Two Projects to Start the City of Willits Towards Energy Independence

Prepared for the City of Willits, California

by the

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

Rev. 02/27/06, bsc

Preface

This document builds upon the work outlined in the report "*Recommendations towards Energy Independence for the City of Willits and Surrounding Community*"[1], focusing on 2 projects we can begin with today. The selection criteria of these projects included the substantial reduction of existing energy costs, the potential of 'innovation grants', and augmentation of the City of Willits and surrounding community in time of severe energy crisis or disaster.

It was prepared by members of the Willits Ad Hoc Energy Group, an offspring of the Willits Economic LocaLization (WELL) Energy project. Some of the participants share roles with the Renewable Energy Development Institute (REDI), also located here in Willits.

Where possible, the cumbersome technical aspects of the discussion have been relegated to the appendices. 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/Papers/2EnergyProjects.pdf

Ad Hoc Contributors:
Brian Corzilius -- bcorzilius@corzilius.org
Phil Jergenson -- pjergenson@saber.net
Richard Jergenson -- rjergenson@saber.net
Ron Orenstein -- rborenstein@saber.net
Gary Owen -- gwo@pacific.net
Ralph Pisciotta -- pisciotta@instawave.net

With sincere appreciation to the WELL Energy Group whose research laid down the basis for this work: Jason Bradford, Rob Burke, George Cottrell, Ron Cole, Brian Corzilius, David Drell, Heinz Dullinger, Phil Jergenson, Richard Jergenson, Christopher Martin, Dave Mowen, Ron Orenstein, Gary Owen, Ralph Pisciotta, Claudia Reed, Keith Rutledge, Brian Smith, Wally Stahle, Kris Wagner, Ann Weller and the many others who have sat in!

[1] Published and distributed in 2005 and available on the web at:
http://www.willitseconomiclocalization.org/EnergyIndependencePlan.pdf

Table of Contents

Foreword

As this paper was being researched and prepared, the Willits City Council voted in approval of solarizing the city facilities. Although this paper contains provisions for the partial solarization of the water treatment plant, those provisions are not meant to be in conflict with the proposal put forth by Councilman Ron Orenstein. Rather, the suggestions contained herein should be viewed as adjunct – in other words, to help plan the implementation of that project and to expand the vision for the future.

1. Executive Summary

Energy costs have risen dramatically over the past year and analysts are forecasting additional increases in the near future due to instability in various parts of the world. As energy costs escalate, those that are impacted first are those of low or fixed income. We, as the community of Willits, must work to plan for this potential crisis to ensure a strong community in times of need.

This paper proposes 3 steps the City of Willits can undertake, potentially with substantial grants, to address the looming crisis as well as to decrease the vulnerability of the City itself (and thus the pockets of the taxpayers). These include 1) A renewable energy mix at the water treatment plant to ensure continued operation in the event of a power grid failure, 2) The production of methane, a replacement for propane and natural gas, at the sewage treatment plant to ensure fuel for heating, and 3) the reinvestment of a small percentage of the realized energy savings (from these and similar projects) into a community energy conservation center to provide assistance in reducing energy costs to those most in need.

2. Becoming Prepared as a Community

The recent events surrounding Hurricane Katrina drove home two important points for any community to take note:

1) The need to keep municipal water systems operational, and
2) The potential plight of the lower- and fixed-income members of a community.

Coupled with this winter's cold and the escalation of energy prices – especially natural gas – we as a community would do well to learn the experience of Katrina and start examining our own preparedness. Listening to our municipal and county representatives discuss disaster preparedness at the 'Town Hall' meeting here in Willits late last year, we realized we still had so much to do in advance of a local calamity.

In this paper we would like to offer a two-part proposal to address provisions for water and heating fuel in times of disaster. Rooted in these proposals are not only viable solutions but also real benefit to the City in terms of offsetting energy costs and potentially, increased revenues and employment opportunities.

In a nutshell, the two parts of the proposal are as follows:

1) At the Water Treatment Plant, we propose situating a solar array of sufficient size to keep one pump running during part of each day (if the power grid fails) to ensure potable water to the primary storage tank for the City. This would ensure the hospital and much of the valley floor community has water in times of disaster. In conjunction with the solar array would be a small hydroelectric generator to

provide electricity to the water treatment maintenance facility. This would provide power for at least minimal system monitoring and maintenance operations through the crisis.

2) At the Sewage Treatment Plant, we propose modifying the 'headworks' to divert a significant portion of the incoming solids into a 'biodigester'. The purpose of this biodigester would be the production of methane gas – a natural byproduct of sewage treatment and an equivalent of natural gas and propane[2]. This methane would be fed directly into a gas turbine generator to produce electricity to offset the sewage treatment's energy needs. Excess gas could then be compressed and distributed to the City and community in times of need. Such gas, in compressed form, could be used interchangeably with propane for home heating as well as to power City and emergency vehicles.[3]

As to the costs for the implementation of these facilities, we have included overall estimates as well as potential grant sources based on similar projects of this nature completed elsewhere in the United States. Of note here are grants from both FEMA and Homeland Security (where community emergency preparedness and response are concerned) as well as from the EPA and Department of Energy (DOE) (with regard to sequestering methane emissions[4] and innovative energy projects).

In writing this proposal we are aware that there is an effort underway to solarize City facilities. We are also aware that the Sewage Treatment plant is undergoing redesign, with the potential for reconstruction as a wetlands facility. This proposal does not conflict with either action under way; instead it augments that work, helping to further decrease the vulnerability of the City of Willits to escalating energy costs.

3. Ensuring Potable Water in Power Grid Failure

According to a recent story in The Willits News, the hospital is fed from the primary Willits water tank at a tap at the half-way mark. Should a catastrophic event occur (e.g. earthquake or other disaster causing power grid failure), the hospital's water supply would soon be in danger. As time progressed, eventually all of the area served by the Willits Water Treatment Plant (WTP) would be impacted and emergency services would be pressed thin to move sufficient water resources to those in critical need. This section of this proposal focuses on addressing this potential (emergency) scenario.

3.1. Solar Array to keep One Pump Operational

[2] These are minor differences, primarily based on the purity of the generated gas. Natural gas is comprised primarily of methane.
[3] Such vehicles would need to be converted to run on natural gas / propane.
[4] Methane is considered 25 times worse than CO_2 as a greenhouse gas and sources emitting the gas into the atmosphere (such as landfills) are under increasing scrutiny by the EPA.
[**http://www.eere.energy.gov/femp/newsevents/fempfocus_article.cfm/news_id=8961**]

The WTP is served by three 100 horsepower (Hp) pumps. Two are Variable Frequency Drive (VFD, an energy-saving and control measure allowing the pumping volume to be varied), while the third is a soft-start pump that doesn't permit variable flow. During the winter months, only one pump is used but during the summer, two pumps run pretty much 24/7. The pumps are located in the lower (Morris) reservoir and run on 480VAC. Power is fed to them from a 9KVA, 3 phase PG&E connection at that site[5]. Annual electricity consumption at the lower / Morris reservoir is 405,280KWhr (usage is primarily for the pumps)[6].

To run one of the three pumps requires roughly 85KW of power[7]. Taking into account losses in a generation system, one would need approximately 90KW worth of solar generation capacity to power one pump.

Although solar is relatively expensive as far as power generation options, for the relatively small power consumption of each pump, solar is one of the most cost-effective options. The goal here is (should a power grid failure occur), that we would be able to continue pumping some water each day to prevent the main system tank from getting below the critical level. Since the average insolation[8] for Willits is 5 hours/day, we could use a solar array to provide an average of 5 hours of pumping per day which should be sufficient, in conjunction with water conservation measures, to keep the tank at an acceptable level.

During a tour of the WTP, led by Ron Orenstein, potential solar PhotoVoltaic (PV) panel mounting sites were surveyed. The upper reservoir (where the maintenance operations are housed) has good sites. However, at the lower reservoir pump site, the banks are steep and covered with oak. As a result, there wasn't a good place to locate a PV array conventionally. **One of the group suggested locating the array on the water and this was warmly received by the WTP employees leading the tour since it would potentially reduce evaporation as well as reduce the use of algaecide due to reduced sunlight entering the reservoir**. As it is viewed, siting such an array on the water is still the best option and would also gain a lot of attention in both the trade and general press due to its innovative approach.

For the purposes of this proposal, and in the vein of disaster preparedness, only an array large enough to keep one pump operational is described. Details of such an installation, as well as cost figures, can be found in the Appendices, beginning on page 7. It is expected that some of the costs would be offset by a Homeland Security (DHS) / FEMA

[5] General operation information from Denny Caine, WTP supervisor, in an August 20, 2005 email to Ron Orenstein.
[6] Electricity consumption from Ron Orenstein, Council member and Vice Mayor, as presented to the Willits Ad-Hoc Energy Committee.
[7] One horsepower equates to approximately 750 watts of energy without consideration of pump inefficiencies, so a 100 Hp pump would require roughly 85 thousand watts (85KW) to operate.
[8] 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.

grant based on the goals of water system reliability and disaster preparedness. More information on prospective grants can be located in the appendices beginning on page 40.

3.2. Hydroelectric to keep Maintenance Operational

Plant maintenance operations are housed roughly 500 meters from the pump site at the lower reservoir. During a time of crisis, some electricity needs to be provided to this facility to ensure the viability of our water system. Annual electricity consumption at this location amounts to approximately 66,000 KWHr[9].

One could conceivably site another array at the maintenance facility (there appears to be sufficient ground area to support such); but there is another alternative discovered while touring the WTP facilities that is far cheaper – specifically that of hydroelectric from the Fish and Game mandated outpour at the lower reservoir.

Why couldn't we employ hydroelectric for both the pumps as well as the maintenance facility? Based on the analysis of the potential hydroelectric site, there is only about 56KWhr/day worth of potential generating capacity and the pumps alone each require 85-90KW to operate[10].

While the hydroelectric potential is miniscule in contrast to the demands of the pumping facility, it is quite sufficient for keeping much of the maintenance facility operational[11]. In addition, since the dam and piping for such a hydroelectric installation already exists (the most costly part of a hydroelectric project), the installation of hydroelectric at the Morris reservoir would be fairly inexpensive.

Details of such an installation, as well as cost figures are contained in the Appendices, beginning on page 11. As with the solar installation for the pumping facilities, it is expected that DHS/FEMA grants can be procured.

4. Reducing Sewage Treatment Costs while Producing Heating Gas

It is our understanding that the Willits Sewage Treatment Plant (STP) is under consideration for re-design, potentially as a wetlands treatment based facility. The opportunities reconstruction of the STP bring should include consideration of conservation measures (for examples, see the section beginning page 18), as well as the planning and installation of renewable energy sources located at the plant itself to offset

[9] Electricity consumption from Ron Orenstein, Council member and Vice Mayor, as presented to the Willits Ad-Hoc Energy Committee.

[10] A KW (kilowatt) is the instantaneous generating capacity or consumption, while KWHr (kilowatt-hour) is the averaged production or need over a timespan, in this case, 1 hour. For example, a 100W light bulb requires 100 Watts in order to illuminate and it requires a source capable of generating 2400WHr to keep it illuminated over 24 hours.

[11] The potential hydroelectric capacity identified could fully meet 1/3 of the current consumption at the maintenance and upper (#1) reservoir facility, worst case.

operating costs. This section of this proposal presents one such consideration – that of methane production – which would also potentially assist the larger community in times of natural gas and/or propane shortages.

The present STP facility consumes roughly 1,042,147 KWHr annually -- the highest consumer in the city, as well as one with the highest peak electricity rates[12].

A STP is designed to remove the solids from the waste stream entering the plant, clarifying the remaining water to a level deemed environmentally safe for discharge. Solids removed from the waste stream are placed in landfills, or when possible, used as fertilizer for croplands (see the section beginning on page 34 for more information on biosolids as a fertilizer).

