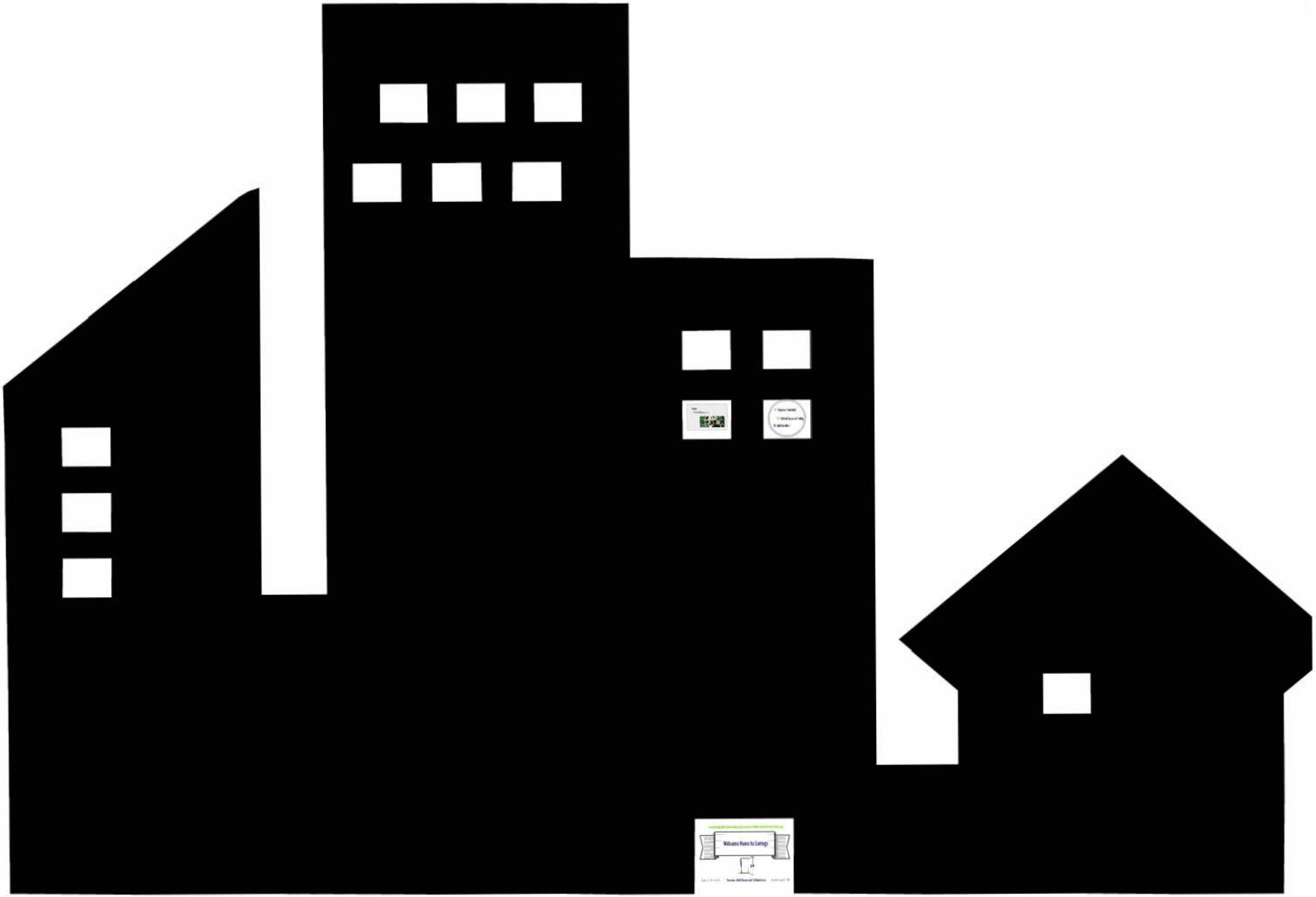
Incentivizing Distributed Energy Generation in Multifamily Affordable Housing

