Choosing Solar For the Telecom

Boubacar Sow
Subsidiary Director Senegal

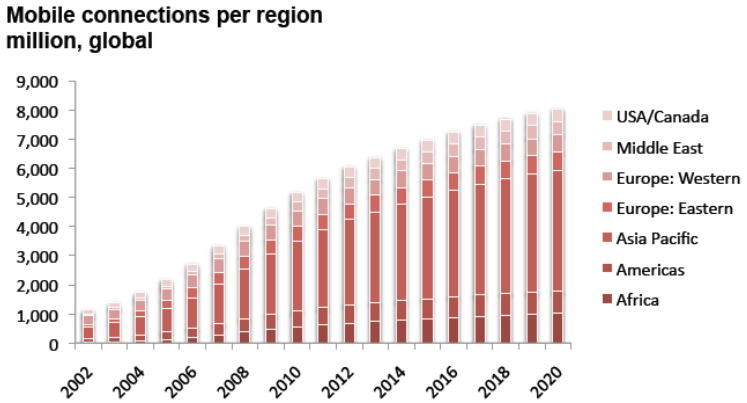
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New challenges for Telecoms

1

- Stress on **ARPU** (developing countries + rural areas)
- Search for **margins stabilization or growth**

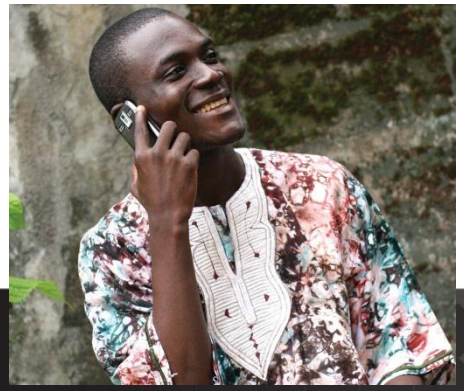


GSMA, *Mobile's Green Manifesto,* November 2009

2

- Thighter directives from **governments &consumers concerns**
- 20% of green BTS in 2020







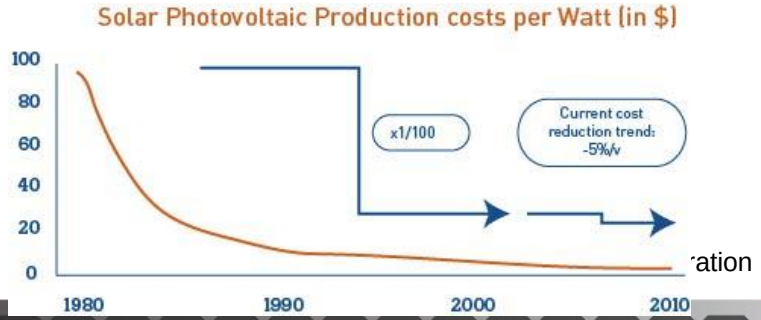


3

- For a small van transporting 300 litres of fuel, each additional hour adds roughly 3% to the price / l.
- 80% of the service interruptions are **due to a power supply cut**
- 10% of BTS fuel replaced by water

4

- **Solar power** expected to **achieve competitiveness** with the power grid retail price in many regions of the world ("grid parity")



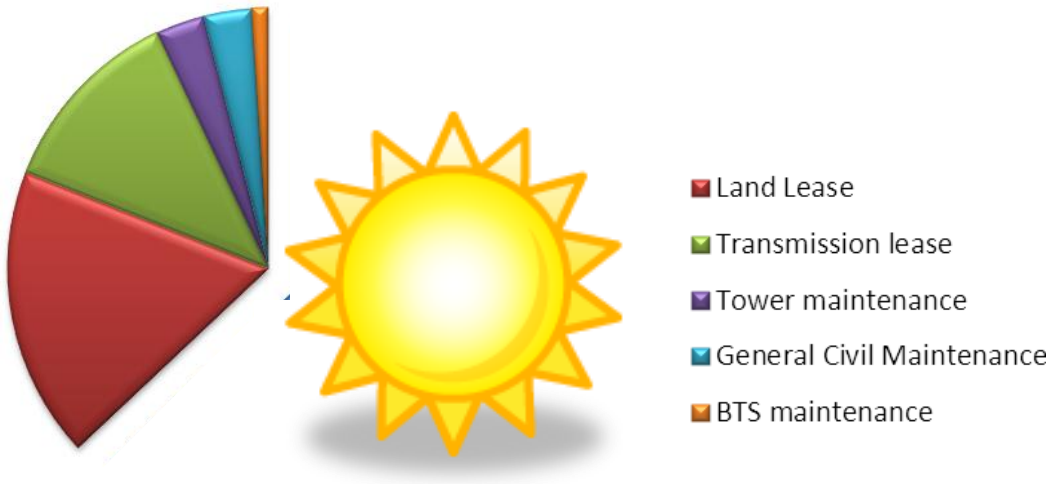
Energy cost reduction as a key leverage to stabilize your operating margins

Off-grid site OPEX breakdown, example of an operator in Africa (100% diesel- GE site, 1 000W power)

The more PV, the less fuel OPEX (sun is for free !)

Per site:

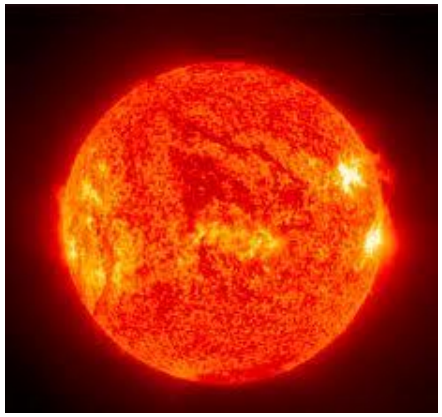
- 13 500l of fuel / year
- Maintenance visit every 12 days
- > 20K€ OPEX / year directly linked to fuel consumption and GE maintenance



> Average 20K€ /year / site OPEX Savings for our Telecom customers

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Put in a reliable source of energy… get predictable costs



The sun delivers the equivalent of 10 000 times the current global energy consumption

- Sun is an **immediate** and **unlimited** source of energy
- **Reliably predictable** thanks to statistical databases
- PV is a **time tested technology** for Telecoms

→ *First SunPower PV installation for Telecom in 1989*

→ ***3 000 sites equipped worldwide by SunPower***

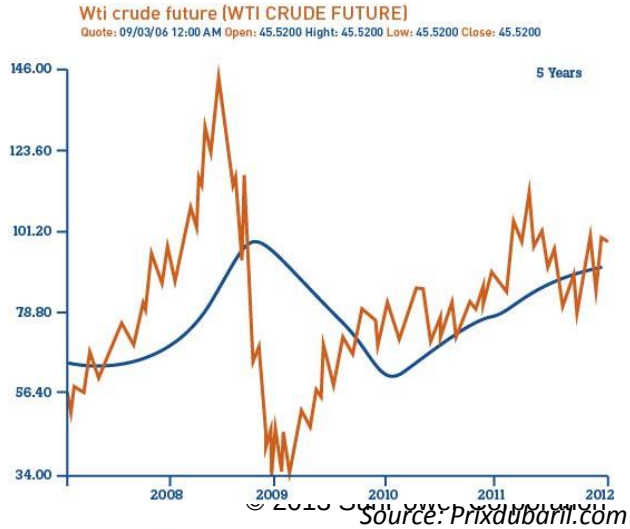
→ *Types of network: fixed, mobile, SAT, radio*

→ ***> 400 000 hours** (= 45 years) MTBF*

→ **No operational or costing hazard** linked to:

- availability,
- transport (fuel theft, haulers problems)
- nor fuel price volatility

→ ***No surprise**: SunPower brings you a **clear financial plan** with transparent costs on the lifetime of your generator.*



Source: Prixdubaril.com

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*Mean Time Between Failure

Optimize the sizing of systems to ensure sufficient power generation while avoiding excess CAPEX.