A methane biodigester works on waste solids to produce gas for use as an energy source. It does this by the use of anaerobic bacteria which consume the waste and form methane as a by-product. Methane is a viable replacement for natural gas and propane, including use in electricity generation, fuel for vehicles, cooking and heating. Information on methane vs. natural gas can be found in the section beginning on page 27, and information on powering vehicles with natural gas or methane can be found beginning on page 29.

An existing or newly constructed STP can easily be converted to generate methane, in turn using it to generate electricity to offset plant operational costs. Further, excess electricity can be fed back into the grid for credit, or used to compress excess methane gas for use elsewhere as a natural gas replacement. The digested solids that remain after passing through the biodigester can then be used as cropland fertilizer providing additional revenue to offset STP operating costs.

Details of such a STP methane installation, as well as cost figures are contained in the Appendices, beginning on page 13. The Environmental Protection Agency (EPA) as well as the Department of Energy (DOE) have provided grants to other municipalities for such a conversion. For discussion of a functioning STP doing methane recovery, please refer to the section beginning on page 25.

4.1. What if We Need More Gas?

As the production of methane at the STP takes off, there may come a time when we start looking around to see how we can generate more of this gas for use in our community. Borrowing from the discussions put forth in the original 'Energy Report', there are a couple of areas worth exploring. One is the diversion of the waste stream into a modified

[12] From Ron Orenstein, based on City of Willits PG&E bills. This figure includes the main STP, STP irrigation, flow meter and pump. Peak rates are $0.26/KWHr. **Note, the City of Willits would do well to go to PG&E and have the peak rates they pay standardized** (peak rates currently vary from $0.15 to $0.26/KWHr).

methane biodigester. The other is the extraction of methane from the old landfill (we believe it is currently 'flared' off or burned).

The advantage of extracting methane from the old landfill is that all of the plumbing is in place and that the same equipment used in waste water treatment conversion of methane can be used at the landfill. This is a bonus in terms of training, maintenance and spare parts.

The EPA has a program entitled "Landfill Methane Outreach" which has funding available. More information on the untapped potential as well as equipment types and examples can be found in the original 'Energy Report', section E.3.

5. Caring for our Neighbors – An Eye for the Future

The final part of this proposal involves, quite literally, investing for the future. What we are proposing is the establishment of an 'energy fund' to provide assistance to those that cannot afford to undertake energy conservation measures (insulation, efficient windows, etc.), let alone the use of renewable energy. Such a measure is important as low- and fixed-income neighbors will be the first and hardest hit by rising energy costs. This program should be funded out of the cost savings realized when local energy systems are put into place offsetting the City of Willits energy expenditures. Specifically, say 1% to 5% of the realized cost savings should be invested into a community energy conservation program run by an independent non-profit organization whose primary purpose is to provide funding and personnel to carry out such work.

One example of such an organization that already exists is the Renewable Energy Development Institute (REDI). Although somewhat inactive at the present time, the organization's membership and structure is in place such that a program like this may be easily facilitated.

For the program itself, an example to follow is Humboldt County's Redwood Coast Energy Authority[13], which is funded by local municipalities, PG&E, the PUC and the DOE.

A small investment in community energy conservation will go a long way toward energy independence. Additionally, it could potentially stimulate local jobs and thereby increase city tax revenues. Let's make Willits Mendocino County's "Energy Resource Center"!

[13] Redwood Coast Energy Authority: http://www.redwoodenergy.org/ or (800) 931-RCEA.

Appendix A. Details; Water Plant Solarization

A.1. Overview

A tour of the water plant's lower reservoir (Morris) showed that space for siting a large array of solar PV was not available without removal of trees and grading. One of the party suggested the siting of such an array on the reservoir itself as an alternative. Further investigation turned up research suggesting that siting a PV array on or near a body of water could actually increase the amount of energy generated. One of the plant workers also noted that siting an array on the reservoir could potentially reduce evaporation as well as reduce the need to treat the water with algaecide due to lower solar exposure.

In this discussion, we will follow through with the premise that the best site for a large array to drive the plant's pumps would be on the water at the lower, Morris reservoir. The remainder of this appendix will address the physical mounting and cost considerations for such an array.

A.2. The Equipment

A.2.1. Floating Solar Array

For convenience, we will assume Kyocera 167g PhotoVoltaic (PV) panels will be employed (167Watt rated). The size of these panels will be simplified as 60" x 40" x 2". Furthermore, we will use a 5hr/day average year-round insolation figure.

Panel mounts from **2-Seas** (of Willits) will be used for this discussion (bottom-hinged for attitude adjustment [2-Seas p/n UNI-GR/10H], $10K per 100 panels, retail). The panel mounting hardware will be affixed to a raft float frame as described in the next paragraph.

The raft flat and framing would come from **DockWorks** (of Lakeport). Standard raft sizes go up to 8' x 40' (the largest that could be transported without special considerations).

Given these factors, we will use a PV panel mount of 25degrees[14]. Avoiding inter-panel shadowing would require an area of 50" x 60" per panel, going to a max height of 20" with consideration of mounting hardware.

[14] Optimized for April through September production. Attention is needed to layout and angles to ensure no inter-panel shadowing. Some studies report marked increase of power production with panels situated on or adjacent to bodies of water.

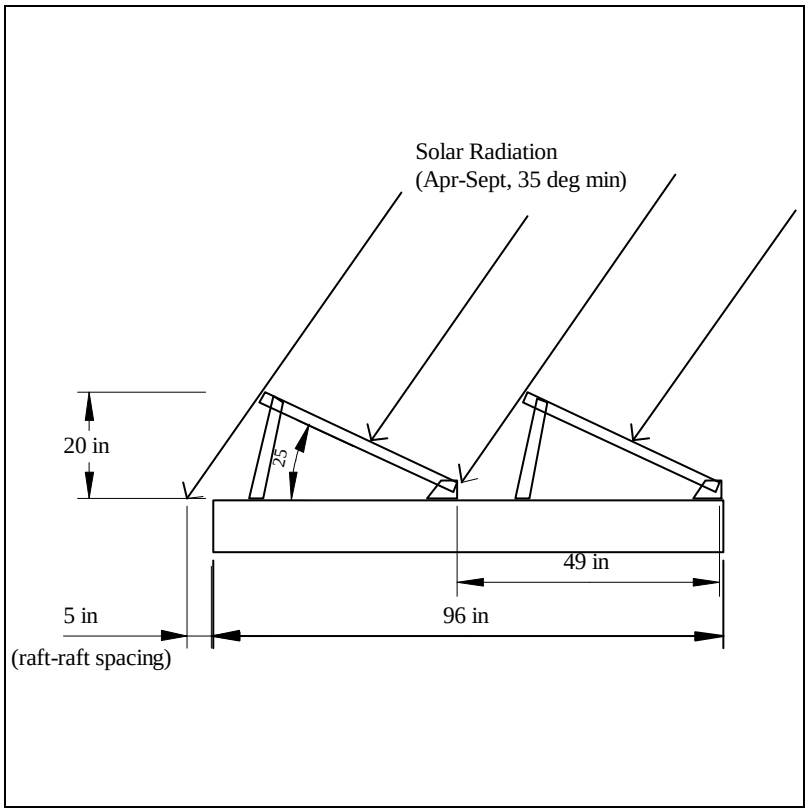


Figure 1. Panel Spacing on Raft Width, Optimized for April 1 - September 1 Solar Angle

Summary of Construction:

- 8' x 40' PV raft sections[15], pin-hinged for ease of section isolation and maintenance [$6.4K ea., retail]
- 3' x 40' joiner raft section to tie units together and allow maintenance access to individual sections [$2.4K ea., retail]
- Each 8' x 40' PV raft section would support 2x8 panels (16 total or ~2.6KWatts each) using panel mounting hardware from 2-Seas of Willits..
- Sections would be linked with modular, water proof cable (e.g. Seacon of San Diego)
- Invertors to convert the DC power produced by the PV panels to AC power for the pump(s) could either be placed on joiner raft or on-shore.
- Power cable routing power to shore would be underwater.

A.2.2. On-Shore Conversion

Located on shore are the electronics necessary to convert the Direct Current (DC) from the PV array into Alternating Current (AC), 480VAC 3 phase (called inverters). Additionally, on-shore equipment also includes the PG&E interface and circuits to isolate the electricity from the grid to ensure continued operations during electric grid failure

[15] 8' x 40' raft is the largest off-the-shelf unit that can be transported by truck without escort vehicles.

(called ‘islanding’). Because this equipment is specific to the installer’s preference, this proposal will not go into detail here. The only critical consideration is that the equipment be able to isolate the system from the grid in event of failure, while still providing electricity to WTP systems.

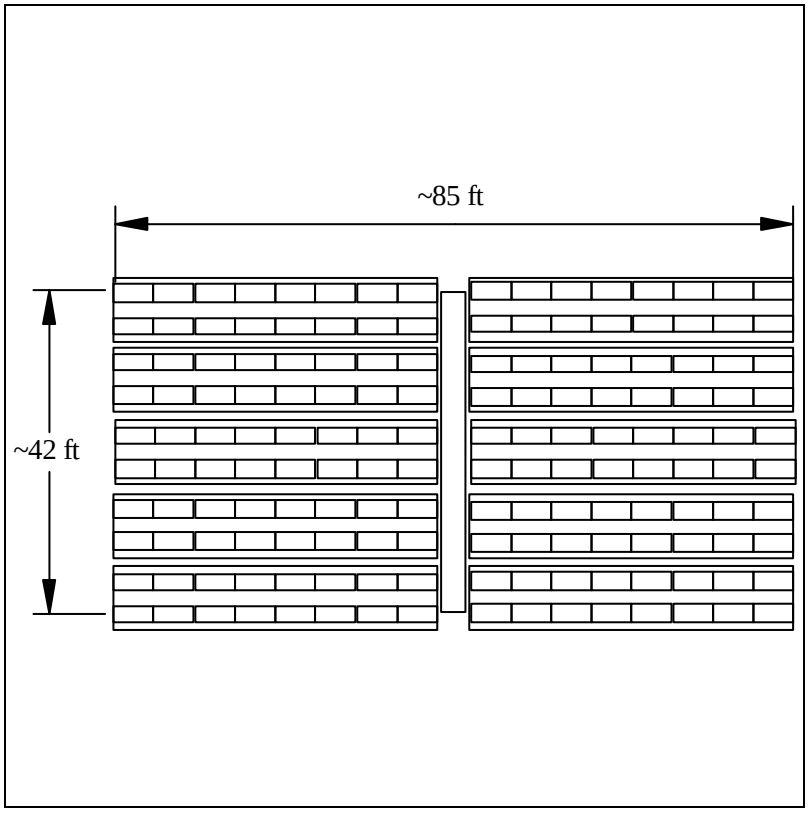


Figure 2. 27KW 10-unit PV Raft w/ Joiner Layout & Dimensions

A.3. Costs of the Floating Array

For a ~90KW array:

34 PV raft sections @ ~$6,400ea, retail	$217,600
4 Joiner raft sections @ ~$2,400ea, retail	$9,600
544 PV mounts @ ~$100ea, retail	$54,400
Cabling and water tight connectors (est.)	$8,000

Total cost, mounting & special cabling: **$289,600**

Cost of mounts & raft per W installed: **$3.19/Watt retail**; **(**est. ≤$2/W in volume noted)

A.4. Production and Estimated Costs

A ~90KW array would produce ~450KWhr/day (5 hour insolation) or **164,250KWhr/year** [164MWhr] at peak rates. This equates to **$24,637.50 annually** at

the $0.15/KWhr peak rate charged. *This does not include the cost savings due to reduced algaecide use or lowered evaporation losses.*

Estimating a final, installed rate of $8/Watt[16], this 90KW array would cost an estimated $726,000 before rebates and grants are considered. With a rebate of $2.80/W (SGI program or equivalent), and 0% Clean Renewable Energy Bond rate, the cost now becomes $468,000.