Welcome Home to Savings

March 14, 2014

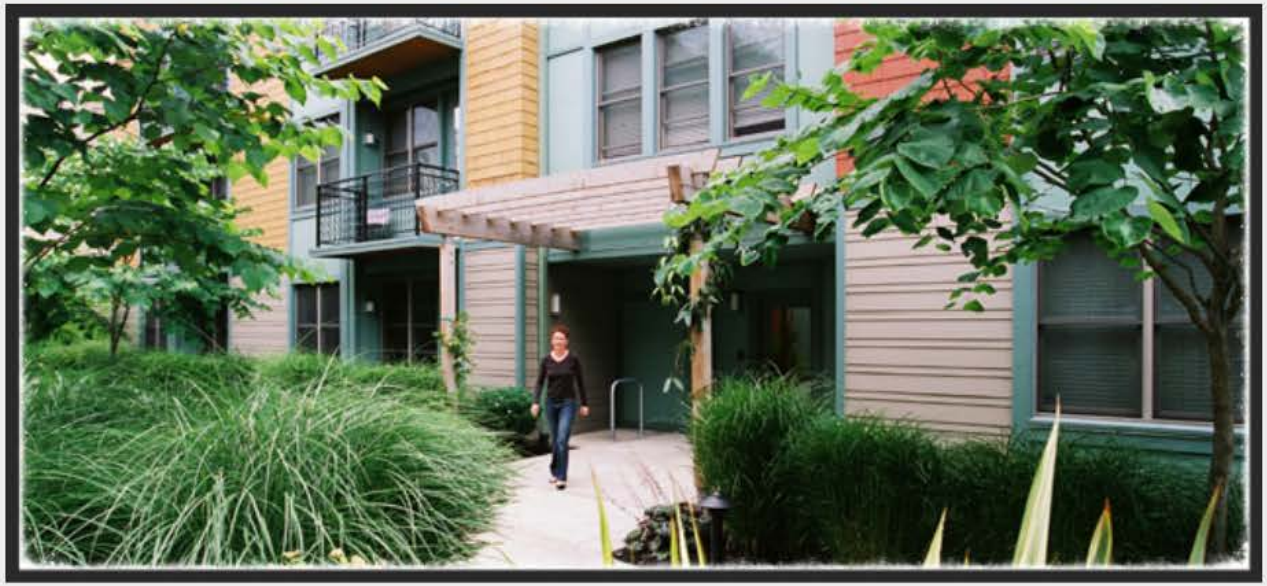
Team Millennial Makers

Washington DC


Welcome Home to Savings

Georgina

Property Manager
Non-Profit Affordable Housing



Programs' Complexity

Difficult Access to Funding

Split Incentives

MADE

What is MADE?

"One-stop shop" for distributed generation

Supporting financially viable projects

Fixing the split incentive

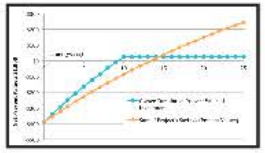
- Financial incentive to building owners
- Bringing in new investors
- Adapted to different technologies

CASE STUDY

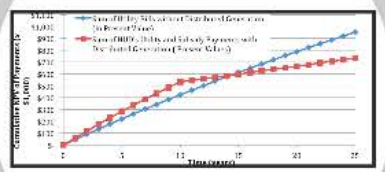
Solar Panels in California

Sharing the savings with the owner

- Initial investment by owner
- Reduced utility bills for HUD over 25 years
- Redistribution of 10% of savings to owner over 10 years

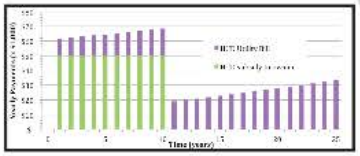


Saving energy and money



- Payback of 15 years including financial help to owner

Cash Flows & Net Present Values



NPV Owner : $25,000 over 10 years (IRR: 5%)
NPV HUD: $220,000 over 25 years (IRR 13.6%)

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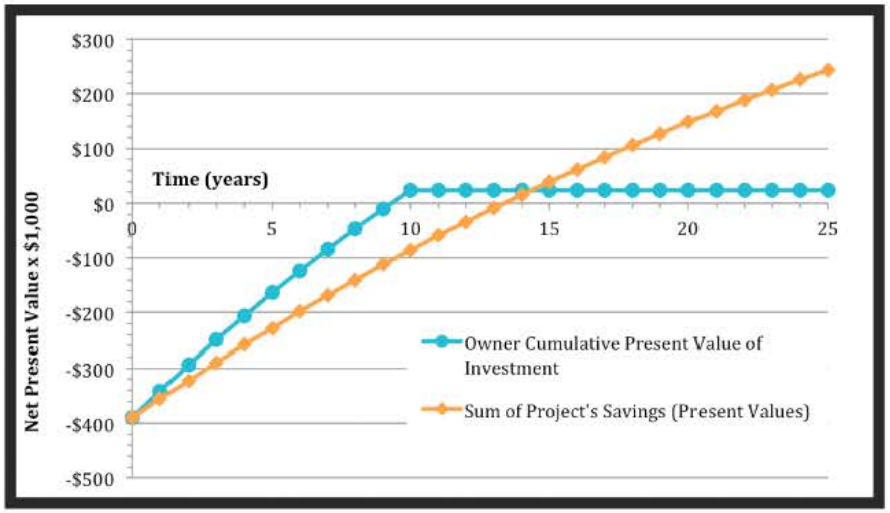

