions

Biodigester: A system where bacteria, in an anaerobic (without air), low temperature process digests biomass producing biogas. Biogas is typically about 60 percent methane and 40 percent carbon dioxide with a heating value of about 55 percent that of natural gas.

BTU: (British Thermal Unit). One BTU is the amount of energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit. It is equivalent to 778 foot pounds of work or 252 calories. See also, Therm.

Co-Generation: The generation of other forms of energy (e.g. heat) in addition to electricity. It is used typically at sites like gassifiers where either the primary or byproducts of electricity generation are notable.

Co-Location: The siting of businesses in proximity of needed resources. For example, siting a carpet manufacturer next to a plastics recycling processor ensures the use of the recycled material as the raw material for the carpet manufacturer. Siting a business that generates waste heat as part of the manufacturing process in a cluster of others ensures the waste heat is used to heat the other businesses, or perhaps to lower the daily startup energy costs for another energy-intensive process downstream.

Distributive Generation: The use of small(er) power generation facilities near the point of use to better serve the local area. Distributive generation reduces transmission (distribution) grid loads and helps to balance the same during peak usage. The size of the plants generally is between 30KWhr and 1MWhr. Distributive generation generally is setup as a partnership to major electricity providers (e.g. PG&E) and electricity is typically purchased in ‘blocks’ from the distributive generation owner at discounted prices.

Embedded Energy (aka Embodied Energy): The energy (cost) to produce a substance. This is often used in the review of construction materials for ‘green’ building as well as the cost of generating fuels (e.g. ethanol, hydrogen).

Gassifier: A device that burns materials, generally with controlled oxygen, such that the gaseous fuels contained in the material are released directly to drive an internal combustion or turbine engine directly. The content of the gaseous fuels generally includes (by greatest concentration first) hydrogen, methane, carbon monoxide then nitrogen.

Grid: The electrical transmission wires, often at much higher voltage, that connect power plants to the consumer.

Insolation: The amount of usable sunlight falling on a given area. This may be impacted or degraded by shadows, fog, inversion layers as well as by time of day.

Net Metering: Net metering is used for small power generation facilities like solar, wind and micro-hydro where the intent is to produce power for the site where it is located. The excess electricity is fed into the transmission grid, running the electric meter backwards. During times the site cannot produce electricity, electricity is pulled from the grid running the meter forwards. In this manner, the grid is used as a big storage battery. Credit for electricity produced is provided only up to the total electricity used (i.e. no net gain).

Pumped Storage: A form of hydroelectric where power is generated during peak electric rate periods, then pumped back up during low electric rate periods – in effect a battery used to offset peak loads. Also see ‘Stored Systems’.

Rankine Engine: Also called the steam-Rankine technology. Water is turned to steam through heating by direct firing or solar, which is then expanded through a turbine generator.

Stirling Engine: A heat-differential engine, where one part of the engine is heated which causes the gas in the chamber to expand, thereby driving a piston.

Stored Systems (e.g. Stored Hydro): The generation of electricity, energy or work, storing it for later recovery. For example, the pumping of water to a higher reservoir expends electricity, generally at a cheaper rate, for storage until the cost of electricity increases. The stored (potential) energy is then used to generate electricity at that higher rate. Another example is the generation of solar power during the day (peak electricity), feeding it into the grid with credit at peak electricity rates. This is offset by use of electricity, from the grid, after solar generation hours, at the off-peak or lower energy rates. Examples on a small scale include chemical batteries, phase change salts, fuel cells and flywheels.

Therm: Another measure of energy potential (or work potential), generally used for energy forms related to heat. One Therm is equal to 100,000 BTU.

Watt: The fundamental unit of electric power as well as mechanical power. 746 Watts equates to 1 horsepower. One Therm equates to 0.0293 MWhr (Mega or millions of Watts per hour). KWhr is thousands of watts per hour and equates to 3412 BTU. Note that a human produces about 635 BTU or 75 watts per hour in work potential.

Appendix C. Current Willits-Area Energy Usage

Willits Area Imported Energy Usage, Present Day

[Off-grid & local co-generation (solar, hydro, etc.) not considered]

Fuel	Annual Residential	Annual Non-Resid.	Total (annual)	Units	Unit Cost	Annual Value	Total (daily), Therms	Total Daily MegaWattHrs (MWh)	Average Daily per Person (KWh)	CO2 Emission Factor	Total CO2 Emissions (tons)	Fuel Source & Processing	Data Sources (see Notes)
Natural Gas	0.91	0.87	1.78	MT	$1,200,000	$2,136,000	4,877	143	11	11.70	10,413	15% Calif., 24% Foreign (Canada); pipelined	1, 2, 3, 7
Electricity	37	28	65	MKWh	$140,000	$9,100,000	6,080	178	13	1.43	46,475	78% Calif. (Calif. Fuels: 33% natural gas, 13% nuclear, 12% hydro, 10% coal, 10% renewable), minor Foreign (Canada); transmission lines	non-resid=1, 12; resid=4; 8
Gasoline			5,626,746	Gallons	$2.50	$14,066,865	17,111	501	38	19.80	55,705	42% Calif., 35% Foreign; pipelined, sea transport; in-state refineries	3, 5, 10
Other Transportation Fuels (e.g. Diesel)			838,026	Gallons	$2.50	$2,095,065	3,031	89	7	19.80	8,296	as above, negligible bio fuels	as above
Propane			750,000	Gallons	$2.25	$1,687,500	1,397	41	3	12.67	4,751	refined, generally from natural gas	14
Firewood			8,423	Cords	$175	$1,474,069	3,231	95	7	1.00	10,487	See note 16	6, 9
Total Daily Consumption:							**35,727**	**1,046**	**79**				
Total Annual Value of Consumed energy:						**$30,559,499**							

Annual Cost [per Person], [per Household] of Total Fuels Consumed (note 11):	**$2,297**	**$5,986.19**
Percentage of Median After-tax Household Income Expended on Energy (note 13):		**24%**

Total Annual Emissions for Consumed Energy (tons):	**136,127**	
Annual CO2 Emissions [per Person], [per Household] in tons from above-noted fuels (notes 11, 15):	**10**	**27**

Abbreviations

MT	MegaTherm (1 Million Therms)
MW	MegaWatt (1 Million Watts)
MKWh	MegaKiloWatt Hour (1 Billion Watts per hour, or 1 GigaWatt)
KWh	KiloWatt Hour (1 Thousand Watts per hour)

Conversion Formulas

1 KWh = 3414.3 BTU (British Thermal Units)
1 Therm = 100,000 BTU = 0.0293 MWh
1 horsepower = 0.746 KiloWatts
1 ton = 2000 lbs (pounds)

Fuel Potentials (Obtainable)

Gasoline	111,000 BTU/gallon		
Grade 1 distil. fuels	132,000 BTU/gallon	(e.g. diesel)	
Biodiesel	119,000 BTU/gallon		
Wood, dry	5650 BTU/lb	14,000,000 BTU/cord	
Propane	1870 BTU/ft3	68,000 BTU/gallon (1 gal liq. = 36.3ft^3 gas)	

Peak consumptions

Natural Gas:	December, January (15%/mo of annual)
Electricity:	August, December, January (10%/mo of annual)
Transp. Fuels:	August (8.9% of annual)

Transportation Fuel Emissions (lbs per gallon) (note 10)

Hydrocarbons (CxHy)	0.15
Carbon Monoxide (CO)	1.1
Carbon Dioxide (CO2)	19.8
Nitrous Oxides (NOx)	0.07
Benzene	0.004

Sources & Notes

1. PG&E data for town of Willits
2. Distribution of natural gas generally limited to town proper
3. California Energy Commission
4. Extrapolated from (3) figures for Mendocino County using (13)
5. US Department of Transportation, extrapolated for local population
6. Mendocino Air Quality Management
7. Gas costs set @ $1.20/Therm, CO2 emissions in lbs/Therm
8. Electricity costs set @ $0.14/KWh, CO2 emissions in lbs/KWh
9. 1 cord ~= 2500 lbs (128 ft^3), CO2 emissions in lbs/lb, conventional wood stove, 20% moisture
10. Emissions data source: Rocky Mountain Institute except firewood (OMNI Environmental)
11. Per-person impacts derived by dividing region total by population (thereby includes share of non-residential consumption)
12. Majority of business & industry located in town proper
13. US Census Figures, 2000
14. Census of local dealers, Propane CO2 emissions in lbs/gallon
15. When agricultural, commercial, industrial, mass transit and other common interests are considered, the per household annual share of GH gasses are estimated at 80 tons (source RMI).
16. Wood source includes pellet fuel, firewood source undefined but majority likely from immediate area.

Greenhouse Gas Emissions & Fuel Cost Comparison by Common Energy Units Consumed:

Fuel	Cost Ranking (lowest=1)	Emissions Ranking (lowest=1)	Equiv Annual Qty	Units	Unit Cost	Annual Value	Equiv daily, Therms	Equiv daily MWh	CO2 Emission Factor	Total CO2 Emissions (tons)
Natural Gas	2	1	0.365	MT	$1,200,000	$438,000	1,000	29	11.70	2,135
Electricity	6	6	10.69	MKWh	$140,000	$1,496,600	1,000	29	1.43	7,643
Gasoline	4	4	328,840	Gallons	$2.00	$657,680	1,000	29	19.80	3,256
Other Transp Fuels	3	2	276,485	Gallons	$2.25	$622,091	1,000	29	19.80	2,737
Propane	5	5	536,864	Gallons	$2.00	$1,073,728	1,000	29	12.67	3,401
Firewood	1	3	2,607	Cords	$165	$430,214	1,000	29	1.00	3,246

Appendix D. Reducing Present Energy Consumption by 50 Percent

Individuals and Households:	**Willits Area Government and Community:**
1. Drive **smaller more efficient vehices**. Drive the vehicle capacity needed for the trip.	1. Goal to have 80% of our community **employment local** by 2012 (reduce commuting, keep $$ local). Encourage by tax breaks and grants to entrepreneurial and other business startups and expansions.
2. **Ride share** when possible. Plan and combine multiple trips (and shop local when possible). Share or co-own special purpose and large capacity vehicles (e.g. vans, trucks, etc.).	2. Encourage **industrial co-location** (waste stream re-use, shared heating costs, etc.) through zoning and new business development advisory services.
3. Install an **attic fan** to help cool your house, reducing the need to turn on the airconditioner in the summertime (savings 5-15%). [assumes your house is already insulated and windows upgraded]	3. Scale b**uilding permit fees** by energy efficiency and alternative/passive energy content. Question all building applications as to energy impacts.
4. Lower your **thermostat** in the winter (and raise in the summer). Heat/cool (and light) only the portion of the house being used. Consider a programable thermostat upgrade. (savings: >5%)	4. Expand the **recycling center** so that usable items (e.g. building materials) are segregated and purchasable [revenue stream pays for workers/program].
5. Buy **EnergyStar appliances** when upgrading home appliances (savings: 5-30%). Replace light bulbs with **compact fluorescents** (savings: 5%).	5. Promote existing (e.g. PG&E, CPUC) programs to increase **household efficiency** (insulation, thermostat settings & upgrades, compact fluorescent bulbs, EnergyStar appliance upgrades, etc.).
6. Consider **solar hot water** either to preheat or to replace existing hot water heater (savings: 15-30%).	6. Start a community-wide **solar and alternative energy cooperative** to ensure lowest prices and best advice. CCEnergy helped establish Sebastopol's and is interested in doing one here.
7. Consider **solar / alternative electric** for your house and take advantage of the rebate programs (typically 50%) for the same.	7. Promote and encourage **ride sharing**. Parking lot for the same? Evaluate local commute needs and determine if **MTA schedule** changes or additions could supplement.
8. **Conserve water** by fixing leaky faucets, upgrading toilets and installing irrigation drippers and timers.	8. Locate and administer grants for local **co-generation startups** (bio-waste gassifiers, etc.). Outside funding sources include the PUC, SBA.
9. **Employ local** businesses and labor. Use **local products** (when building, etc.).	9. Locate and administer **electric vehicle incentives** (including city vehicles). Expand vehicle **charging stations** (number of).
10. **Recycle** building waste as well as your other 'junk' -- one person's trash is another's treasure!	10. Take ownership of the local electric grid and create a **community-owned power company** [call for article on process]. This will also reduce electric costs to the community and greenhouse gasses from electricy production we use. It will also keep the r

On both levels (private and community/government), there are many things that can be done that make a difference. What is important here is that any efforts towards conservation make a marked impact on the costs of developing local energy. More specifically, saving a KiloWattHour through conservation is the best investment any entity can make in developing new power sources. As such, ***it is strongly recommended that an on-going 'Energy Tips' column be initiated in the local Willits News*** to help facilitate such conservation measures. Good tips can be found through the PG&E[18] or the Rocky Mountain Institute[19] websites as an example.

[18] www.pge.com
[19] www.rmi.org

Appendix E. Potential Local Energy Sources & Production

This appendix covers energy production that could be created in the Willits area. We have tried to show what local resources would be used, the estimated cost of such an installation and the resulting energy production. The section begins with a summary table of the potential sources and their mix with respect to load matching and costs. The sub-sections following provide detailed explanations of each potential energy source.

As you read through this, remember that conventional power generation (e.g. fossil and nuclear) have both upfront (capital) and on-going costs (fuel) which means a substantial portion of total costs are spread over time. Renewable energy has a high upfront cost but extremely low or negligible on-going costs which require a different approach to financing.

