Cost Comparison of Living Energy Farm Off-Grid Electrical System

Living Energy Farm is a community in Virginia that is designed to operate without fossil fuel. Our residential electrical system is based solely on DC electricity. Our "DC microgrid" is effective, efficient, and durable. What follows is a cost-benefit comparison of LEF's DC microgrid with conventional off-grid design.

Conventional off-grid systems can vary enormously in scale. Wealthy people may install very large systems, backwoods "off-griders" smaller systems. The following document compares the LEF model with a community microgrid built near us that employs conventional off-grid technology. That system is similar in scale and intent to the LEF electrical system. In the following, LEF refers to LEF's DC microgrid system. COGS refers to the community microgrid built near us, the "conventional off-grid system" to which we are comparing our system.

Off Grid System Comparison

LEF – total power supply from photovoltaic (PV) power = 2000 watts
COGS – PV power = 4000 watts
LEF – total up-front per capita cost = $500
COGS – total up-front per capita cost = $2600
LEF – generator backup power = NONE
COGS – generator backup = YES
LEF – battery storage = 100 AH
COGS – battery storage = 2000 AH
LEF – annual battery degradation cost = $25
COGS – annual battery degradation cost = $1500 – $2000
LEF – annual equipment degradation cost = $100
COGS – annual equipment degradation cost = $1000
LEF – support for 24/7 use of appliances = NO
COGS – support for 24/7 use of appliances = YES
LEF – firewood for space heating dependency = 5% (active solar space heating supported by PV)
COGS – firewood for space heating dependency = 100%
LEF – refrigeration = yes but limited
COGS – refrigeration = yes, full size
LEF – air conditioning = YES (aqueous thermal absorption, not possible in all locations)
COGS – air conditioning = NO
LEF – system failure mode = no system wide failure, slowly weakening systems support conservation and allow correction before anything shuts down, multi-linear system cannot fail in total
COGS – system failure mode = immediate whole system collapse when batteries weaken, requires generator support which is difficult in inclement weather
LEF – support for smart phones, laptops, and internet = yes, but limited to battery powered devices
COGS – support for smart phones, laptops, and internet = yes
LEF – toxic impact of consumable materials = very low, no toxic heavy metals
COGS – toxic impact of consumable materials = high, extensive use of lead, re-processed abroad
LEF – life expectancy of core system components = 40 or more years
COGS – life expectancy of core system components = batteries, 5 – 7 years, generator, 10 years, other components, 40 years or more
LEF – non-electric energy storage = extensive
COGS – non-electric energy storage = none
LEF – behavioral impact of system design = slowly weakening systems teach users to adapt their lifestyle to energy availability. Some tasks have to wait for a sunny day.

COGS – behavioral impact of system design = With a conventional AC grid, enormous capital costs are invested in power production, and end users only pay for that energy in small increments. Consumptive behavior is encouraged. With a COGS system, the incentives are mixed. Like an AC system, capital is invested in power production, but a COGS system is limited in total power output, which users know. COGS operates with generator backup and users are habituated to AC grid power. In our experience of community-based COGS systems, users often plug in power using devices and forget them, just like they do with AC power. The LEF system does not allow that.

In summary, the AC grid is based on a steam boiler economy. With a steam boiler, per-unit energy output declines significantly as the boiler gets larger. High voltage AC power travels over long distances with little loss. DC power does not. Given our habituation to the AC economy, COGS systems attempt to support traditional energy use patterns, but the cost is very high. The battery degradation cost alone is devastating. The LEF system by comparison is not free, but annual operating expenses are extremely low. PV power is fundamentally different from boiler-based energy. PV power is modular and DC. The LEF model fundamentally re-orients energy usage patterns based on the strengths of PV power instead of trying to imitate the AC grid. There is a big shift in LEF design away from electrical storage, which has an enormous impact on costs.