3-Minute Statement to the Hawaii County Energy Advisory Commission, 18 Oct. 2012

Big Island Clean Energy Security via Roof PVs

Ulrich Bonne, Kailua-Kona, HI

Objective: To lower electricity cost from 0.41 to < 0.20 $/kWh*, have affordable, clean energy security for 200,000 residents in ~73,000 homes, while profitably retaining HELCO**'s grid**

Proposal: B.I. home roof area avg. = 1076 ft2, good for 10 kW.

- **Install 6 +/- 4 kW PVs to all 73,000 B.I. homes,** with battery **back-up to** minimize **5-9 pm back-up load from the grid**
- **Utilize 70% of PV energy on site, w/ 3-5-h battery back-up**
- **Pay $20/month MMC** & give 30% to utility, and maintain its (**residential load**) $-profit for its** shareholders **of ~$9-18M**
- **Use part of 30% PV, free kWh for EV charging or H2 prod.**
- Pono: Use PV on-grid w/HELCO back-up, not lower cost of PV off-grid w/o HELCO, but benefit from zero or low-cost "fuel" for EVs or FCVs
- Next step: Study such DoE micro-grid PV projects vs. weather dynamics. See e.g. www.silentpwr.com/blog on the SMUD project in Sacramento & others

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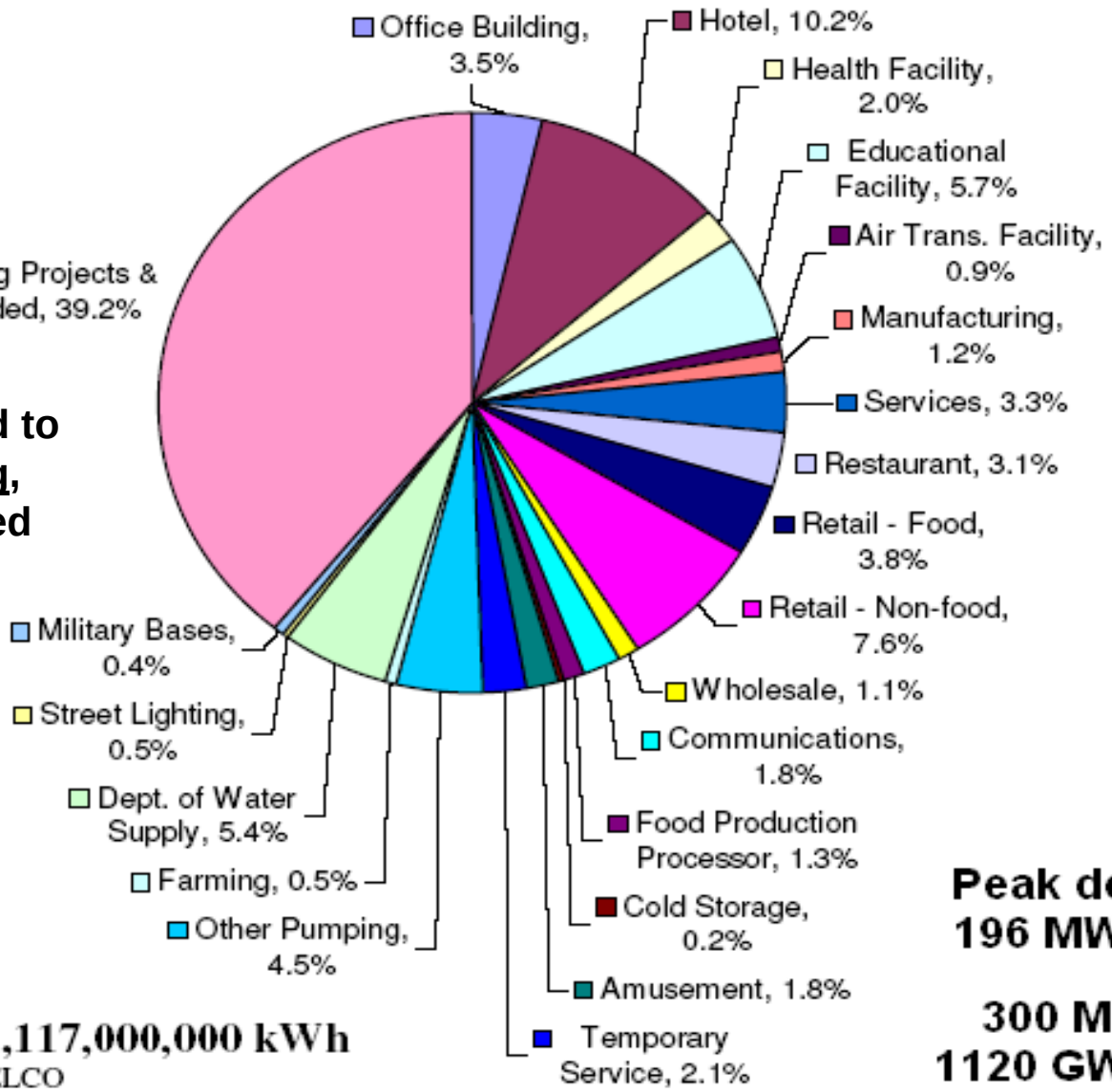
* About what **imported natural gas-fired** generation may achieve **today**