An important consideration here is that part-to-most of this system could be funded by a grant from FEMA and/or Homeland Security since what we are dealing with here is the security of our community.

A.5. Summary of Benefits

- Ability to function in times of grid failure / disaster.
- Reduced algaecide use.
- Reduced evaporation of reservoir waters.
- Hedge against escalating energy costs.
- Annual income from the sale of 'green credits'.
- High national visibility – water industry trade magazines, alternative energy magazines, etc..
- Potential eco-tourism benefits.

[16] The $/Watt figure includes not only the raft and PV modules but also the on-shore equipment (inverters, grid inter-tie and islanding or grid isolators).

Appendix B. Details; Water Plant Hydroelectric

B.1. Overview

New hydroelectric installations are typically problematic due to the regulations of Fish and Game. Generalized, the alteration of stream beds and surrounding natural habitat is forbidden. This applies to any type of damming or flow diversion. As a result, the best candidates for hydroelectric are existing waterworks where diversions already exist.

B.2. Potential Production

At the Willits Water Plant facility, the stream feeding the upper reservoir was observed to run at **0.96 ft^3/second** early September 2005 (driest part of the year). Fish and Game requires Willits to release the same volume flowing into the upper reservoir out the lower reservoir during the dry season. This is accomplished through an 8" outlet pipe plumbed into the lower dam (an estimated head of 50 feet or 15.4 meters). As noted above, this presents an ideal opportunity to develop hydroelectric potential without undue costs or environmental reviews.

How much could be generated, considering the worst-case flow of 0.96 ft^3/second (0.026m^3/sec)? Using the standard hydroelectric formula KW = 5.9 (factor) x m^3/sec (flow) x m (head), we can plug in the above values: 5.9 x 0.026m^3/sec x 15.4m = 2.3KW. Given that the flow is continuous and worst case, this means that we could produce ~56KWhr/day or **20,148KWhr/year** (20.1MWhr).

This equates to **$3022 annually** at the $0.15/KWhr peak rate charged.

B.3. Sizing the Equipment

Since the actual amount generated will be much higher with considerations to wet season flows, the hydroelectric generator must be sized to meet the higher flows. Given the size of the outlet pipe (8 inches), a **10KW generator** would be a reasonable unit to consider.

The retrofitting of the dam for production of hydroelectric would involve the modification of the outlet pipe with a drop-in generator as well as running power lines to the maintenance building nearby (also the point of electrical service from PG&E)[17]. No alterations of the streambed, dam or other associated works would be required.

As with the solarization of the lower/Morris reservoir, 'islanding' electronics for the grid inter-tie will be an important consideration.

B.4. Estimated Costs

[17] In order to provide electricity to the maintenance facility near the lower reservoir. The lines would have to be extended there.

Costs are estimated to be $50,000 for the turbine and associated gear, $5,000 for the modification of the existing 8" outlet pipe, $6,000 for the utility interconnection and $6,000 for the installer for an **estimated total of $67,000**.[18] Although there are no rebates for hydroelectric power, it is considered renewable and qualifies for **green credits** as well as sale over the grid.

B.5. Summary of Benefits

- Ability to function in times of grid failure / disaster.
- Hedge against escalating energy costs.
- Annual income from the sale of 'green credits'.
- Potential eco-tourism benefits.

[18] Based on a similar installation by Canyon Hydro in an Aspen Colorado ski resort -- as reported in Home Power Journal, issue #111.

Appendix C. Details; Sewage Treatment Solids Diversion & Methane Production

C.1. Overview

A Sewage Treatment plant employs three treatments steps: 1) *Preliminary* where the 'junk' is weeded out, 2) *Primary* where the majority of the organic solids are removed, and 3) *Secondary* where the remaining solids are removed and the remaining water is treated to applicable standards. Removal of organic solids is a required step regardless of the type of treatment the plant employs.

Methane production depends upon the use of a 'digester' to consume the organic solids and produce gas through anaerobic (without air) bacterial action. The addition of a digester does not alter the plant's normal operations, with the exception of providing a transitory use of the organic solids that must be removed regardless. Such organic solids are typically placed in a landfill, or used to fertilize croplands, and the employment of a digester does not alter this need.[19]

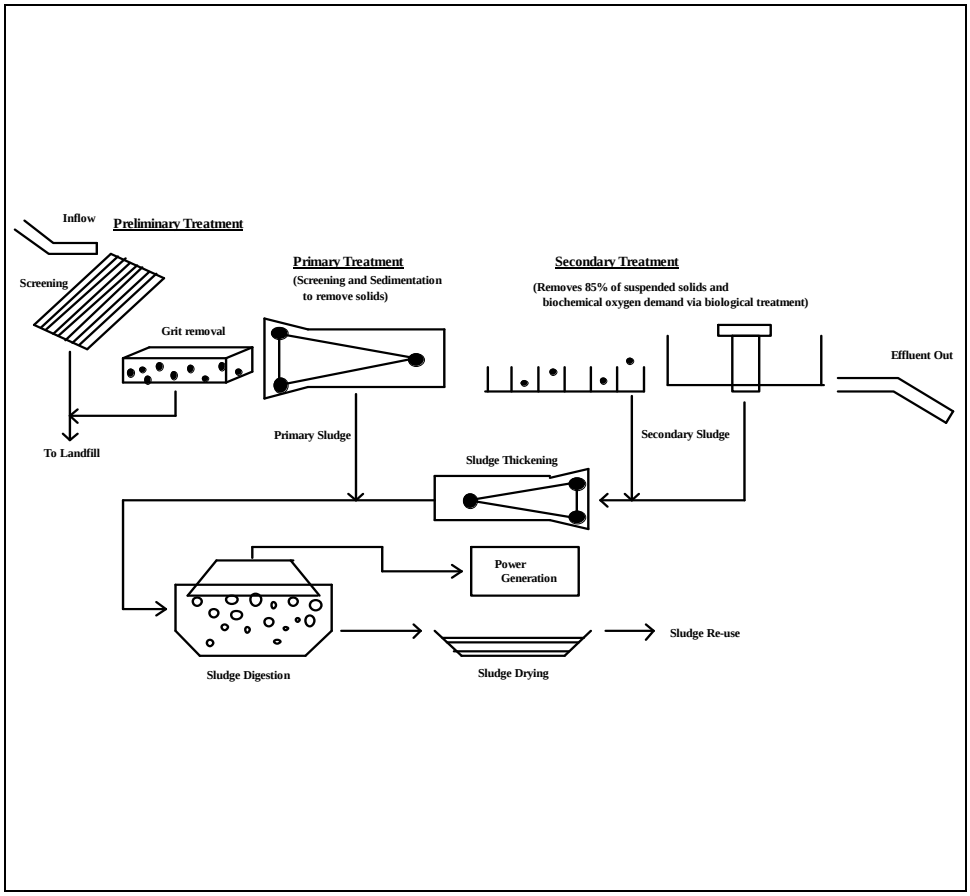


Figure 3. Sewage Treatment with Methane Digester

[19] Note, if the Willits Waste Treatment Plant does send the residual organic solids to the landfill, please consider reading the article in the appendices on Biosolids as Cropland Fertilizer – the cost savings (and potential revenue) could be worthwhile.

Methane production can also be augmented by the addition of certain waste streams from other sources. These include the addition of paper, yard waste, kitchen scraps, etc. to the biodigester. Such additions augment the carbon portion of the carbon-nitrogen ratio (expressed as C/N where the ideal is 20 to 50), making the digestion process more efficient. This may be a future consideration to further reduce waste streams in the Willits area.

The gas produced by the methane biodigester can be fed directly into an engine that drives an electric generator. Traditionally internal combustion engines, similar to the one in your car, have been employed but their efficiencies are typically under 20%. Over the last 5 years the industry has begun switching to the use of turbine-based generators (e.g. Capstone micro turbines) that have efficiencies in the 70% range, coupled with fewer parts and lower maintenance costs. One benefit of using the newer turbines is that they can run without gas enrichment, and in some cases, don't require scrubbing the gas. The electricity generated is then used by the plant with excess being sold into the power grid (under a generation contract or community owned utility structuring).

Gas from the biodigester can also be compressed for bottling and/or distribution as a replacement for imported natural gas and propane. Typically this involves a multi-stage compressor driven by the electricity generated by the methane-fueled generator. In addition, some CO_2 and H_2S scrubbing may be required, though this process is fairly straightforward[20].

The figure below illustrates the flow and use of so-called 'bio-gas' in a converted STP. Note how co-generation is employed to reuse the heat generated by the turbine in the process of generating electricity!

[20] Scrubbing is the removal of undesired components of the gas, in this case CO_2 and H_2S. Reduction of CO_2 can actually be performed during digestion using lime water ($CaCO_3 + H_2O$) which typically also increases the methane production. Scrubbing CO_2 after digestion can be accomplished by the use of calcium hydroxide (CaOH) while H_2S scrubbing can be as simple as using rust (FeO_3) to react.

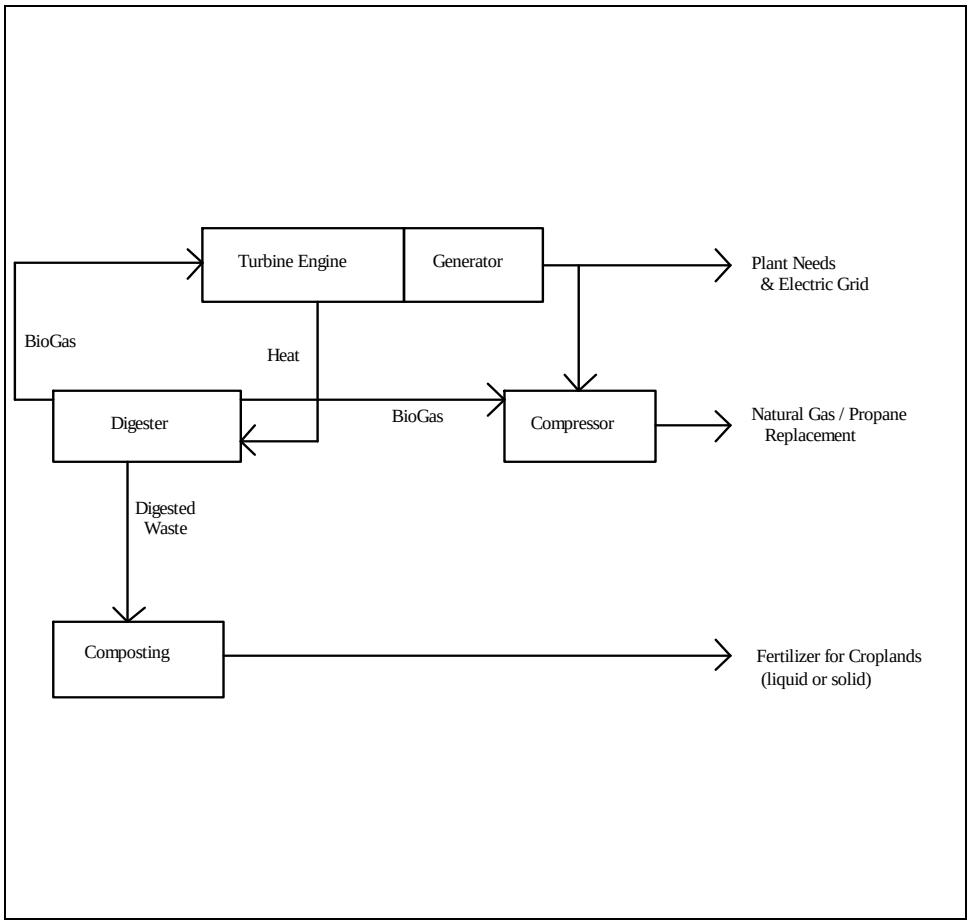


Figure 4. Sewage Treatment Biogas Flow

C.2. Cost Considerations

The addition of a methane digester is relatively inexpensive in terms of resultant benefit, with costs for a treatment plant the size of Willits typically well under $1 million. Such additions or upgrades are generally undertaken during a plant upgrade or new plant construction. The impact on normal operation of the plant is minimal, with the resultant energy generated offsetting the cost of running the plant.

