Keep The Lights On - Ukiah

Problem:

To avoid starting wildfires during red flag weather conditions, PG&E now shuts down their power distribution and grid transmission systems as needed, with expensive consequences for our community. Ukiah owns its distribution system, but all our power is imported over the transmission grid system. Two main lines service our area, one from the east over route 20, and the other from the south along route 101. Either one is sufficient, if the loads are not too large.

In 2019, there were five red flag triggered events blacking out some parts of Mendocino county PG&E distribution systems, two of them affected transmission to Ukiah, for a total of four days without power within the city limits. The loss of business was almost $7M (based on sales tax data) and the cost of commercial and residential food loss was more than $1M (based on interviews), for a total loss of $8M from this one event. People with medical needs requiring power around the clock were threatened and hospital admission doubled. The Ukiah blackout could have started three days earlier, when the Sonoma county distribution system was down, but the southern transmission line was still energized. That line probably started the Kincade fire.

In 2018, there were 19 red flag weather events.

Possible Solutions:

The solution is local power production that can operate during a grid shutdown. This could provide all, or part, of our current load of 300 megawatt hours per day. There are three basic options, fossil fueled generators, hydro power, and solar plus battery storage.

Fossil fueled generators are a short-term solution which does not help the entire community. This power is expensive, producing power at four times the current price, not counting the cost of the generator. The investment sits idle 99% of the time, yet requires regular maintenance and operation to insure they work when needed. They are noisy and contribute to poor air quality. Storing fuel safely is essential, and gas and diesel degrade over time. Resupplying fuel may be problematic in an extended emergency. Generators operate best running continuously at near full load, and are not well suited to variable or intermittent loads without a battery supplement.

The dam at Lake Mendocino has two generators which are already part of Ukiah's power production. They are able to supply about 8% of normal load on an extended basis, provided there is enough water behind the dam, which may not be the case late in the fire season. They need to be upgraded to be able to stand alone, but can be part of the solution.

Solar plus battery storage is the preferred option. Solar costs per watt are dropping and panel efficiencies are increasing, making solar power cost competitive with other commercial power sources. Grid scale fixed ground mount arrays can be installed for about $2/ watt, and occupy a little over 2 acres per megawatt of array. Canopy mounted arrays are about 50% more expensive, but can be installed in developed locations. Solar power variation over the year in Ukiah ranges from 3.5 to 6.5 noon equivalent hours, with an average of 5 hours annually. This means a kilowatt array would produce an average of 5 kilowatt hours per day over the course of the year. An emergency system should plan for production during the solar minimum, using a conservative number of 3 hours per day, a whole system solution for Ukiah's daily load of 300 megawatt hours would require a 100 megawatt array. Because the array is sized for operation during the solar minimum, it will produce an extra 60% over the course of the year, which is an asset that may be sold on the market, or used for local economic development. A 100 megawatt fixed ground mount array would cost about $250M, including land and connecting

transmission lines. Transmission right of way has to be considered in planning. This system should operate for over 30 years, producing fixed cost, inflation-resistant power.

The important second part of any renewable "stand-alone" system is battery storage. Battery costs are dropping fast, making this part of the renewable portfolio relatively cost effective for the first time. Grid scale batteries over 150 megawatt hours are now being installed regularly. A whole system solution of Ukiah would need a 250 megawatt hour battery, which would cost about $100M, including inverters, battery charging management, air conditioning, and fire suppression. Battery life is about a decade.

The whole system solution takes advantage of the best volume discount pricing on the array and batteries, and requires no rewiring of any part of the city distribution system. The down side is a big price, with an array occupying a large parcel of land, and would have to be done all at once. The alternative is a partial solution, providing a fraction of our normal load for the duration of the emergency, yet able to contribute to normal day to day operations.

California requires all utilities to be 100% green by 2045. Ukiah still has 30% "brown" power in our production portfolio, which must be replaced eventually. If we choose less than the whole city solution, let's pick 30%. This would mean producing 90 megawatt hours of power during the solar minimum, giving an array size of 30 megawatts, requiring about 60 acres. A fixed ground mount array would cost about $60M. Add another $10M for land and a connecting transmission system, gives an array total of $70M. An array this size will produce 50% of our annual load.

The battery portion of the system will need to be massively distributed in order to provide 24-hour power for each home. Assume a 5 kilowatt hour battery (est. $3K) in each of 6,500 homes, with inverter and switching electronics (est. $1K), and the skilled labor to install each unit (est. $2K). This would power an efficient refrigerator/freezer, some LED lights, TV, a computer and internet connection. At $6k per house, the total is $40M, for about 30 megawatt hours of storage.

Each unit would need to automatically switch over when the city grid goes down, giving power to critical circuits. These distributed residential units should be designed to take input from home solar arrays, or generators, as well. Medical needs folks might have a second unit installed in parallel, as needed. Additionally, each unit might be web addressable, or programmable, so that when the city grid is energized, residential storage could be scheduled for a particular time of day. This would allow the city to plan the allocation of finite power resources, without a massive restructuring of the existing city distribution system.