Local Energy Production Potential

Type	Energy Product	Limitations	Siting	Resources	Annual Production (per textual description)	Cost/MWHr	Industry Cost per KWhr (9)	Feasibility	Notes
BioElectric	Electricity, heat	Continuous	Recycling plant, Ridgecrest, mill sites	Wood waste	~2340 MWhr	~$53	$0.04-0.10	High	1, 2
BioFuels	Liguid	Continuous	Farm	Oil crops	~720 MWhr	~$139	N/A	Medium	1, 4
Biodigester	Gas	Continuous	Landfill, sewage plant, ranches	Food and biowaste	~259 MWhr	~$278	N/A	Medium	1, 2
Solar Electric	Electricity	Peak sunshine periods	Rooftops, unusable land (hillsides)	Land, sun	~10640 MWhr	~$8364	$0.25-0.75	High	1, 3, 8
Solar Thermal	Electricity	Peak sunshine periods	Unusable land (hillsides?)	Land, sun	~1232 MWhr	~$3247	$0.09-0.18	Medium	1, 3
Solar Thermal	Heating/Cooling	Peak sunshine periods	Point-of-Use (rooftop)	Rooftop, sun	~2156 MWhr	~$603	N/A	High	1, 3
Geo Thermal	Heating/Cooling	Continuous	Point-of-Use (heatpump)	N/A	N/A	N/A	N/A	Low	N/A
Hydroelectric, Conventional	Electricity	Wet season	Streams with sufficient flow and head	Waterways	N/A	N/A	$0.05-0.15	Low	1, 6
Hydroelectric, Pumped Storage	Electricity	1/2 day	Municipal water system	Watershed	~40 MWhr	~$18940	$0.06-0.13	Medium	1, 7
Wind	Electricity	Wind conditions	>12 mph average wind site	Land, wind	~10080 MWhr	~$397	$0.05-0.10	Medium	1, 5

Notes:
1. All costs are based over 1 year's production. System cost can be derived by multiplying Annual production by cost/MWhr.
2. Year-round operations are based on 360 days
3. Year round is based on 4 hours/day, 280 days/year, 10% loss
4. Cost based on 20 acre farm plus processing plant
5. Based on 1MW turbines, 280 days operations; suitable site selection & evaluation needed
6. Micro-hydro only, individual level
7. Using existing Willits reservoirs (and piping?) -- site attributes needed
8. Larger systems=lower cost; residential systems, especially off-grid, are the most expensive per KWhr.
9. Sources: http://www.solarbuzz.com/DistributedGeneration.htm, http://www.griffincoal.com/au/Tables.html, http://egov.oregon.gov/OdA/energy.shtml

E.1. BioElectric and BioGas from Wood Waste

E.1.1. Overview

A biomass-to-bioenergy system can be considered as the management of flow of solar generated materials, food, and fiber in our society. As we transition to a post-petroleum society, we will see a sharp increase in the local use of wood for home heating as we transition to alternative forms of energy. This use and increase must be carefully managed. For our discussions here, we are considering community-scale use of such products and their benefits.

Wood waste is the by-product from mill processing, forest undergrowth clearing as well as sustainable forest harvesting; yet it can also include construction debris, shipping pallets and packaging as well as some waste stream diversion. Additionally, wood (willow) can be raised as a result of waste water wetlands, such as are being built at the new Willits Waste Water Treatment facility.

Wood waste can be employed either directly to fire a steam-powered turbine generator or fed into a gassifier to extract gaseous fuel (hydrogen, methane, etc.) to drive a gas-fired turbine or reciprocating engine generator. Wood waste can also be fed into a distillation-like process to produce methanol and similar products. In the 3 processes noted, waste heat can then be piped to the surrounding community to provide heating (and cooling), a process known as co-generation. With the gassifier and distillation processes, the resulting fuel can be transported to other locations as a replacement for current propane, natural gas and kerosene fuels as well as a replacement fuel for essential transportation needs.

For our considerations here, only the gassifier process will be considered due to the efficiency of conversion into electricity and the low pollution concerns. Such gasification involves the collecting of wood products and drying to less than 20% moisture, pyrolysis, combustion and then reduction – the last 3 comprising the gasification process, producing up to 40% hydrogen, 3% methane and the rest inert gasses – with the resulting gas directly driving the (electricity) generating engine.

E.1.2. Resource Usage

1 acre of forest land provides approximately 10,000 linear board feet of wood and approximately 100 ft^3 of usable process residue[20,21]. To harvest sustainably, *restrict harvest to 1%/acre/year*[22]. This gives us ~93ft^3/acre/year harvestable.

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[20] US Forestry Service
[21] 1 linear board foot = 12"x12"x1", therefore 12 board feet = 1 ft^3
[22] Without sustainable harvest, not only can the fuel not be sustained but the potential loss of biodiversity may result.

Given that timber harvesting long operated without the use of petroleum resources (most recently by steam-powered implements and manual labor), the aspect of considering mill waste is not beyond reason. Current mill byproducts in the Willits area easily exceed 5 dry tons per day[23].

Other sources of materials include forest undergrowth clearing and construction waste – all of which could be served by waste stream sorting and diversion.

E.1.3. Energy Production

Doug Fir has a weight of 28lbs/ft^3, a good medium for the range of species in our woodlands. Based on sustainable harvest practices (93ft^3/acre/year), this equates to **2600lbs of harvestable wood fuels / acre / year**.

Given an obtainable energy of ~5600 BTU/lb, this translates into **145 Therms** or **4.27 MWhr per acre per year**.

E.1.4. Siting

It is envisioned that an experimental gassification plant (electricity and heat co-generation) could be initially sited near the current recycle center. The heat generated could then be used in the local businesses and residences of that area, or to dry incoming wood for fuel use.

A medium-scale plant could be co-located north of the Brooktrails community to employ wood removed for on-going fire suppression as well as north-side timber harvesting.

A large scale plant could be sited at Ridgecrest pass to mitigate air-inversion problem in Little Lake Valley and to make use of quarry trucks (returning carrying fuels) and/or the rail line. Alternatively, a plant could be located at the old landfill, in conjunction with equipment for landfill gas power generation use (see 'biodigesters').

*Provided we can provide 10 dry tons a day (roughly 2 dump trucks), and that the plant can produce energy at 20% efficiency, it is estimated a plant's production could be **<u>~6.5 MWhr/day</u>**.*

E.1.5. Initial Costs

The design and construction of a medium scale gassifier plant could cost an estimated \$10-15 million. However, smaller off-the-shelf plants are available for under \$100K. Specifically, Ankur Scientific of India makes a 200KW plant that employs an internal combustion engine that can be had for **<u>~$125,000</u>** including fuel and waste handling.

[23] Ed Burton states easily over 45 thousand pounds weight, equating to over 11 dry tons daily.

This could be a joint public/private venture with the majority of funding coming from the private sector (e.g. wood waste generators), with the city purchasing the resultant power for sale in the community-owned utility company.

E.1.6. On-Going Costs

On-going costs for the plants operation would include labor for wood harvest and processing as well as plant maintenance. Additional cost considerations must be made for plant emissions which can be mitigated by proper plant design (i.e. the fuel and waste handling).

E.1.7. Equipment Sources

The Japanese company Kawasaki Heavy Industries have created a modular plant designed specifically to be co-sited with timber processing and will handle 5-20 dry tons/day. It is a "pressurized fluidized bed gassifier gas turbine power generation system" and has been optimized for electricity production while integrating waste heat recovery for localized heating or process needs. The gassifier output of the plant (normally feeding the electric turbine) could have a portion diverted for biofuel as desired.

The Indian company Ankur Scientific has developed small gassifier plants ranging in size from 3KW to 850KW[24], with the 200KW unit being tested by the University of South Dakota. They handle 35lbs of dry wood per hour for their 10KW unit, and 450lbs/hour for their 200KW plant. The University of South Dakota was working to test the unit with a Capstone micorturbine, specially modified for the gassifier. However in the initial tests, a conventional internal combustion engine was employed, with an estimated efficiency of 18% (a turbine is a more efficient engine, though more complicated and costly in terms of both initial cost and repairs). In addition, the University added fuel handling facilities to automate the input and output processing, including using a portion (~5%) of the produced gas to run a thermal oxidizer to process the waste slurry resulting from the gassification. These additions are estimated to add an additional $25-40K to the system cost.

Gassifiers:
http://www.ankurscientific.com
http://www.khi.co.jp/earth/english/pdf/04_houkokusyo_e17.pdf
http://www.chiptec.com/

Microturbines (for above):
http://www.capstoneturbine.com/index.cfm

[24] The 10KW plant runs roughly $10K FOB, while the 200KW unit tested runs roughly $30K FOB, not considering the generating engine or processing & handling facilities.

E.2. BioFuels from Oil Crops

E.2.1. Overview

Note: the use of BioFuels to produce ethanol is not discussed here due to the high *<u>embedded energy</u>* *of the resultant fuel*[25] *and the large amount of the greenhouse gas* CO_2 *that is given off in the process.*

Oil-producing crops can be produced in the Willits area providing, with minor processing, liquid fuels for essential diesel-powered vehicles and operations as well as home and business furnaces. Such uses can employ either straight oil or oil that has processed into biodiesel. Vegetable oil is fairly harmless, while biodiesel, though substantially less flammable than “dino” diesel, requires special containers and handling, treating it more like conventional liquid fuels. Diesel vehicles modified to run on vegetable oil still require either biodiesel or “dino” diesel to start the engine. Because of this requirement, this paper will focus on the production of vegetable oil to biodiesel.

Many different oil crops exist including Soybean, Canola (rape seed), Jatropa and even algae. Yields vary by crop, and for the following, mustard was used for the figures. Note that the processing of the mustard oil plant yields by-products that may be used as natural pesticides, animal feed as well as fertilizers. Biodiesel (essentially an esterification conversion) is processed seed oil using methanol and sodium or potassium hydroxide (lye) and the by-product yields glycerin, a component of soap as well as material that can be processed as animal feed.

E.2.2. Resource Usage

Mustard yields ~140 gallons oil per acre[26]. The cost to farm it is just under 10 gallons of processed fuel oil (per acre), leaving a net product of say **<u>130 gallons of oil per acre per year</u>**.

Note: *Any considerations of arable land use must be second to current and foreseen food production needs. For our considerations here, only fuel for essential transportation is considered.*

E.2.3. Energy Production

The finished (biodiesel) product has an obtainable energy of ~119,000 BTU/gallon translating to 1.19 Therm/gallon or 0.03487 MWhr/gallon. Subtracting 10 gallons of oil

[25] It is thought that enzymatic hydrolysis of lignocellulosic (wood and crop) biomass will open the way to low cost and efficient production of ethanol; but this is still in the laboratory.
[26] University of New Hampshire Biodiesel Group http://www.unh.edu/p2/biodiesel/, no local production figures are available.

for the cost of the process chemicals, this leaves 120 gallons giving us a yield of **155 Therms** or **4.53 MWhr per acre per year.**

E.2.4. Siting

A BioFuels production facility would involve not only the processing plant, but also the oil crop farming venture(s).

It is suggested that the oil crop farming venture could exist as a private consortium, perhaps as adjunct to a Community Supported Agriculture (CSA) Co-op.

*A production farm of 20 acres (2400 gallons), combined with annual collections of ~18,000 gallons (5 gal/day * 10 restaurants or oil sources) would provide us with approximately* *20,000 gallons of biodiesel a year* *for critical vehicle transport (e.g. ambulances, city vehicles, etc.) at a value of just under* ***2 MWhr/day****.*

E.2.5. Initial Costs

The acquisition of farmable crop lands would cost between $10-50K/acre depending on total acreage purchased. Preferable, perhaps, would be the leasing of the land for such crops, say at $1000/acre/year.

Oil handling and modular biodiesel production facilities would run an estimated $25-50K, while collection vehicle(s) may add another $20 to 50K to the capital cost, giving us a total estimate of **$200K** for a 5-year land lease and processing equipment.

E.2.6. On-Going Costs

Growing oil crops would require fertilizers, potentially some type of pesticides, labor and fuel. The biodiesel processing plant would require labor as well as process chemicals (methanol and sodium hydroxide). In addition, there is the reduction of potential crop lands as well as combustion emissions from the vehicles employing the fuel[27].

E.2.7. Equipment Sources

The Austrians have developed a modular, automated biodiesel processing plant that is the size of a standard shipping container.

Modular Biodiesel Systems:
http://www.biodieseltechnologies.com/

[27] Biodiesel emissions compared to "dino" diesel are: CO=0.5, CO2=0.78, particulates=0.65

E.3. BioDigesters

E.3.1. Overview

A biodigester is a system that converts biological waste (such as manure, sewage sludge, food waste streams or landfill) into methane and associated gases[28], through anaerobic bacterial digestion, which can then be used as fuel for internal combustion engines, to drive an electric generator turbine or to heat homes in place of natural gas or propane.

A biodigester system needs to process the biowaste, collect the gas given off it, then compress it for transport or fueling. The by-product of the process (the 'sludge') is a concentrated nitrogen fertilizer and the pathogens in the waste are reduced or eliminated by the warm temperatures in the digester tank, thus providing feedstock for local farmers.

E.3.2. Resource Usage

Biodigesters sited in our area might employ food waste streams, centralized manure dumps or mine the existing (sealed) landfill. The fuel restrictions come down to a carbon-nitrogen ratio (known as the C/N ratio), with 20-30 being optimum[29].

The redesign of the Willits sewage plant (to an open wetlands, aerobic process) precludes the use of sewage sludge as a consideration.

E.3.3. Energy Production

For electricity production, approximately **¾ cubic meter of biogas is needed to produce 1 KWhr** of electricity[30].