C.3. Funding Considerations

Similar upgrades have been performed throughout the United States and many have been funded with assistance from EPA (methane reduction) and DOE (innovative community energy) grants. Since Willits is in the process of redesigning the Waste Water Treatment Plant, the addition of methane production should be a consideration for long-term cost reduction and energy independence.

C.4. Summary of Benefits

- Reduction of solids disposal problem.
- Hedge against escalating energy costs.
- Annual income from the sale of ‘green credits’.
- Generation and sale (income) of local ‘natural gas’ and propane for residence and business sale.
- Income from processed solids as cropland fertilizer.
- Potential replacement fuel for city and emergency vehicles.
- Potential eco-tourism benefits.

Appendix D. A Brief Primer on Distributed Solar PhotoVoltaics (PV)

The first 2 paragraphs below were excerpted from: **Humboldt County General Plan 2025 Energy Element Background Technical Report**, Schatz Energy Research Center Humboldt State University, 2005.[21]

Although PV power can be generated at centralized solar power plants, the majority of growth in the PV market is for smaller distributed systems. Most of the distributed systems installed in the developed countries are grid-connected systems. Grid-connected systems are comprised of PV modules, often roof mounted, and an inverter that converts the DC electricity produced by the PV modules into AC electricity. No batteries are required. Instead, these systems effectively use the electrical grid for energy storage. When excess power is produced, it is fed out to the larger electrical grid and consumed by a neighboring customer. When the PV power production is less than what is required onsite, like at night, electrical power is drawn from the grid to meet the onsite loads.

California is one of the leading states in the U.S. in PV installations. Since 1998, the California Energy Commission has offered installers of small (< 30kW) PV systems a substantial rebate that has covered as much as half of the installed system cost. In addition, electric utilities in California must offer their customers net metering. With net metering, a customer is able to spin the meter backwards and earn credit when the PV system is producing excess power. The customer's bill is settled on an annual basis, so excess solar power generated in the summer can be banked as a credit and then used up in the wintertime. In some cases, customers may choose time-of-use (TOU) rates that assign a greater value to electrical power that is produced during peak periods (summer time, noon to 6 PM). TOU metering can mean considerable cost savings – in terms of system sizing – if most of the electricity consumption is in the evening, since peak electricity rates are often 3 times evening rates.

PV-based grid-connected systems are required by law to isolate themselves from the grid in the event of a grid failure (blackout). The primary reason for this is to ensure the system does not feed electricity into the 'grid' while linemen are conducting repairs. Unfortunately, when this happens, the PV host facility also loses electricity. PV grid-tied inverters are beginning to appear with a feature called 'islanding' which means that while they perform the required isolation of the grid, they no longer shut down internal power as well. Instead they merely isolate themselves from the grid while continuing to allow electricity being generated to be available for use by the PV host.

[21] http://www.redwoodenergy.org/uploads/Tech%20Report%20Public%20Draft.pdf

Appendix E. Cost Saving Considerations in Sewage Treatment

The following discussion on saving costs in sewage treatment facilities came from the article "**Energy Efficient Alternatives for the Fortuna Wastewater Treatment Facility**" by Jennifer Fuller with support from The Community Clean Water Institute Fortuna Water Quality Project.

E.1. Activated Sludge Process

The activated sludge process has been identified as the number one energy consumer in the wastewater treatment process. The Fortuna wastewater treatment facility uses the majority of the energy required to operate the facility during the activated sludge process. The primary component of the activated sludge process is aeration. Aeration is the most energy intensive mechanical process of all wastewater processes. Therefore, activated sludge is the largest energy consuming process simply due to aeration.

The aeration process introduces air or oxygen into the wastewater to promote aerobic biological activity, which degrades the organic matter in the waste stream. The biological material produced is separated from the effluent in the secondary clarifiers. The material that settles out is either wasted or returned to the process where it is mixed with incoming wastewater. The more oxygen transferred to the wastewater the higher the dissolved oxygen concentration. Aeration serves two purposes, first is to deliver oxygen to the water and second to mix the wastewater, which will keep the microorganisms in suspension. The amount of air supplied to reduce the organic material is usually sufficient to satisfy mixing requirements.

The air or oxygen can be delivered to the wastewater stream either mechanically or through a diffused system, which uses different types of diffusers (fine bubble or coarse bubble). Some of the diffusers are more efficient at transferring the air or oxygen to the water. The Fortuna facility uses a course bubble diffuser. These aeration systems can account for 60% of the facilities energy requirements. This makes aeration an excellent target for energy reduction strategies. In order to optimize the aeration process a detailed system evaluation is required. Basin geometry, oxygen transfer method, wastewater characteristics, biological loading, equipment type and size, aeration controls methods and maintenance should all be evaluated carefully in order to determine the tradeoffs associated with energy reduction.

The equipment used in the aeration process are referred to as blowers. The blowers compress and distribute air to the aeration basin at pressures up to 15 psi. The City recently purchased two 60 horsepower blowers, which are now in operation. The older 100 horsepower blowers will remain as backups during extreme events.

E.2. Preliminary Treatment

Preliminary treatment consists of screening, grinding and grit removal. The primary objective of the preliminary treatment process is to protect plant equipment from large

objects and debris. Only a small portion of the plant's energy requirements is used in the preliminary treatment process; however, it is still feasible to reduce energy by redesigning the inlet works of the wastewater treatment plant. Fortuna's preliminary treatment system is not working correctly and could be causing some increased energy usage later in the process. This system is essential to the success and efficiency of the process. This is an area that must be improved to conserve energy later in the process.

E.3. Primary Treatment

Primary treatment or primary sedimentation is where a significant portion of settle-able solids and biochemical oxygen demand will be removed. After evaluating a year's worth of environmental data, inconsistencies in the effectiveness of the primary clarifiers were observed. The clarifiers are failing to remove the proper amount of solids and BOD from the wastewater stream. This leaves the aeration system to remove all of the remaining BOD and the secondary clarifiers to remove all of the extra solids.

It is predicted that by improving the removal efficiencies of the primary clarifiers a significant cost savings for energy use would result. This has been identified as an area that can be easily and fairly inexpensively upgraded to improve the overall treatment and energy efficiency.

E.4. Sludge Stabilization

The sludge is stabilized by an aerobic process, which also uses aeration to transfer oxygen to the sludge. Once the sludge is stabilized it is pumped into drying beds where it remains until completely composted. The problem associated with the aerobic process is that aeration is required and it has been established previously that aeration is extremely energy intensive. The stabilized sludge product is pumped to drying beds where it is composted for use as a soil amendment; however, the drying beds are subject to anaerobic conditions, which result in a very odiferous sludge product. This odor becomes a nuisance to the community.

E.5. Energy Efficient Alternatives

With rising energy prices and stricter discharge requirements energy conservation is the primary management tactic to reduce operating costs while meeting budgetary constraints. Energy efficiency not only helps save money but also reduces pollution. Several energy efficient technologies will be discussed in the following sections. These technologies only represent a fraction of what is available however; these are most applicable to the Fortuna facility.

[Editor's Note: Many of the items discussed herein are also applicable to the Water Treatment Plant]

E.5.1. Variable Frequency Drives

Variable frequency drives are electronic device used to control motor and equipment speed. These electronic devices simplify speed control systems. Variable speed drives have many benefits, which include reduced energy usage and improved process control. The systems can be used in conjunction with motors of any size including pumps used in the wastewater treatment process.

VFD's consist of three main parts; the rectifier, the regulator, and the inverter. The Rectifier converts alternating current (AC) into direct current (DC). Then the inverter switches the rectified direct current to alternating current, which results in a variable alternating current frequency. The regulator controls the rectifier and the inverter in order to maintain the proper frequency and voltage. There are three types of variable frequency drives, these include:

- Pulse Width Module Inverters (PWM)
- Voltage Source Inverters (VSI)
- Current Source Inverters (CSI)

The PWM is the most common variable frequency drive and is typically used in applications where motors are less than 100 horsepower.

E.5.2. Energy Efficient Motors

Energy efficient motors or high efficiency motors consume less energy and can lead to a significant decrease in operational costs as compared to standard motors. The high efficiency motors typically cost 10 to 30 percent more than the standard motors; however, the high efficiency systems are constructed of better materials and have longer life spans. These motors are traditionally more durable, generate less noise, and have an improved tolerance to over-voltage. There are many benefits to using energy efficient motors, cost just being one of them.

In the past several decades the traditional methodology for designing wastewater treatment facilities has been to over size everything. Commonly motors are operating at 70-80% of the estimated capacity. These conditions lead to excessive energy usage.

Motors are most efficient at certain operating points. If the system is not operated in that region then the result is an inefficient motor. Critical to energy conservation are properly sized pumps, fans, motors and compressors. Proper maintenance of motors is also critical to maintaining the optimal operating efficiency.

E.5.3. SCADA or Other Data Monitoring Systems

The Supervisory Control and Data Acquisition System (SCADA) is a computer operating system that automatically monitors and controls wastewater treatment operations. There are many different types of computer control systems; however, in this research only the SCADA system will be examined. There are a variety of benefits associated with the

SCADA system; energy cost savings (through process monitoring), reduced operating and maintenance costs, better process control and more accurate data collection.

E.5.4. Pump Modification

Pumps are the predominate type of equipment in wastewater treatment systems. Therefore, optimizing pump efficiencies is essential for energy conservation. Pumps can operate inefficiently for a number of reasons. Typically, pumps are oversized for the system and the result is low efficiency. Other problems can also affect the efficiency of pumps these include:

- Low quality parts
- Improper pump use
- Worn out parts
- Changes in operating conditions

Pump tests can be performed to determine if the operating parameters of the pump have changed from the manufacturer specified operating point. During the pump test data for the following parameters must be collected: flow, discharge pressure, suction pressure, temperature and amps. The data is then graphed and compared to the manufacturer specified conditions. When a significant discrepancy exists the pump can be corrected by changing the impeller, pump or system head. Optimizing pumps can be accomplished in several different ways:

- Reduce impeller size
- Reduce discharge head
- Reduce the size of the pump to operate closer to optimal efficiency (have a backup system for excessive events)
- Add a variable frequency drive
- Increase suction head
- Proper maintenance and maintenance records

E.5.5. Cogeneration

Cogeneration is becoming essential in the survival of many wastewater treatment facilities. Cogeneration is a safe, effective, reliable and cost effective method of power generation that has been in use for many decades.

Cogeneration systems in wastewater treatment facilities use anaerobic digester gas (methane) to power prime movers, which generate electricity. A significant reduction in electricity usage can be achieved through cogeneration. Decreasing the amount of electricity required to operate a facility ultimately leads to a substantial cost reduction. Cogeneration systems are complex and can be difficult to understand. The primary thing to remember is that waste gas generated during the anaerobic sludge stabilization process is used to power a prime mover, which in turn runs a generator that generates electricity.

E.5.5.1 Heat Recovery

During cogeneration only a portion of the gas is converted to electricity while the other portion is lost throughout the process as heat. Some of the heat that is generated during cogeneration can be captured and reused. Heat can be recaptured with heat exchangers or routed through a building and used for space heating. Heat recovery is essential to the success of cogeneration systems in wastewater treatment. The excess heat can be heat exchanged with incoming effluent to preheat the effluent as it enters the anaerobic digester.