- **Rationalized** CAPEX (no oversizing)
- Guaranteed system **efficiency** :
  - with a comprising understanding of local constraints
  - avoiding underestimation
  - using time-tested components



→ *Over **3 000 telecom sites worldwide** experience in **pragmatic** sizing*

→ *Tenesol **support** worldwide, to check input parameters on field*

→ *> 30-persons project / **technical team** for multiple-energy-generators*

→ ***Efficiency-driven** recommendations : **open architecture** including any possible source of energy*

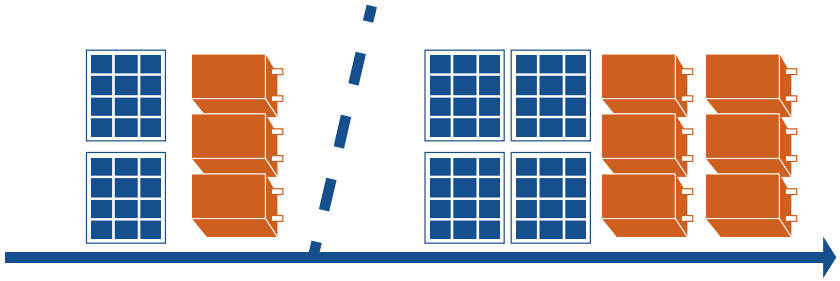


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SunPower approach to solar alternative systems: Full adjustment to BTS lifecycle…

NEW SITES, LOW POWER → 100% Solar

- Start to the need with PV
- Scale-up progressively according to the evolution of power need



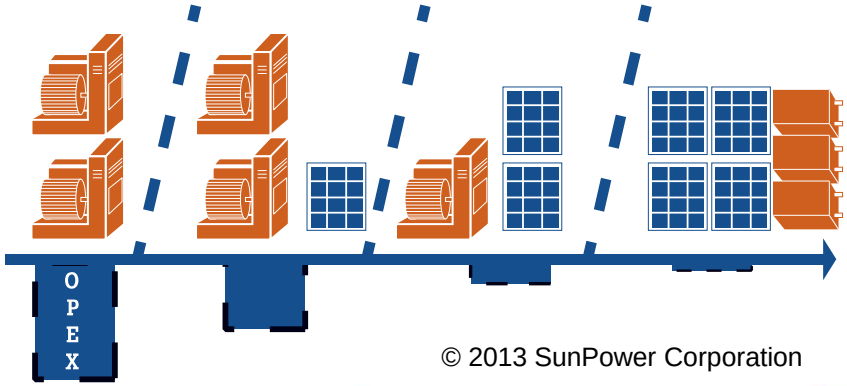
HIGH POWER & BACKBONE SITES → Go Hybrid

- Go for PV / GE hybrid solution
- Always secure backbones with 2 different sources of energy



EXISTING SITE WITH GE → Revamp step by step

- Progressively revamp BTS power generation
- Go for hybridation with a little PV to start cutting OPEX
- Self finance additional PV field with OPEX savings, to finally substitute GE instead of replacing

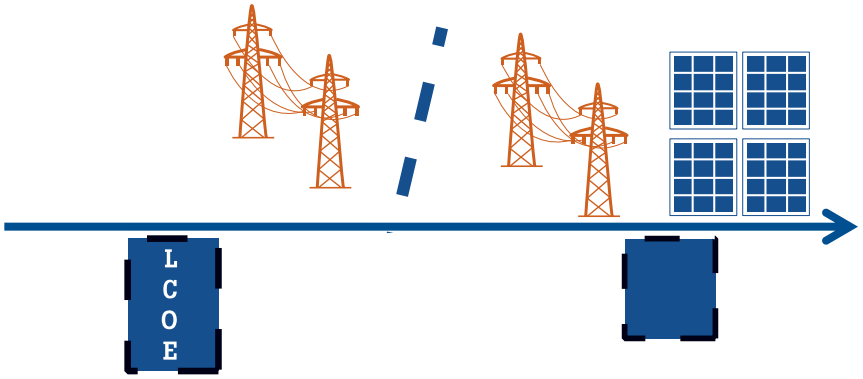


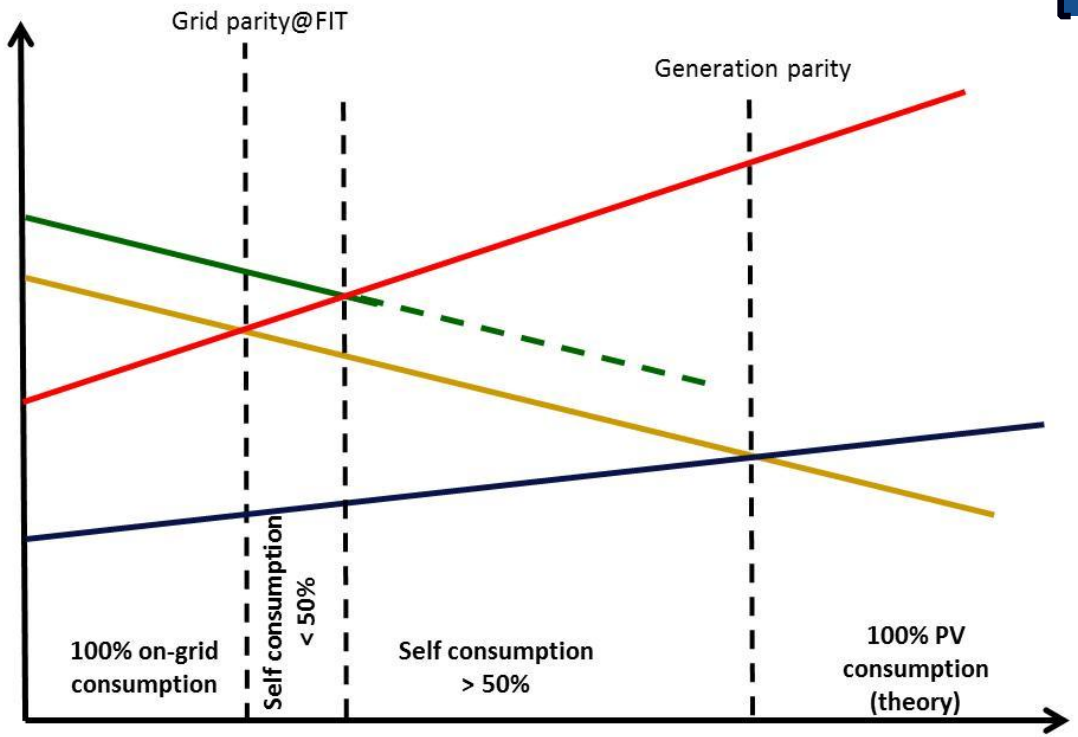
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…even for on-grid sites

EXISTING SITE WITH GRID CONNECTION
→ get lower LCOE introducing PV

- Input alternative energy where grid parity is matched
- Secure power supply against unreliable grids
- Get money from PV production with FIT (Feed-in-tariffs) or use directly your production where FIT attractiveness is low





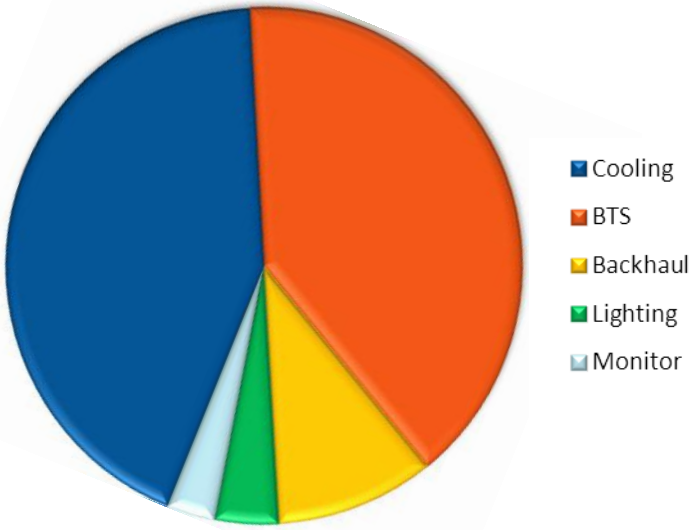
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Global energy approach to optimize site consumption