E.3.4. Siting

E.3.4.1. Waste Stream

One viable possibility is to capture the local waste stream (vs. sending it out of the county) and processing it through a modular digester facility. We will need to design the system to properly mix the waste stream with regard to the C/N ratio. The system will also need

[28] Typical digesters produce 50-70% methane and 30-40% carbon dioxide, 5-10% hydrogen as well as other gasses. The heat value of this raw gas is roughly ½ of natural gas.
[29] UN's FAO paper entitled "A System Approach to Biogas Technology", June 1997, http://www.fao.org/sd/EGdirect/EGre0022.htm.
[30] "Renewable Energy Sources and Technologies on Farm Systems – Focusing on Danish Scenario"; The Royal Veterinary and Agricultural University, Denmark, 2004. http://www.kursus.kvl.dk/shares/ea/03Projects/32gamle/_2004/EnergyProject2004.pdf.

to sequester the hydrogen sulfide produced to ensure equipment longevity. The remainders from this (biodigester) process can be re-composted and employed as a crop fertilizer.

E.3.4.2. Landfill

It is also possible to re-examine the old landfill to determine if it may be configured to capture the methane gas currently being vented. The Los Angeles County Calabasas landfill microturbine project would serve as a good example of a low cost system that generates remarkable amounts of electricity[31]. The case study in the referenced document gives a good account of the considerations that need to be made, including the fuel content of the landfill gas, the problems (and methods for removal) of moisture from the gas, and the issue of siloxanes[32]. Calabas Landfill noted **requirements of 0.6 scfm of 35% methane gas per KWhr produced** and discussed a manifold collection approach which could easily be employed at our landfill.

Another option is to create a new landfill to accept Mendocino County-wide waste, as well as perhaps Sonoma County (who is now beginning to ship their waste out at considerable expense) – a potential revenue source by itself. Creating a new landfill not only gives us a chance to process and control our waste locally but to also design it correctly with respect to leachant as well as methane capture.

E.3.5. Initial Costs

Both sources of biogas (waste stream and existing landfill) would employ the same technology and related considerations.

The Calabas landfill project reports a cost of roughly $2400/KW capacity (with consideration of capital financing)[33]. This works out to between $0.03 and 0.056 per KWHr generated (depending upon capitalization costs). Thus a system of one 30KW turbine would run ***~$72,000*** and would generate ***720KWHr/Day.***

E.3.6. On-Going Costs

There is the cost of gas filtering (to remove moisture and siloxanes) and the compression of collected gas to feed the turbine generators. There is also the cost of system monitoring and maintenance to factor in.

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[31] http://www.capstoneturbine.com/onsites/pdf/Wastecon03.pdf
[32] Siloxanes are constituents of cosmetics, deodorants and man-made lubricants and consist of methane, silica and oxygen. The combustion of siloxanes produces an abrasive compound harmful to gas turbine generators.
[33] ~400 acres, 10 x 30KW turbines.

E.3.7. Equipment Sources

Capstone Microturbines (as used in the Calabas Landfill project):
http://www.capstoneturbine.com/index.cfm

E.4. SolarElectric Energy

E.4.1. Overview

Solar panels (photovoltaics or PV) produce electricity directly by converting light energy through the use of semiconductor material (generally silicon) and they contain no moving parts. Solar electric is one of the better investments we can make for energy independence, even with the relative low efficiencies of today's products (typically 8-17%), due to their long life (>25 years), minimal maintenance and the reduction of greenhouse gasses. The following quotes illustrate this best, but the cost of solar panel manufacture can only be met while we still have sufficient fossil fuel reserves.

> The sun sheds enough energy on Earth in one minute to meet its energy needs for an entire year
>
> All of the energy needs of the U.S. could be met with a 100 square mile installation of photovoltaic panels in the Nevada desert
> - *American Solar Energy Society*

Solar-generated electricity can be supplied directly to the electric grid for conventional use, as well as to re-charge electric vehicles. When supplied to a grid, it first must be converted to Alternating Current (AC) by an inverter.

Solar panels currently run ~$3.60/watt. With idle industrial capacity and capable workers, Willits would do well to court one or more solar PV manufacturers with the goal of setting up a local production facility. This would ensure a good supply, potentially at reduced cost, for the local community. One manufacturer, Evergreen Solar, has developed a kiln-based process that is relatively low-tech and low waste. Evergreen would be our preference for such an endeavor.

E.4.2. Resource Usage

Solar electric can be mounted on building roofs, used in the creation of shade structures, or mounted on an unusable hillside. The main issue is that each panel have an unobstructed view of the sky, at a proper angle, to ensure the unimpeded production of electricity.

In considering the potential production, one must first de-rate the rated wattage of a photovoltaic panel to account for wiring losses, etc. Typically a value of around 20% is used; and using a generation goal of 100 watts per panel translates to a 125W rated panel for our basis. A general 125 Watt panel has a dimension of ~25" x 60". Setting the panel's angle at 45 degrees to account for the sun's average angle at our latitude, the panel along its long axis, and considering the shadow cast by each, the required flat-area (or ground) dimensions per panel are 60" x 38" [we'll use 5' x 3']. This gives us 40 panels wide (on the 5' dimension) and 65 panels long (on the 3' dim) per acre[34] or 2600 panels total/acre[35]. Thus, each acre has the potential of generating 260KW.

E.4.3. Energy Production

For this region, our average solar <u>insolation</u> is 4.5 hours x 260 KW (amount per acre) gives us 1.17 MWhr/day potential per acre. Based on this, our production would be **14,570 Therms** or **427 MWhr per acre per year.**

E.4.4. Siting

Owner-initiated purchase & installation on existing residential and commercial buildings should be encouraged. *[estimated >612,000 ft^2 for 20% residential at 20x30', estimated >225,000 ft^2 commercial buildings for a total estimate of* ***<u>>23 MWhr/day</u>*** *production].*

City-collaborated installations on large community & public buildings should be undertaken. *[estimated >90,000 ft^2 for an additional* ***<u>>2 MWhr/day</u>*** *production].*

The City should also consider acquisition of rights to old industrial buildings and contaminated lands (re. RemCo) for siting of PV arrays. Where roofs are insufficient, consider public shade structures. Do not use arable land, use hillsides instead. *[estimated that an additional 12+ acres could be located (>510,000 ft^2), for an additional >****<u>13 MWhr/day</u>*** *production].*

E.4.5. Initial Costs

Selection and structural modifications of space to site the panels, cost of panels and the electric inverters themselves would generally amount to ~$1 million/acre (~$3.6 million/MW) before state and federal incentives (30-50%). This gives us a cost figure of **<u>~$650K/acre or ~$2.3M/MW</u>**.

From the private sector perspective, there are rebates (based on per-watt of installed energy), business tax deductions, as well as distributive generation incentives.

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[34] 1 acre is ~206' square or 42,436 ft^2.

[35] The land the solar panels would be on would be unusable for other purposes (e.g. use existing roofs, the creation of shade structures, hillsides)

From the city government aspect, this can be funded from revenues on monies collected from permit fees and carbon (or similar energy) taxes, as well as conventional bonds. The city would want to ensure such systems are tied into a community owned electric company to ensure revenues pass back into city coffers.

E.4.6. On-Going Costs

Quarterly panel cleaning labor would be required. Additional costs may include the potential loss of usable land if indiscriminate placement of PV arrays are permitted.

E.4.7. Equipment Sources

Solar (PV) panels are produced throughout the world by a wide variety of processes. A purchasing cooperative (such as CCEnergy, see Solar Sebastopol in the appendices, page 66) can provide recommendations on best products and prices. Local solar contractors can provide additional information and installation.

E.5. SolarThermal Energy, Passive (Heat)

E.5.1. Overview

Solar radiation is stated to be roughly 1000 watts per square meter with much of the energy in the infra-red region. This energy can be captured and used directly (as opposed to conversion to electricity) with higher efficiencies. Solar thermal can be captured in low energy form (e.g. direct heating of air or water for bathing), or concentrated, via parabolic mirrors, for high temperature applications including metallurgy as an extreme example.

E.5.2. Resource Usage

Generally the thermal energy generated by solar (or geo) does not transport well and is better suited for point-of-use (i.e. individual households or business clusters). Therefore, the resource most widely used by such collectors would be the building roofs themselves.

E.5.3. Energy Production

At the individual and commercial levels, using conventional solar thermal collectors, the use of solar thermal energy can reduce reliance on current natural gas, propane and wood use with respect to heating.

*Given a figure of 20% of total households to be used for solar thermal, single collector (to account for those without good exposure) [1021 houses], 80% of commercial and public buildings with 3 collectors average [100 buildings] and given a average efficiency of ~20,000 BTU/day for a 32 ft^2 solar collector; this would yield **~7.7 MWhr/day** of equivalent energy (1314 32ft^2 units).*

Additional residential, commercial and public building heating can come from passive solar modifications, distributions from the biowaste (wood) gassifier plant for those close to the plant, as well as geothermal installations.

E.5.4. Siting

Siting of the passive collectors would be on individual and commercial facilities as described above.

E.5.5. Initial Costs

Selection and structural modifications of space to site the collectors and the cost of collectors themselves would generally amount to ~$400 to $1400 per 32 ft^2 (5.86KWhr/day equiv thermal energy, 280 days/year). Given the roof-based installations noted previously in this section, the cost would be ***~$1.3M***.

From the private sector perspective, there are rebates (based on square foot coverage of installed collector) as well as business tax deductions.

E.5.6. On-Going Costs

Collector cleaning.

E.5.7. Equipment Sources

Solar collectors are produced throughout the world, and can be produced locally. A purchasing cooperative (e.g., such as CCEnergy, see Solar Sebastopol in the appendices, page 66) can provide recommendations on best products and prices. Local solar contractors can provide additional information and installation.

E.6. SolarThermal Energy, Concentrated (Electric)

E.6.1. Overview

Solar thermal can be converted to electricity through the use of a Stirling engine (a heat differential engine reaching >30% efficiencies). In this case, the sun is concentrated through a large parabolic reflector to drive the engine. Another term for this type of energy production is Concentrated Solar Power (CSP). A similar system uses CSP to either directly superheat water or to heat a salt solution used to heat water, in both cases, the generated steam drives a turbine generator; but these are systems containing hundreds of reflectors focusing on a central tower in which the steam is generated.

Solar thermal installations also include brine ponds where the sun heats them up to around 100 degrees C and Freon is used to drive a Rankine engine. However, the environmental issues surrounding the ponds (and the use of Freon) preclude consideration of this form of energy production here.

For our considerations, only passive solar collectors and CSP-driven Stirling engines will be examined. With the possible exception of the Stirling engine, solar thermal collection equipment can be manufactured locally – a plus when it comes to costs and maintenance.

E.6.2. Resource Usage

Sandia National Labs is working on a grid-tied system using 10 meter parabolic dishes to focus sufficient solar thermal energy to drive 30KW Stirling generators[36]. Similar devices can be built here now to meet future energy needs. **Each (30KW) system would require roughly 1/8 acre**.

E.6.3. Energy Production

Given operations of 4 hours/day, 280 days/year (insolation considerations), a derating to 27.5KWhr for system losses, the expected production of each unit is estimated to be 30.8 MWhr/unit/year. Given 8 30KW systems per acre, this translates into ***~246 MWhr / acre / year***.

E.6.4. Siting

Using similar considerations as those presented under Solar Electric (page 25), it is envisioned that a 5 acre site could be developed, potentially in conjunction with the wind turbine site (page 35). The production of this 5 acre assemblage would total ***~4.4MWhr/day***.

E.6.5. Initial Costs

[36] http://www.sandia.gov/news-center/news-releases/2004/renew-energy-batt/Stirling.html

Stirling engines run approximately $1000/KWhr generation capability. To this the cost of the parabolic reflector must be added. For a 5 acre site developed as described, the cost would be ***~$4M***.

Potential funding sources includes CPUC rebates and public-private ventures.

E.6.6. On-Going Costs

Quarterly collector / reflector cleaning labor.

E.6.7. Equipment Sources

Systems can be purchased complete (engine and parabolic reflector), or the engine alone, with production of the parabolic reflector locally.

- Sun Machine (Germany)
  www.sunmachine.de/english/stirling_1.html
- BSR Technologies (Germany) – low, medium and high temperature engines
  www.bsrsolar.com
- Solo Stirling Engines (Germany)
  www.solo-germany.com/english/inhalt/innovation_1.html
- Stirling Energy Systems
  www.stirlingenergy.com

E.7. GeoThermal Energy

E.7.1. Overview

Geothermal energy generally relates to using the difference in temperatures between surface (or air) temperatures and that found at depth. Geothermal can be divided into low, medium and high temperature systems based on the temperature found at depth.

In extremes (high and medium temperature applications), it can relate to natural geothermal steam vents such as those in the Maacamas east of Cloverdale or in Greenland (where water is pumped to hot rocks at depth to be turned into steam to drive turbine generators to create electricity).

In low temperature systems, the temperature difference between the surface ambient and depth (typically a constant 58 degrees F in our area) is used to drive a conventional heat pump that can then be used to heat or cool a building's interior.

Generally, only low temperature systems are applicable in the Willits area and these systems serve the residential and private business concerns best. Due to the widely varying demand needs of such installations (not to mention the broad diversity of available commercial units and their efficiencies), it would be difficult to estimate the overall contribution to the Willits area energy mix. As such, we only mention this technology here as a consideration on the private level.

E.8. HydroElectric, Conventional

E.8.1. Overview

Hydroelectric takes the potential energy of water flowing down hill, generally a natural watercourse, to drive a turbine generator. When considering hydroelectric, the most important factor is the height of the intake pipe relative to the generator (called head), and the volume of flow (diameter of pipe minus friction losses). Additionally, with the exception of large rivers or tidal flows, effective hydro requires a reservoir to moderate flows.

The advantage hydro has over solar is that it produces 24 hours a day (at least in the 'wet' season) and can approach 85% efficiencies. The disadvantage are the environmental considerations, specifically the disruption of the stream bed, and where applicable, the impact on native fisheries.