E.5.5.2 Micro turbines

Micro turbines are used as prime movers in the cogeneration process. These systems are adaptable low emission power generation systems, which are made small enough that even a small wastewater treatment facility could benefit. The turbine can operate independently or through a grid connection. The maintenance required for a micro-turbine is minimal compared to a traditional gas turbine. Air emission equipment will be required to stripe the methane gas of sulfur compounds and water vapor prior to being used in the micro turbine. The waste gas is high in hydrogen sulfide, sulfur dioxide and water vapor. Therefore, additional capitol costs are required for the pollution equipment.

Appendix F. Constructed Wetlands Pros and Cons

The following was excerpted from: **Pipeline** (published by National Small Flows Clearinghouse); Summer 1998, Vol. 9, No. 3

F.1. Overview

Constructed wetland systems have many uses. When they are used to treat domestic sewage or wastewater from typical small community sources, they provide additional, secondary, or advanced treatment to waste-water that already has had most solid wastes removed in a septic tank or by some other form of preliminary treatment (i.e. conventional preliminary treatment is still required).

Chemicals in some industrial waste-waters—for example, pesticides, herbicides, and large amounts of ammonia—can kill the plants in wetlands that contribute to treatment. Additionally, wetland plants may accumulate high concentrations of metals from some wastewater sources.

F.2. Advantages and Disadvantages of Constructed Wetlands

Advantages

• Compared to many other treatment methods, constructed wetlands are inexpensive to build and maintain.
• They require little or no energy to operate
• They can provide effective waste-water treatment.
• They can help systems comply with environmental regulations.
• They can enable the development or use of difficult sites.
• They can help protect local water resources.
• They can provide additional habitat area for wildlife.
• They can be aesthetically pleasing additions to homes and neighborhoods.
• They are viewed as an environmentally-friendly technology and are generally well-received by the public.

Disadvantages

• Constructed wetlands require more land area than some other treatment options ($$).
• Surface flow wetlands can attract mosquitoes and other pests.
• Wetlands are not appropriate for treating some wastewater with high concentrations of pollutants.
• Although wetland systems that are properly and adequately designed consistently perform within acceptable standards, their performance within that range may be more variable and less predictable than other treatment methods.
• There may be a prolonged initial start-up period before vegetation is adequately established in the wetland and before system performance is optimal.

• Constructed wetlands may not be able to operate year-round in certain parts of the country due to weather and related conditions.
• Because there are still some unknowns with wetlands, as a precaution, engineers often choose to “over design” systems (rather than to design them most cost-effectively).

Appendix G. Examples of Methane Recovery at Sewage Treatment Facilities

The following was excerpted from: **Humboldt County General Plan 2025 Energy Element Background Technical Report**, Schatz Energy Research Center Humboldt State University, 2005.[22]

G.1. Biogas from Wastewater Treatment Facilities

Wastewater treatment plants (WWTP) often utilize an anaerobic digestion process to treat municipal sewage sludge. During this process, biogas composed of approximately 60% methane is produced. This anaerobic digester gas (ADG) is commonly used at the treatment plant to supply heat for the digester units and/or electricity for plant operations. The use of ADG in this way is a mature technology. Currently, California has 10 wastewater treatment biogas plants that produce electricity (totaling about 36 MW of capacity) and 12 wastewater treatment biogas plants that produce useful heat (California Energy Commission, 2005).

Biogas plants that generate electricity typically have used standard internal combustion engine (ICE) generators. Today, however, emerging electrical generation technologies are beginning to find a place in the biogas industry. High temperature fuel cells and micro turbines are examples of emerging technologies that are currently being used on a demonstration basis to generate electricity and heat using ADG. The City of Portland has run both micro turbines and fuel cells on their ADG. Fuel Cell Energy of Danbury Connecticut currently has four 250 kW molten carbonate fuel cells installed and running on ADG at WWTPs in California. Both Ingersoll Rand Energy Systems and Capstone MicroTurbine Corporation produce micro turbines capable of converting ADG to electricity and heat. Capstone MicroTurbine has been filling orders in the WWTP market since 2000, and Ingersoll Rand Energy Systems since 2002. Whenever biogas from wastewater is used to produce electricity a lot of gas cleanup is required, and this can add substantial equipment and maintenance costs to the system.

G.2. Energy from ADG in Humboldt County

The Eureka WWTP was designed to utilize the ADG produced on site and has been operating reliably since its construction in 1984. Their system utilizes twin internal combustion engines (ICEs) designed to run directly on ADG to produce roughly 95 kW of electric power for “in house” use. The heat generated from running these ICEs is used to maintain the temperature of the twin digester units at 98 ° Fahrenheit. Approximately 1.1 MCF of ADG are produced per month at the Eureka WWTP. This ADG flow rate is converted to approximately 95 kW of continuous electric power and an unspecified amount of heat (Bailey, 2005). The Eureka WWTP utilizes its ADG to offset a portion of its energy consumption from the electric and natural gas grids.

Operating characteristics for the Eureka plant were used to estimate potential ADG production for other WWTPs in Humboldt County. Inflow data were collected for all

[22] http://www.redwoodenergy.org/uploads/Tech%20Report%20Public%20Draft.pdf

WWTPs in Humboldt County, with the exception of Weott. Each facility showed large seasonal variation in flows due to infiltration from leaky sewage lines.

Since ADG production is a function of the solids content of the waste stream, averages of inflows from May 1 to October 31 were used to estimate ADG production potential at each plant. A value of 0.0079 cubic feet ADG per gallon of inflow was calculated from the Eureka WWTP data and used to estimate the ADG production potential for the other municipalities shown in Table 9. The ratio between the volumetric flow rate of ADG produced and the electric power generated at the Eureka WWTP was used to estimate the potential for electricity generation at the other WWTPs. The cumulative additional electrical capacity for all the new ADG facilities would be 79 kW, with over 86% of this coming from the three larger facilities (Arcata, Fortuna, Kinleyville). Assuming a 70% capacity factor, these three plants could generate 418 MWh of electricity annually.

Installation of the necessary equipment (an anaerobic digester if not already present, gas clean-up equipment, and an electrical generator) would likely only be practical for the three larger WWTPs. This is because ADG energy recovery systems such as these are typically only cost-effective for larger facilities. In addition, most smaller facilities use aerobic digesters that do not produce energy rich methane gas.

Aside from the Eureka WWTP, Arcata is the only other WWTP in Humboldt County currently using ADG as an energy source. The Arcata WWTP uses a percentage of its ADG to provide heat for the anaerobic processes occurring in their digester. The remaining ADG is flared.

The remaining portion of the project cost could be partially offset with PG&E's Self-Generation Incentive Program (SGIP) that would pay a rate of $1,500 per kW or up to 40% of the projects' capital cost.

Appendix H. Methane vs. Natural Gas

H.1. Natural Gas Primer[23]

Natural gas is a hydrocarbon fuel that is found in reservoirs beneath the earth's surface. Natural gas is composed primarily (70-90%) of methane (CH4). The Chinese began using natural gas as early as 500 BC. Today it is used for space and water heating, process heating, electricity generation, and as a transportation fuel. The use of natural gas is expected to rise substantially in the coming years because it is a relatively clean alternative to other fossil fuels like oil and coal. This is true in California and throughout the western United Sates where many new natural gas fired electrical generation plants are being brought on-line. In addition, the U.S. accounts for the largest portion of the world's natural gas consumption (currently about 45%), but holds only about 3% of the world's reserves. This explains why there is so much interest in importing liquefied natural gas (LNG) from other parts of the world. However, at best this would be a stopgap measure because world supplies of natural gas are only expected to last about another 50 years.

H.2. Methane Chemistry[24]

Methane is a gas made up of one molecule of carbon and four molecules of hydrogen. It is the major component of the "natural" gas used in many homes for cooking and heating. It is odorless, colorless, and yields about 1,000 British Thermal Units (Btu) [252 kilocalories (kcal)] of heat energy per cubic foot (0.028 cubic meters) when burned. Natural gas is a fossil fuel that was created eons ago by the anaerobic decomposition of organic materials. It is often found in association with oil and coal.

The same types of anaerobic bacteria that produced natural gas also produce methane today. Anaerobic bacteria are some of the oldest forms of life on earth. They evolved before the photosynthesis of green plants released large quantities of oxygen into the atmosphere. Anaerobic bacteria break down or "digest" organic material in the absence of oxygen and produce "biogas" as a waste product. (Aerobic decomposition, or composting, requires large amounts of oxygen and produces heat.) Anaerobic decomposition occurs naturally in swamps, water-logged soils and rice fields, deep bodies of water, and in the digestive systems of termites and large animals. Anaerobic processes can be managed in a "digester" (an airtight tank) or a covered lagoon (a pond used to store manure) for waste treatment. The primary benefits of anaerobic digestion are nutrient recycling, waste treatment, and odor control. Except in very large systems, biogas production is a highly useful but secondary benefit.

Biogas produced in anaerobic digesters consists of methane (50%-80%), carbon dioxide (20%-50%), and trace levels of other gases such as hydrogen, carbon monoxide, nitrogen, oxygen, and hydrogen sulfide. The relative percentage of these gases in biogas depends on the feed material and management of the process. When burned, a cubic foot (0.028

[23] http://www.redwoodenergy.org/uploads/Tech%20Report%20Public%20Draft.pdf
[24] http://www.eren.doe.gov/consumerinfo/refbriefs/ab5.html

cubic meters) of biogas yields about 10 Btu (2.52 kcal) of heat energy per percentage of methane composition. For example, biogas composed of 65% methane yields 650 Btu per cubic foot (5,857 kcal/cubic meter).

H.3. Potential Energy and CO_2 Emissions

Source	**Energy (Btu per unit)**	**CO_2 (lbs per unit)**	**CO_2 (lbs/million Btu)**
Natural Gas	1,027 Btu/ft^3	0.1164 lbs CO_2/ft^3	117 lbs
Heating Oil	138,700 Btu/gallon	22.38 lbs CO_2/gallon	161 lbs
Propane	91,333 Btu/gallon	12.67 lbs CO_2/gallon	139 lbs
Electricity	10,346 Btu/kWh	1.43 lbs CO_2/kWh	419 lbs

Source: Rocky Mountain Institute[25]

[25] http://www.rmi.org/sitepages/pid343.php

Appendix I. Powering Vehicles with Natural Gas, Propane or Methane

The first two sections of this appendix were excerpted from: **Humboldt County General Plan 2025 Energy Element Background Technical Report**, Schatz Energy Research Center Humboldt State University, 2005.[26]

I.1. Compressed Natural Gas Vehicles

Until recently, natural gas seemed like a positive alternative to petroleum diesel. The natural gas resource base seemed abundant. Natural gas produces less CO2 per unit of energy than any other fossil fuel. Natural gas is the cleanest burning of all fossil fuels. Natural gas was the lowest priced vehicle fuel. Until recently, the Humboldt County Transit Authority was considering switching to buses powered by natural gas. However, the price advantage that natural gas enjoyed has greatly diminished, and there are potentially serious supply problems. It now appears that North American natural gas production has peaked and is going into permanent, long-term decline. At the same time, the use of natural gas continues to increase in the U.S.

Consequently, natural gas imports continue to rise. However, world supplies of natural gas are only expected to last about another 50 years. As mentioned earlier, there are some natural gas deposits in Humboldt County, but the county supplies only a small fraction (about 10%) of its own total needs. In summary, the use of natural gas as a transportation fuel does not appear likely to make energy in Humboldt County more secure or sustainable over the long term.

I.2. Propane Vehicles

Propane is widely available in Humboldt County. The bulk of it is used for stationary applications like space heating and water heating. Only a limited amount is used for vehicles.

Propane has lower volumetric energy density than gasoline, but significantly higher volumetric energy density than compressed natural gas. As with natural gas, emissions are very low. The price per unit of energy for propane is typically comparable to that for gasoline. Propane traditionally occurred as a component of natural gas. In this case the supply of propane was dependent on the production of natural gas. More recently propane has been produced as part of petroleum refining. This production method significantly increases the supply of propane.