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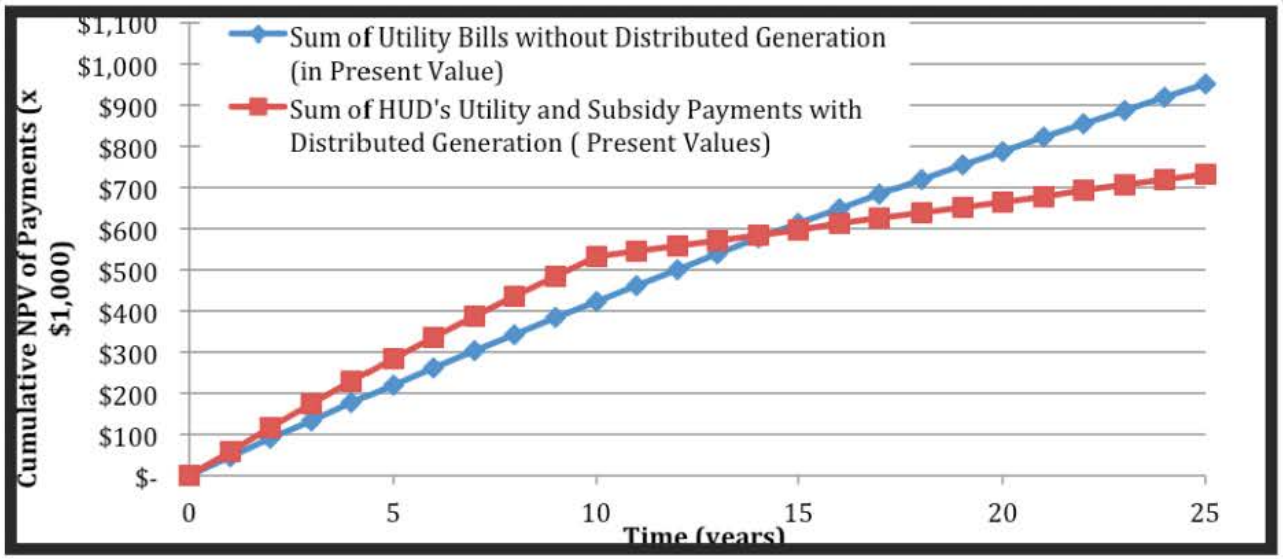

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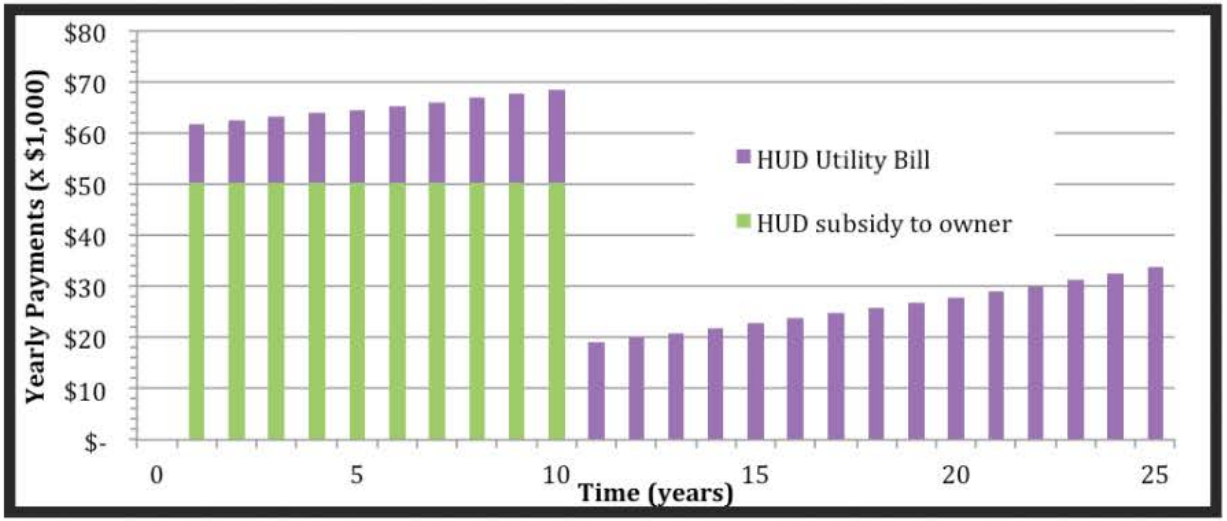

NPV Owner : $25,000 over 10 years (IRR: 5%)
NPV HUD: $220,000 over 25 years (IRR 13.6%)

Scalability

Location

What happens in states where solar energy is not profitable?

- **Prioritize** states where it is profitable
- **Adapt** the financial aid to keep HUD's NPV positive
- **Combine** MADE with local incentives

Achieving the 100 MW goal

~ 800 projects of 40 units and 120 kW in 20 States

Budget: $540 million

Savings - Investment: $100 million

200,000 short tons of CO2 saved per year

Owner:

Av. IRR: 4.3%
Av. NPV: $12,000
10 years

HUD

Av. IRR: 5.6%
Av. NPV $658,000
25 years

Technology

What if?

- A new technology emerges
- Emergency DG is more important than renewable source

Investment		
Yearly usage	292000	kWh
System Capacity	100	kW
Cost to Install System	$230,000	(CHP)
Federal Tax Credits (30%)	0	
Net Cost	$230,000	

Savings over Utility Bills over the years		
%DG	100%	
% Grid	0%	
Natural Gas Use	11881	MMBtu/yr
Natural Gas Price	$8.00	/MMBtu
Natural Gas Price increase	0.34%	/yr
Sun Hours	0	hrs
Yearly DG generation	292000	kWh
Electricity Rate	$0.12	
Electricity Price increase	2.2%	
inflation discount rate	3.7%	

Change only a few numbers:

- Tax Credits
- Use and price of natural gas or fuel
- Hours of production

Location

What happens in states where solar energy is not profitable?