In the case of hydroelectric located on an undeveloped stream (as opposed to being integrated with the reservoir) the development costs can be considerable and include potential loss of arable land, topography studies and surveys, native wildlife assessments, potential loss of wildlife diversity, land ownership issues, reservoir development costs, the costs for pipeline runs as well as the engineering for structural supports for the same.

E.8.2. Resource Usage

The Willits water system is mandated to maintain an outflow from the lower reservoir equivalent to the inflow at the upper reservoir. In a survey conducted in September of this year (2005), 0.96 ft^3/second was flowing into the upper reservoir. The outflow (below the lower reservoir's dam) is through a steel pipe and a small hydro unit can be located in these pipeworks without disruption to the stream bed or to the water plant's facility.

E.8.3. Energy Production

The September flow noted (0.96ft^3/second) can be considered worst case according to the operators. Using this figure (0.026m^3/second), a head of 50 feet (15.4 meters) and the formula Power (KW) = 5.9 factor x flow (m^3/sec) x head (m) gives us a potential of 2.3KW. Extending this over 24 hours would give us **~56KWhr/day**.

E.8.4. Siting

The system would be sited in the outflow pipe just below the lower reservoir's dam (where the outflow is emitted).

E.8.5. Initial Costs

Based on the existing piping and valves already in place, such a system would basically only require a housing for the hydroelectric generator and wiring to the grid at the pump station (~300 feet away). Estimates for the system range from **$20K to $40K**.

E.8.6. On-Going Costs

Depending upon the turbine generator design, at some period (typically 2-4 years), the turbine's impellor may have to be removed for inspection and rebuild. This is due to the wearing action of the water. At the same time, the generator itself should be inspected and necessary maintenance attended to.

E.8.7. Equipment Sources

- Wasserkraft Volk AG (Germany) www.wkv-ag.com
- Advanced Hydro Solutions (Ohio) www.advancedhydrosolutions.com
- Canyon Hydro (Idaho) www.canyonindustriesinc.com
- Harris Hydroelectric (California) www.harrishydro.com

E.9. HydroElectric, Pumped Storage

E.9.1. Overview

Pumped storage or 'stored' hydroelectric is an old and widely-used concept that works with stored water, pumping it between 2 reservoirs and taking advantage of the differing electricity rates throughout the day. Specifically, water stored in an upper reservoir is released during the peak electric rate period to drive a generator on the way to the lower reservoir. During off peak rates, the water is pumped back up to the higher reservoir. Often, the generator is designed to also function as the pump (called a Francis turbine), saving equipment and maintenance costs.

Pumped storage can recover up to 80% of the stored energy[37], and it is one of the most widely used methods in the world to 'store' electricity and release it during consumer demand peaks. In a scenario of renewables, where many of the forms (as discussed herein) are 'intermittent' (e.g. solar and wind), pumped storage plays an integral role in evening out the power availability.

Generally, the electricity rate structure needs to approach 4:1 to be cost effective (e.g. $0.08/KWhr off peak to $0.32/KWhr peak rate). Given electricity cost increase projections this may be quite attainable.

Pumped storage hydroelectric, since it would be implemented on a developed water system is a feasible option for consideration.

E.9.2. Resource Usage

The existing Willits water system (reservoir, piping, etc.) would be the sole consideration for this installation. There would be no need to disrupt existing stream beds (ref. Fish and Game Concerns and regulatory issues). Some water system operating procedures may need to be changed to accommodate the generation capacity of the system, including monitoring reservoir reserve capacity, watershed condition, etc..

E.9.3. Energy Production

Pumped storage hydro is year-round, though generation is limited to the amount of storage you have (i.e. how much of the reservoir can you empty) and to peak rate periods.

For a pumped storage hydro system, let's make some assumptions in order to develop preliminary potential generating capacity:

Assuming a 130' altitude difference between the 2 reservoirs with an 8" pipe between them running a distance of 2500 feet, assuming that we can sustain a flow of 2000 gallons per minute (4.46 ft^3/min) through that pipe. Let's further assume that the excess capacity in the lower reservoir is 5 acre foot[38] (~1.63 million gallons).

The equation Power (KW) = 5.9 x Flow (m^3/s) x Head (m) or Power (W) = Flow (gpm) x Head (ft) / 9 is used to estimate potential power generation[39]. Calculating friction losses at the above flow rate, pipe size and length gives an offset of 50' leaving us a functioning head of 80 feet. Using the flow of 2000 gpm gives us a potential of 18KW system generation.

[37] When electric rate structures are considered.
[38] 1 acre foot is equal to 325,851 gallons.
[39] http://www.ecology.com/archived-links/hydroelectric-energy/

If this was a 24 hour system, this could potentially provide 0.4 MWhr/day; but this (pumped storage hydroelectric) system can only run as long as we have storage capacity in the lower reservoir, and ideally mainly during peak electricity rates.. With 5 acre feet moving through the pipe at 2000 gpm, we get just over 13.5 hours generating time (12 used, the other 12 for return pumping), for a total of 216 KWhr/day. From this we still need to subtract out the cost to pump the water back to the upper reservoir. Given general system losses and inefficiencies, this cost may amount to as much as 260 KWhr/day. However, the electric rates for each must be considered to see the cost benefit. Given a 3:1 ratio of peak to off-peak rates (and accounting for peak being generally from 11am to 6pm, only 7 hours of the 12 we are generating for or ~433KWhr), this gives us an equivalent of ~433KWhr generated. When the energy required to pump it back up is subtracted (260KWhr), the *net generation* is equivalent to ~***170 KWhr/day***.

E.9.4. Siting

The system would be sited in between the 2 reservoirs of the Willits water system. Piping between the 2 reservoirs would be required as well as the raising of (at least) the upper reservoir's dam to increase the storage capacity to accommodate the volume pumped. The addition of the generator/pump, housing for the same and the connection to utility transmission lines would be required.

E.9.5. Initial Costs

Pumped storage generally costs around $1200-2000/KW for large scale power plants. Given that we already have the reservoirs in place, the costs of such a system in the Willits reservoir would include the generator/pump, generator/pump housing, piping between the reservoirs, raising the dams to accommodate the extra storage needed and the installation of proper transmission lines. This could run from **$750K to over $1.2M**

E.9.6. On-Going Costs

On-going costs would include labor for monitoring and periodic maintenance (including cleaning and inspections).

E.9.7. Equipment Sources

- Bharat Heavy Electricals, Ltd (India) www.bhel.com
- First Hydro (UK) www.fhc.co.uk
- Toshiba Industrial & Power Systems (Japan)
- www.toshiba.co.jp/f-ene/hydro/english/index.htm
- Canyon Hydro (Idaho) www.canyonindustriesinc.com

California Pumped Storage Systems:

- Hems Pumped Storage Project (PG&E), Fresno
- Alta Mesa (SoCal), developed by Mark Technologies (SF) in conjunction with Harza Engineering (Chicago)

E.10. Wind Energy

E.10.1. Overview

Wind turbines produce energy by letting the wind turn large rotors which, in turn, drive electric generators. Wind turbine generation is based on the cube of the wind speed, the air density which varies with altitude and the surface (diameter) swept by the rotor. Efficiencies (extraction of wind power) are typically around 45%.

Wind-generated electricity has become one of the best values around, on-par or better than conventional (coal or natural gas) power plants, with price per installed watt at around $0.035. The caveat is having a site with sufficient wind (and proximity to existing power lines) to make the project feasible.

Wind-generated electricity sources are often paired with solar electric (PV) generation to compliment the times of day each produce electricity.

E.10.2. Resource Usage

Wind turbines require siting in a good wind production area, generally passes or mountaintops. For that reason, the cost of land for wind turbines can be cheaper than that within habitable or farmable land. Land area required is based on the size of the rotor for the unit selected and the available wind power for that area. For the Altamont Pass wind turbines, ***approximately 1.8 ha (4.5 acres) are required per each unit*** to produce maximum power[40]. However, very little of this land is taken up by the turbine so dual use is possible (grazing, farming, the potential siting of other renewable energy producers, etc.).

E.10.3. Energy Production

A general figure of potential power production is 1000 watts per square meter of swept (turbine blade) area. This figure, similar to solar's figure, must then be moderated by system losses due to inefficiencies of equipment. *The larger the turbine (and blade),and the stronger and steadier the wind flow, the better the production of electricity.*

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[40] Renewable Energy: Economic and Environmental Issues; BioScience Journal, vol 44, #8, September, 1994 [also available at http://dieoff.org/page84.htm].

Generally a tower height of over 60 feet and an average wind speed (year-round) of over 12mph is required to be economically feasible.

Power (KW) = Blade Swept Area x Average Wind Speed x Factor

See the next subsection for site production figures

E.10.4. Siting

Little Lake Valley, due to its geology, is a poor site for large-scale wind-powered generators[41]. However, there are 2 potential sites off the valley floor, one at the highway 20 pass going to Fort Bragg and the other at the Ridgecrest CDF station (on property owned as part of the Willits water system). In order to evaluate any site, a recording anemometer is required and should be installed and the data collected over the course of a year.

Any site selected must have access to power lines to ensure generated power is fed back into the grid. It should also be surveyed to ensure it does not lie in a bird migration path; and that it is sufficiently distant from neighbors to preclude auditory disturbance.

Let's say we can site 4 x 1-MWhr hour units (generally 60-80m high with a rotor diameter of ~54 meters) between these two locations and that the average wind speed is 75% of the rating for the units. *This gives us a generating capacity of 3 MW. Running 12 hours a day[42] will give us **<u>36 MWhr/day</u>*** on 18 acres.

Note: a *recording anemometer is being configured and sites reviewed for potential generation capabilities. Once that information is available, generation capabilities and sizing will be updated herein*.

E.10.5. Initial Costs

Generator costs (based on system sizing) are ~$1 million per megawatt[43] generating capacity. Given the configuration described, an investment of ***<u>$4M</u>*** would be required.

E.10.6. On-Going Costs

Periodic maintenance and cleaning. Industry figures put this at $18K – 30K[44] per year.

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[41] Small-scale, low wind velocity capable turbines are being developed with an eye toward direct integration into buildings (company: Aerotecture). This will be monitored as to its feasibility for the local community as more information becomes available.
[42] 12 hours is used to account for wind variability.
[43] "Study advocates 'large-scale' U.S. wind power program", Stanford Report, August 23, 2001.
[44] Ibid.

E.10.7. Equipment Sources

- Suzlon (Denmark) – has majority of Asian market share, projects in Minnesota, etc. -- www.suzlon.com
- Arcadia Wind Power (New York) – offers development and financing of utility scale installations -- www.arcadiawind.com
- GE Energy (US) -- http://www.gepower.com/businesses/ge_wind_energy/en/index.htm
- Bonus Energy (Denmark) -- http://www.bonus.dk/uk/index.html
- Others: Vestas (Denmark), Gamesa (Spain), NEG-Micon (Denmark),

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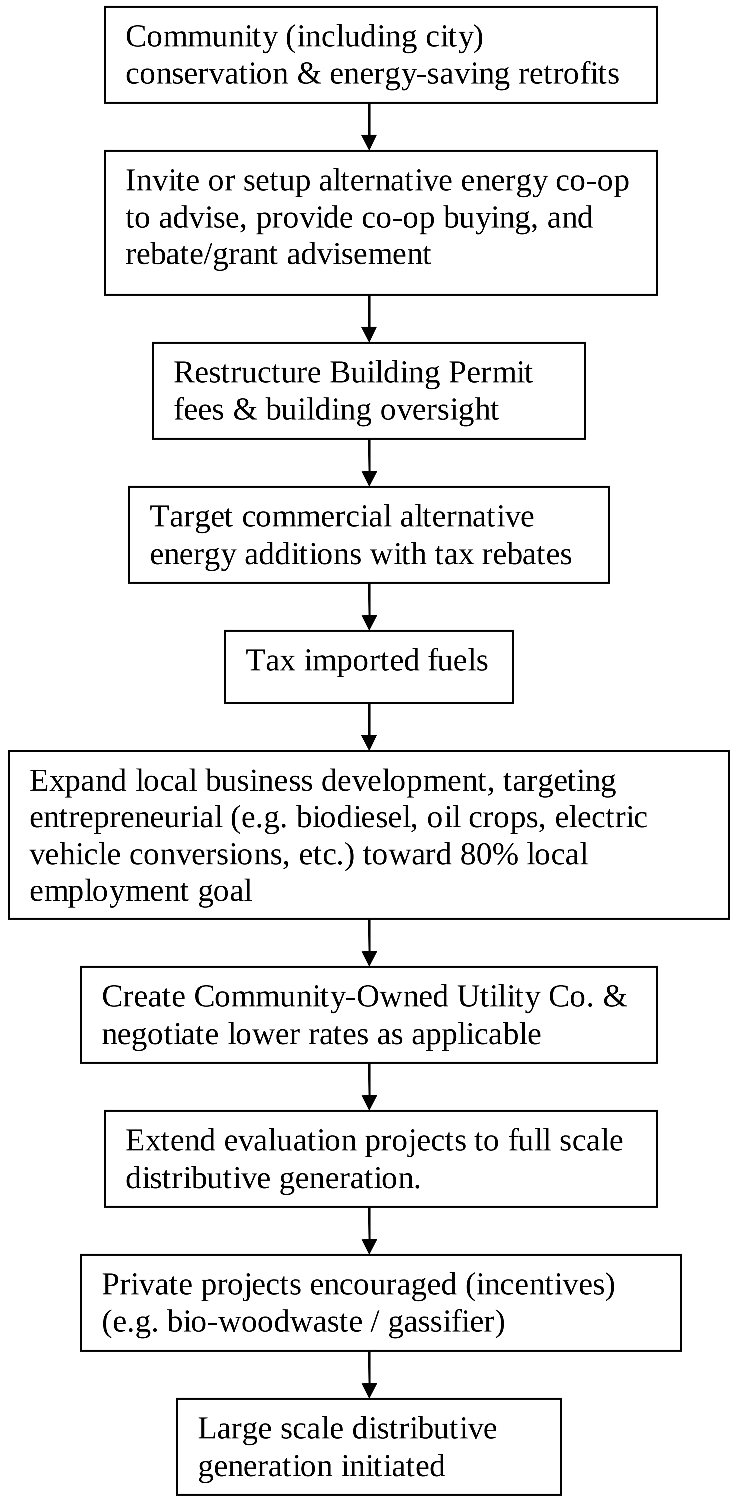
Appendix F. Energy Transition Chart

When considering the final 'energy mix', the load curve – that of peak consumer demands, must be considered.