- New ICT equipment offer possibilities to reduce dramatically the energy consumption of a BTS relatively to the number of devices
- Up to **7 000W**+ for existing sites ->
- below **1 000W** for most energy efficient new sites

Site power consumption breakdown



Source: GSMA, Mobile's Green Manifesto, 2009

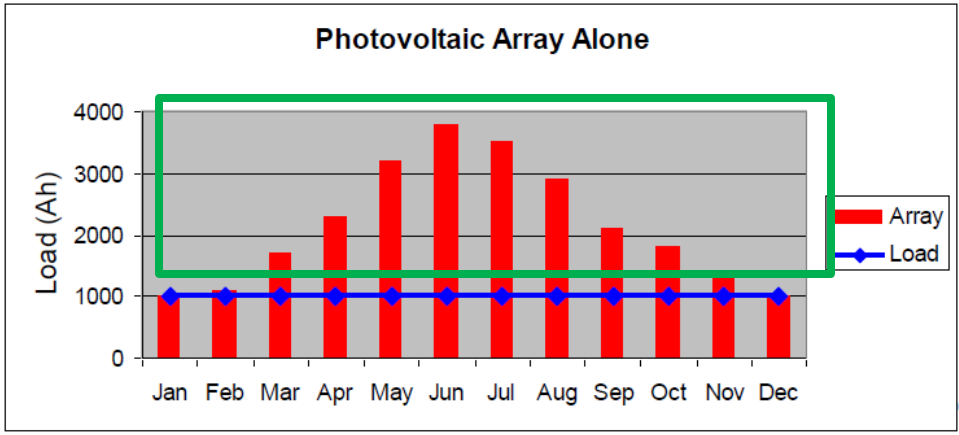
Eg: switching from air conditioning to air extractors, Tenesol has helped a global telecom ***operator to decrease both the consumption of the BTS and the necessary CAPEX for PV installation****.*

New sites are closer to CAPEX breakeven power range

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Social Responsibility: Skill transfer and energy distribution

- SunPower carries out the training of locals to installation and maintenance, fostering **local jobs creation**
- Different **energy distribution** models
  - ✓ Free redistribution for locals (humanitarian aid image)
  - ✓ **Community grid** projects including both villages and BTS owner (long term sustainable solution, no theft and breakage)







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Social Responsibility: About Genset CO2 generation

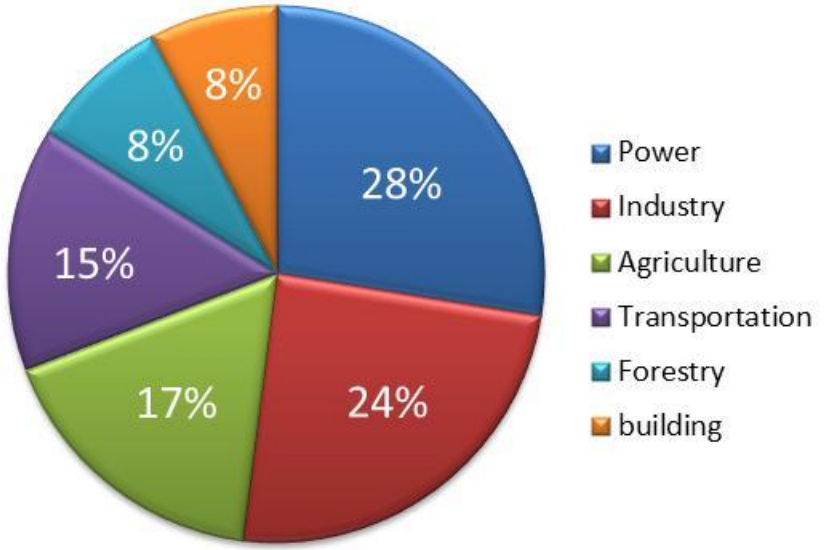
- **Carbon neutral growth** : PV is a CO2 Free process

- **CO2 emission** for a 100% GE site (estimation on average GE, 5l /hour, with diesel)
  > 35t / year excluding fuel transport
  > 54t / year including fuel transport

→ 1 650€ / site / year @30€ / t

Direct emission by sectors Gt CO2, 2020, Global

Total = 51,9 Gt



Source: GSMA, Mobile's Green Manifesto, 2009

The typical annual CO2 emissions per average GSM subscriber is now about 25 kg CO2, equating to the same emissions created by driving an average car on European motorways for about an hour.

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Dealing with Economics

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TCO approach, or the importance of SunPower 360° analysis before making a decision

