



# Expanding the Global PV Market

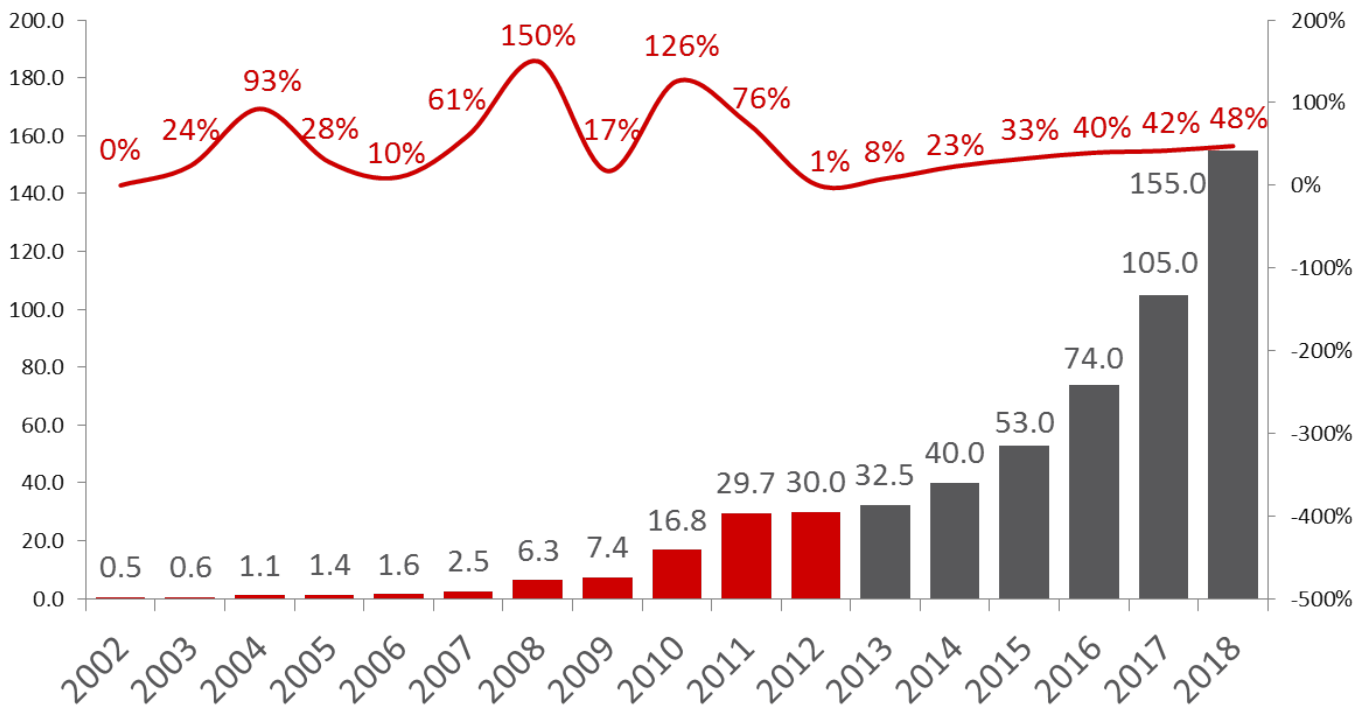
## Smart Modules are the Key

Giuseppe D'Elia  
*Italy Country Manager, European Distribution Channel Manager, Upsolar*

Wednesday, June 19, 2013



# Global PV Market Size and Growth (GW, %)



Source::Bloomberg



# Causes for Untapped Global PV Potential

- Solar systems not being built - *Why isn't everyone, everywhere going solar?*
  - Landscape/rooftop constraints
  - Uncertainty on the returns
  - Cost vs. Benefits analysis/misperception
  - Regulatory red tape, lengthy administrative processes
- Solar's ongoing reputation – *Why do people still think it's difficult/expensive to install and own solar PV systems?*
  - Solar as static/expensive/foreign vs. transparent/dynamic/educational/interactive/easy
  - Misinformed about ease of system management and safety
  - Lack of positive feedback loop from success of existing systems
  - Negative Media