Envisioned Fuel / Energy Source	Total (annual)	Units	Total (daily), MWhr	Primary (present-day) Fuels Replacing	Target Usage	Implementation Strategy	Production Strategy	Notes
Wood Biowaste	2340	MWhr	6.41	Electricity, local natural gas & propane	Residential, commercial & public facilities, electric vehicles. Local area heating.	Joint public-private venture & funding.	Local utility company to ensure credit for excess production.	
Oil Biocrops	20000	Gallons	1.91	Gasoline (vehicle conversion), diesel	Public transportation, emergency vehicles	Entrepreneurial (SBA grants, etc.)	Small business, market-driven	Transitional fuel as food needs will require crop lands employed
Solar Electric	10640	MWhr	29.15	Electricity, some propane & natural gas	Residential, commercial & public facilities, electric vehicles	Commercial and residential by owner-driven install with co-op, tax and rebates. City/public via grants, permit fees & public utility revenues.	Net-metering initially, owner-driven install. Long-term as part of local utility to ensure credit for excess per-site production.	
Solar & Geo Thermal	3388	MWhr	9.28	Natural gas, propane as used for heating	Residential, commercial & public facilities	Owner-driven install, with co-op, tax and rebates.	Point-of-use only	
Hydro Electric (both)	83	MWhr	0.23	Electricity, some propane & natural gas	Residential, commercial & public facilities, electric vehicles	Public utility funding (grants, funds from carbon taxes, etc.)	Local utility company to ensure credit for excess production.	Use of other energy sources for pumped storage off-peak.
Wind	10080	MWhr	27.62	Electricity, some propane & natural gas	Residential, commercial & public facilities, electric vehicles	Public utility funding (grants, funds from carbon taxes, etc.)	Local utility company to ensure credit for excess production.	
Firewood	12635	Cords	141.94	Same (firewood)	Residential heating & cooking, small-scale gassification for small engine/vehicles	Stove upgrades will be needed to mitigate particulate pollution [EPA grants?]	As present	This is a 50% increase over present use acknowledging that outlying areas will turn to local fuels to offset propane and natural gas loss.
Total Estimated Production:			**216.54**					
36% Present-day consumption*:			**376.70**					
*50 reduction general energy, 75% reduction in transportation fuels								

Appendix G. Steps to Energy Independence



Appendix H. Funding Options

When looking at the purchase and installation of a new facility, it is quite easy to think in terms of payback. As Keith Rutledge states, "one point on the 'payback' issue is to consider that the current strategy of purchasing power from the utilities will NEVER pay for itself. Finding renewable means to provide the same commodity at the same price should be encouraged." This is true in terms of the pollution aspect as well as in terms of the ability of a local generation facility in controlling escalating prices – a factor that provides some benefit for those of financial disability in the community.

In the following subsections, we present various means of financing renewable and local energy production. Where possible, links to further information have been provided.

H.1. Potential Funding Sources

Based on similar projects in other communities of comparable size, the following lists *some* of the types of grants and fund sources available for the energy projects discussed within this paper.

US Department of Energy – Grants and funds for power plant studies, possibly for building. [http://www.sc.doe.gov/grants/grants.html]

Housing and Urban Development (HUD) – Community and business heating / cooling, also for low-income housing energy upgrades. [http://www.hud.gov/grants/index.cfm]

USDA – Rural development grants, including alternative energy. [http://www.rurdev.usda.gov/rd/farmbill/9006resources.html]

Homeland Security – Security of energy supplies (local generation and local utility control). [http://www.dhs.gov/dhspublic/]

California Public Utility Commission (PUC), Pacific Gas & Electric (PG&E) – Rebates, grants for grid tie-in as well as for local generation. [http://www.cpuc.ca.gov/, http://www.pge.com, http://www.pge.com/selfgen/]

California Energy Commission (CEC) – low interest loans for government entities (like the City of Willits). [http://energy.ca.gov/efficiency/financing/index.htm]

Environmental Protection Agency (EPA) – Grants and funds for wood waste cleanup. [http://www.epa.gov/ogd/, http://www.epa.gov/epaoswer/hazwaste/minimize/rpsinc.htm]

Taxation –

1) Permit fees tiered by the amount of energy-saving considerations and solar, geo or other energy production. [Request permit fees from the City of Sebastopol, Sonoma County for an example]

2) Local carbon tax (e.g. $0.01/unit) imposed on in-jurisdiction sales of imported energy products (gasoline, diesel, propane, firewood, etc.). Imported means coming in from outside of the Willits area.
3) Business Tax Rebates (e.g. up to 10% total revenues/year) provided up to allocated annual percentage against the cost of adding alternative energy generation at the business itself (i.e. incentive to increase business PV roof installations).
4) Local Provider Preference where bids for city or community products favor local vendors by a bid margin of 5-15%.

Municipal Bonds – self explanatory, but the presentation of these to investors can be based on the 'green' or renewable aspect of the project, a factor playing more significant roles these days.

Income from Alternative (green) Energy Installations (beyond revenues from the sale of the energy) via green tags aka energy credits aka carbon credits aka renewable energy certificates (RECs) aka tradable renewable certificates. Basically these are traded on the open market (green/renewable energy producers sell them, while dirty producers purchase them to offset their carbon and other emissions. These can represent a significant source of *annual* on-going income and are often based on a value per MegaWatt Hour produced.
http://www.ems.org/renewables/green_tags.html - describes what they are,
http://www.green-e.org/ - provides certification.

Remember that roughly $30 million currently leaves this area annually to pay for energy imports. Keeping some or all of that locally will stimulate the local economy while providing much needed revenue streams for the city as well as local employment.

Other potential funds, grants & programs:
http://www.pewclimate.org/states.cfm?ID=18
http://www.californiasolarcenter.org/incentives.html
http://www.energy.ca.gov/research/innovations/

H.2. Example Municipal Financing Approaches

This section seeks to summarize some of the strategies that municipalities might use in order to finance the study and construction of alternative energy projects. Case studies of other cities that have successfully employed these options will be cited.

There are four general avenues to explore:

1) Use of "Own Source Revenues,"
2) Direct Borrowing,
3) Third Party Financing, and

4) Utility Company Financing

1) Own Source Revenue: A City simply allocates funds to the desired project in its annual capital budget. If the budgetary savings generated by the alternative energy program can exceed on an annual basis the amount of money invested in the infrastructure of that program, then it makes immediate sense to simply create a "line item" in the Capital Budget for that purpose. This is often the case with energy efficiency improvements, rather than energy generating equipment.

Incorporating energy efficiency and/or generating projects within the Capital Budget establishes it as an on-going commitment and gives it the status of a perceived service the municipality provides to maximize the asset value of its buildings and facilities.

The City of Phoenix started an "Energy Conservation Savings Reinvestment Plan" in 1984 with mere $50,000 seed money. The purpose was to encourage energy efficiency in municipal buildings. Each year, Phoenix invested half of all documented energy savings back into the Plan. By 1992, the Plan had financed retrofits which had resulted in $18 million of audited savings. By 2002, the amount had risen to $42.6 million in savings. All from a $50K investment.

The School District of Philadelphia started with NO start-up capital. The District simply offered a financial rebate to individual schools that could demonstrate energy efficiency savings against previous years expenditures. Students and staff at each school created measures to save power and fuel through conservation. The District then shared 40% of the savings with the school, earmarked 20% for future energy-savings projects, and folded 40% back to the overall District budget. By the end of the first year, district wide savings were $3 million, with 2/3 of the schools showing improvement. After 10 years, the total savings was $45 million. In this way, an public entity can actually look at the annual energy budget as a ***potential source of revenue.***

2) Direct Borrowing: The two basic two ways for cities to borrow money are **Bonds and Loans**. With both mechanisms of borrowing the capital for energy projects, municipalities can recover the financing costs through the energy savings these investments achieve over the lifetime of the loan. The chief drawbacks, however, are that 1) the municipality itself assumes all the financial risks associated with the success or failure of the endeavor, and 2) the municipality increases its overall debt load.

Bonds: General Obligation Bonds (GOS) usually necessitate approval of the electorate, which can achieve public "buy-in" to the overall concept. These typically cost from 5.75 to 7%. And there is a fairly long lead time to get the project up and running and saving money.

The State of Iowa issued over $12 million in "energy conservation bonds" to finance the retrofit of state-owned facilities. A special corporation was set up to manage the program. Energy improvements installed as of early 2005 have cost a total of $19 million but are saving the State $3.4 million per year.

Back in California, San Francisco citizens passed two measures in 2001 to sell $100 million of bonds to install renewable energy projects (photovoltaics and wind turbines) on schools and City and County buildings. The projects are expects to yield about 10-12 megawatts of solar and about 30 megawatts of wind power electricity. The principal and interest on the bonds will be repaid by the revenue generated by the projects and will not result in any higher taxes.

Private Institution Loans: A faster way to get availability of capital is to borrow from eager financial institutions. However, such loans generally carry a more costly rate, are not tax-exempt in nature, and put the municipality directly at risk.

Loans From Other Governments: Both the State of California and the Feds have loan programs to encourage the saving and production of energy on local levels.

The California Energy Commission's Energy Efficiency Financing program provides financing at 4.5% for both feasibility studies and the installation of energy-saving measures. This include energy audits, lighting improvements, high efficiency motor and pumps, building insulation, HVAC modifications, automated controls, and energy generation including renewable energy projects. The CEC loan can finance up to 100% of the project with a maximum of $1 million per application. Projects must have simple payback of 9.8 years or less. The loan itself must be repaid from the accrued project savings within 15 years.

The City of Fairfield took a $2 million loan from the CEC in 2002. Fairfield used the money to improve its HVAC system, installed automatic controls, installed a co-generation system, upgraded to more efficient lighting, and switched to lower energy use equipment. The savings realized in electricity and natural gas use annually totals $283,062. This pays back the cost of the investment in about 7.1 years. After that, the savings is available for other budgetary uses.

In New Jersey, the Atlantic County Utilities Authority installed a $3.5 million photovoltaic energy system at a wastewater treatment plant using a low-interest loan from the NJ Environmental Infrastructure Trust program and a $1.9 million rebate from the NJ Office of Clean Energy. The 500kW project will provide the electricity for the operations of the wastewater treatment plant. In addition, the ACUA has also installed a $12 million wind energy project at the same site, a geoexchange heating and cooling system at the Township Building, and is using landfill gas in another energy generation system, and uses biodiesel in its entire fleet of 102 trucks and equipment.

3) Third Party Financing: What if you could undertake a comprehensive building energy retrofit program and install alternative energy generating systems WITHOUT having to provide the capital yourself AND someone else would assume take the financial risk and guarantee the performance of the project? Would that sound pretty good?

There are two ways to structure such a sweet deal: **Lease Purchase Agreements** and **Performance Contracts**.

Under **Lease Purchase Agreements** a City contracts with a financial institution or energy service contractor who purchases and installs energy efficiency equipment and then rents it to the City. At the end of the lease, the City buys the equipment at a nominal cost. The lease is structured so that the payments are less than the energy savings produced by the project. In most cases, the cost of the lease can be considered an operating expense; thus it does not appear on the balance sheet and does not contribute to the debt load of the municipality.

The City of Buffalo, NY, contracted a lease purchase agreement with Oppenheimer & Co., Inc., to energy retrofit 55 City facilities for a total cost of $3.5 million. $1.2 million of that was immediately available as an incentive from the local electric utility, Niagara Mohawk. The total 15 year benefit to Buffalo will be in excess of $6.1 million.

Performance Contracts are arrangements between a municipality and specialized energy service contractors (ESCOs) which offer turnkey energy efficiency and/or generating packages. The contractor finances and installs the equipment, manages the operation, and monitors the energy consumption or energy output regularly to ensure that the energy benefit projections are achieved. For those municipalities with no capital and no expertise to implement energy projects, ESCOs represent one of the best solutions. Typically, the ESCO guarantees that the energy savings will be sufficient to repay the monthly debt service costs. This guarantee typically adds 8% to the total financing costs, but it completely mitigates the element of risk to the City.

Jefferson County, KY, contracted with CES/Way International to retrofit 7 municipal buildings for $2.5 million. CES/Way arranged the financing, installed the equipment, trained the building operators, monitored the benefits, and guaranteed the energy savings would be sufficient to repay the debt. Annual energy savings were $530,000, or about 20% of the total investment per year.

4) Utility Financing: Privately-owned utility companies that have been granted a monopoly to provide electric power and/or natural gas within a certain area are mandated by the State Public Utility Commission to encourage and financially assist the creation of additional energy supply generators.