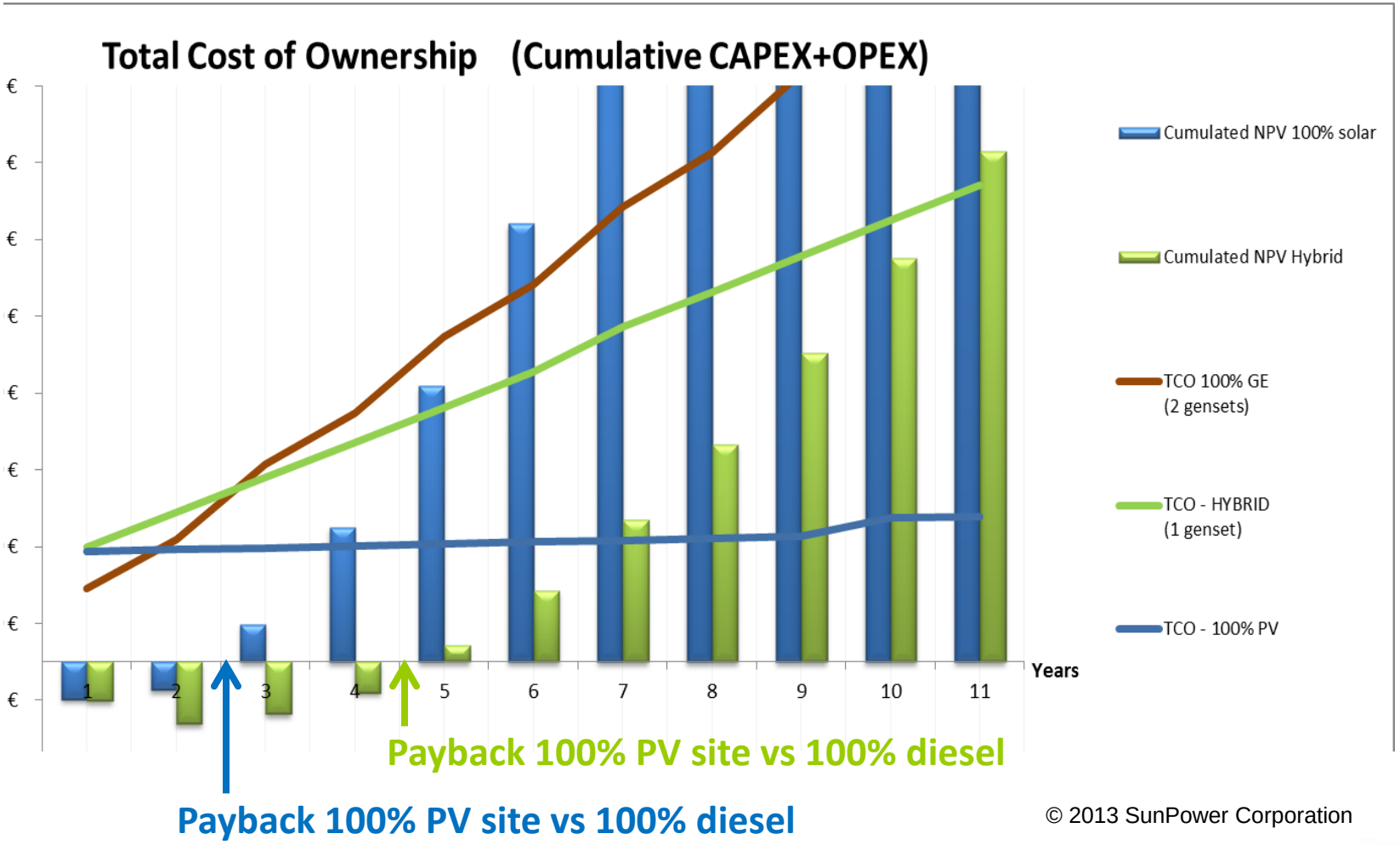
Basic fuel retail price: $0,9/l

Remoteness: 1h fuel transport

24/7 BTS operation

BTS power 1000W

Sun power 4kW/m²



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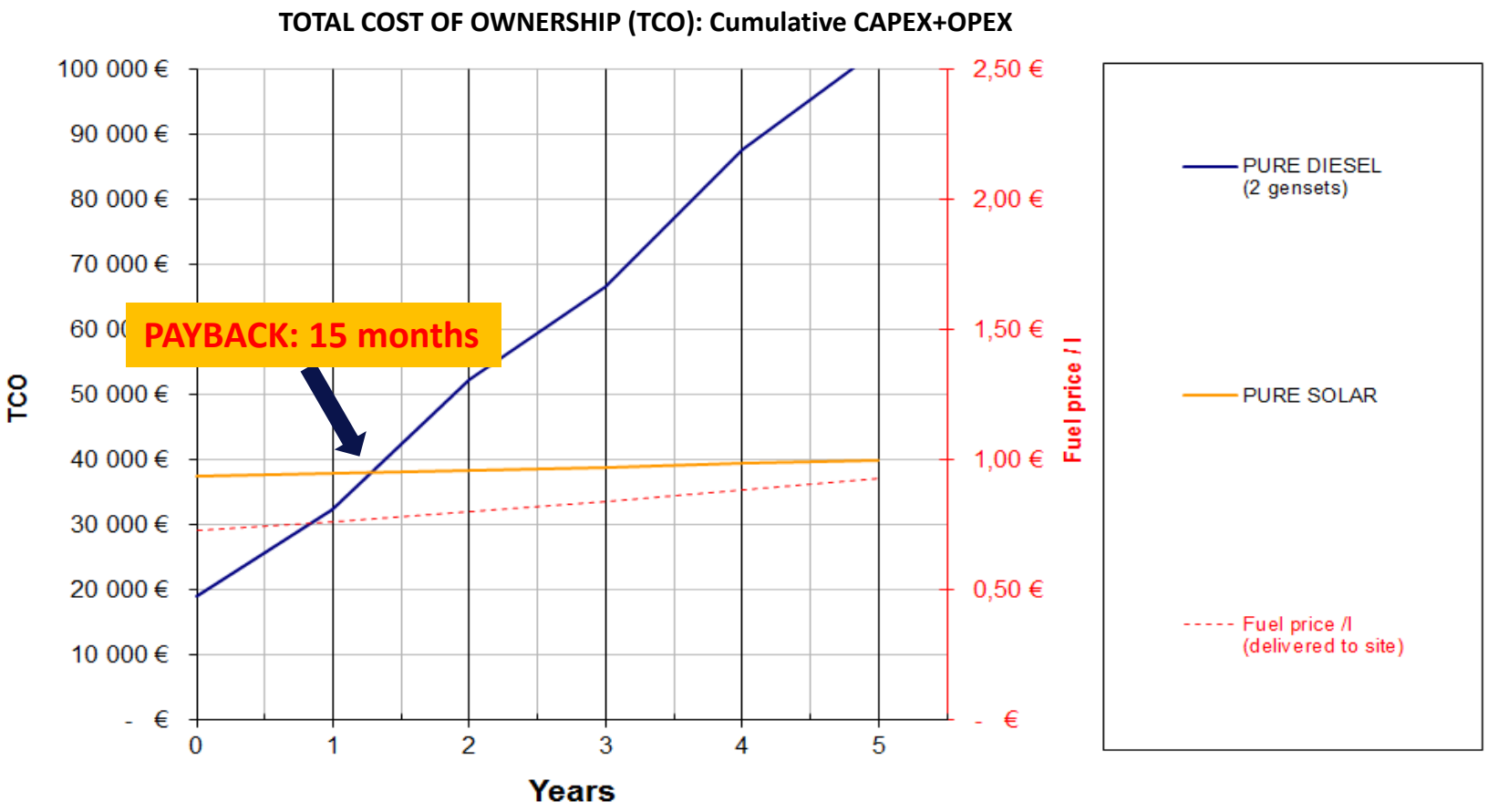
The more sun, the greater efficiency

Basic fuel retail price: $0,9/l

Remoteness: 1h fuel transport

BTS power 1000W

Sun power 5kW/m²



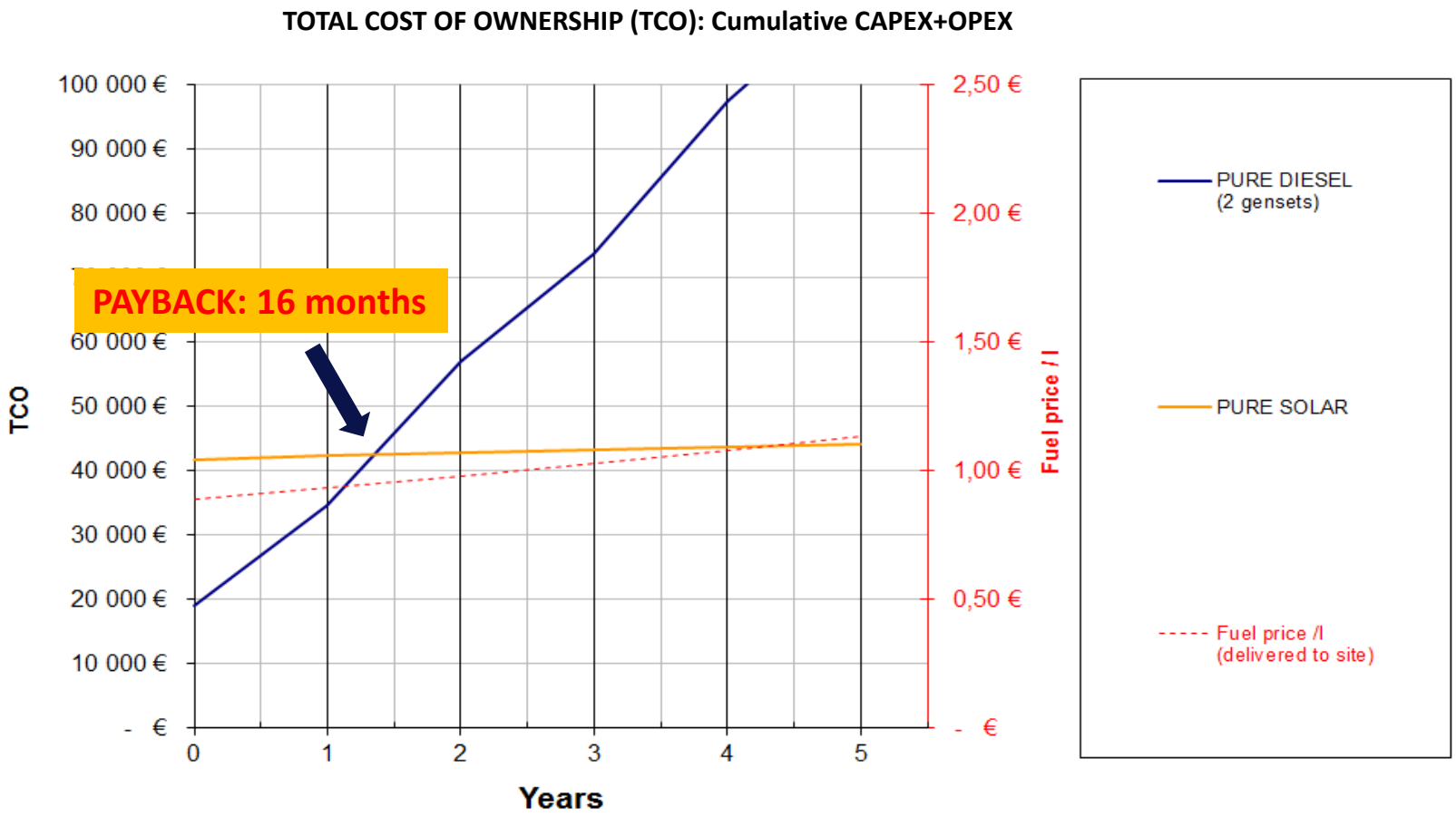
The higher the fuel price, the shorter the payback