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System Capacity	100	kW	% Grid	0%	
Cost to Install System	$230,000	(CHP)	Natural Gas Use	11881	MMBtu/yr
Federal Tax Credits (30%)	0		Natural Gas Price	$8.00	/MMBtu
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Change only a few numbers:

- Tax Credits
- Use and price of natural gas or fuel
- Hours of production

Communications

Key stakeholders:

PARTNER WITH:

Investors

banks, PPA, installers, utility

Cities, States, Local Agencies

INFORM:

Building Owners

Brochure

Summary of MADE

Promotes program

Website

ENERGY CALCULATOR

List of Available Programs by State

Case Studies

Webinars

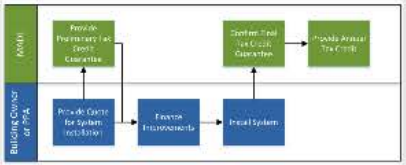
MADE

Thank you !

Questions?

Appendices

Installation and financial aid distribution process



- Adapted to PPA and engagement of new investors
- Dealing with uncertainty of installation costs

Building energy usage
24.5 million BTU/house = 7209 kWh/house

= 20 kWh/house per day
= 800 - 1600 kWh/day for 40-80 unit home
= 292 MWh/house per year (for a 40 unit home)

Solar panel area requirement for 100kW system
assuming 10W/sq. ft = 10,000 sq. ft

Equation of the Net Present Value of the Project: NPV project

NPVproject (t) = -Io + SC SH 365 UR sum [(1-APS) (1+APE) / (1+DR)] ^ t

where:

Io = system cost at t=0
SC = System Capacity in kW
SH = Sun Hours in hours per day
UR = Utility Rate at t=0 in $/kWh
APS = Loss rate of efficiency of the solar panels
APE = Increase in price of electricity per year, based upon Country increase over the last 10 years
DR = Discount Rate. We used the Treasury Bond value of 3.7%
t = Number of years of cash flows studied

Equation for the subsidy calculation:

If NPV project is positive:
S = CRF (Io + NPV(t) 10%)
where:
CRF = [DR (1+DR) ^ n] / [(1+DR)^n - n]
n = Number of years during which the subsidy is given

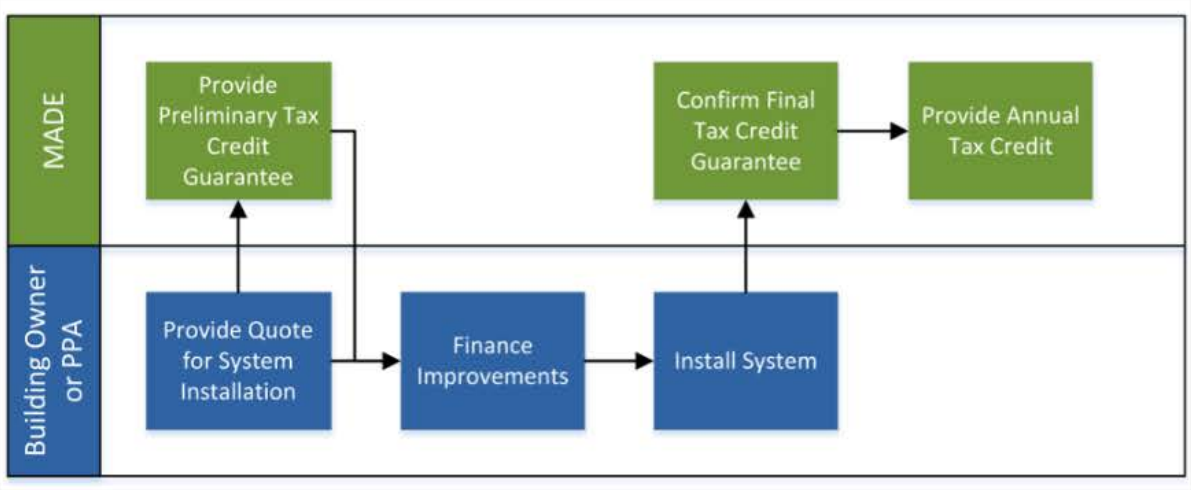
If NPV project is negative:
S = CRF (Io + NPVproject (t))