In March 2001, the CPUC created the "**Self-Generation Incentive Program**" (**SGIP**) to be administered by PG&E in our area. The **SGIP** offeres financial incentives to customers (primarily business, large institutional, and municipal) who install distributed generation facilities to meet all or part of their energy needs. Photovoltaic, wind, and fuel cell renewable fuel sources and micro-turbine, gas turbines, and internal combustion (Stirling?) engines were named as eligible technologies. These technologies are required to serve on-site load and to be interconnected with the grid. Hydroelectric generation facilities were not named but may be qualified through the Program Modification Process. In 2003, AB 1685 extended the program through 2007.

However, on the first day that applications were accepted for 2005, PG&E received 315 applications. As of April 2005, there were 437 projects requesting a total of $389 million for solar, wind, and fuel cell projects. The amount of money available to be granted for 2005 was a mere $18 million.

A parallel program, the State **CEC Emerging Renewables Rebate**, offers $2.80/watt for distributed energy generation projects that are interconnected to the grid and are used for, but do not exceed the on-site needs of a facility. The **CEC Emerging Renewables** rebates cannot be combined with any **SGIP** funds.

In addition to these four general financing strategies currently available and being used by municipalities around the country, there is a **creative fifth type of financing** coming over the horizon in the future.

This involves the pre-sale of **Renewable Energy Credits** (**REC**) by a would-be energy producer, such as a municipality, to an entity, such as another utility or corporation, in need of green credits to meet government mandates for emissions reductions. The concept is similar to the sulfur dioxide and nitrous oxide off-setting credit markets created by EPA in 1995 and 1999, where credits are auctioned and traded. Generally, one **REC** represents one megawatt-hour of electricity of renewable, carbon dioxide-free electricity which can be used to displace one megawatt of fossil fuel derived electricity. Some industry analysts predict that within 20 years, tradable REC will create a $3 trillion commodity market. Already, in Connecticut, **REC**'s trade at about $40 per megawatt-hour.

NativeEnergy, INC. sold in advance the total lifetime RECs for two distributed energy projects (wind turbines on the Rosebud Sioux Reservation and biogas from farm methane in Pennsylvania) in 2001 before construction even began on the projects in order to finance the cost of construction of the projects.

Even the federal government could be interested in buying alternative energy produced by solar, wind, or hydro generation facilities owned by a City:

The EPA itself now purchases a total of 122.5 million kilowatt-hours of green power annually, equivalent to 44% of the electricity consumed in all EPA facilities nationwide.

Summary: The City of Willits spends approximately $284,000 per year to PG&E for electrical and natural gas energy. Additionally, other fuels (gasoline, diesel, propane) add another ($?) load to the budget. Imagine the revenue freed up if, for instance, a 20% reduction in energy costs could be achieved. If the City could utilize some of the above-described financial strategies to conserve energy and/or to actually produce energy with little or no long-term expenditure of revenue by itself, this would enable the realized cost savings to be used for other, more constructive purposes. In this way, the energy portion of the City budget can be looked upon as a potential source of additional revenue available to meet the needs of the Willits community.

Much of the material for this Appendix was gleaned from www.iclei.org (the International Council for Local Environmental Initiatives) and www.dsireusa.org (the Database of State Incentives for Renewable Energy). Additionally, www.energy.ca.gov (the California Energy Commission), www.pge.com/selfgen (the Self-Generation Incentive Program), www.renewableenergyaccess.com (Renewable Energy Access), and an article by Ed Ritchie in "Distributed Energy, The Journal for On-site Power Solutions" (Nov./Dec. 2004) were used.

Appendix I. Entrepreneurial Opportunities in a Post-Petroleum Economy

An economy of declining petroleum (and the associated higher prices) provides many opportunities for new business development. Such business may be of the conventional type, or as ***Community Supported Manufacturing*** (CSM). The following lists *some* of the potential needs the community may be faced with that can be addressed through the local entrepreneurial spirit. It is not meant to be an exhaustive list of all possibilities.

I.1. Service, Tool and Process Needs

- Electric chain saws and other woodlot or personal tools currently powered by gasoline or diesel.
- Solar-recharged power carts (DC conversion & storage, AC output).
- Electric vehicles including tractors, ATVs, rickshaws, cars and trucks.
- Rail vehicles (e.g. Ultra Light Rail, see page 54) to replace truck-based product transport as well as local mass transit.
- Machining & manufacture of parts for above, including electric motors, etc.
- Portable wood gassifiers for residential, ranch and business use in converting wood to gas for internal combustion engines and heating.
- High temperature solar furnaces for glass, metallurgy, ceramics, etc. [The French Solar Research facility in the Pyrenees has demonstrated such devices].
- Solar electric wafer manufacture and assembly (into photovoltaic) to ensure local availability at lower cost. A partnership for a local manufacturing facility with an existing manufacturer (e.g. Evergreen Solar) could be negotiated now.
- Vehicle cooperative to pool resources towards necessary vehicles being available when they are needed (aka 'CarShare'). Existing cities with car coops include San Francisco and Vancouver BC.

I.2. Employment Needs

- Wood harvesting (heat, energy products, building materials). Ensure sustainable harvesting, i.e. no more than 1%/year of any area.
- Waste stream diversion; including mining both the old landfill as well as the on-going waste stream for re-use, raw materials (like metals, glass) and energy products (e.g. tires, methane gas and hydrocarbon 'soup' runoff).
- Food production, perhaps in the form of Community Supported Agriculture (CSAs)
- Medical supply manufacturing, including medicines, instruments, pill capsules, oil press and distillation, etc..
- Cloth and paper manufacturing (e.g. from wood, hemp, flax, etc.) as well as baskets or related packaging for perishable goods.
- Bio fuel production (oil and ethanol-source feed stocks, wood distillation, etc.) for critical vehicle use.

- Petroleum-based and other lubricant reclamation or recycling and reprocessing.
- Battery recycling, refurbish and manufacture (vehicles, tools, storage of solar & other energy forms).
- Raw material production, including Portland cement, metal products and glass products (from recycled and reclaimed materials), etc..
- Building material production (bricks, blocks, beams, etc.)
- Local communications (e.g. community radio, internet, etc.).

Appendix J. Transportation, a Vision of the Future

One cannot discuss energy independence without discussing transportation issues. Since our current energy inventory shows that ***over 56% of our consumption is for transportation***, examining these issues now can help in present day community energy reduction steps as well as to mitigate problems in worker and goods transport in a future of declining petroleum.

J.1. Current Transportation Modes

Willits is the halfway point along the North Coast Railroad (NCRR). Running north to the Eureka/Arcata area and the Humboldt Bay and south to Schellville, the NCRR spans a distance of about roughly 300 miles. The line north of Willits to Eureka is closed due to slides blocking the track, especially along the Eel River corridor. There are no immediate plans to repair these sections of track. In 1998 the Federal Rail Authority (FRA) closed the entire line due to flooding and damaged track. While funding for track repair is in place there is no money available to pay for labor -- a real catch-22. There is pending legislation that, if passed, could fast-track the repair process from Schellville to Willits -- a distance of about 150 miles.

Conventional motor trucking currently serves as the exclusive conveyance for bringing all of our life-support products into our community and for the delivery of what products are produced or grown here. Willits is served by state Highway 101 running north/south and Hwy. 20 to the west to Ft. Bragg.

Mendocino Transit Authority (MTA) is the county mass transit system, based in Ukiah, Ca. 24 miles south on Hwy. 101. Buses operate daily serving and connecting the Mendocino County. MTA also operates the Dial-a Ride bus daily in Willits. A 10% service cut-back has just been implemented due to a decrease in ridership. Diesel fuel is used in these buses although they could easily be converted to bio-diesel or biofuels. Santa Barbara, for example, has electric buses in its fleet.

Amtrack is a longer-distance mass transit option, yet provides only bus-connection service with the depot located at the Skunk Train station. Greyhound also provides service to Willits, with the 'depot' located behind McDonalds.

The automobile/pickup is the primary vehicle used to solve our personal transport needs. Fuels are gasoline and diesel. A biodiesel station has just opened in town, though it is unknown how many use, or will use this fuel. Although there are approximately 13,000 people living in the 95490 area, only about 5000 people live within the city limits, the remaining 8000 people live outside Little Lake Valley, mostly in the immediate mountain range. Primarily by necessity of transportation, such rural lifestyles consume more energy than their urban counterparts who live within city limits. According to the Mendocino County Air Quality Board, the California State Department of Finance Population Projections show that between 2000 and 2010 Mendocino County is projected to add 15,000 people (for a 16% increase in population), with a significant portion in the rural area. Additionally, the same data shows that since 1981 Vehicle Miles Traveled per capita has increased significantly county wide from 17 miles per person per day to 28 miles per person per day.

California Department of Transportation (Caltrans) has conducted traffic studies within Willits city limits. The traffic count includes: Willits-to-Eureka at 5000 vehicles a day, Willits-to-Laytonville and Covelo at 2000 vehicles a day, Willits-to-Fort Bragg at 2500-3000 vehicles a day and, most significantly, Willits local traffic at 28,000 vehicle trips daily![45]

J.2. The Impact of the Current Transportation Modality

The widespread use of unconsolidated transportation (i.e. non-public) impacts our community in unmitigated energy use and the accompanying pollution. However, there are other far-reaching impacts not often discussed. J.H Crawford, writing in his publication "Carfree Cities"[46], notes there are many externalized costs that motorists create upon the community. The following list is extracted from his book:

- Intimidation of pedestrians and bicyclists
- Reduced availability of public transit
- Deterioration of human-scale public places
- Noise-related stress
- Vibration to nearby structures
- Road maintenance costs in excess of road taxes
- Capitol and maintenance costs of parking lots
- Reduction in real estate values caused by nearby roads and highways
- Additional police, fire and ambulance services
- Air, water and land pollution (and climate change from greenhouse gasses)
- Petroleum production subsidies
- Military actions to protect petroleum supplies

J.3. Transportation Transition Issues

J.3.1. Asphalt (and Tires) comes from Petroleum

Like many things we take for granted, the primary constituent of our roadways is made from petroleum products. Within a post-petroleum world, asphalt will become quite expensive and alternative materials may need to be developed that have the resiliency and

[45] This CalTrans study was part of the assessment conducted for the Willits Bypass project. Copies of the report may be viewed at the Willits Environmental Center. The high number of local trips can be accounted for by the manner in which cars are counted (i.e. one car may cross a counter several times in the course of conducted errands).
[46] International Books, 2002.

robustness that asphalt and aggregate does. On the other hand, a post-petroleum world will have fewer personal vehicles plying the roadways so repairs may be required less frequently. However, some (to most) roads will still need to be maintained as alternative means of transport begin to be developed; and one solution is to recycle asphalt from unused roads, or to use recycled tires as a road base and binder source. This same recycling may be one solution for vehicle tire production.

J.3.2. Hydrogen realities

The vision of a hydrogen economy, as put forth by the Bush administration, is a pipe dream. Since the 1960s (and possibly well before) various groups have been looking at hydrogen as a potential fuel and have worked on ways of producing hydrogen as well as storing and transporting it. Back in the 1960s metal hydrides had been touted as the best solution for storage, while natural gas was presented as the best feedstock for manufacturing the gas. Over the ensuing 40 years scientists have explored everything from spun carbon to nano-technology for the storage and yet in the last month, metal hydrides were again touted as the best method of storing hydrogen in a vehicle (and the capacity is still below 9% by weight of the metal hydride medium!). Worse, the production of hydrogen (not withstanding the diminishing supply of natural gas) still costs over 150% of the amount of energy the resultant hydrogen would contain (aka the ‘embodied energy’). As a result, it is our belief that hydrogen has a problematic future and should not be considered as a solution to powering vehicles (personal or otherwise), let alone our economy, in the foreseeable future.

J.3.3. The Ideal Fuel

So what might be the ideal fuel for powering future vehicles similar to what we have today? First, let us say that the traditional personal vehicle may well be a thing of the past. The availability of liquid fuel, at a reasonable cost, is in question. Further, the social impact of large personal vehicles being used primarily for non-essential travel cannot be sustained in a world crying just to feed its own.

Having said that, the ideal (transportation) fuel is one that is independent of its feedstock (the energy needed to produce it). Specifically, given the wide range of potential energy sources we have been discussing that are available locally, what can all of them share? Given that a means of distributing electricity already exists, basing future transportation on electricity is ideal. Through such, regardless if our power is generated by solar photovoltaic panels, waste wood gassifiers, landfill biodigesters, or by hydroelectric, there is no need to convert it further to power a vehicle. Conversion constitutes a loss in terms of efficiency, and electric vehicles are far more efficient to run than internal combustion engines, let alone the maintenance far cheaper.

J.4. Future Transportation

J.4.1. Electric Vehicles

While we have said that personal vehicles may be a thing of the past, vehicles used in people or goods transport or to do farm or manufacturing work must be accommodated.

Electric vehicles, when designed properly, can equal the torque (power) of today's trucks and busses, and the range is simply a factor of how much on-board storage (batteries) the vehicle is designed to carry.

An example of the high-torque of electric vehicles is the classic diesel locomotive that first appeared in the 1940s. This is a hybrid system where a diesel drives an electric generator, which in-turn drives electric motors located at the wheels. As to battery capacity, most busses actually require a large ballast weight (such as concrete) close to the road to keep the vehicle stable – this can easily be replaced with storage batteries. And looking back at our example of diesel locomotives, the heavier the weight, the better the traction on steel rails (again, the weight provided by batteries to store the electric 'fuel').

As importantly, electric motors and lead-acid batteries are a simple technology that lends itself well to local manufacture and maintenance (as do the vehicles themselves). One final point; electric vehicles require far less maintenance since there are no fluids, filters, sparkplugs, exhaust systems, etc. to replace or wear out.

J.4.2. City / Government Transport

As we have discussed elsewhere in this paper, existing city and emergency vehicles will need to continue to run and discussions have been presented on locally-produced liquid biofuels that can be employed for the same (e.g. biodiesel and ethanol). We have also discussed the gradual transition of city vehicles to hybrid and full electrics. A mix of both will be required.