Basic fuel retail price: $1,1/l

Remoteness: 1h fuel transport

BTS power 1000W

Sun power 4kW/m²



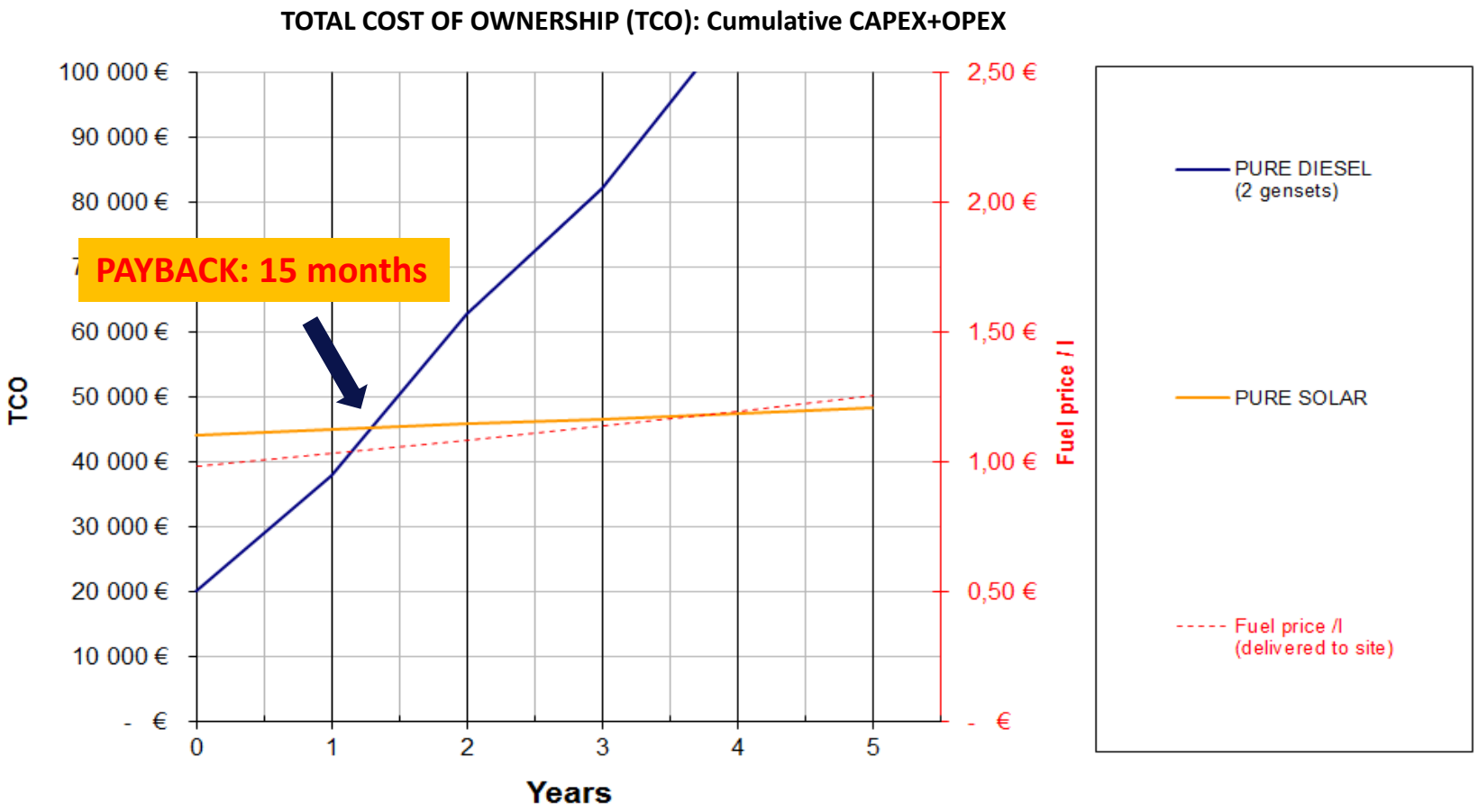
The more distance, the shorter the payback

Basic fuel retail price: $0,9/l

Remoteness: 12h fuel transport

BTS power 1000W

Sun power 4kW/m²



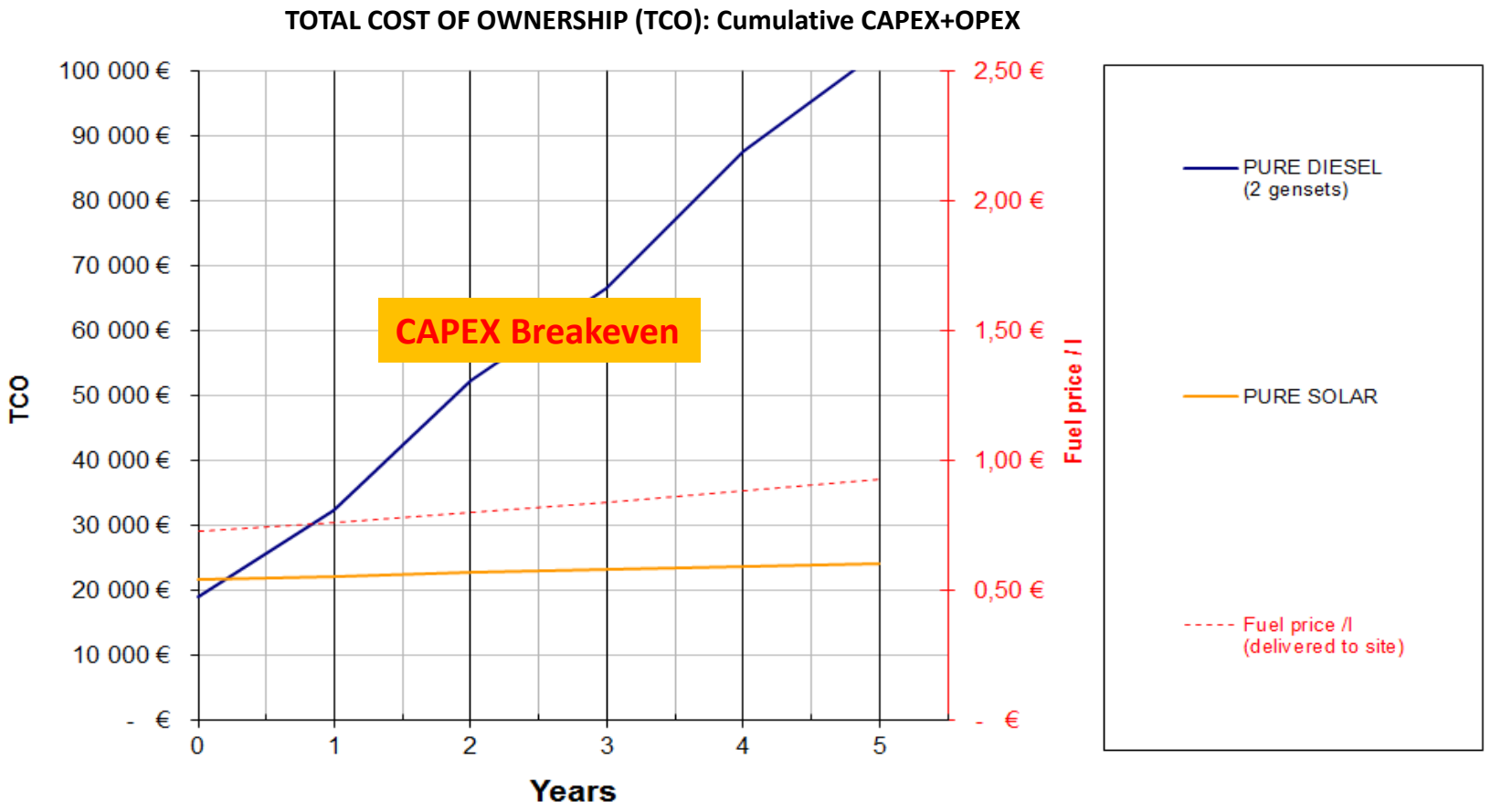
The lower the BTS power, the smaller CAPEX gap