# Enter Smart Modules

**Smart modules...** empower end users, commercial businesses and landowners, to produce their own energy through

- making the decision to go solar a no-brainer **no matter what location**
- making it a more attractive investment by **lowering costs and increasing performance**
- Encouraging **global awareness** of the status of existing solar technologies

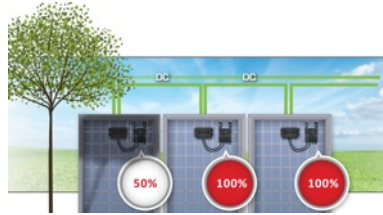
# What makes smart modules smart?



Module +  
Module Level  
Electronics



Design  
Flexibility



Maximum  
Power Point  
Tracking @  
Module Level



Remote,  
module-level  
Monitoring  
Capabilities



Increased  
System  
Safety

# Smart Module Technologies

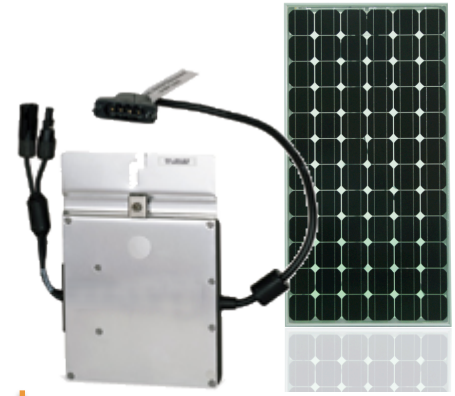
**Tigo**<sup>®</sup>  
energy



**solar**edge

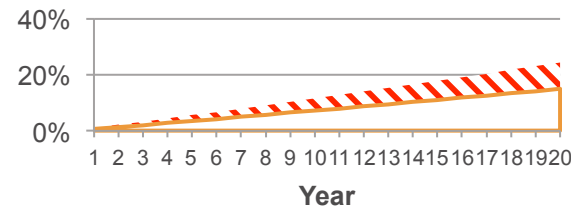
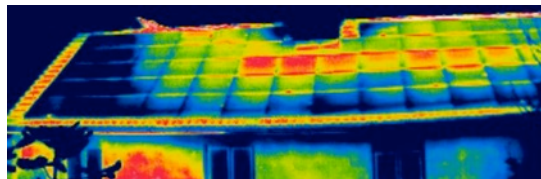


Power Optimizers



Microinverters

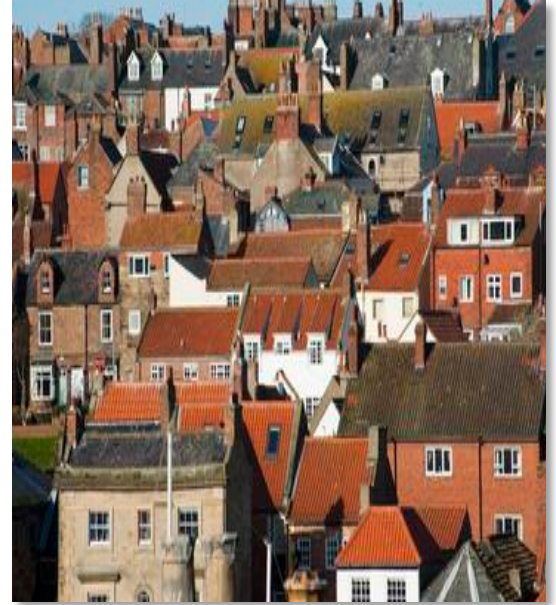
# Mitigate Mismatch – Increase Energy Harvest



	Low	Medium	High
Irradiance Mismatch (clouds and soiling)	4%	8%	10%
Thermal Mismatch	3 degrees	6 degrees	7 degrees
Variable Degradation (module binning range)	2%	4%	5%
<b>Year 1 mismatch loss</b>	<b>1.5%</b>	<b>5%</b>	<b>7%</b>