However, there are long-term supply problems with both natural gas and petroleum, so the use of propane as a transportation fuel does not appear likely to make energy in Humboldt County more secure or sustainable over the long term.

I.3. Methane as a Transportation Fuel

[26] http://www.redwoodenergy.org/uploads/Tech%20Report%20Public%20Draft.pdf

Pure methane has an octane rating of over 120. Biogas (methane plus some CO_2, as derived from a methane digester) still exceeds an octane rating of 100. Since the octane rating is indicative of the propensity of the fuel to pre-ignite (lower octane, more tendency to 'knock'), methane and its impure relative biogas are excellent in traditional engines. The only adjustment is a slight advance in the engine timing (generally set to fire at 30 degrees BTDC).

With the ability to produce methane locally (e.g. at the municipal level), methane would make an excellent fuel source for powering municipal and emergency vehicles as petroleum and natural gas prices escalate.

Appendix J. The Federal Government is Interested in Methane Power

The following is excerpted from an article appearing in ***FEMP Focus*** - Winter/Spring 2005, entitled **"Wastewater Digester Gas Can Produce High Quality Methane Fuel for Federal Facilities"**[27]. The article encourages federal facilities to partner with local municipalities in order to employ potential energy production from methane.

J.1. Overview

Wastewater treatment plants (WWTPs) with anaerobic digesters can produce high quality, high Btu methane that can be used to fuel a federal facility power plant. There are more than 16,000 wastewater treatment plants in the United States ranging in size from multi-billion dollar complexes to small, single community plants. More than 3,500 of these facilities employ anaerobic digestion. Since methane production is one of the products of digestion, many treatment plants use a portion of the gas to supply heat needed to complete the digestion process. But only 2 percent of these plants utilize the digester gas to produce electricity. Most of these plants could produce power from the gas and still heat their digesters with the waste heat from the generation process.

The average American creates approximately 100 gallons of wastewater every day. It is composed of 99.94 percent water and must be treated and purified before it can be reintroduced to the environment. In larger treatment facilities this process involves anaerobic digestion where, in the absence of oxygen, bacteria digest residual solids and create methane gas as a byproduct. This gas can be converted to significant amounts of energy and with minimal processing can be used as a substitute for natural gas.

J.2. Applications

Wastewater digester gas can serve as a natural gas fuel substitute in applications such as boilers, hot water heaters, reciprocating engines, turbines and fuel cells. The gas produced by anaerobic digestion is usually more than 60 percent methane and some plants with state-of-the-art facilities have the potential of producing a biogas with concentrations of methane that reach up to 95 percent. This biogas is produced on a continuous basis and contaminants, such as hydrogen sulfide, are removed prior to use. Other processing may include dehydration, filtering or carbon dioxide removal.

The most common use of wastewater treatment methane is for internal process heat used in the wastewater digesting process. This can be provided directly or by converting to steam in a boiler. The most popular technology to convert wastewater treatment gas to electricity employs internal-combustion engines that run a generator to produce electricity.

This is most often used to power internal operations with the excess being sold back to the grid. Heat generated by these engines can also be recovered and used to heat digesters

[27] http://www.eere.energy.gov/femp/newsevents/fempfocus_article.cfm/news_id=8961

and plant facilities thus improving overall system efficiency. Another proven application employs microturbines which also produce electricity. These can be modularized and easily expanded as gas production expands.

New technologies are being employed in the use of biogas and these include fuel cells and Stirling engines. Some fuel cells operating on wastewater digester methane produce up to 2 megawatts of electricity.

The Stirling engine is attractive for this application because it is an external combustion engine and does not require the degree of gas cleanup that other technologies require. These can also be modularized.

J.3. Potential for Federal WWTP Biogas-to-Energy Projects

A recent study found that there were approximately 140 wastewater treatment plants with anaerobic digesters greater than 3 million gallons per day that were within 5 miles of large federal facilities. (Anaerobic digesters are generally used when wastewater flow is greater than 3 million gallons per day). Data obtained from the EPA's Water Discharge Permit database indicates that over 1,600 wastewater treatment plants and nearly 800 federal facilities are located within 15 miles of each other.

Federal energy managers should be aware of two types of opportunities to undertake WWTP biogas-to-energy projects. For large federal facilities that have their own treatment plants, numerous possibilities to save on energy, water, or related operating costs (including sludge removal) should be considered. In addition to the types of energy generation projects discussed above, other improvements could be financed through FEMP's Biomass Alternative Methane Fuels (BAMF) Super ESPC relating to the processing of wastewater. For federal facilities that are located near (under 15 miles) a municipal WWTP, they should explore whether it is of sufficient size to produce excess biogas, the availability of the biogas, and what end-use application would make economic sense.

J.4. Benefits of Wastewater Digester Gas and the BAMF Super ESPC

Under the BAMF Super ESPC, agencies can partner with prequalified, competitively-selected energy services companies (ESCOs) and use an expedited contracting process to implement their projects quickly, avoiding the uncertainty and delay of depending on appropriated funding. The ESCO arranges financing for project development, equipment, and installation, and the debt is paid back over time from the guaranteed cost savings generated by the project. FEMP's experienced project facilitators can guide the agency through the entire process, providing expert consultation and assistance with technical, contractual, and financial aspects of the project. For more information about ESPCs, visit FEMP's web site.

In a typical BAMF WWTP digester gas project, the ESCO builds a pipeline from the treatment plant to the Federal facility and then installs or reconfigures the end use

equipment to utilize the resource. WWTP gas-to-energy projects can bring immediate and long-term benefits to Federal facilities:

- Energy cost savings.
- Energy security
- When WWTP gas is piped directly to its end use, it provides security from interruptions in the gas and electric grids.
- For facilities that require back-up or standby electricity generation, WWTP gas systems provide the lowest cost while still accommodating a steady base load.
- Utility cost stabilization—Because the WWTP gas resource is obligated under a long-term contract, WWTP systems provide an excellent hedge against fluctuations in fuel and electricity prices.
- Environmental benefits—Significant reductions in greenhouse gas emissions (The methane from wastewater is 25 times more harmful to the atmosphere than carbon dioxide).
- Progress toward Federal goals for use of renewable energy.

Appendix K. Biosolids as Cropland Fertilizer

The following is excerpted from an article in **Small Flows** – Fall 1997 (Vol. 11, No. 4) entitled **"Improving the Public's Perception of Biosolids"** by Jeremy Canod.

K.1. Overview

Biosolids are the treated end products generated during the treatment of sewage. In other words, they are the processed organic solids that have been separated from the liquid portion of municipal wastewater during treatment. Following treatment these solids may be incinerated in a furnace, disposed of in a landfill or a designated surface disposal site (e.g., monofill), or land applied for beneficial purposes.

Over the past 25 years, there has been an increasing interest in the land application of biosolids to agricultural and landscaping areas, in addition to using heat drying/pelletizing, composting, and alkaline stabilization processes to produce biosolids by-products. Biosolids must meet quality and reuse standards as defined by federal and state regulations. Bio-solids treated in accordance with these regulations have been proven safe and should leave no cause for concern. Yet, there remains skepticism in the public's eye as to just how safe the various uses of biosolids really are, particularly the land application of biosolids. The fact is, biosolids are one of the most studied materials that have ever been regulated by the U.S. Environmental Protection Agency (EPA), whose findings conclude that biosolids applications, when conducted properly, improve soil conditions and increase plant productivity. It also eliminates the disposal of a useful by-product.

K.2. Why use biosolids?

Many treatment facilities, both large and small, choose to land apply their biosolids because it tends to be the most environmentally friendly, economical, and resourceful disposal option. According to EPA, approximately 54 percent of all biosolids are land applied (for purposes that include land reclamation, fertilization of forest land and agricultural crops), or composted to make organic fertilizers for landscaping. Biosolids consist of a variety of materials including organics, soil, and sand. Many of the constituents, including nitrogen, phosphorous, and zinc, are essential for sustaining plant and animal life. Microorganisms, trace amounts of metals, and synthetic and naturally occurring chemicals are also present in biosolids. These constituents have the potential to be harmful to health and the environment if they are not treated and/or removed. However, rigorous pre-treatment processes at wastewater treatment plants and industrial facilities significantly reduce these harmful constituents to levels where they no longer present a threat to the environment or human health. The presence of beneficial nutrients in biosolids make land application an attractive option to farmers and growers, therefore creating an increased demand for a beneficial byproduct that would other-wise be landfilled or incinerated.

Approximately 65 percent of all land applied biosolids are being used on agricultural land to grow various crops intended for both human and non-human consumption. Although recycling biosolids back to the land is a common practice, there are not nearly enough biosolids to fertilize all crops grown in the U.S. According to EPA, less than 1 percent of the total food supply has been fertilized with biosolids.

K.3. Addressing Fears and Misconceptions

When people become aware that the food they are eating, the grass on their golf courses, and the ball fields that their children play on were grown with the help of what used to be municipal sewage, they tend to become unsettled with the thought. According to John Walker, leader of EPA's Biosolids Management Implementation Team, the public and some environmentalist groups are concerned with the use of land applied biosolids for various reasons. These include problems with odors, fears about the potential for groundwater contamination, and fear that the federal and state regulations on biosolids reuse are not being properly followed. Walker addressed each concern.

K.3.1. Odor

Different kinds of recycled biosolids each have their own distinct smells, depending on the type of treatment they have under-gone. Some have only a mild, musty smell, while other biosolids, when freshly applied, have a stronger odor that tends to be offensive to some people. These odors, whether strong or not, are primarily caused by compounds containing sulfur and ammonia. Forms of these compounds, such as nitrate, ammonium, and sulfate, also serve as beneficial nutrients for plants to grow. Biosolids sold as fertilizer have a mild, organic smell similar to soil. Walker said people tend to become concerned when they smell a foul odor and realize it's coming from land-applied biosolids. "They have the misconception that raw human waste, laden with toxic chemicals, is being applied—that's simply not the case." The fact is, Walker added, biosolids that meet federal treatment, application, and monitoring requirements are safe for use.

K.3.2. Contamination

Those concerned with ground and surface water contamination feel that biosolids contribute excess nutrients, trace metals, microorganisms, and pathogens. On the contrary, biosolids must meet federal, state, and local regulations, eliminate harmful constituents and utilize those that can be beneficial to the soil and environment. When applied to crops, application rates are matched to calculate crop demand (called the agronomic rate) for beneficial nutrients, such as nitrogen and background levels of constituents already existing in the soil. This ensures that land application sites do not become overabundant with plant nutrients and trace metals that may adversely affect ground and nearby surface waters.

K.4. Regulations

In order to avoid ground and surface water contamination, biosolids must be applied at the agronomic rate and must meet a number of pathogen reduction requirements, constituent limits, and loading rates that contain monitoring and record keeping provisions to assure requirements are met. For example, under the federal biosolids rule, treatment plants are required to treat their biosolids using methods such as high temperature, chemical stabilization, and moisture removal to substantially reduce bacteria, viruses, and protozoa. When applied to land, these pathogens are further reduced by competing microorganisms. Additional safeguards to health and the environment are afforded by site and crop harvesting restrictions. Those biosolids that are composted and heat-dried are virtually pathogen-free. In most cases, people do not realize that these biosolids are closely regulated, according to Walker, and people sometimes assume that untreated, raw sewage is being applied to the land.

K.4.1. Media Alarm

Recent negative reports about biosolids, such as a three-part series by CNN in June 1997, titled "Hazardous Harvest," portray biosolids and untreated sewage sludge as one and the same. High quality biosolids can be used sustainably when applied to agricultural land to nourish and improve the fertility, structure, and properties of the soil. However, many people do not know much about the rules that regulate biosolids and are convinced that they are not being followed properly.