Basic fuel retail price: $0,9/l

Remoteness: 1h fuel transport

BTS power 500W

Sun power 4kW/m²



TCO synthetic comparison
1200W 24/7 BTS, Africa average

	100% Diesel solution	Low-cost PV solution	Standard PV solution	SPWR HE PV solution
CAPEX 1 (incl. transport and land acquisition for PV plant)	15 000	33 000	39 000	39 000
Installation	5 000	9 500	9 500	8 000
CAPEX 2 (replacement)	50 000 (Generator replacement every 2 year)	30 000 (2 battery replacements, @15000€ / each)	18 000 (1 battery replacement)	18 000 (1 battery replacement)
OPEX x 20yrs	200 000€ (refueling + maintenance)	12 000 3 visits/year@400€ each)	12 000 (3 visits/year@400€ each)	24 000 (3 visits/year@400€ each)
Total Cost of Ownership 10 yrs	**270 000**	**84 500**	**78 500**	**77 000**
Space footprint		80m² +	80m²	50m²
Max time before first replacement	2 years	5 years	7 years	7 years

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Our next goal: financing your projects

- Payment over time, leasing, PPA…
- Specific Offer to be built, depending on:
  - Final Destination
  - Project Size
  - Customer profile
- Main Challenges to overcome:
  - Volatile Economy
  - Geography
  - Regulatory Frameworks





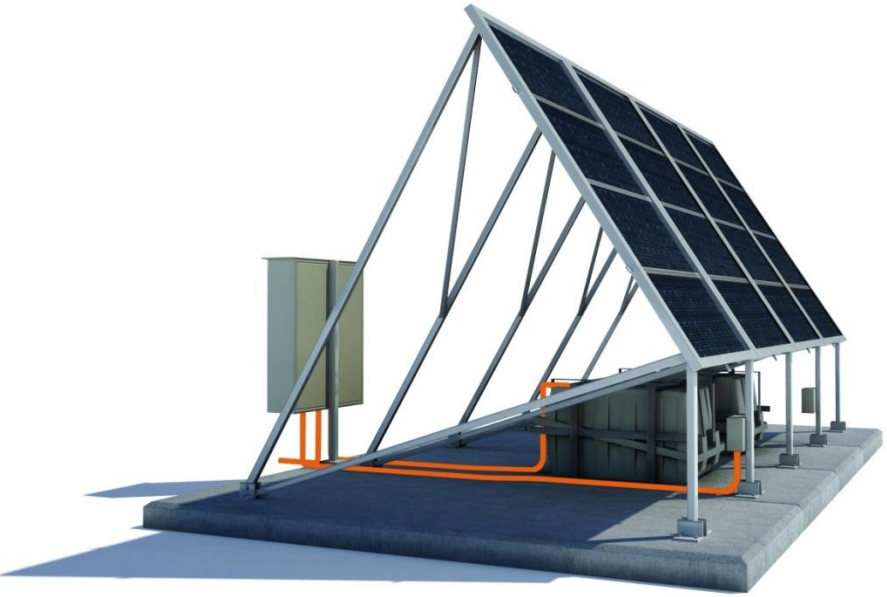
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Bringing the High Efficiency

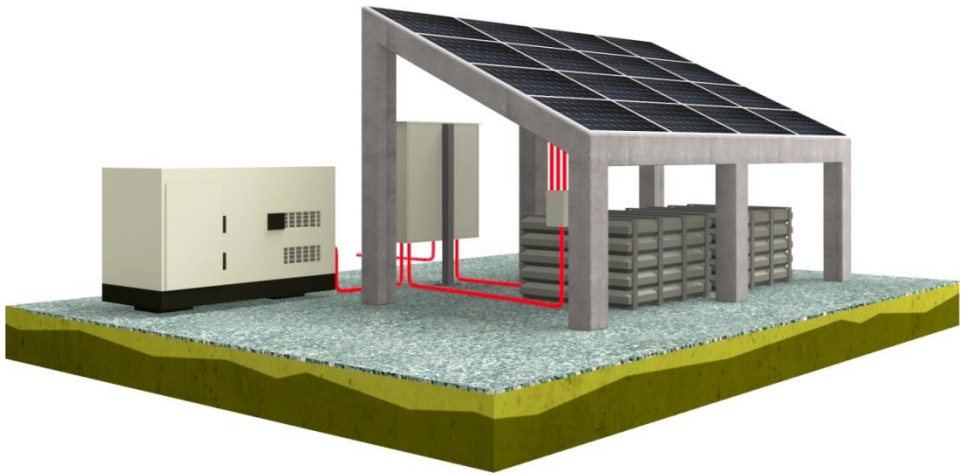
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SunPower solution overview



PV solution



Diesel Hybrid solution

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SunPower off-grid telecom layout

NEW

NEW

NEW

NEW

NEW

SMS Web portal



I/O extension module (optional)



TSX logger

GPRS, TCP/IP

Modbus



Connected to SunPower web portal



PV modules

SunPower high efficiency modules



MPPT Charge Controller



Intelligent Load Controller

RoHS

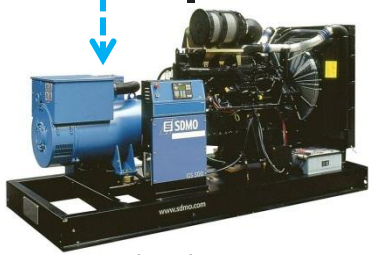


Load

- **Degraded mode: system still operates if TSX fails**
- **Mercury free**



Battery Bank



Diesel Generator (hybrid sites)

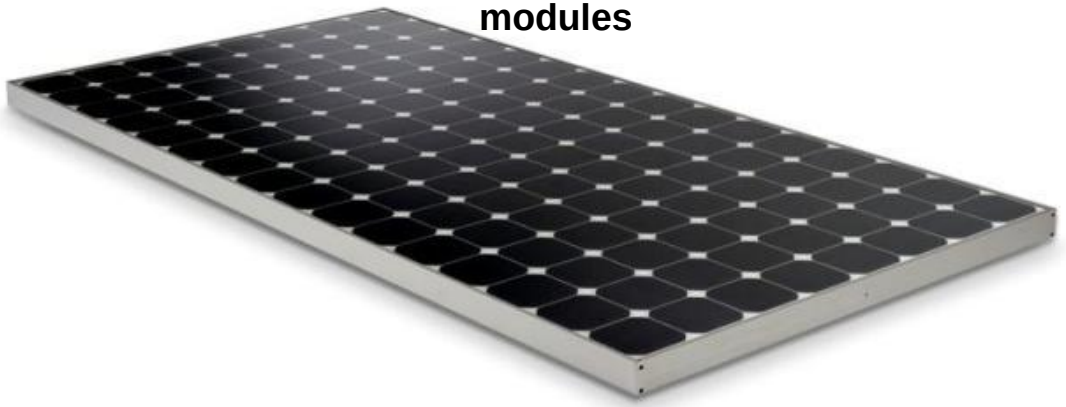
Genset, modbus connected

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Top efficiency combination

- **Industry leading panel efficiency: 20%**
- Produce up to 50% more than conventional panels
- Best energy performance (kWh/kWp)

SunPower high efficiency modules



Most powerful PV modules in the market



- Maximum Power Point Tracking Technology
- 97% yield
- Maximizes the power harvest from SunPower high efficiency panels

MPPT charge controler

Most efficient PV power harvesting technology

The heart of the SunPower panel is the Maxeon solar cell

- The Maxeon cell has a fundamentally different design from a Conventional Cell: it's built on a solid copper foundation.
- Copper plated solar cells cost more to manufacture than Conventional Cells, but the investment pays off with a much more reliable and high-performing solar cell.
- SunPower is the only manufacturer with a cell built on a solid copper foundation – the Conventional Cells are made by baking a metal paste onto the silicon wafer – just like screen-printing a logo onto a T-shirt.