# Install Solar PV Systems Anywhere



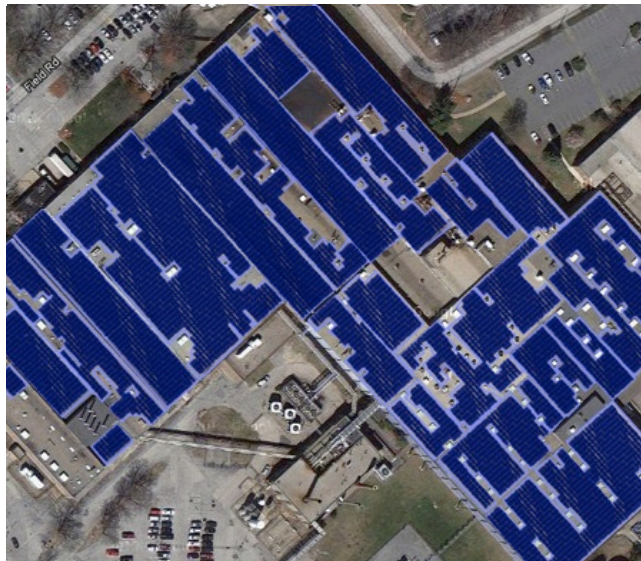




# Bringing Projects to Life with Smart Modules



# Optimize Rooftop Potential



Standard Modules: 3,500 modules

**Smart Modules: 7,404 modules**

- 3,564 Partially Shaded
- 3,840 Unshaded

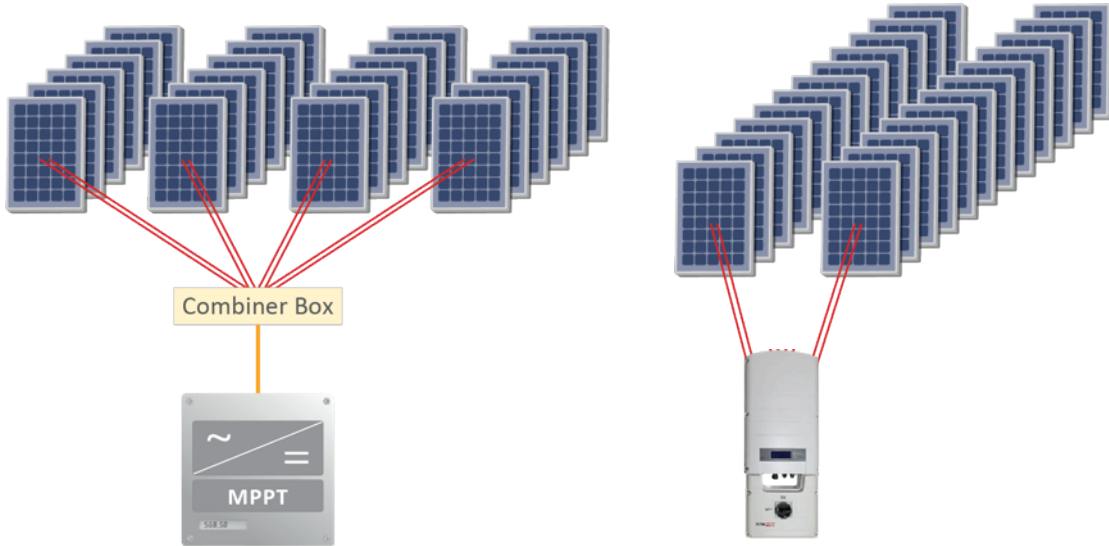
# Flexibility with Design



- Four facets covered
- Parallel strings of unequal lengths
- Modules of different sizes with different power ratings, oriented at different angles



