Decarbonisation of Energy Infrastructure in Displacement Situations:

Technical Tips and Tools for Energy Systems

Peter Lilienthal, Ph.D.
Global Microgrid Lead, UL and HOMER Energy by UL, Founder
Oct. 26, 2021

Organised jointly by ICRC, UNITAR and Energypedia

HOMER Background

1992: Originally developed at NREL by Dr. Lilienthal

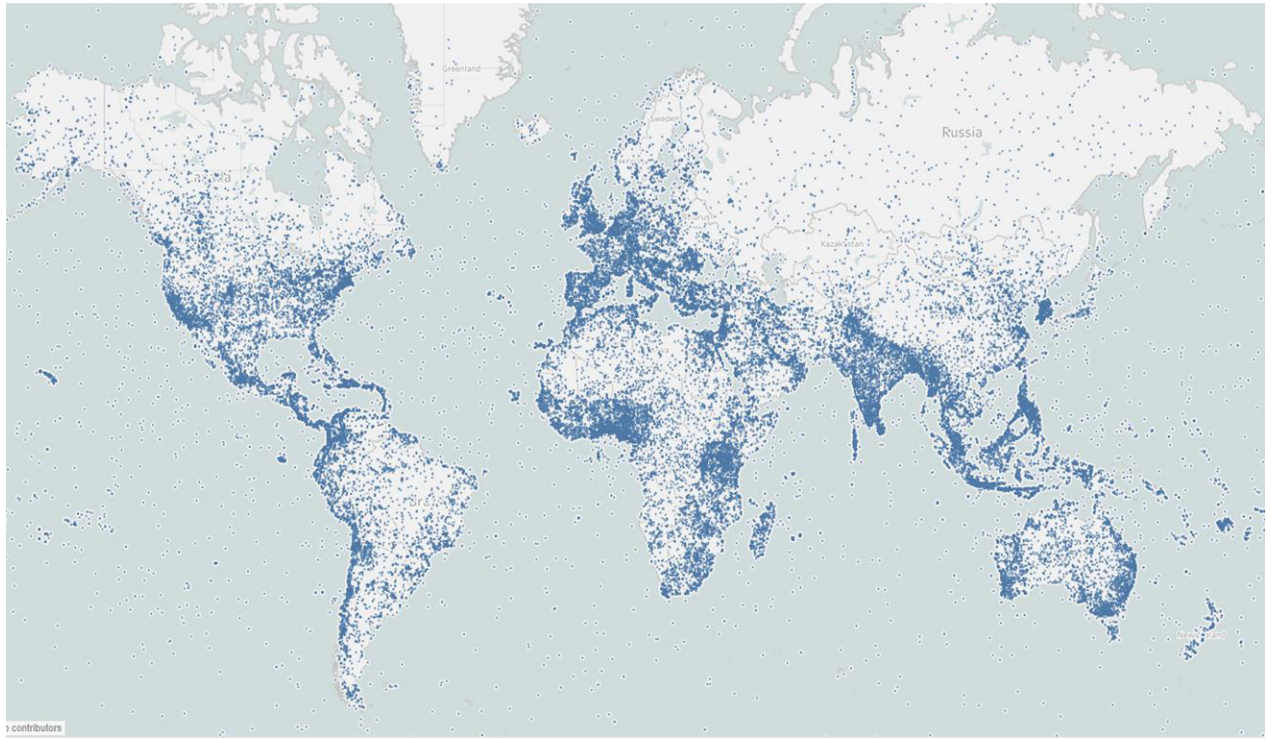
1997 & 2002: Major upgrades

2009: Licensed to HOMER Energy

2010: Powering Health v.1

2014: HOMER Pro

2019: Acquired by UL



De-facto Global Standard

- >250,000 people have used HOMER
- >100,000 opted-in to our network
- >90,000 projects modeled since 2014

www.homerenergy.com

https://poweringhealth.homerenergy.com/

- 2010: Funded by USAID as part of PEPFAR (President's Emergency Plan for AIDS Relief)
- 2020: Adapted by World Bank ESMAP for Covid Relief
- 2021: New project by World Bank ESMAP for broader energy needs in displacement situations
- Intended for non-engineers
- Lots of explanatory information
- Creates initial design & HOMER file for use in desktop version of HOMER Pro