SunPower panel with Maxeon



FRONT



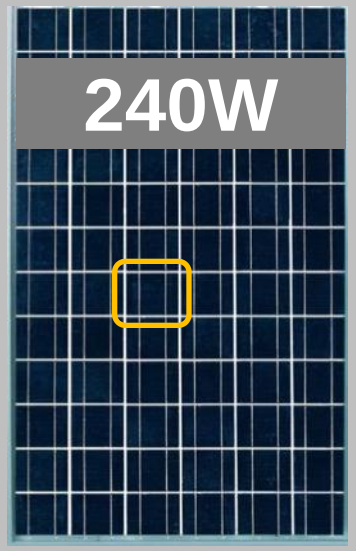
No metal

BACK



Copper-plated

Conventional panel (same size)

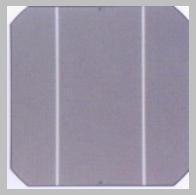


FRONT



Thin lines of metal paste

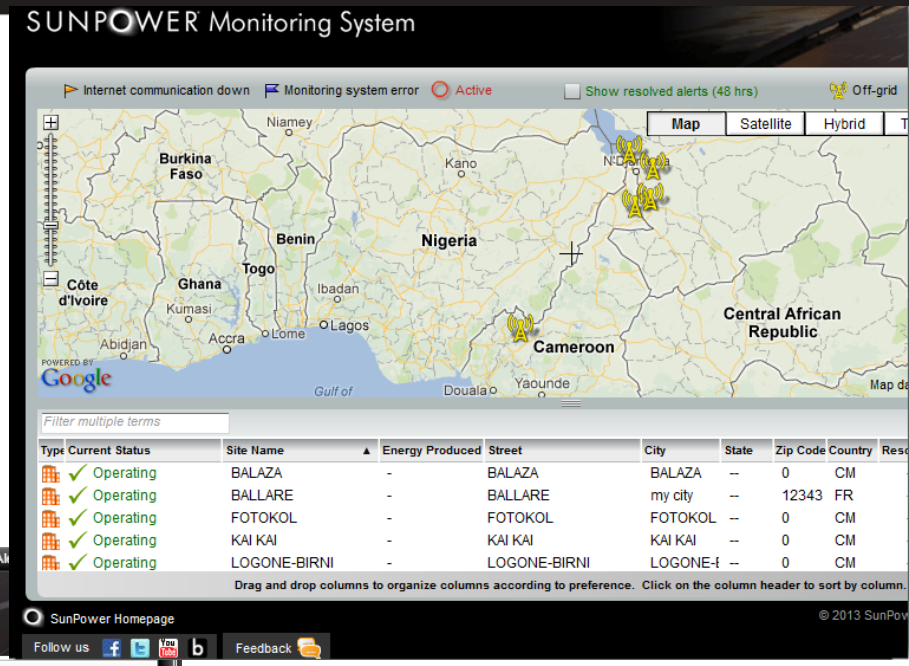
BACK

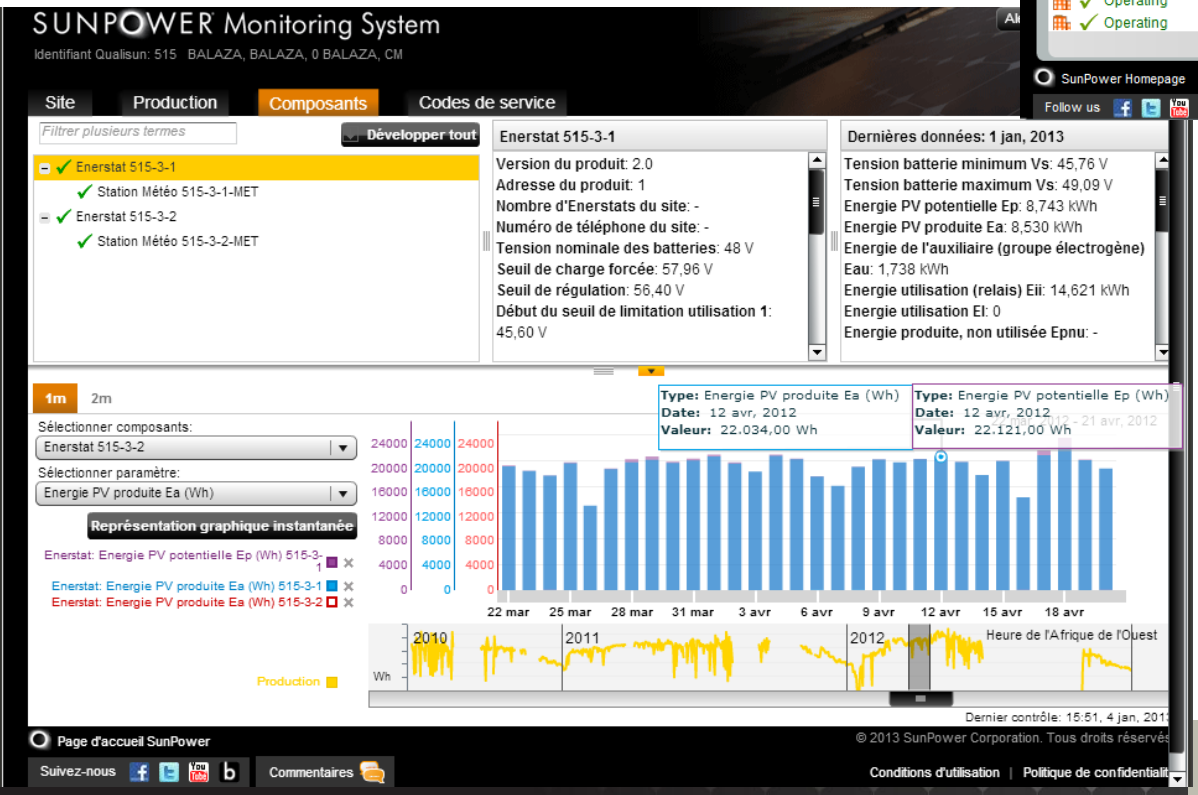


Full-coverage metal paste

Control, everywhere

- Local and remote monitoring
- Detailed and consolidated Fleet supervision
- Remote site management





SMS* local and remote monitoring

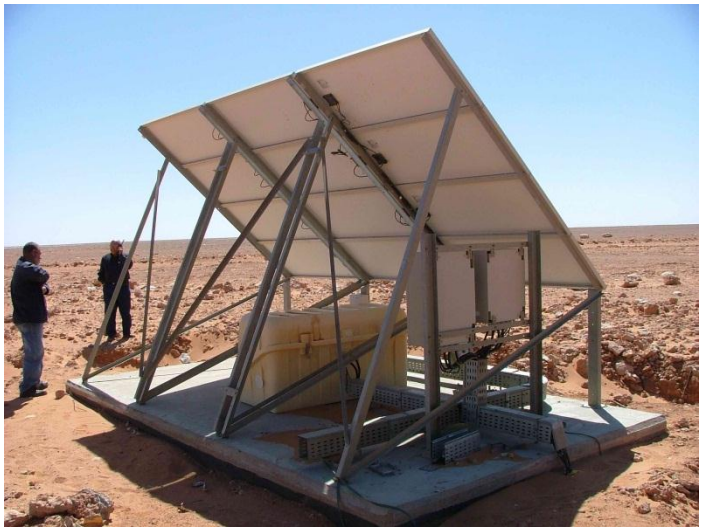
**SunPower Monitoring System*

XXX

Supporting structures

Standard structure

- Wind proof calculated
- Corrosion proof aluminum



Theft proof concrete sealed structure

- Concrete sealed mounting
- Welded frames
- Theft proof bolts



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Less material, less space, quicker installation