# Decrease BoS & Installation Costs – Fixed String Voltage

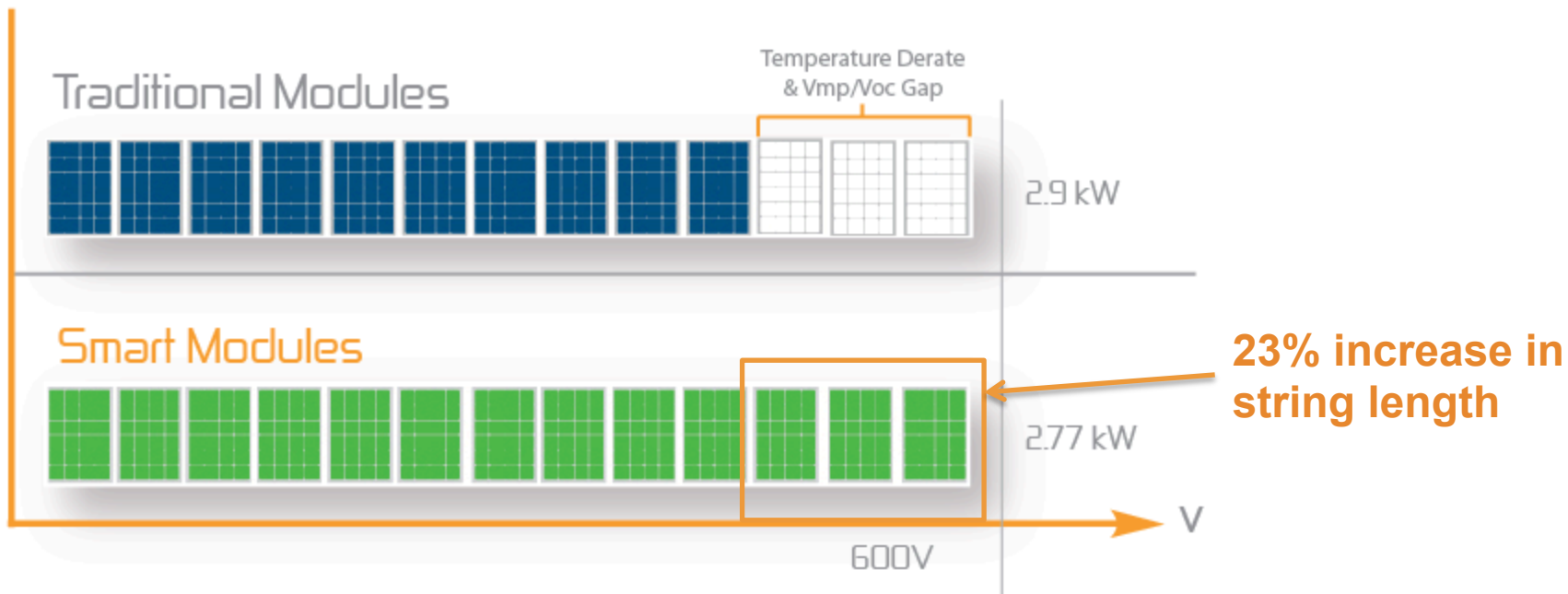


## Benefits:

- 2x longer strings
- Less homerun cabling
- Potential to eliminate DC homeruns
- No fusing or combiner box required

Save cost by decreasing DC wiring, conduits, fuses, combiner boxes, etc.

# Decrease BoS & Installation Costs – Smart Curve





# Decrease BoS & Installation Costs – Case Study



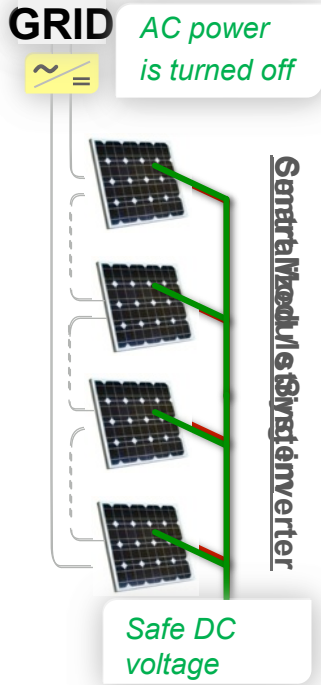
**Project location:** Kaisersesch, Germany

**System Size:** 1 MW

**# of Modules:** 4092

**Flexible Design:** unequal strings, longer strings resulted in DC wiring **cost reduction of 67%** compared to the same system layout with a traditional inverter

# Increased Safety



## Risk:

- Exposure to sunlight = energized PV system
- Hazardous voltages when opening disconnects interrupts current flow (rooftop systems operate at up to 1000 VDC)