J.4.3. Local Mass Transit

Public transportation will be an important aspect in a post-petroleum community where cottage industry goods and workers need to be transported and where conventional use of (personal) vehicles will be unaffordable due to the cost of energy in general.

In observing the traffic flows in Willits, and given the known bottlenecks and lack of north/south arteries, there exist the fundamentals of a future mass transit system that's already built and in place. We're referring to the seldom (if ever) used railroad tracks of the California Western Railroad (CWRR) and the NCRR. In studying the Willits area map, it becomes apparent that 5 of the 6 schools are no more than 2-3 blocks from the existing rail line.

There exists today a US-manufactured electric tram that transports 16 passengers (40 with the extension unit) and has operating costs averaging $0.07 per mile versus equivalent gasoline powered vehicles costs of $0.15 per mile or more.[47] The tram uses deep-cycle 12 volt lead acid batteries, a 25HP AC motor and a 324 volt AC drive system providing sufficient power to climb 10% grades. The tram is also available as a hybrid, using either diesel or Liquid Natural Gas (LNG). One of our group is exploring the possibility (with the manufacturer) of a conversion from rubber tired to steel (railroad) wheel. If feasible, this vehicle is a prime candidate to convert to a Light Rail Vehicle (LRV) and it is estimated the complete, converted vehicle would cost under $100K new.

As the City of Willits map illustrates, not only could most of the schools be serviced by a rail-based mass transit system, but the senior center, swimming pool, downtown shops, Veterans building, library, fire department, police department, city parks, Courthouse, City Hall, County Museum, Roots of Motive Power park, Rodeo grounds, Chamber of Commerce, Evergreen Shopping Center, Safeway Shopping Center, Howard Hospital and the yet to be built new hospital, Harrahs Manor Subdivision, the yet to be built subdivision of 60+ new homes and the yet to be built assisted senior care center would also be within easy reach of such a system. Of course the existing landmark Willits train station, which is an intermodal station with bus connections and Amtrak pickup/dropoff, would also be serviced by the same line.

Additionally these trams could be converted to solar electric with panels mounted on the vehicle roofs and panels mounted on the station rooftops. Suntools of Willits demonstrated and documented this technology in 1991-1994 with the Soltrain project (solar/electric and battery powered).[48]

Light and Ultra Light Rail (ULR)[49] is a far-reaching option that could also potentially connect other parts of the county (e.g. Ukiah, Fort Bragg), placing Willits as a future transportation hub and potentially increasing the local employment and city revenues as a result.

In a book[50] published in 1977, Christopher Swan advocated a transition of Yosemite from asphalt roads to rails. Initially the asphalt in the middle of the road is removed and light rails are laid down. As the rail is built the remaining asphalt is removed and the native habitat is restored where roads once ran. It was an interesting concept, though well before its time, and the book is beautifully illustrated and the concepts well thought out.

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[47] The tram is called Eltram and is produced by Electric Vehicles International (www.evi-usa.com).
[48] Contact Richard or Phil Jergenson for additional information (email: RJergenson@saber.net, PJergenson@saber.net)
[49] See Michael Hackleman's proposal entitled "Ultra Light Rail, a Community Industry Consortium", available upon request from Michael (email: Michael@hackleman.net). This paper, with roots in the Jergenson brothers' work as well as many others, discusses the economics of a Light Rail electric (rechargeable, not wired) transport system, beginning first with existing rail, then progressing to re-routable, bolt-down lightweight tracks on existing streets or thoroughfares.
[50] "YV88, an Eco-Fiction of Tomorrow", Christopher Swan, Sierra Club Books, 1977.

As petroleum’s availability declines and road maintenance issues become a concern, this may very well become a consideration in ensuring a viable and sustainable community.

Regardless, the City and Community of Willits needs to begin contemplating local mass transit options today in order to ensure they become a reality and our community retains its capacity to support itself. Preliminary considerations should at least include electric vehicle charging stations as well as trial electric mass transit, perhaps simply as a basic tram system deployed during the most congested times of year (e.g. during Frontier Days, etc.).

J.4.4. Personal Transport

But how will individuals transport themselves to places not served by public transport, or from remote locations to places where public transportation does exist? Given that the roads will still exist, in some state or another, the first step will be to expand bike routes, or to declare whole roads as bike routes. Such bike routes would serve not only conventional bicycles but also electrical-assist bikes as well as other totally or partially human powered transportation means.

For those that can afford them, Personal Electric Vehicles (PEVs) will also be an option and some provision needs to be made to find a way to collect funds (i.e. tax) in order to maintain the roads on which they will drive.

Without discouraging PEVs, some incentive does need to be put into place to encourage Ride Sharing or Car Share. Ride sharing is just that, if you are going somewhere, take your neighbor or a friend. A variant of this called Casual Car Pooling, where people needing a ride are picked up by those needing a passenger (e.g. for carpool lanes), is popular in the Bay Area. Car Share is a different concept where a co-op exists that members belong to and pay a share of ownership in, and with which a pool of vehicles are jointly owned. When one needs to go somewhere (and hopefully public transportation has been considered first), one makes reservations and a car is made available. Incidentally, both of these approaches can (and should) be put into place now to reduce the number of vehicles on the road.

In many European countries where the price of gasoline has been selling for $5.00 a gallon, these alternatives to private vehicle ownership were pioneered; and they are becoming increasingly popular in this country. For example, one company called City Carshare rents cars for $4.00 hour and $.44/mile including gas, insurance, parking and maintenance (there is also a one-time sign-up fee). Rentals include pickup trucks, hybrids, Vans, Beetles and more. Zipcar, Flexcar and Carlink are additional companies with similar rates and programs.

Returning to PEVs, Willits needs to consider establishing a precedent to encourage electric vehicles today. At the minimum, Willits should establish electric vehicle charging points by placing 20A, 100 volt receptacles in specially-marked parking spaces throughout the city. In some cities, solar roofs or canopies provide much needed shade in the summers and create solar/electric charging stations. This approach increases the visibility of alternative energy (and the use of) to its visitors, while providing a fundamental service to its community. And since charging conventional electric vehicles requires only a nominal amount of electricity (roughly $0.25/hour), the excess could be fed into the local electrical grid as another source of power.

Appendix K. Creating a Community Owned Utility Company

When developing electrical generation capacity, there comes a point when the energy produced exceeds the use at the local level. Also, certain forms of electrical generation produce energy only at certain times (like pumped storage hydroelectric, solar, wind, etc.). In order to balance the 'mix' so that electricity is available when the community needs it, being part of a larger grid consortium can be beneficial (e.g. they may be able to provide additional energy flowing into our grid when we need it and visa versa). This appendix presents information regarding Community Owned Utilities and Community Choice Aggregations (CCAs), both of which are relevant in these considerations.

K.1. Forming Community-Owned Electric Utilities

Deborah Penn, Energy User News, 7/24/2002[51]

Cities Look to Power their Own Way

Communities and their citizens across the country are exercising their basic franchising authority to gain control over an essential local service-electricity. City officials are evaluating an option that has existed since the electricity industry began, a form of self-franchising that is an alternative to granting a franchise to an investor-owned utility. Through the creation of a community-owned electric utility, citizens achieve local control and with it greater stability in the price, reliability, and responsiveness of electric service.

Renewed Interest in Public Utilities

The interest in forming community-owned utilities, often called public power utilities, is greater now than it has been in several decades. In fact, last year more than 200 communities requested information on the public power option from the American Public Power Association (APPA). The California League of Cities estimated that at least two dozen communities in California were studying the public ownership alternative. If any of these communities succeed in taking over the ownership and operation of the local system, they will join approximately 2000 existing public power utilities that serve the electric power needs of 40 million Americans.

Local policymakers, concerned about the troublesome results of electricity restructuring, are looking to protect their citizens against the volatility and uncertainty of the electricity marketplace. They recognize that having local control over decisions regarding generation resources, electricity prices, and service policies may determine the economic health of their communities.

Cities considering municipalization have only to look at more than 2000 existing public systems to see what is possible. Commercial public power customers paid an average of

[51] http://www.energyusernews.com

6.9 cents per kilowatt-hour compared with 7.5 cents per kilowatt-hour paid by commercial customers of investor-owned utilities, according to year 2000 data from the U.S. Department of Energy's Energy Information Administration. Public power utilities provide reliable service in part because their employees are part of the local community. Emergency response by utility employees is subject to immediate and direct accountability by local officials. Also, community-owned electric utilities have control over the capital improvements they make to keep up their local distribution systems. Simply put, a public power utility exists to serve its consumer-owners and has no other geographic areas or missions to serve.

Until a few years ago most municipalization efforts were driven by customers who were dissatisfied with the investor-owned utility's electric rates and were drawn to public power's proven track record of providing lower-cost electricity. More recently, as investor-owned utilities merge and consolidate often-distant operations, communities are becoming frustrated with the closing of customer service centers, loss of personal contact, and a decline in local service responsiveness they once enjoyed. Communities are pursuing public ownership to ensure reliable, predictable, responsive service.

Public Power = Local Partnerships

Cities are learning how valuable these local publicly owned electric systems are in achieving a community's goals. A public power utility is part of the same public service community that deals co-operatively with public works projects, downtown renovation, service extension policies, energy-efficiency programs, and business development and industrial parks.

Local business and industry may join with cities in exploring the public power option as a means to reliable, affordable, clean, high-quality electric service. Given the increasingly heavy reliance on delicate computer systems for many aspects of business operations, customers are more concerned about reliability than ever before. Municipal electric systems work with these commercial and industrial customers to help boost power quality. They provide these business customers with the benefit of "one-stop shopping" for municipal services, including attention to concerns about the reliability and quality of power at the customers' sites. Also, the public power utility has the flexibility to work with local businesses to pursue creative options such as distributed resources, smaller-scale electric power resources typically located near the point of end use.

Although most communities look at public power as a catalyst for lower consumer bills or local economic development, other community goals are served as well. One community, Belleair, FL, a small town in the Tampa Bayarea, is trying to buy the existing poles and wires in town to improve the reliability and aesthetics of the local distribution system. Belleair Mayor George Mariani, Jr. says the town's exploration began in the early 1990s when Florida Power Corporation refused to provide citizens with sufficient value in a project to underground distribution lines. The city commission did not want citizens to pay $4.25 million for an underground system that would be owned fully by the investor-owned utility. With the town's franchise grant to the investor-owned utility expiring in 10 years, they saw the opportunity to purchase the system instead.

Mayor Mariani says "an intermediate goal would be to systematically replace the decrepit and unreliable system with new under- ground utilities over a period of approximately 5 years." If Belleair owns the distribution system, he says, the town could "improve the reliability of the infrastructure, charge cheaper rates, improve property tax values by improving the aesthetics of the community, could make some contribution to the town's general operating funds or “all of the above."

City Options

In the new market environment, cities are evaluating many more options than just the renewal of their traditional franchise grants to investor-owned utilities. Feasibility studies typically show that acquiring the investor-owned utility's distribution facilities with full ownership and operation brings the greatest economic benefit to the community. But cities may work toward this goal of serving the entire community in stages. For example, the municipality may establish a partial system, then obtain a power supply contract or build or buy generation to serve municipal government facilities or specific business customers at a savings.

Corona, CA, is an example of a community that is pursuing numerous options simultaneously. Last year the city council established a municipally owned electric, natural gas, telephone, and telecommunications utility to serve the community of about 135,000 people. The council's actions authorized the city manager to take all necessary steps to create and establish a municipally owned utility to provide these services. According to George Hanson, the city's power utilities manager, the city is taking steps to help businesses within the community during this time of unpredictable price volatility in California.

The Corona City Council also approved the development of a power generation facility to be located at the city's wastewater treatment plant. The natural gas fueled combined-cycle cogeneration plant is expected to be between 10 and 23 MW and fully operational in late 2003 or early 2004. The power generation facility will be integrated with a biosolids handling operation. Heat from the generation process will be used to dry sludge and reduce the city's cost for treating sludge.

Forming the Public Utility

Communities typically begin the process of forming a municipal electric utility by conducting a preliminary feasibility study that examines the city's electric load growth, projects the cost of service from alternative wholesale power suppliers, and estimates the capital and operating costs of a new municipal utility. These costs are compared with the projected cost of service from the incumbent utility. Such a study estimates a range of savings, identifies risks and benefits, and recommends a course of action. A preliminary review of legal issues should be done at this time to make sure there are no insurmountable legal impediments.

Follow-on studies evaluate and appraise the distribution facilities that serve the city and analyze the potential cost of acquisition and severance required by the incumbent utility. If the city and incumbent supplier do not succeed in arriving at a purchase price, the next step would be to either take over the system through condemnation or construct alternative duplicate facilities to serve the community. An election may be held to authorize the establishment of the municipal utility or to authorize revenue bonds to secure funds for the acquisition. Throughout the study and implementation process, citizens should be kept well informed about the city's goals and how well they are being met.

Establishing a municipal electric utility takes hard work and long-term community resolve. It means taking accountability for the community's future electric service. On the other hand, public power is a very pragmatic solution for communities, and the potential exists for significant continuing savings for the city, its residents, and businesses.

The community that pursues public ownership typically experiences immediate benefits just from studying the option. The incumbent utility may take steps to improve reliability or service responsiveness and may become more active in community affairs. Large customers in town may be offered special incentive rates tied to long-term contracts with the supplier. In some cities, the movement for public ownership does not result in the creation of a new utility, but the initiative is effective in gaining valuable concessions from the investor-owned utility for the city's consumers and taxpayers.