K.4.2. Regulating Biosolids

The EPA concluded more than 20 years of study and research when, in February 1993, it issued its most comprehensive set of regulations aimed at ensuring the quality of recycled biosolids and their safe application. By promulgating the Part 503 Rule, as required by the Clean Water Act Amendments of 1987, EPA established quality criteria for biosolids by setting strict limits for trace metals, enforcing substantial reduction of pathogens, monitoring contaminants, restricting site access, minimizing odor, preventing runoff, and ensuring that biosolids are applied at agronomic rates.

In creating the rule, EPA worked with a variety of biosolids "stake-holders," including farmers and soil scientists, to examine every aspect of wastewater solids in the environment, including their impact on groundwater, air and soil quality, and surface runoff. Not only are biosolids regulated stringently at the federal level, but they are also monitored at the state and local levels. Every state has its own biosolids regulations criteria that meet and often exceed the requirements established by Part 503. To further ensure that land-applied biosolids generated from a waste-water treatment plant meet Part 503 standards, EPA and state regulations require wastewater treatment facilities to apply for a biosolids application permit, explaining quality, quantity, and ultimate use or disposal of the biosolids they produce. However, Part 503 applies to any person who is a preparer of biosolids (a person who changes the quality of biosolids) for uses intended for application, disposal, or incineration. Therefore, preparers must apply for permits. These people are usually the owners and operators of treatment facilities that treat domestic sewage.

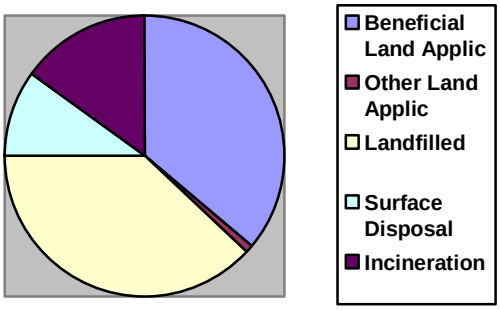
However, biosolids preparers can include industrial facilities that separately treat wastewater or any other individual, corporation, or government entity that changes the quality of biosolids. In addition, federal standards require that biosolids be sampled and tested. The frequency of monitoring is determined by the amount of biosolids being land applied. For example, biosolids generators that produce a dry weight of biosolids equal to or greater than 1,500 metric tons but less than 15,000 metric tons should be monitored once per 60 days, or six times a year, according to the Part 503 Rule.

K.5. Educating the Public

EPA, WEF, and regional, state, and local biosolids organizations are providing extensive information in an effort to inform the public of the benefits of properly treated biosolids. EPA is working with biosolids stakeholders to develop "Codes of Good Practice." Walker said that this group consists of a variety of professionals whose common goal is to promote sound practices that not only meet state and federal regulations but also minimize nuisances and are neighbor friendly, in addition to exploring new measures to ensure that biosolids produced are as safe as possible. The group then shares its findings with EPA and distributes helpful information to the public. "We know that our federal standards are doing a good job of managing biosolids; however, nothing is perfect. So our stakeholders meet to discuss what areas need more attention and what should be done about it," Walker said. He explained that one issue the group has focused a lot of attention on is exploring the public's general concern with biosolids odor.

Current disposal practices of Biosolids

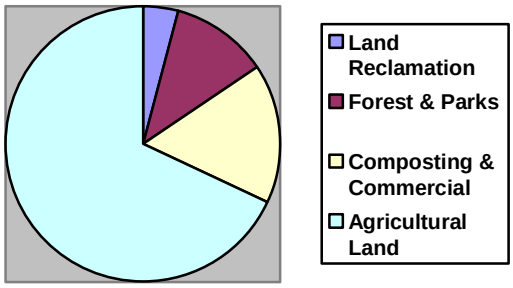
Beneficial land application	36%
Other land application	1%
Landfilled	38%
Surface disposal	10%
Incineration	15%



Biosolids Beneficial Use Breakdown

Land reclamation	4%
Forest and parks	11%
Composting and commercial	16%

Agricultural land 66%



Source: U.S. EPA Biosolids Reuse

In response, Al Gray, Water Environment Federation (WEF) deputy executive director, pointed out that biosolids and untreated sewage sludge are different by-products. Gray explained in a subsequent interview with CNN that biosolids are processed, regulated, monitored, and have been subjected to severe risk assessments by EPA, WEF, and many scientific organizations that continue to monitor and test biosolids. Gray also referred to a recent report by the National Research Council's Water Science and Technology Board that reaffirms EPA's and WEF's original positions that treated municipal wastewater biosolids can be safely used on food crops when done in accordance with federal regulations.

This report, *The Use of Reclaimed Water and Sludge in Food Crop Productio*n, was produced by an independent group of experts following three years of study that examined the adequacy of existing regulations for pathogens, trace metals, organic compounds; effects on soil, crop, and groundwater; and legal, economic, and institutional issues. *(This report is available through the National Academy Press for $29, plus shipping, by calling 800-624-6242.)* EPA concludes that decades of research on biosolids has shown though EPA has no current evidence that environmental or human health problems result from the odor of biosolids, to lessen the cause for concern a group of professionals will be assembled to assess odors. Walker added that other key issues discussed include the transportation and storage of biosolids, ways to further regulate industrial waste, and exploring how the production of biosolids compares to that of animal waste and other waste by-products.

In the future, EPA, the U.S. Department of Agriculture, universities, and other wastewater professionals will be exploring new biosolids issues such as advanced treatment, productive uses, and tailor-making biosolids and other by-products for special uses yielding a variety of environmental benefits.

K.5.1. Educational Efforts

WEF is also making strides in promoting the benefits of biosolids recycling by educating the public through a variety of information avenues. WEF produces several biosolids

resources including a monthly newsletter, publications, and fact sheets that are available to the public. WEF also sponsors a variety of conferences, teleconferences, and on-line discussion groups that bring together the major stakeholders in the biosolids arena, as well as involving the public's input.

WEF offers an Internet homepage *(http://www.wef.org/biosolids.htm*l) that provides updated biosolids coverage from around the country, newsletter samples, contacts, public information materials, conference listings, regulations listings, networking opportunities, and links to other related homepages.

At the regional level, stakeholder associations such as the Northwest Biosolids Management Association (NBMA) promote the beneficial uses of biosolids management among member agencies (sewage plants in the northwest U.S.); industry; local, state, and federal regulators; and the public. The NBMA promotes public education about biosolids management options and provides continuing education for its members. Some of NBMA's recent activities include a monthly newsletter, an annual biosolids conference for northwestern states, the distribution of more than 20,000 information folders and fact sheets, training sessions, the development of a homepage *(http:/www.nwbiosolids.or*g), and demonstration projects at area farms.

Although NBMA's members and many of their projects are in Washington, Oregon, Idaho, Alaska, and Canada, their public outreach and information publications on biosolids are available to anyone.

For more information concerning biosolids, the Part 503 Rule, contacts, and EPA's efforts toward enhancing biosolids public awareness, contact EPA's Office of Wastewater Management at (202) 260-7356. EPA information is also available on the Internet at http://www.epa.gov/OW-OWM.html. *For more biosolids information from WEF, contact Loraine Loganat (703) 684-2487. And for more information from NBMA, call (206) 684-1145.*

Appendix L. Grant and Funding Sources

The following is a list of some loans and grants that potentially may be able to be pursued to offset or completely pay for the projects outlined in this paper. Included with each funding possibility is a section entitled 'Target' which indicates the target for the fund use. This list is not intended to be comprehensive -- being the result of a quick search – but rather an indication that grants are available to partially, if not substantially, offset the cost of the projects described. The important thing to remember in applications for grants is 1) community security, 2) community preparedness, and 3) reduction of community vulnerability to fluctuating energy prices.

L.1. Environmental Protection Agency (EPA)

Safeguards of potable water, natural resources and oversight over potentially harmful chemicals (including reduction in methane emissions). [http://www.epa.gov]

Grant Title: Solid Waste Management Assistance
Target: Sewage Treatment Methane Recovery and Biosolids Reuse (solid waste reduction)
Funding Opportunity Number: EPA-R9-WST-06-004
Posted Date: Feb 09, 2006
Current Closing Date for Applications: Mar 27, 2006 March 27, 2006-- Initial proposals must be postmarked by or received through Grants.gov by this date. Please refer to the full announcement, including Section IV, for additional information on submission methods and due dates.
Award Ceiling: $60,000
Award Floor: $30,000
CFDA Number: 66.808 -- Solid Waste Management Assistance
Cost Sharing or Matching Requirement: No
Overview: The U.S. Environmental Protection Agency Region 9 is soliciting proposals to fund projects that address solid waste reduction and management. Funds will be awarded pursuant to Section 8001 of the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. §6981. Funding will be in the form of cooperative agreements. Funds will be awarded to applicants carrying out projects that serve the following states and territories: Arizona, California, Hawaii, Nevada, the U.S. territories in the Pacific Islands, and the lands in Indian Country belonging to over 140 federally recognized tribes which fall under EPA Region 9's geographic area.
Eligible Applicants: Others (see text field entitled "Additional Information on Eligibility" for clarification), County governments, Native American tribal governments (Federally recognized), Special district governments, Public and State controlled institutions of higher education, State governments, City or township governments, Private institutions of higher education, Individuals
Contacts: Adrienne Priselac, (415) 972-3285 Heather White, (415)972-3384 Caleb Shaffer, (415)972-3336

Grant Title: Source Reduction Assistance Grants Program

Target: Sewage Treatment Methane Recovery (methane release prevention) – also potential for landfill methane recovery development.
Funding Opportunity Number: EPA-R9-WST7-06-006
Posted Date: Jan 31, 2006
Current Closing Date for Applications: Mar 15, 2006 March 15, 2006: Proposals must be postmarked or filed electronically through Grants.gov. Please refer to the full announcement, including Section IV, for additional information on submission methods and due dates.
Award Ceiling: $100,000
Award Floor:
CFDA Number: 66.717 -- Source Reduction Assistance
Cost Sharing or Matching Requirement: Yes
Overview: EPA Region 9's Pollution Prevention (P2) Program is soliciting proposals to fund projects supporting source reduction/pollution prevention activities focusing on promotion of green building for residential construction, providing assistance to Tribal and Island Governments to implement pollution prevention programs, and reduction of priority chemicals. Funding will be in the form of grants or cooperative agreements, depending on the nature of the project. Funds will be awarded pursuant to the Clean Air Act, Section 103(b) and (g); Clean Water Act, Section 104(b)(3); Federal Insecticide, Fungicide, and Rodenticide Act, Section 20; Safe Drinking Water Act, Section 1442 (a)(1) and (c); Solid Waste Disposal Act, Section 8001(a); and Toxic Substances Control Act, Section 10. These authorities prescribe that the funds must be used to promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of pollution and conservation of resources. These activities relate generally to the gathering or transferring of information or advancing the state of knowledge.
Eligible Applicants: Private institutions of higher education, City or township governments, Independent school districts, County governments, Public and State controlled institutions of higher education, Nonprofits having a 501(c)(3) status with the IRS, other than institutions of higher education, Native American tribal governments (Federally recognized), State governments, Others (see text field entitled "Additional Information on Eligibility" for clarification). All projects must be carried out within EPA Region 9, which is comprised of the States of California, Nevada, Hawaii, and Arizona; U.S. territories in the Pacific, or on the 146 federally-recognized tribes and the Region.
Contacts: Jessica Counts, (415) 972-3288 John Katz, (415) 972-3283

Loan Title: Drinking Water State Revolving Fund
Target: Water Treatment Plant solar and hydroelectric
Overview: Provides loans to help public wastewater treatment works implement security measures.
Contact: http://cfpub.epa.gov/safewater/watersecurity/financeassist.cfm

L.2. Department of Homeland Security (DHS)

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

Federal Emergency Management Agency (FEMA) considered part of Homeland Security and deals with disaster mitigation & training.
[http://www.fema.gov]