Financial Analysis for different technologies

	Solar Panels			Fuel Cells		Combined Heat and Power System
	California	North Carolina	North Carolina + incentive	National Average	California	National Average
Electricity Rate ($/kWH)	$0.16	$0.11	$0.11	$0.12	$0.16	$0.12
Natural Gas Rate ($/MMBtu)				$0.10	$0.10	$0.10
Yearly usage (kWh)	292,000	292,000	292,000	292,000	292,000	292,000
System Capacity (kW)	100	120	120	100	100	100
Cost to Install System	$556,500	$636,000	$636,000	$1,200,000	$1,200,000	$329,300
Federal + State Tax Credits	$166,950	$190,800	$254,400	$610,000	$610,000	$72,000
Net Cost to Install System	$389,550	$445,200	$381,600	$590,000	$590,000	$256,400
Production Hours	5.74	5.01	5.01	8	8	8
Yearly DG Generation (kWh)	220,000	219,000	219,000	292,000	292,000	292,000
% electricity from DG (t=0)	75%	75%	75%	100	100	100
% electricity from the Grid (t=0)	25%	25%	25%	0	0	0
Project NPV	$246,133	$(12,977)	$50,623	$(51,970)	$148,452	$235,788
Project IRR	8.6%	3.4%	4.8%	5%	7.6%	12.0%
Project Payback	14 years	None	22 years	23 years	16 years	10 years
HUD NPV	$219,720	$(0)	$45,560	$2,445	$136,083	$208,169
HUD IRR	13.6%	3.7%	5.6%	7.0%	11.2%	26.0%
HUD Payback	15 years	None	22 years	20 years	16 years	11 years
Owner NPV	$24,413	$(12,977)	$5,063	$(57,415)	$12,366	$27,619
Owner IRR	4.9%	3.1%	4.0%	1.7%	4.1%	6.0%
Owner Payback	10 years	None	16 years	None	10 years	9 years