** **MMC = Minimum Monthly Charge** ***www.AlohaFuels.pbworks.com

ulrichbonne@msn.com***

Big Island kWh Sales in 2005 (HELCO Data)



The PVs described below were applied to residential housing, but could be applied to other rate payer segments

Total: 1,117,000,000 kWh

Source: HELCO

J. Johnson, D. Leistra, J. Opton-Himmel, & M. Smith

Peak demand:
196 MW Dec.05

300 MW, 43%
1120 GWh/year

ulrichbonne@msn.com

$/kWh Comparisons: Homes on- & off-grid vs. utilities

All entries normalized to 1 kW(peak)	Home PV	Home PV+B	Home PV+B	Utility PV	Fossil Fuel
CAPEX per 1 kW(peak) PV	On-Grid	Off-Grid	On-Grid	On-Grid	Utility
--	$/kW(peak)	$/kW(peak)	$/kW(peak)	$/kW(peak)	$/kW(peak)
PVs and inverters	3,000	2,500	2,500	1,500	1,500
Batteries, enough for 5-hour storage	0	1,000	1,000	2,500	0
Charge controller & information technoogy	0	340	340	0	0
Back-up generator, 2 kW/kW-PV	0	200	0	200	0
Installation of system (100% of hardware)	3,000	4,040	3,840	4,200	1,500
Transmission & distribution, at 1 M$/mile	0	0	0	3,333	3,333
Environmental impact anal., permits & reports	0	0	0	33	100
Real utilization of generated kWh by home or grid, %	70	70	70	70	43
OPEX for 30 yrs. per 1 kW PV; Capacity Factor, %	16	16	16	16	90
Minimum Monthly Charge	2,400	0	2,400	0	0
Land lease at 6000 $/y/acre	0	0	0	360	18
Op.& maintenan., taxes, salaries, insurance	0	0	0	3,520	7,220
Transmission loss (~10% for utilities)	0	0	0	1,383	4,872
Fuel for generator energy, back-up	0	720	0	360	58,906
Total life cycle cost in $/kW(peak)	**8,400**	**8,800**	**10,080**	**17,390**	**77,449**
A. Levelized electr.cost w/o subsidies in $/kWh	0.200	0.209	0.240	0.455	0.360
B. Levelized electr.cost after subsidies in $/kWh	0.129	0.124	0.157	0.363	0.360
C. Real level.electr.cost after subsidies in $/kWh	0.185	0.177	0.225	0.498	0.415
			FSyn\TL-11-MP-H2-Techs, 9 Oct.'12		

Big Is. Roof PV Energy

ulrichbonne@msn.com

Roof-PV Options for Big Island Rate Payers

Plan:

1. Homes & businesses: PVs w/ battery back-up +
+ add'l. back-up by utility, on-grid

2. Homes & businesses: PVs w/ battery back-up +
+ add'l. back-up by genset, off-grid

Rationale:

- **PV is renewable, distrib. & low-maint. electricity source**
- **Battery back-up is needed to meet the 5-9 pm peak demand period, cut transm. losses & cut imported oil**
- **On-grid additional back-up via NEM (or FIT) contract**
- **Off-grid additional back-up via home generator set**

PV Investment: 6 kW PV * 73,000 * 5-6 $/W = $2.67billion

200,000 / 2.75 ~73,000 homes, avg. suitable roof area 100 m2 or 1076 ft2, enough for 50 PV panels of 200 W = 10 kW.