PoweringHealth Webapp

Peter Lilienthal, Ph.D.
Founder, HOMER Energy
Global Microgrid Lead, UL

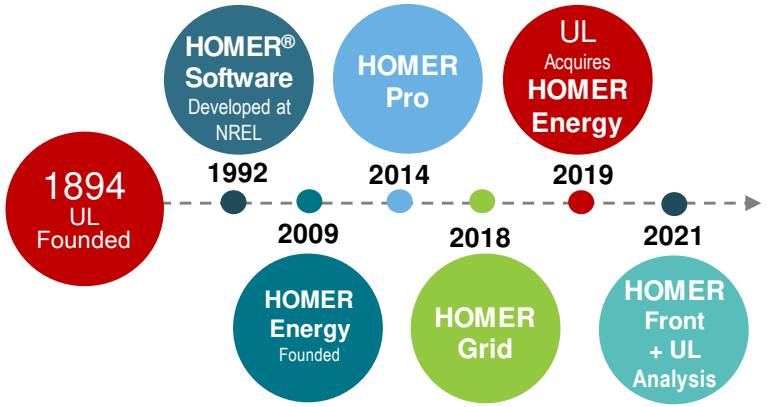
Solar for Healthcare
August 18, 2021

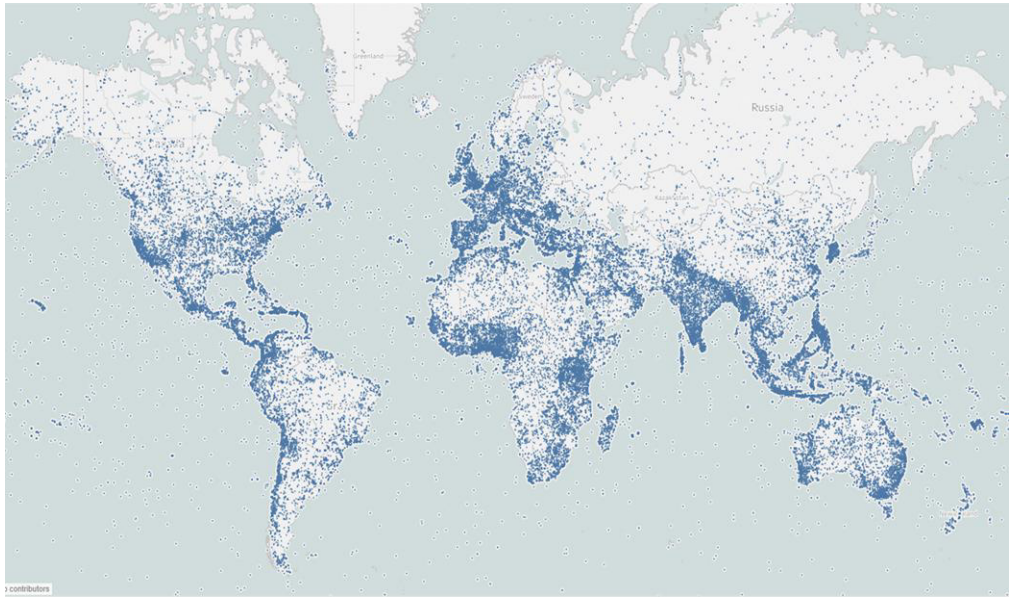
Poweringhealth.homerenergy.com

HOMER Energy by UL

Designing Hybrid Systems for almost 30 years

- 1992 – National Renewable Energy Lab creates Village Power Program
- 2009 – HOMER Energy spun off with exclusive license
- 2010 – USAID funds PoweringHealth 1.0
- 2019 – Acquired by UL (Underwriter's Laboratory)
  - 14,000 staff in over 100 countries
- 2020 – World Bank funds PoweringHealth v. 2.0 for COVID relief





De-facto Global Standard

- >250,000 people have used HOMER
- >100,000 opted-in to our hybrid system design network
- >90,000 projects modeled since 2014

Poweringhealth.homerenergy.com

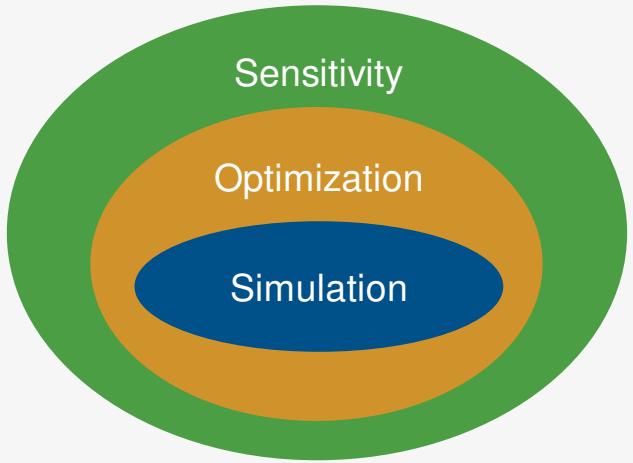
Microgrid/ DER optimization and design in HOMER®