An additional 70 megawatt hours of battery ($30M) would allow load shaping (charging with low cost power to use during high cost power intervals) during regular operation of regional grid, and power commercial and civic loads during power down. Using 20' container systems of 1 megawatt hours each, this storage could be distributed close to large loads, like supermarkets, or grouped at one location. The total cost of all storage, residential and commercial, would be $70M, for a total partial solution cost of $140M.

The existing solar installers are already over-subscribed, so training more installers would be part of this project. This could be coordinated with the Mendocino College solar program, working with local installers. Whatever program develops in Ukiah will be a model for the rest of the county and beyond. The PG&E power shutdown program has barely begun, and the full extent of the economic dislocation has yet to be appreciated. The entire state will begin to shift to this kind of renewable plus storage for emergency resilience. Installation jobs skills learned here will be vital for years to come.

This project would have to be phased to allow funding development and training of installers. Households with medical needs should be prioritized, then low income, with the eventual goal of 100%

coverage. Individuals with resources could add extra storage, onsite solar, or energy efficiency improvements, aided by up front loans with appropriate repayment plans as part of the electric bill.

The sooner we begin to address the power down challenge, the better off we will all be, as the next fire season is only months away.

Funding Possibilities:

Any consideration of funding must start with understanding our current costs. Ukiah now pays about $6M per year for power delivered to our substation. A single blackout during a mild fire season cost $8M. The goal is a system which protects against the economic cost of blackouts, while minimizing any increase to our current power costs. Let's examine the funding for the partial solution.

Solar arrays produce a valuable product for decades. A 30-year loan, at 3%, costs 5% of the principal each year. The 30MW array at $70M, would cost $3.5M per year, and produce 50% of our power annually, replacing $3M in current prices. There are rebates, tax credits, and accelerated depreciation methods that could reduce the annual payment by 1/3 or more, but are not available to the city. However, there are investment firms interested in funding projects in northern California who can take advantage of these breaks, passing some of the savings along to the city, which could help defray the other cost of the system.

Due to the shorter life of batteries, the $70M storage portion of the partial solution would have to be financed over a decade, costing 12% annually, or $8M per year, which funded through an investment firm could reduce. The power savings from load shaping could save $1M a year. Grant funding is available. For comparison, the recycled water purple pipe project was built with a $45M grant.

Funding Options:

Ukiah has a unique opportunity because we have our own power utility, with access to funds and bonding authority unavailable to most individuals. Additional sources of funds are institutional investment funds, local investors, California Infrastructure Bank, California PUC Self-Generation Incentive Program, Federal grants, and the USDA Rural Energy for America loans. Increased electric rates or sales tax may be needed. No action has guaranteed, but unknown, possibly massive costs. Years of deferred maintenance will require added investment, so any solution is going to be expensive, but fixed costs can be budgeted, and hedge against inflation.

Going Forward:

Short-term goal: Keep The Lights On - Ukiah wants to build public awareness of the imperative to create an alternative to PG&E blackouts, and communicate that need to the City Council.

Mid-term goal: Once the Council is on record, serious investigation of design details and funding possibilities can begin. The solutions presented here are estimates of possible options, and we, as a community, need to decide what works best.

Long term goal: We must have equipment installed and functioning as soon as possible.

If you agree, please help us!

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ESTIMATED costs of **POSSIBLE** 30% solar system

The goal of this option is production of 30% of our normal power needs from solar, during the winter solar minimum, eliminating the entire "brown power" portion of our current production portfolio, while providing emergency power when needed. This assessment assumes a single 30MW fixed ground mount array, with a 70MWh main battery and distributed storage of 5KWh batteries in every one of 6,500 homes in Ukiah. Funding cost estimates assume long term fixed loans, with possible rebate discount, or possible grant funding for the battery portion of the system. To avoid ruinous costs from blackouts, some increase in revenue will be required, perhaps increasing sales tax rates and/or electrical power rates. The desire is reliable power, even during emergencies, with known long term fixed costs. The current annual cost of power is assumed to be $6M.

30% solution		no grant	1/3 tax	battery grant
array		no rebate	rebate	no rebate
30MW array at $2/W	$60M			
66 acres of land at $100K/ac.	$6.6M			
5 miles transmission at $600K/mi.	$3M			
array total		**$69.9M**		
financed 30 years at 3%, annual cost		$3.5M		
less 1/3 discount from tax breaks			$2.4M	
value of 50% power deferred		$3M	$3M	
array annual income (loss)		($500K)	$600K	($500K)
main battery				
70MWh at $400K/MWh	$28M			
6,500 units **distributed battery**				
5KWh at $3K	$19.5M			
inverter, switch, and rewire at $3K	$19.5M			
battery total		**$67M**		
total system cost		**$136.9M**		
less $40M battery grant				$27M
financed 10 years at 3%, annual cost		$8M	$8M	$3.3M
less 1/3 discount from tax breaks			$5.4M	
value load shaving power deferred		$1M	$1M	$1M
battery annual (loss)		($7M)	($3.6M)	($1.3M)
annual system (loss)		($7.5M)	($3M)	($1.8M)
needed increase in retail power rates per KWh		$0.07	$0.04	$0.03
needed increase in sales tax rate		1.1%	0.66%	0.5%