At 500 kWh/month, 4.3 kW for 100% average utilization
6.1 kW for 70% average utilization

At 250 kWh/month, 3.0 kW for 70% average utilization

ulrichbonne@msn.com

Big Island Utility – Now & After PV On-Grid v.1.1

Sales to 73,000 homes @ 0.41 $/kWh, using 39% & 0% oil-based product

	BEFORE	AFTER 100% PV
	270*0.39=105 MW	~ 1 MW
Annual oil-kWh sales	*438 GWh / $ 180M	4.38 GWh / $ 2M
Annual excess PV-kWh sales	$ 0 M	54 GWh / $ 22M
PV-kWh freebees	$ 0 M	134 GWh / $(55)M***
Annual MM Charges <2.5% homes	<$ 0.5M	$20/mo./home $ 18M
Annual fuel costs	42 Mgal / $-125M	0.4 Mgal / $- 1M
Annual O&M generation expen. 3%	$- 10M	$- 5M
Annual O&M distrib. expenses 3%**	$- 27M	$- 27M
Annual Profit of 10%	$- 18M	$- 9M
Balance	0	0

Installed PV cost: 6.1 kW*73,000*4 $/W = $1800M; or 3kW ÷ $900M

*** = 500 kWh/mo.*12 mo./y*73000 homes/1000000*0.41 $/kWh**

**** O&M Expenses are assumed to be 3% of CAPEX/year**

***** free electricity, worth $55M if sold at 0.41 $/kWh, or worth**

134*4 = 536 million EV miles or 45,000 EVs @ 12,000 miles/year, at a fuel charger cost of $3000/30y/12000 = 0.83 ¢/mile

134*0.7/33.7*60mi,/GGE = 167 million FCV miles or 14,000 FCVs at a fuel cost of 3-4 $/GGE-H2 or 5 - 7 ¢/mile. CV at ~ 15 ¢/mile

ulrichbonne@msn.com

Big Island Utility – Now & After PV On-Grid v.1.2

Sales to 73,000 homes @ 0.41 $/kWh, using 39% & 0% oil-based product

	BEFORE	AFTER 100% PV
	270*0.39=105 MW	~ 1 MW
Annual oil-kWh sales	*438 GWh / $ 180M	4.38 GWh / $ 2M
Annual excess PV-kWh sales	$ 0 M	76 GWh / $ 31M
PV-kWh freebees	$ 0 M	112 GWh / $(46)M***
Annual MM Charges <2.5% homes	<$ 0.5M	$20/mo./home $ 18M
Annual fuel costs	42 Mgal / $-125M	0.4 Mgal / $- 1M
Annual O&M generation expen. 3%	$- 10M	$- 5M
Annual O&M distrib. expenses 3%**	$- 27M	$- 27M
Annual Profit 10%	$- 18M	$- 18M
Balance	0	0

Installed PV cost: 6.1 kW*73,000*4 $/W = $1800M; or 3kW ÷ $900M

*** = 500 kWh/mo.*12 mo./y*73000 homes/1000000*0.41 $/kWh**

**** O&M Expenses are assumed to be 3% of CAPEX/year**

***** free electricity, worth $46M if sold at 0.41 $/kWh, or worth**

112*4 = 448 million EV miles or 37,000 EVs @ 12,000 miles/year, at only the fuel charger cost of $3000/30y/12000 = 0.83 ¢/mile

112*0.7/33.7*60mi,/GGE = 140 million FCV miles or 12,000 FCVs at a fuel cost of 3-4 $/GGE-H2 or 5 - 7 ¢/mile. CV at ~ 15 ¢/mile

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