HOMER Pro | HOMER Grid | HOMER Front

INPUTS

- Economics
- Load Profile
- Site-Specific Renewable Resources
- System Components

ANALYSIS

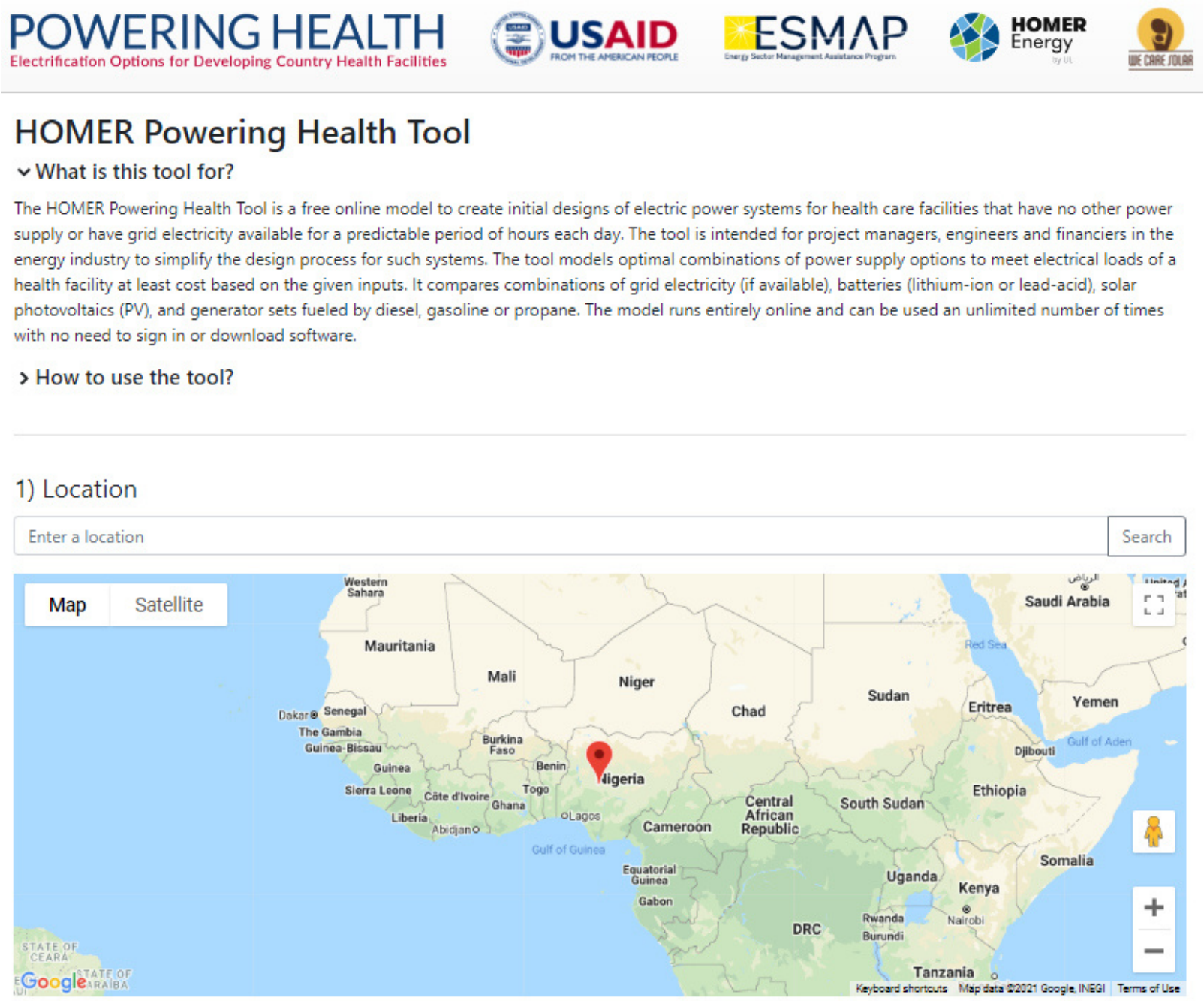


RESULTS

- Economics & Engineering
- System Sizing
- Performance Details
- Financials
- Various Reports