State	Avg. Sun Hours	Utility Rate	System Capacity (kW)	% DG	Project NPV 20 years	Project NPV 20 years	HUD NPV 20 years	HUD IRR	Owner NPV 20 years	Owner IRR	Tax Credit	Electricity rate ($/kWh)	Present Value of MAHP subsidy	Profitable?
AK	3.75	$0.18	120	75%	$ (3,972)	$ (22,176)	$ (15,868)	0.4%	$ (2,631)	4.1%	30%	240,000	232,229	Y
AL	4.25	$0.11	140	75%	$ (147,486)	$ (164,861)			$ (96,[illegible])		30%	240,000		N
AR	4.67	$0.10	140	75%	$ (96,[illegible])	$ (144,[illegible])			$ (64,[illegible])		30%	240,000		N
AZ	6.50	$0.13	90	75%	$ 20,798.87	$ 41,640.46	$ 40,681.40	7.8%	$ 18,646.60	6.2%	30%	240,000	496,317	Y
CA	5.74	$0.19	120	75%	$ 146,340.68	$ 284,330.65	$ 135,963.85	18.8%	$ 38,812.12	8.9%	30%	240,000	560,212	Y
CO	5.54	$0.12	120	75%	$ 27,262.11	$ 61,750.35	$ 50,112.32	6.0%	$ 8,010.84	3.9%	30%	240,000	545,228	Y
DC	4.33	$0.13	140	75%	$ (96,929.62)	$ (131,446)			$ (61,[illegible])		30%	240,000		N
FL	5.00	$0.13	120	75%	$ (26,667.07)	$ 20,786.24	$ 32,724.85	7.2%	$ 7,238.46	3.2%	30%	240,000	547,344	Y
GA	4.92	$0.11	120	75%	$ (70,[illegible])	$ (87,[illegible])			$ (49,[illegible])		30%	240,000		N
HI	4.83	$0.35	100	75%	$ 452,722.27	$ 1,094,211.86	$ 942,763.88		$ 354,811.74	8.2%	30%	240,000	830,401	Y
IA	4.4	$0.11	140	75%	$ (141,187.27)	$ (172,041)			$ (97,[illegible])		30%	240,000		N
ID	4.83	$0.10	120	75%	$ (147,534.73)	$ (164,953.47)			$ (96,[illegible])		30%	240,000		N
IL	5.14	$0.12	140	75%	$ (96,484.84)	$ (156,765.34)			$ (66,[illegible])		30%	240,000		N
IN	4.75	$0.11	140	75%	$ (141,182.34)	$ (185,387.7)			$ (96,[illegible])		30%	240,000		N
KS	5.16	$0.11	140	75%	$ (96,108.84)	$ (132,441.4)	$ (10,872.1)	4.0%	$ (7,963.1)	3.4%	30%	240,000	610,234	Y
KY	4.44	$0.11	120	75%	$ (141,182.34)	$ (173,[illegible])			$ (73,[illegible])		30%	240,000		N
LA	4.83	$0.08	120	75%	$ (117,734.83)	$ (155,834.72)			$ (52,[illegible])		30%	240,000		N
MA	5.42	$0.14	120	75%	$ 126,773.04	$ 86,216.74	$ 59,477.7	5.4%	$ 8,818.18	3.4%	30%	240,000	612,353	Y
MD	4.47	$0.13	120	75%	$ 18,854.12	$ (7,786.32)	$ 28,017.4	4.1%	$ (7,750.9)	3.0%	30%	240,000	717,252	Y
ME	4.58	$0.14	120	75%	$ (32,[illegible])	$ 37,242.27	$ 37,337.48	5.2%	$ 2,559.44	3.4%	30%	240,000	704,845	Y
MI	4.5	$0.11	140	75%	$ (97,140.12)	$ 29,141.18	$ 28,235.87	4.0%	$ (14,[illegible])	3.4%	30%	240,000	716,713	Y
MN	4.58	$0.11	120	75%	$ (141,36.47)	$ (163,14.9)			$ (102,[illegible])		30%	240,000		N
MO	4.75	$0.11	120	75%	$ (141,826.37)	$ (168,[illegible])			$ (104,[illegible])		30%	240,000		N
MS	4.42	$0.11	120	75%	$ (125,279.03)	$ (154,[illegible])			$ (76,[illegible])		30%	240,000		N
MT	4.83	$0.11	120	75%	$ (141,734.21)	$ (147,[illegible])			$ (71,[illegible])		30%	240,000		N
NM	6.75	$0.13	90	75%	$ 20,724.8	$ 106,231.98	$ 95,973.9	4.9%	$ (3,813.3)	4.9%	30%	240,000	480,550	Y
NC	4.44	$0.11	120	75%	$ (126,234.44)	$ (156,[illegible])			$ (70,[illegible])		30%	240,000		N
ND	4.5	$0.11	120	75%	$ (98,[illegible])	$ (127,[illegible])			$ (47,[illegible])		30%	240,000		N
NE	4.75	$0.09	120	75%	$ (126,[illegible])	$ (147,[illegible])			$ (67,[illegible])		30%	240,000		N
NH	4.33	$0.13	140	75%	$ (141,[illegible])	$ (194,[illegible])			$ (96,[illegible])		30%	240,000		N
NV	6.33	$0.13	120	75%	$ 72,847.12	$ 126,[illegible]	$ 85,[illegible]	7.0%	$ (4,[illegible])	4.1%	30%	240,000	480,[illegible]	Y
NY	3.75	$0.19	140	75%	$ (32,[illegible])	$ (32,[illegible])	$ (13,[illegible])	7.0%	$ (3,[illegible])	4.1%	30%	240,000	581,[illegible]	Y
OH	4.25	$0.11	140	75%	$ (136,[illegible])	$ (166,[illegible])			$ (94,[illegible])		30%	240,000		N
OK	4.67	$0.11	120	75%	$ (120,[illegible])	$ (149,[illegible])			$ (69,[illegible])		30%	240,000		N
OR	3.08	$0.11	120	75%	$ (140,[illegible])	$ (168,[illegible])			$ (94,[illegible])		30%	240,000		N
PA	3.83	$0.11	120	75%	$ (126,[illegible])	$ (153,[illegible])			$ (73,[illegible])		30%	240,000		N
RI	4.25	$0.16	140	75%	$ 3,[illegible]	$ 98,[illegible]	$ 90,[illegible]	5.0%	$ (2,[illegible])	4.1%	30%	240,000	592,[illegible]	Y
SC	5.08	$0.11	120	75%	$ (45,[illegible])	$ 28,[illegible]	$ 31,[illegible]	4.0%	$ (8,[illegible])	3.0%	30%	240,000	603,[illegible]	Y
SD	4.58	$0.10	120	75%	$ (135,[illegible])	$ (163,[illegible])			$ (101,[illegible])		30%	240,000		N
TN	4.42	$0.11	140	75%	$ (136,[illegible])	$ (170,[illegible])			$ (76,[illegible])		30%	240,000		N
TX	5.08	$0.11	120	75%	$ (45,[illegible])	$ (62,[illegible])	$ (1,[illegible])	4.1%	$ (12,[illegible])	3.9%	30%	240,000	637,[illegible]	Y
UT	5.58	$0.10	120	75%	$ (56,[illegible])	$ (74,[illegible])			$ (16,[illegible])		30%	240,000		N
VA	4.25	$0.11	140	75%	$ 18,[illegible]	$ 26,[illegible]	$ 33,[illegible]	5.1%	$ 9,[illegible]	3.9%	30%	240,000	681,[illegible]	Y
WA	4.5	$0.09	120	75%	$ (135,[illegible])	$ (125,[illegible])			$ (102,[illegible])		30%	240,000		N
WI	4.25	$0.16	140	75%	$ 49,[illegible]	$ 120,[illegible]	$ 120,[illegible]	6.1%	$ 7,[illegible]	3.9%	30%	240,000	702,[illegible]	Y
WV	3.67	$0.09	140	75%	$ (207,[illegible])	$ (242,[illegible])			$ (141,[illegible])		30%	240,000		N
WY	4.08	$0.10	90	75%	$ (10,[illegible])	$ 34,[illegible]	$ 36,[illegible]	3.1%	$ 1,[illegible]	3.9%	30%	240,000	525,[illegible]	Y

