

FLORIDA SOLAR ENERGY CENTER

***Turn on the Lights and Let the
Sun Shine In***

On-Site Power Production

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Philip Fairey

A Research Institute of the University of Central Florida

Task Group Membership

Philip Fairey, Chair

Glenn Chinery

Matt Howes

Tim Merrigan

Lee O'Neal

Charles Segerstrom

David Springer

Mark van Topel

Objective

Develop the method and procedures to incorporate on-site power production into HERS Ratings.

Main Issues

- ❖ Apply against just the rated energy uses or against all energy uses?
 - DOE's Zero Energy Home (ZEH) program.
 - Impact of additional rated features on perceived PV benefit.
- ❖ Apply against just electrical energy use or against all energy uses?
 - Normalization does not apply.
 - Equivalent power production.

Energy Use Alternatives

Method 1: PV applied against total use

Method 2: PV applied against H,C & HW

Table B. Comparison of HERS Scores for 3500 kWh/yr PV System

Energy (MBtu)	Chicago	Miami	Baltimore	San Diego
HERS base	43.8	38.1	40.4	10.7
Total	65.8	60.2	62.4	32.7
PV	11.9	11.9	11.9	11.9
Score: Method 1	83.6	84.0	83.8	87.3
Method 2	85.5	86.3	85.9	102.3

Difference is 15 HERS points!

Fuel Type Impacts

There are significant differences between all electric and natural gas home HERS scores unless natural gas use is adjusted.

Climate:	Electric	N. Gas	* N.Gas_{adj}
Baltimore	83.7	82.2	83.8
San Diego	87.3	84.4	86.4

* Site natural gas use multiplied by 0.40 to account for modern efficiency of electric power production.

HERS Score Differences

Another view of the data

	<u>Baltimore</u>	<u>San Diego</u>
All Electric	83.7	87.3
N. Gas	<u>82.2</u>	<u>84.4</u>
Difference:	1.5	2.9
All Electric	83.7	87.3
Adj. N. Gas	<u>83.8</u>	<u>86.4</u>
Difference:	-0.1	0.9

Proposal

- ❖ Apply on site power production to the total energy use of a home.
- ❖ Apply on site power production against all site fuels.
 - Convert fossil fuels to equivalent electric power using the efficiency of a modern, high-efficiency, central power plant.

Some Definitions

On Site Power Production (OPP):

Electric power produced at the site of a Rated Home. OPP shall be the net electrical power production, such that it equals the gross electrical power production minus any purchased fossil fuel energy, converted to its Equivalent Electric Power, used to produce the on-site power.

Equivalence

Equivalent Electric Power

The amount of electricity that would be produced from site fossil fuel uses when converted to electrical power using the Reference Electricity Production Efficiency.

Reference Efficiency

Reference Electricity Production Efficiency

An electric power production efficiency, including all production and distribution losses, of 40%, approximating the efficiency of a modern, high-efficiency, central power plant.

Net Power Production

- ❖ Example – Fuel Cell:
 - Produces 10,000 kWh power (29.3 MBtu)
 - Using 500 Therms of natural gas (50 MBtu)
- ❖ Equivalent power production for the site natural gas use
 - $50 \text{ MBtu} * 40\% = 20 \text{ MBtu}$
- ❖ Net on-site power production
 - $29.3 \text{ MBtu} - 20 \text{ MBtu} = 9.3 \text{ MBtu}$

Counting

Purchased Energy Fraction (PEfrac)

The fraction of the total energy consumption of the Rated Home that is Purchased Energy, wherein all site fossil energy uses are converted to their Equivalent Electric Power using the Reference Electricity Production Efficiency of 40%.

Equivalent Power

- ❖ Site energy use

- Electricity: 10,000 kWh
- Natural gas: 900 Therm

- ❖ Conversions:

- $10,000 \text{ kWh} * 0.293 = 29.3 \text{ MBtu}$
- $90 \text{ MBtu} * 40\% = 32 \text{ MBtu}$

- ❖ Total = 61.3 MBtu

New Scoring Equation

$$100 - ((\text{PEfrac} * \text{TnML} / \text{TRL}) * 20)$$

Fuel Cell Example

- ❖ Net power production = 9.3 MBtu
- ❖ Equivalent site use = 61.3 Mbtu
- ❖ Purchased energy fraction (PEfrac):
 - $(61.3 - 9.3) / 61.3 = 85\%$
- ❖ Score for “80 point home”:
 - $100 - ((85\% * 48/48) * 20) = 83.0$