Download at https://www.homerenergy.com/products/pro-vs-grid.html Free 21-day trial

- Easy to use
- Click on a map
- Lots of explanatory information
- Intended for non-engineers
- Creates initial design & HOMER file for use in desktop version of HOMER



Poweringhealth.homerenergy.com

District / Referral Hospital
145 beds

Rural Hospital
50 beds

Small Inpatient Clinic
14 beds

Rural Dispensary - No Inpatient
4 emergency beds

Equipment

- EPI: Immunization
- Outpatient Treatment
- Obstetric Delivery
- Maternity Ward
- MCH
- Neonatal Care
- General Wards
- Laboratory
- Administration & Admissions
- COVID Isolation Ward
- COVID Basic Care Ward
- Operating Theatre
- Radiology
- Intensive Care Unit
- Mortuary
- Staff
- Water Supply
- Water Heating
- Custom Equipment

+ Add

Total

Equipment	Quantity	Nameplate Power (W)	Average Power (W)	Always on?	Daytime Hours on 7:00-17:59	Evening Hours on 18:00-21:59	Night Hours on 22:00-6:59	Total Energy (kW·h/day)
EPI: Immunization								**0.7**
Outpatient Treatment								**0.5**
Obstetric Delivery								**0.2**
Maternity Ward								**1.4**
MCH								**0.1**
Neonatal Care								**0.0**
General Wards								**1.0**
Laboratory								**3.1**
Administration & Admissions								**1.0**
COVID Isolation Ward								**3.2**
Lights LED (add to General Ward)	4	10	10	No	0	4	3	0.3
Exhaust fan (per COVID isolation cubicle)	2	40	40	Yes	11	4	9	1.9
Exhaust fan (staff change area)	1	40	40	Yes	11	4	9	1.0
COVID Basic Care Ward								**26.0**
Lights LED (add to General Ward)	4	10	10	No	0	4	3	0.3
Exhaust fan (per COVID isolation cubicle)	2	40	40	Yes	11	4	9	1.9
Oxygen Concentrator (50% of beds)	1	350	350	Yes	11	4	9	8.4
BiPAP respirator (50% of beds)	3	80	80	Yes	11	4	9	5.8
CPAP respirator (50% of beds)	3	80	80	Yes	11	4	9	5.8
Pulse Oximeter *(rechargeable)	2	20	5	No	0	0	8	0.1
Infusion pump	2	50	50	Yes	11	4	9	2.4
EKG/ EGC (*potable rechargeable)	2	30	30	No	0	0	8	0.5
Exhaust fan (staff change area)	1	40	40	Yes	11	4	9	1.0

Outputs

Least cost system has generator

- Only runs for 212 hours/year

System without generator

- Almost twice as large

Generator only system

- Over 3 times more expensive

List of Suggested Configurations

PV (kW)	Generator (kW)	Grid (kW)	Storage (kW·h)	Converter (kW)	Initial Capital ($)	Total Net Present Cost ($)	Operating Cost ($/yr)	COE ($/kWh)	Fuel (L/yr)	Generator (hrs/yr)
Configuration: Genset / PV / Storage										
6	5	—	14	3	20,024	27,056	401	0.305	227	212
Configuration: PV / Storage										
14	—	—	24	4	33,387	38,748	306	0.437	0	0
Configuration: Genset / Storage										
—	5	—	5	3	9,642	49,829	2,293	0.561	1,745	1,360
Configuration: Genset										
—	5	—	—	—	5,519	98,726	5,318	1.112	4,289	7,309

Inputs Summary

See the HOMER inputs report for this simulation.

Save the HOMER Output File

Download the HOMER Pro output file (.homer) for this simulation (for use with the HOMER Pro desktop application only).

Poweringhealth.homerenergy.com

Conclusion

Very many non-engineers need to understand the basics of solar power systems

- Approximate sizing and costs

Poweringhealth is a simple app that gets the process started

- Creates a HOMER file that can be fine-tuned in HOMER Pro

Solar + storage is the most sustainable source for rural healthcare

Diesel generators

- Not sustainable, if used by themselves
- Can be useful – **if used sparingly, just as backup**