Installation and financial aid distribution process



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	California	North Carolina	North Carolina + incentive	National Average	California	National Average
Electricity Rate ($/kWH)	$0.16	$0.11	$0.11	$0.12	$0.16	$0.12
Natural Gas Rate ($/MMBtu)				$0.10	$0.10	$0.10
Yearly usage (kWh)	292,000	292,000	292,000	292,000	292,000	292,000
System Capacity (kW)	105	120	120	100	100	100
Cost to Install System	$556,500	$636,000	$636,000	$1,200,000	$1,200,000	$329,300
Federal + State Tax Credits	$166,950	$190,800	$254,400	$610,000	$610,000	$72,900
Net Cost to Install System	$389,550	$445,200	$381,600	$590,000	$590,000	$256,400
Production Hours	5.74	5.01	5.01	8	8	8
Yearly DG Generation (kWh)	220,000	219,000	219,000	292,000	292,000	292,000
% electricity from DG (t=0)	75%	75%	75%	100	100	100
% electricity from the Grid (t=0)	25%	25%	25%	0	0	0
Project NPV	$244,133	$(12,977)	$50,623	$(51,970)	$148,452	$235,788
Project IRR	8.6%	3.4%	4.8%	5%	7.6%	12.0%
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Owner IRR	4.9%	3.1%	4.0%	1.7%	4.1%	6.0%
Owner Payback	10 years	None	10 years	None	10 years	9 years

Building energy usage

24.5 million BTU/house = 7209 kWh/house

= 20 kWh/house per day
= 800 - 1600 kWh/day for 40-80 unit home
= 292 MWh/house per year (for a 40 unit home)

Solar panel area requirement for 100kW system
assuming 10W/sq. ft → 10,000 sq. ft

Equation of the Net Present Value of the Project: NPV project

NPVproject (t) = -Io + SC . SH . 365 . UR . sum [(1-APS) . (1+APE) / (1+DR)] ^ t

where:

Io = system cost at t=0
SC = System Capacity in kW
SH = Sun Hours in hours per day
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APS = Loss rate of efficiency of the solar panels
APE = Increase in price of electricity per year, based upon Country increase over the last 10 years
DR = Discount Rate. We used the Treasury Bond value of 3.7%
t = Number of years of cash flows studied

Equation for the subsidy calculation:

If NPV project is positive:

S = CRF . (Io + NPV(t) . 10%)

where:

CRF = [DR . (1+DR) ^ n] / [(1+DR)^n − n]
n = Number of years during which the subsidy is given

If NPV project is negative:

S = CRF (Io + NPVproject (t))