## Smart Modules = DC Voltage Shutdown Features

- Deactivation of system at module level – mechanism triggered when AC circuit breaker turned off (IM)
- Automatic fail-safe shut down of current and voltage automatically when the inverter is turned off or during grid disconnection (FC)
- Electric arc prevention
- Theft prevention solution for unexpected module disconnection

## Results:

- Increased on-site safety for firefighting, maintenance teams
- Asset protection (good for insurance requirements)

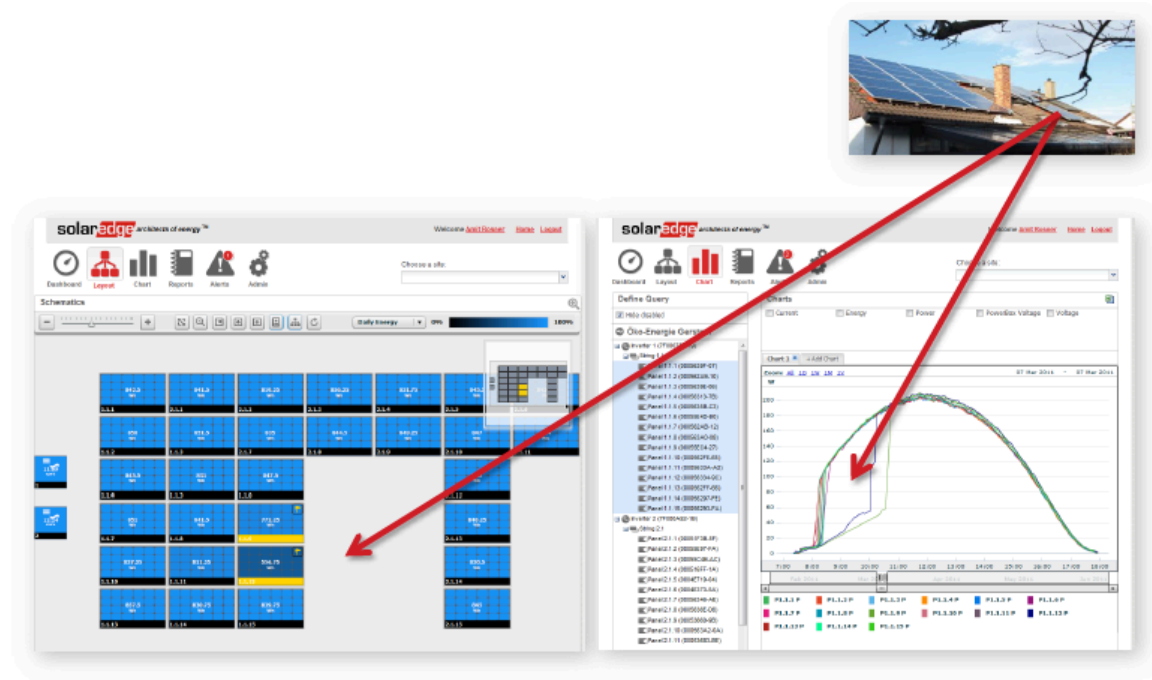


**Project location:** Carmiel, Israel  
**System Size:** 55 kW

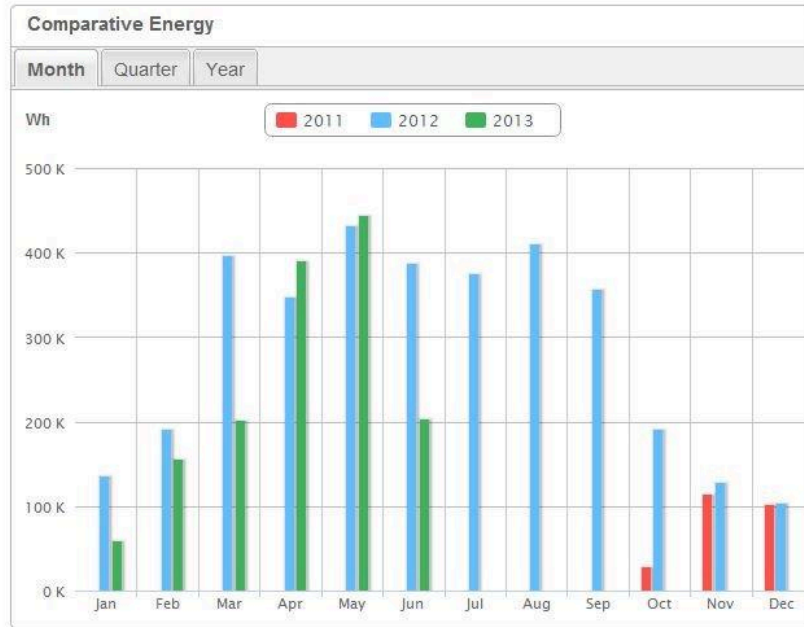
**Safety:** Utilizing petrol stations for solar energy production requires the utmost quality control and adherence to safety.