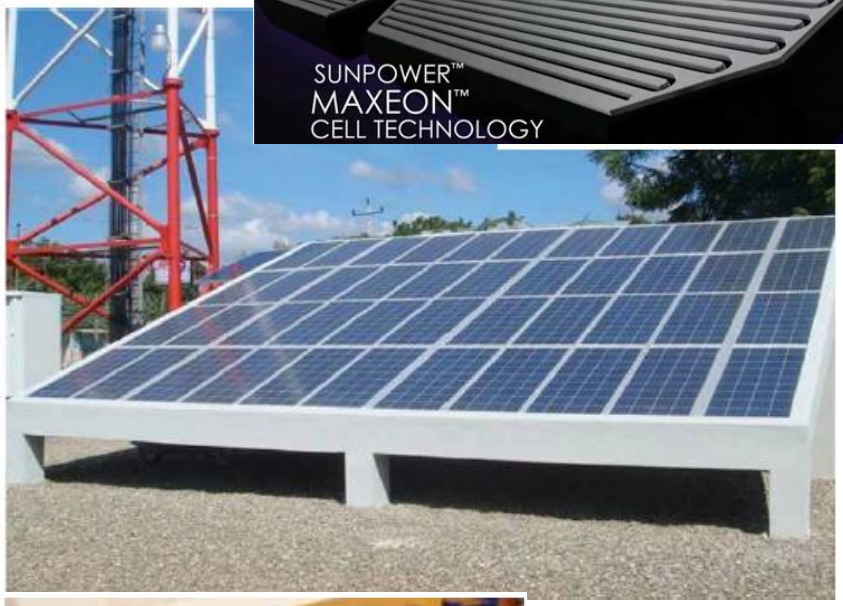
Example of a 1200W BTS in Africa, 5 days autonomy

	Standard offer, PWM charge control	Sunpower high efficiency combination	% gap
Needed Wp power	12 400	9 810	-20%
Nb of PV Modules	40	30	-25%
PV field area	80	50	-37%
Installation time (estimation)	Remoteness-tied	Remoteness-tied	-15%
Transport cost (estimation)	Remoteness-tied	Remoteness-tied	-10%

- ➔ Maximised PV input on revamped sites with existing space constraint
- ➔ Lower expense for land lease or land aquisition
- ➔ Shorter time to network comissioning

Increased reliability





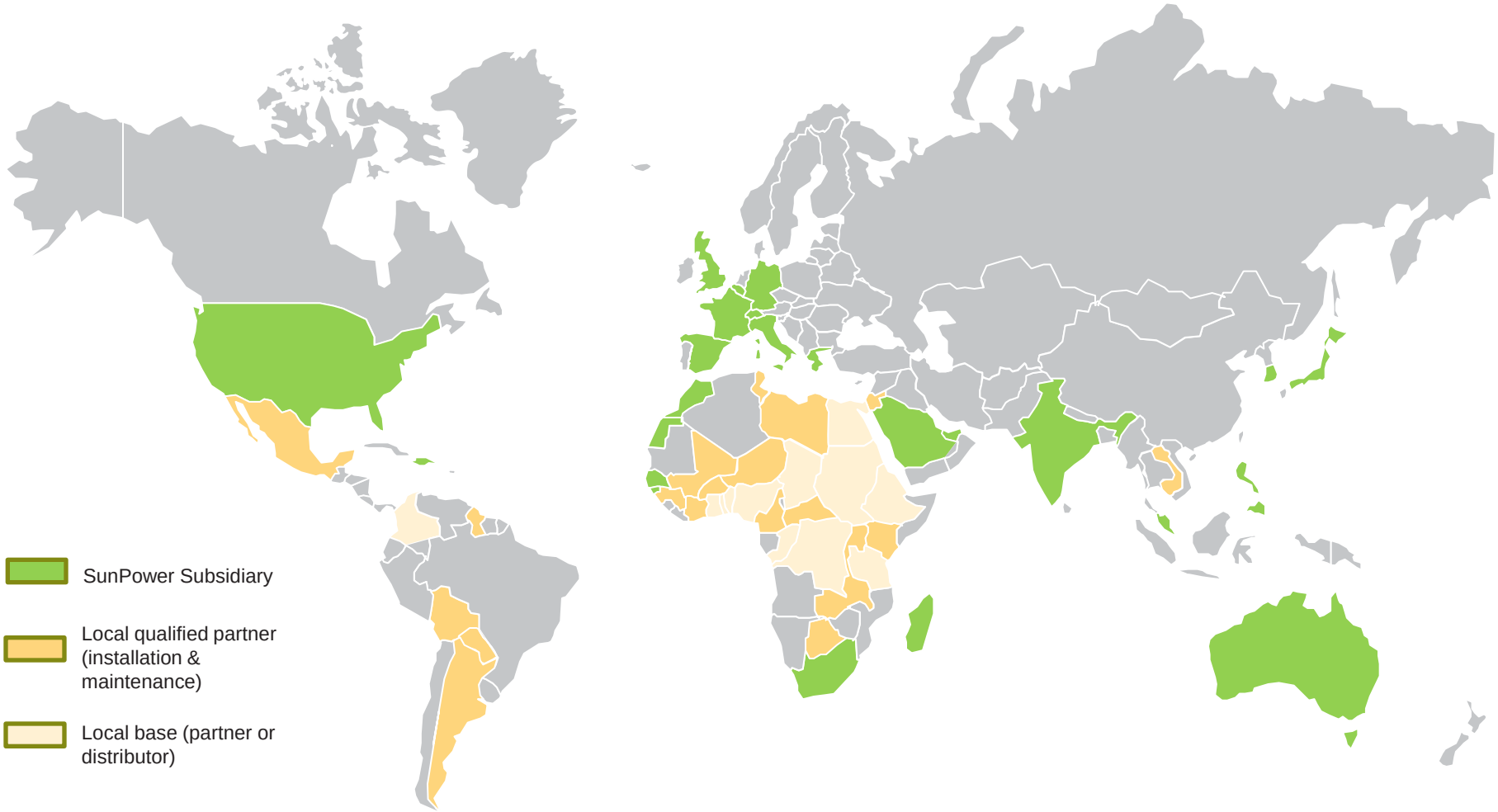


- **Life-proof SunPower Maxeon cells**
- **Increased protection against ligthening** for electronic devices (TSX logger, charge controller, load controller)
- **Autonomous load controller** (can ensure energy supply to loads even in case the datalogger would fail)
- Eurocode compliant Wind calculation for supporting structures, 160km/h to cyclonic zones. Aluminium, corrosion proof
- Top end batteries, with a **time-tested lifetime between 7-10years (vented)** or > 5years (sealed)
- **Service Level Agreement** based on a 30+ years field experience in Telecom solar sytem maintenance

Off-grid systems for life…

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Telecom services map



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SunPower Corporation

Highest efficiency[1]	Highest production[2]	Highest reliability[3]

- World record for highest efficiency silicon solar panel[1]
- >2.5 GW solar PV deployed
- Diversified portfolio: roofs to power plants, on-grid and off-grid applications
- Publicly listed on NASDAQ

- 2012 revenue: $2.4B
- 1 GWp total production capacity at end of 2012
- 5,000+ employees
- We only do solar, more than 200 patents
- Majority owned by Total Group (#11 Fortune 500)[4]

[1] Large-area silicon record, Green, M. A., et. al. “Solar Cell Efficiency Tables,” Progress in Photovoltaics, 2013, vol. 21, p1-11.
[2] BEW Engineering, part of DNV KEMA, SunPower Yield Report, Jan 2013. Compared to Conventional panel: Definitions used throughout presentation: “Conventional Panel” is a 240W panel, 15% efficient, approx. 1.6 m2, made with Conventional Cells. “Conventional Cells” are silicon cells that have many thin metal lines on the front and 2 or 3 interconnect ribbons soldered along the front and back l 15% efficient silicon panels.
[3] #1 rank in "PV Module Durability Initiative Public Report," Fraunhofer ISE, Feb 2013. Five out of the top 8 largest manufacturers were tested. Campeau, Z. et al. "SunPower Module Degradation Rate," SunPower white paper, Feb 2013. See www.sunpowercorp.com/facts for details.”
[4] Source: 2012 Fortune 500 Global Ranking

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Not all solar is the same

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