State	Avg Sun Hours	Utility Rate	System Capacity (kW)	% DG	Project NPV 20 years	Project NPV 25 years	HUD NPV 25 years	HUD IRR	Owner NPV 25 years	Owner IRR	Tax Credit	Electricity use (kWh/yr)	Present Value of MADE subsidy	Profitable?
AK	3.77	$0.18	159	75%	$ 19,673.20	$ 128,229.70	$ 115,406.73	6.9%	$ 12,822.97	4.1%	30%	292,000	855,523	Y
AL	4.23	$0.11	141	75%	$(167,408.46)	$ (104,061.93)		3.7%	$ (104,061.93)		30%	292,000		N
AR	4.25	$0.10	141	75%	$(201,631.21)	$ (144,379.38)		3.7%	$ (144,379.38)		30%	292,000		N
AZ	6.50	$0.11	92	75%	$ 25,790.47	$ 91,168.81	$ 82,051.93	7.6%	$ 9,116.88	4.2%	30%	292,000	496,717	Y
CA	5.74	$0.16	105	75%	$ 148,340.84	$ 244,133.28	$ 313,885.65	13.6%	$ 24,413.33	4.9%	30%	292,000	580,913	Y
CO	5.37	$0.12	111	75%	$ (26,382.11)	$ 42,258.35	$ 38,032.52	5.2%	$ 4,225.84	3.9%	30%	292,000	592,526	Y
DC	4.23	$0.13	141	75%	$ (96,929.92)	$ (21,031.94)		3.7%	$ (21,031.94)		30%	292,000		N
FL	5.408	$0.12	111	75%	$ (28,497.67)	$ 39,766.04	$ 35,789.43	5.1%	$ 3,976.60	3.9%	30%	292,000	592,277	Y
GA	4.865	$0.10	123	75%	$(108,419.89)	$ (46,460.93)		3.7%	$ (46,460.93)		30%	292,000		N
HI	6.02	$0.37	100	75%	$ 872,723.87	$ 1,094,217.40	$ 984,795.66	-	$ 109,421.74	9.2%	30%	292,000	639,422	Y
IA	4.4	$0.11	136	75%	$(143,367.87)	$ (79,043.52)		3.7%	$ (79,043.52)		30%	292,000		N
ID	4.81	$0.10	125	75%	$(145,534.55)	$ (88,863.87)			$ (88,863.87)		30%	292,000		N
IL	3.14	$0.10	190	75%	$(366,969.96)	$ (306,788.34)			$ (306,788.34)		30%	292,000		N
IN	4.21	$0.11	143	75%	$(161,802.94)	$ (96,136.71)			$ (96,136.71)		30%	292,000		N
KS	5.18	$0.11	116	75%	$ (50,336.54)	$ 17,341.45	$ 15,607.31	4.3%	$ 1,734.15	3.8%	30%	292,000	616,534	Y
KY	4.94	$0.10	121	75%	$(130,562.56)	$ (73,868.39)			$ (73,868.39)		30%	292,000		N
LA	4.83	$0.09	125	75%	$(157,274.30)	$ (102,694.35)			$ (102,694.35)		30%	292,000		N
MA	3.95	$0.16	152	75%	$ (28,773.00)	$ 66,530.79	$ 59,877.71	5.4%	$ 6,653.08	3.9%	30%	292,000	812,253	Y
MD	4.47	$0.13	135	75%	$ (60,614.71)	$ 17,786.35	$ 16,007.71	4.2%	$ 1,778.63	3.8%	30%	292,000	717,279	Y
ME	4.35	$0.14	138	75%	$ (32,746.75)	$ 52,599.42	$ 47,339.48	5.2%	$ 5,259.94	3.9%	30%	292,000	736,660	Y
MI	4.1	$0.15	146	75%	$ (57,142.12)	$ 29,145.18	$ 26,230.67	4.5%	$ 2,914.52	3.8%	30%	292,000	776,715	Y
MN	4.53	$0.12	132	75%	$(103,581.67)	$ (34,814.68)			$ (34,814.68)		30%	292,000		N
MO	4.555	$0.10	132	75%	$(162,826.57)	$ (104,610.45)			$ (104,610.45)		30%	292,000		N
MS	4.43	$0.11	135	75%	$(125,270.63)	$ (58,384.08)			$ (58,384.08)		30%	292,000		N
MT	4.69	$0.10	128	75%	$(132,178.51)	$ (71,147.15)			$ (71,147.15)		30%	292,000		N
NM	6.77	$0.11	89	75%	$ 40,514.64	$ 106,533.06	$ 95,879.76	8.5%	$ 10,653.31	4.3%	30%	292,000	482,353	Y
NE	4.845	$0.10	124	75%	$(129,074.66)	$ (70,133.37)			$ (70,133.37)		30%	292,000		N
NC	5.01	$0.11	120	75%	$ (80,650.14)	$ (15,727.82)			$ (15,727.82)		30%	292,000		N
ND	5.01	$0.09	120	75%	$(150,024.68)	$ (97,457.20)			$ (97,457.20)		30%	292,000		N
NJ	3.2	$0.15	188	75%	$(185,836.12)	$ (94,717.97)			$ (94,717.97)		30%	292,000		N
NV	5.31	$0.13	113	75%	$ 15,847.23	$ 93,329.70	$ 83,996.73	7.0%	$ 9,332.97	4.1%	30%	292,000	608,233	Y
NY	3.756	$0.18	160	75%	$ 22,520.04	$ 132,244.24	$ 119,019.82	7.0%	$ 13,224.42	4.1%	30%	292,000	861,224	Y
OH	4.045	$0.12	148	75%	$(154,518.70)	$ (84,251.67)			$ (84,251.67)		30%	292,000		N
OK	4.985	$0.10	120	75%	$(126,275.71)	$ (69,478.80)			$ (69,478.80)		30%	292,000		N
OR	3.86	$0.10	155	75%	$(243,414.05)	$ (184,353.33)			$ (184,353.33)		30%	292,000		N
PA	3.68	$0.13	162	75%	$(172,056.23)	$ (95,662.50)			$ (95,662.50)		30%	292,000		N
RI	4.23	$0.16	142	75%	$ 5,351.28	$ 100,125.13	$ 90,112.62	6.5%	$ 10,012.51	4.1%	30%	292,000	762,613	Y
SC	5.06	$0.12	119	75%	$ (45,637.28)	$ 24,859.73	$ 22,373.76	4.5%	$ 2,485.97	3.8%	30%	292,000	633,186	Y
SD	4.56	$0.10	132	75%	$(153,785.54)	$ (93,959.31)			$ (93,959.31)		30%	292,000		N
TN	4.18	$0.10	143	75%	$(198,586.48)	$ (139,470.99)			$ (139,470.99)		30%	292,000		N
TX	5.00	$0.12	120	75%	$ (56,412.85)	$ 12,825.86	$ 11,543.27	4.1%	$ 1,282.59	3.8%	30%	292,000	637,283	Y
UT	5.39	$0.10	111	75%	$ (76,573.79)	$ (16,871.91)			$ (16,871.91)		30%	292,000		N
VA	6.72	$0.11	89	75%	$ 34,458.79	$ 99,398.73	$ 89,458.85	8.1%	$ 9,939.87	4.3%	30%	292,000	481,640	Y
WA	4.73	$0.09	127	75%	$(181,356.74)	$ (129,744.19)			$ (129,744.19)		30%	292,000		N
WI	4.29	$0.14	140	75%	$ (65,916.74)	$ 14,843.64	$ 13,359.27	4.1%	$ 1,484.36	3.8%	30%	292,000	743,484	Y
WV	3.65	$0.09	164	75%	$(297,604.68)	$ (242,248.33)			$ (242,248.33)		30%	292,000		N
WY	6.06	$0.10	99	75%	$ (26,469.60)	$ 34,226.76	$ 30,804.09	5.1%	$ 3,422.68	3.9%	30%	292,000	528,123	Y