# Operations & Maintenance - Capabilities



# Solar 2.0 – Going Social



## Environmental Benefits



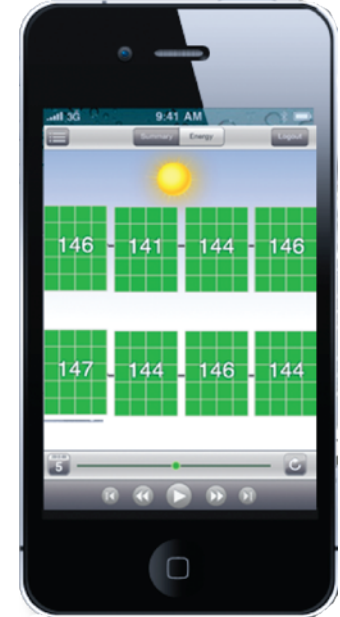
CO2 Emission Saved:  
**2,019.12 kg**



Equivalent Trees Planted:  
**6.75**



Light Bulbs Powered:  
**15,608.52 For a day**



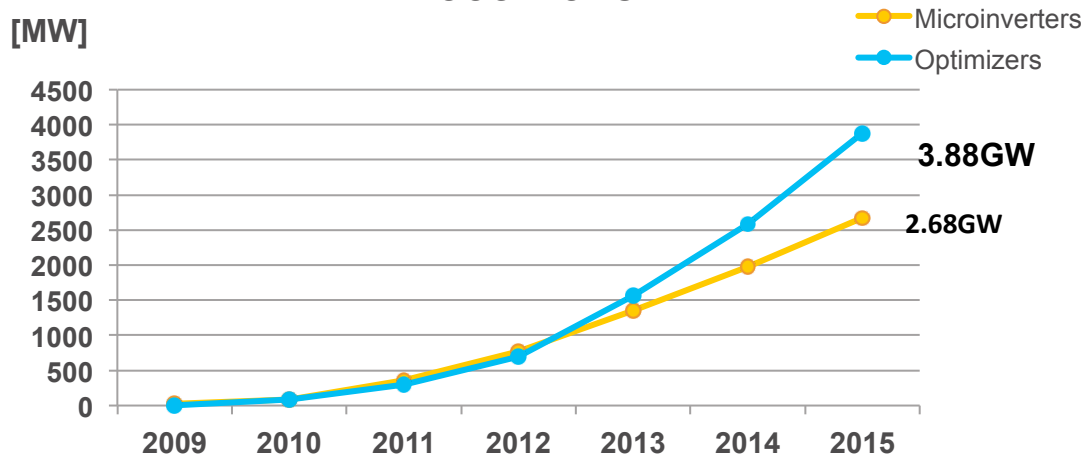


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# Smart Module Horizon

Estimated Shipment (MW) from  
2009-2015



Source: IHS

## The Latest Photon Report:

- Distributed production is the most important trend in Solar BOS
- The winner will be the one able to offer the smart module





# Thank you for your attention!

For more information, contact:

Giuseppe D'Elia

[giuseppe.delia@upsolar.com](mailto:giuseppe.delia@upsolar.com)

Upsolar Booth @ Intersolar – A3.390