Grant Title: Pre-Disaster Mitigation – CFDA Number 97.047
Target: Water Treatment Plant, ability to continue at least partial operations in time of emergency.
Overview: The objective is to provide States and communities with a much needed source of pre disaster mitigation funding for cost-effective hazard mitigation activities that are part of a comprehensive mitigation program, and that reduce injuries, loss of life, and damage and destruction of property. States are encouraged to use grants to implement a sustained pre-disaster hazard mitigation program to reduce risk to the population, the costs and disruption to individuals and businesses caused by severe property damage, and the ever-growing cost to all taxpayers of Federal disaster relief efforts. The program is similar to both the Flood Mitigation Assistance (FMA) Program and the Hazard Mitigation Grant Program (HMGP) in that there is an emphasis on "brick and mortar" mitigation projects and that State and local mitigation plans are required prior to approval of mitigation project grants.
Eligible Applicants: Any State, including the District of Columbia, the U.S. Virgin Islands, the Commonwealth of Puerto Rico, Guam, American Samoa, the Trust Territories of the Pacific Islands, and the Mariana Islands, is eligible as well as Indian tribal governments.
Deadline: Applications for grants must be submitted to the Regional Director by October 1 of each year, or such later date as the FEMA Director may establish.
Application Information: Contact the Regional Office in your area:
http://www.fema.gov/regions/
Links: Program website: http://www.fema.gov/fima/pdm.shtm
Full CFDA description:
http://12.46.245.173/pls/portal30/CATALOG.PROGRAM_TEXT_RPT.SHOW?p_arg_names=prog_nbr&p_arg_values=97.047

Editor's note: The following is excerpted from the FY 2006 Homeland Security Grant Program; Program Guidance and Application Kit and illustrates the breadth of uses for funds available (SHSP=State Homeland Security Program):
"FY 2006 SHSP funding remains primarily focused on enhancing capabilities to prevent, protect against, respond to, or recover from CBRNE, agriculture, and cyber terrorism incidents. However, in light of several major new national planning priorities, which address such issues as pandemic influenza and the aftermath of Hurricane Katrina, the allowable scope of SHSP activities include catastrophic events, provided that these activities also build capabilities that relate to terrorism." [pg. 69] And on pg. 73,

the list of allowable equipment categories SHSP funds may be used for include 'Power Equipment".

L.3. Other Federal Agencies

Department of Energy (DOE)
Grants and funds for energy and 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]

L.4. State of California

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

California Public Utilities Commission (CPUC/PUC) -- incentives for alternative energy implementation. . [http://www.cpuc.ca.gov/]

Funding Title/Type: Supplemental Energy Payments (SEPs)
Target: All projects mentioned within this paper
Incentive Type: Production Incentive
Eligible Renewable/Other Technologies:
Solar Thermal Electric, Photovoltaics, Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Geothermal Heat Pumps, Municipal Solid Waste, Anaerobic Digestion, Small Hydroelectric, Tidal Energy, Wave Energy, Ocean Thermal, Biodiesel, Fuel Cells (Renewable Fuels)
Applicable Sectors: Commercial, Industrial
Amount: For above-market costs as compared to a market price referent (subject to determination by the California Public Utilities Commission and the California Energy Commission)
Terms: 3 - 10 years
Website: http://www.energy.ca.gov/portfolio/
Authority 1: CA Public Utilities Code § 381 et seq.
Authority 2: CA Public Utilities Code § 399.11 et seq.
Authority 3: CA Public Resources Code § 25740 et seq.
Summary: Production incentives, referred to as supplemental energy payments (SEPs), will be awarded to eligible renewable generators for the above-market costs of eligible procurement by California's three largest investor owned utilities (IOUs)to fulfill their Renewables Portfolio Standard (RPS) obligations. The investor-owned utilities are:

PG&E, SDG&E, and SCE. These payments are required by SB 1038 and SB 1078 of 2002, with funding availability of approximately $70 million per year collected for five years from a public goods charge. Only projects selected through competitive solicitations are eligible. SEPs are not available to a facility owned by an electrical corporation or a local publicly-owned electric utility. Facilities must begin commercial operations on or after January 1, 2002 or be re-powered and re-commence operation on or after January 1, 2002, and meet other fuel specific and electricity delivery criteria.

Renewable generators that win a contract through an IOU's competitive RPS solicitation may be eligible for SEPs from the California Energy Commission (Energy Commission). SEPs are not available to a facility owned by an electrical corporation or a local publicly-owned electric utility. Facilities must begin commercial operations on or after January 1, 2002 or be re-powered and re-commence operation on or after January 1, 2002, and meet other fuel specific and electricity delivery criteria.

Once the IOUs received bids and select a tentative "short list" of winners, the CPUC announces the market price referent (MPR). The MPR is the levelized, cents-per-kWh price of a comparable long-term, natural gas electricity product. The MPR also represents a dividing line that is used to determine SEPs:

- Bid prices at or below the MPR may be accepted as per se reasonable to the CPUC;
- Contracts priced at or below the MPR may be accepted as per se reasonable by the CPUC;
- Contracts priced above the MPR may be eligible for SEPs to cover the difference between the MPR and the bid price, subject to funding availability and Energy Commission determination.

The IOUs have the opportunity to finalize contract negotiations after the MPR is announced before selecting their final list of winning bidders. The IOUs submit RPS contracts to the CPUC for approval. Proposed contracts priced above the MPR are considered by the Energy Commission for SEP awards. SEPs will not exceed the difference between the proposed contract price and the MPR. A project awarded SEPs for eligible renewable generation may receive monthly payments from the Energy Commission for up to 10 years (the contract must be at least 3 years in duration).

Program details are available from the New Renewable Facilities Program Guidebook (May 2004), Renewables Portfolio Standard Eligibility Guidebook (May 2004), and the Overall Program Guidebook (May 2004), all of which are available from the Energy Commission's RPS Documents Page.

Contact:
Heather Raitt
California Energy Commission
Renewable Energy Program
1516 Ninth Street, MS-45
Sacramento, CA 95814-5512
Phone: (916) 654-4735

Fax: (916) 653-8251
E-Mail: hraitt@energy.state.ca.us
Web site: http://www.energy.ca.gov/
[Source: http://www.dsireusa.org/]

L.5. Renewable Energy 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.

Retail Certificate Products
The table shown here summarizes renewable energy certificate products available to retail customers nationally or regionally. These are shown to illustrate how widely traded such certificates are.

Renewable Energy Certificate Retail Products (as of October 2005)

Certificate Marketer	Product Name	Renewable Resource	Location of Renewable Resource	Residential Price Premiums*	Certifica-tion
3 Phases Energy Services	Green Certificates	100% new wind	Nationwide	2.0¢/KWh	Green-e
Blue Sky Energy Corp	Greener Choice, Green Tags	Landfill gas	Utah	1.95¢/KWh	--
Bonneville Environmental Foundation	Green Tags	98% new wind, 1% new solar, 1% new biomass	Washington, Oregon, Wyoming, Montana, Alberta	2.0¢/KWh	Green-e
Clean Energy Partnership / Community Energy	Mid Atlantic Wind	100% new wind	Mid Atlantic	2.0¢/KWh	Green-e
Clean Energy Partnership / Sterling Planet	National New Clean Energy Mix	24% wind, 25% biomass, 50% landfill gas, 1% solar	National	0.6¢/KWh	Environm ental Resources Trust
Clean Energy Partnership /	National and	100% new wind	National	1.0¢/KWh	Environm ental

Sterling Planet	Regional New Wind				Resources Trust
Clean and Green	Clean and Green Membership	100% new wind	National	3.0¢/KWh	Green-e
Community Energy	New Wind Energy	100% new wind	Colorado, Illinois, New York, Pennsylvania, W. Virginia	2.0-2.5¢/KWh	Green-e
Conservation Services Group	ClimateSAVE	95% new wind, 5% new solar	Kansas (wind), New York (solar)	1.65-1.75¢/KWh	Green-e
EAD Environmental	100% Wind Energy Certificates	100% new wind	Not specified	1.5¢/KWh	--
EAD Environmental	Home Grown Hydro Certificates	100% small hydro (<5MW)	New England	1.2¢/KWh	--
Green Mountain Energy	TBD (Pennsylvania REC Product)	100% wind	National	1.7-2.0¢/KWh	--
Maine Interfaith Power & Light / BEF	Green Tags (supplied by BEF)	98% new wind, 1% new solar, 1% biomass	Washington, Oregon, Wyoming, Montana, Alberta	2.0¢/KWh	--
Mass Energy Consumers Alliance	New England Wind	100% new wind	Massachusetts	5.0¢/KWh	--
NativeEnergy	CoolHome	New biogass and new wind	Vermont and Pennsylvania (biomass), South Dakota (wind)	0.8 - 1.0¢/KWh	**
NativeEnergy	WindBuilders	100% new wind	South Dakota	~1.2¢/KWh, $12 per ton of CO_2 avoided	**

Renewable Choice Energy	American Wind	100% new wind	Nationwide	2.0¢/KWh	Green-e
Renewable Ventures	PVUSA Solar Green Certificates	100% solar	California	3.3¢/KWh	Green-e
SKY Energy, Inc.	Wind-e Renewable Energy	100% new wind	Nationwide	2.4¢/KWh	Green-e
Sterling Planet	Green America	45% new wind, 50% new biomass, 5% new solar	Nationwide	1.6¢/KWh	Green-e
TerraPass	TerraPass	Various (including efficiency and CO_2 offsets)	Nationwide	~$11/ton CO_2	--
Waverly Light & Power	Iowa Energy Tags	100% wind	Iowa	2.0¢/KWh	--
WindCurrent	Chesapeake Windcurrent	100% new wind	Mid-Atlantic States	2.5¢/KWh	Green-e

Footnote:
* Product prices are updated as of June 2005. Premium may also apply to small commercial customers. Large users may be able to negotiate price premiums.
** The Climate Neutral Network certifies the methodology used to calculate the CO2 emissions offset.
Source:
National Renewable Energy Laboratory.
http://www.eere.energy.gov/greenpower/markets/certificates.shtml?page=1

Appendix M. Equipment Sources and Contacts

In order to maintain the economic health of our community, we need to consider businesses or professionals based in Willits, then Mendocino County *before* going outside the area.

Companies:

Dockworks
Floating raft sections for PV mounting
Paul Racine
100 Soda Bay Road
Lakeport, CA 95453
707.263.0586
707.262.0586 [fax]
www.dockfactory.info

2-Seas
Dave Dell'Ara
Mounting systems for PV (solar) arrays
291 Shell Lane
Willits, CA 95490
707.459.9523
707.459.1833 [fax]
www.2seas.com

SeaCon-Brantner & Associates
Underwater cables & connector assemblies
1240 Vernon Way
El Cajon, CA 92020-1874
619.562.7071
619.562.9706 [fax]
http://www.seaconbrantner.com/

Advanced Power
PV panel providers and installers (as well as Hydro, wind); *Large array experience*
6331 N. State Street
Redwood Valley, CA 95470
707.485.0588
707.485.0831 [fax]
www.advancepower.net

Canyon Hydro
Hydroelectric equipment providers and installers
PO Box 36
Deming, WA 98224

360.592.2235 [voice/fax]
www.canyonindustriesinc.com

Capstone Microturbine Corporation
Turbine generator manufacturer, including units directly usable for landfill and sewage biodigesters (methane).
866- 4-CAPSTONE
http://www.capstoneturbine.com/index.cfm
www.microturbine.com

Power-X
Environment, Energy & Waste Recovery -- Project Development & Financing.
Waste water treatment facility design, methane production, co-generation .
7 West Acacia Street, Suite 6
Stockton, California 95202
209.465.0296
209.465.1605 [fax]
http://home.pacbell.net/ziakhan/frrbotto.htm

This Page Intentionally Left Blank