New Utilities

APPA collects data on public power utilities, including the number of systems formed from or sold to investor-owned utilities. Its data show that during the past 20 years, 48 publicly owned electric systems were created, 25 of them in communities served by investor-owned utilities. New public power systems include: Page (AZ) Electric; Lassen (CA) Municipal Utility District; Trinity County (CA) Public Utility District; Troy (MT) Light & Power; Long Island (NY) Power Authority (LIPA); Massena (NY) Electric Department; Clyde (OH) Light & Power; Emerald (OR) People's Utility District; the City of Hermiston, OR; Tarentum Borough, PA; and the City of Santa Clara, UT.

Public power's critics argue that creating a municipal utility is not a viable alternative because the formation process is so costly. The costliness they refer to, in general, is the litigation brought against the city by the incumbent investor-owned utility in an effort to prevent municipalization. These lawsuits, primarily intended to run the city out of money and political will, have been effective in stopping several dozen municipalization efforts. However, most public power initiatives were dropped only after the city won important concessions from the incumbent utility, demonstrating that municipalization option is an important competitive force for communities. Today, many cities continue to work their way through the process with the ultimate goal of gaining control over local electric service.

Some Public Power Utilities

The largest of the new public power utilities, the Long Island Power Authority (LIPA) in New York, displaced the investor-owned Long Island Lighting Company (LILCO) nearly four years ago. LIPA provides electric service to about 1.1 million customers in Nassau and Suffolk counties and in the Rockaway Peninsula in Queens, NY. In May 1998, LIPA reduced electric rates across the board by an average of 20%, after it purchased LILCO's transmission and distribution system. Since that rate reduction, Long Island's electricity consumers have saved nearly $2 billion. In addition, LIPA has improved the system's safety and reliability program. It is also in the process of adding some 400 MW of new on-island generation and a new tie line to the mainland that will bring in about 330 MW from off-island resources.

LIPA's relationship with its business and industrial customers on Long Island is a priority for the new utility, and it takes an active role in business and civic organizations. LIPA's commitment to Long Island includes an emphasis on regional development through economic development incentives. It provides qualified businesses with the opportunity to obtain rate incentives and energy efficiency-audits. More than 300 companies have taken advantage of LIPA's economic development program, creating or retaining nearly 50,000 jobs.

LIPA offers many special services to retain and attract key industrial and commercial customers. The utility offers a Commercial Energy Analysis in which an LIPA energy expert examines existing equipment and analyzes the customer's potential energy savings. It then provides specific recommendations for energy saving measures and estimates the cost of projected annual savings. LIPA's Commercial Construction Program provides financial incentives to customers who agree to install energy-efficient equipment in buildings under construction or renovation. The program offers technical assistance to developers to facilitate the construction or renovation of buildings with an energy use performance that exceeds standard building practice.

Outlook for Forming Community-Owned Utilities

Public power initiatives are most likely to succeed when they have the strong support of local civic and business leaders and local citizens. In San Francisco, public power supporters were greatly heartened by the narrowness of their defeat last November. Although the telecommunications companies joined the incumbent investor-owned utility, Pacific Gas & Electric, in spending well over $1 million to fight the initiative, still public power lost by only 533 votes out of more than 129,000 cast. Tom Ammiano, the president of the city's Board of Supervisors, said the results were still a win for public power. "Now public power is on the table in San Francisco," he said. Supporters may bring the issue to the voters again later this year.

A group of Florida cities have franchise agreements that give them the right to buy the incumbent's distribution system at the end of the franchise term. They have been taking the steps necessary to acquire utility properties and to set up municipal utilities. Belleair's right to do this has been challenged by Florida Power Corporation. However, a judge ruled recently that the franchise agreement is clear and unambiguous, and Belleair has the right to buy the investor-owned utility's poles, wires, and other equipment needed to create a community-owned utility. The judge ordered both sides to come to an agreement over the utility property's worth. Also, the judge ordered Florida Power Corporation to continue to supply power to Belleair citizens in the interim. The investor-owned utility must continue to collect the "pass through" franchise tax of 6% from ratepayers and pay it to the town for the use of public rights of way.

The public power evaluation has the strong support of the mayor in Belleair, FL. Mayor Mariani says that from the beginning the city's evaluation made several important assumptions: that citizens, who are ratepayers, would be considered the "stockholders" of the new enterprise and would pay less for electricity; that the town must earn a reasonable return on its investment; and that the risk evaluation must conclude that a return is a reasonable expectation. Mayor Mariani says the whole thing boiled down to a simple business decision and the town began its due diligence.

Public power utilities are providing their communities with stability and accountability at a time when the electricity industry is changing very rapidly. While critics charge that public power is an outmoded concept, the fundamental control that consumers have through their community-owned utilities is proving vital in face of the risks of the new electricity marketplace.

Deborah Penn is vice president, Information Services, American Public Power Association.

K.2. Northern California Power Authority

Don Dame of the Northern California Power Authority[52] spoke to the Willits Community June 20, 2005. The following are notes from his talk and from the questions posed by the Willits Community in attendance.

Who is the Northern California Power Authority?

[52] www.ncpa.com

The Northern California Power Agency (NCPA) is a public agency of the State of California and works as an independent power broker unaffiliated with investor-held utility companies. The NCPA, as part of the Independent System Operators (ISO) can offer communities the ability to purchase blocks of electric power at discount, for distribution at the local level to community power customers. This electric power can additionally be specified as to its content (i.e. by percentage of renewable sources), making membership one way to achieve a higher ‘green’ energy content for the community. In effect, membership is the cooperative ownership of generation plants without (necessarily) the maintenance and power management issues. NCPA membership is open to municipalities, rural electric cooperatives, irrigation districts and other publicly owned entities.

Membership in the NCPA can be at many different levels

At the lowest level, membership allows the community to buy power they need without having to go through investor-owned utilities like PG&E. Under this scenario, the City of Willits simply negotiates contracts to purchase the power needed, then the City bills its customers. Under CPUC laws, the City may add a certain value to cover its expenses or to reinvest into expanding local power generation capacities.

At the highest level, membership allows communities that have their own power generation facilities to balance their ‘mix’ with other generation sources they do not own, thereby reaching the load needs of the community without having to become a wholly self-contained producer and utility.

At all levels, the NCPA ensures that power will be available to their member communities when they need it for the loads they have contracted.

NCPA Generation Plants Keep Rates Low

With wholesale energy prices higher than ever, NCPA's members found their jointly owned generation plants enable them to keep their rates low. And having generation resources provides assurance that retail rates will be competitive long into the future.

NCPA Membership is Diverse

NCPA Members include: The City of Ukiah (they own their transmission lines and have generation capacity), Healdsburg (does not have any generation capabilities), Redding, Biggs, Gridley, Lompoc, Roseville, Alameda, Palo Alto, Lodi, Santa Clara, BART, Port of Oakland, Placer County Water Agency, Lassen Municipal Utility District and several others.

The City of Willits may do well by contacting the City of Ukiah person that manages their utility to gage their feelings about the NCPA and the success of their program.

NCPA and Willits Community Considerations

Willits should not only consider becoming a Community-owned Public Utility, but also a member of the NCPA. Being a member of the NCPA would effect the formation of a Community-owned Public Utility at its very basic level: specifically the ability to buy blocks of power at a wholesale rate (negotiated to lock-in a long-term stable rate) to resell to the community. Ownership (and maintenance) of power lines, transformers, power generation facilities and the like would not be necessary at this level.

Once established as a NCPA member and Community-owned Public Utility, Willits could develop generation facilities with a cooperatively-owned pool behind them to sell into (and to offset their generation limitations such as time of day, etc.). Technically, at this stage, Willits would be moving into what is called a Community Choice Aggregation (or CCA for short). The CCA classification falls under California AB117 and is basically a descendent of the Direct Power construct that predated deregulation[53]. However, as a member of the NCPA, much of the problematic aspects (such as the price contract management and vulnerabilities) of being a CCA are mitigated.

As the Willits utility generation facilities grew, we could then examine disenfranchising PG&E by condemning PG&E's local facilities such as the power lines and transformers. This falls under Article 11 of California's regulations and would remove the PG&E charge that would have persisted to this point for power transmission. This would place complete control into the hands of the community and create additional local employment in the maintenance of such facilities.

NCPA Summary

The Northern California Power Agency is a public utility network that can offer advice on becoming a community-owned utility to whatever degree Willits may be interested (i.e. from buying blocks of power at a discount to complete ownership of local power generation and transmission facilities). Should the Community of Willits follow through in the goals towards becoming our own utility, membership in the NCPA could be seen as a way to mitigate costs and to help stabilize prices while developing power generation facilities of our own.

K.3. Legal Aspects

[53] A CCA means the power is generated locally, that PG&E (or some other power entity) provides all no-electric supply functions such as billing, and that the CCA entity is at full risk of market fluctuations. In addition, all legal and professional needs and costs are borne by the CCA.

On December 16, 2004 the California Public Utilities Commission approved Administrative Law Judge Kim Malcolm's Proposed Decision in its Community Choice Aggregation proceeding, *making it legal for any California municipality or county to find an alternative electricity provider for its community*. San Francisco, Los Angeles County and San Diego County have completed studies on how to accelerated renewable energy and efficiency investments at twice the state mandated levels of green power in the electricity mix, reducing the exposure of residents and businesses in these municipalities to increasingly volatile fossil fuel prices - achieving massive greenhouse gas reductions -- all without so much as a rate increase. Go to www.local.org for more information.

The transition to a Community Choice Aggregation, to a community-owned utility, and perhaps the specification of the mix of power (i.e. ‘green’) will most likely require a referendum placed on the ballot for the community to approve.

Appendix L. Creating a Community Alternative Energy Co-op

A Community Alternative Energy Co-op provides a central point where citizens as well as business and the City can come to get accurate information about alternative energy without obligation. This includes information on current regulations, types of equipment, assistance with designs, information on state incentives and financing as well as assistance on finding and choosing a local contractor. It is important that such a non-profit group exists to help people make the right decision and to promote alternative energy on the private and commercial levels. With the new California 'Million Solar Roofs' initiative, this will prove even more important.

L.1. Solar Sebastopol and Community Cooperative Energy

Phone Conference with Pete Blair of Solar Sebastopol regarding Alternative Energy (AE) Co-ops (December 29, 2004)

The Sebastopol Community Solar Group "Solar Sebastopol" was created with the goal of having 1 MegaWatt of solar energy installed in the city, both on private and commercial buildings, by the end of 2005. This followed a study recommending such by Sonoma State University. The goal was announced to the community and kicked off by the Solar Sebastopol fest. Solar Sebastopol is a non-legal entity of the city.

- The Solar Sebastopol Program has been run and managed by Co-operative Community Energy (www.ccenergy.com) until now. CC-Energy made the initial dollar investments for the Sebastopol Solar festival in 2003, as well as for the marketing and outreach efforts of the Program. The 2004 fair was supported by booth fees and volunteered hours by Pete Blair, CC-Energy Sebastopol office manager, CC-Energy CEO Dan Pellegrini, and volunteered hours by the Fair Coordinator and the Marketing person as well.
- Pete Blair was hired by CC-Energy and originally managed the group until a larger (5+) person steering committee was created. This steering committee includes people from Sonoma State University, the city of Sebastopol, and industry experts.
- The CC-Energy co-op provides system design, sells (by co-operative purchase) solar components, does the PUC paperwork, provides advocacy and recommends solar installers/contractors. The co-op does not install systems.
- The city considered providing funding on 2 fronts – that of the rebate amount (effected since it is a short-term loan) and that of the remaining costs of solar installation (not effected since this would constitute public monies for private use). In the case of the former amount, this is generally now provided by manufacturers or distributors.
- Others can join the co-op simply by signing on as a co-op member. The membership is available to those involved in the field (e.g. installers, vendors), and those wanting a solar system installed. Out of about 250 members to date, well more than half purchased solar systems through the co-op.

- The co-operative initially had friction from local (solar) contractors who felt they were taking business by providing low(er) cost components but that friction has generally been alleviated due to the opening by the Solar Sebastopol Program of installers to providing components themselves.
- One of the more interesting aspects of the co-op's functions is to teach others, including building inspectors about the installation standards, above and beyond the universal building code (UBC). This is to ensure only the highest quality installations are performed and to ensure that community members are getting a system that will work for years to come. The Solar Sebastopol Program is building a database of installations (including photographs) as well as customer comments about installers. These will be added to the website and will be available to anyone looking for an installer.

<u>Had they (the city of Sebastopol) considered becoming a energy producer (i.e. their own power company?</u> Yes but they could not figure out how and asked if I had any info. I mentioned that Green Mountain Power (ref. The Hopland array) might be a good contact for info on such. I followed this later by sending them a copy of the article "Forming Community-Owned Utilities".
<u>What is the city doing to encourage or increase participation in the Solar Sebastopol idea and goals?</u> The city is now inquiring if a project includes alternative energy. If so, they are charged a lower fee. Conversely, if a project that contains NO solar component is to be permitted, then that project will incur additional fees that will go towards supporting the Sebastopol Program. These fees are then used to fund literature and associated programs about the goals for the public as well as to offset the costs of the program.

<u>Would CC-Energy be interested in setting up, or helping us setup, a co-op in Willits?</u> I described the Sustainable Willits group and noted that, based on what I had heard so far about CC-Energy and the Solar Sebastopol, that the addition of a 2nd city and the breadth of our group may help Solar Sebastopol in its goals. Pete was quite interested, mentioning that they may want to attend one or more meetings.

<u>Contact Info:</u>
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Solar Sebastopol Links:
http://www.ci.sebastopol.ca.us/solarsebastopol.shtml
http://www.ccenergy.com/news/solarsebastopol.html

Note: The Willits Economic Localization group is working to get a representative from CCEnergy to speak to the community later this year.

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