

# 3M Renewable Energy Division



Tracy Anderson, Director  
Energy Generation  
3M Renewable Energy



# Photovoltaics (PV) industry overview



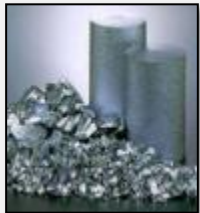
Utility Scale



Commercial & Industrial



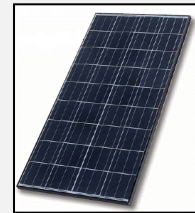
Residential



Polysilicon & Wafer  
\$0.29/W



Cell  
+\$0.18/W



Module  
+\$0.48/W



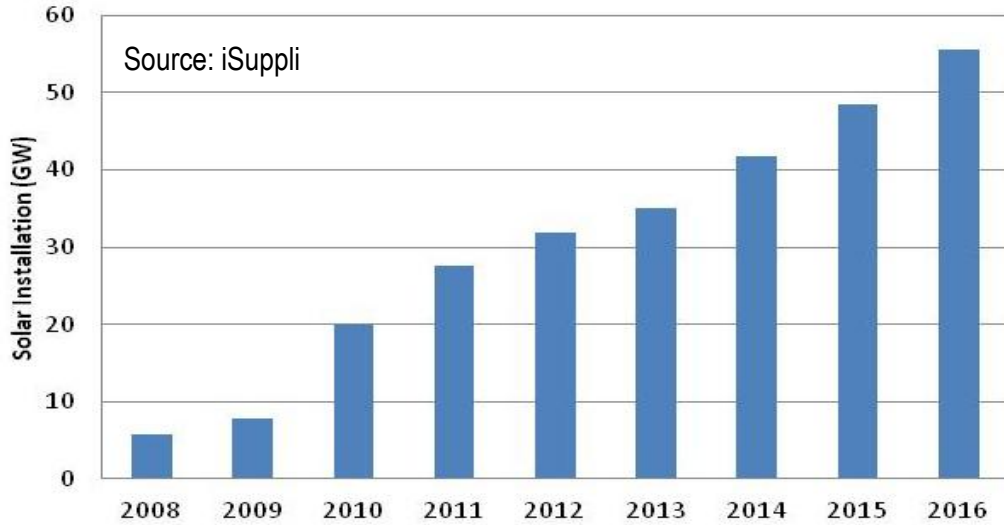
BOS/Install  
+\$1.82/W

**PV Market Size: \$92B**  
**2013-17 vol. CAGR: 19%**

**2011 WW Installations: 28 GW**  
**No. of Panels Installed: 112M**

# PV is rapidly expanding around the world

## Strong Global Growth Projection



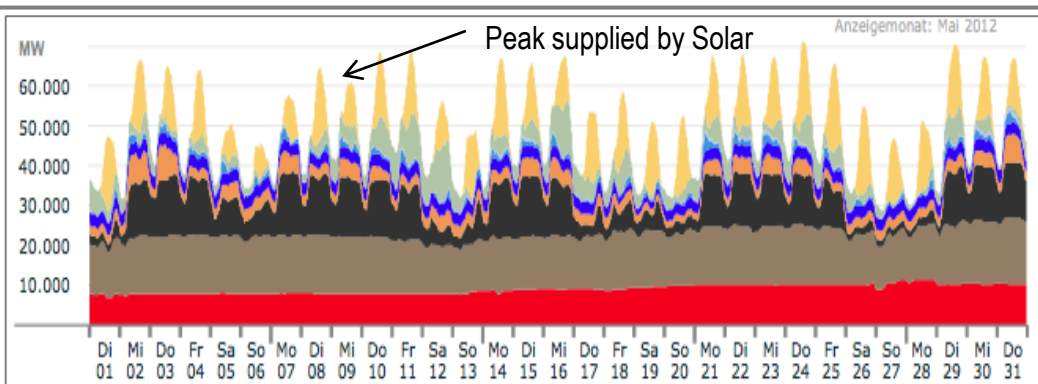
## Top Companies by Number of Systems

1. Walmart Stores	144
2. Walgreen Co.	134
3. Kohl's Department Stores	124
4. Costco Wholesale	62
5. Macy's	41
6. Staples, Inc.	35
7. IKEA	30
8 (tie). Lackland Storage	26
8 (tie). REI	26
10. Whole Foods Market	17
11 (tie). General Motors	12
11 (tie). Johnson and Johnson	12
13. Prologis	10
14. Lord & Taylor	8
15. JC Penny	6
16 (tie). FedEx Corporation	5
16 (tie). Hartz Mountain Ind.	5
18 (tie). SAS Institute	4
18 (tie). Stop and Shop	4
18 (tie). Toys "R" Us	4
18 (tie). Tiffany & Co	4
18 (tie). L'Oreal USA	4
18 (tie). Bed Bath & Beyond	4

## Becoming Mainstream

(Installed on 144 Walmart Stores)

Total No. of Solar Energy Systems Installed  
Source: SEIA

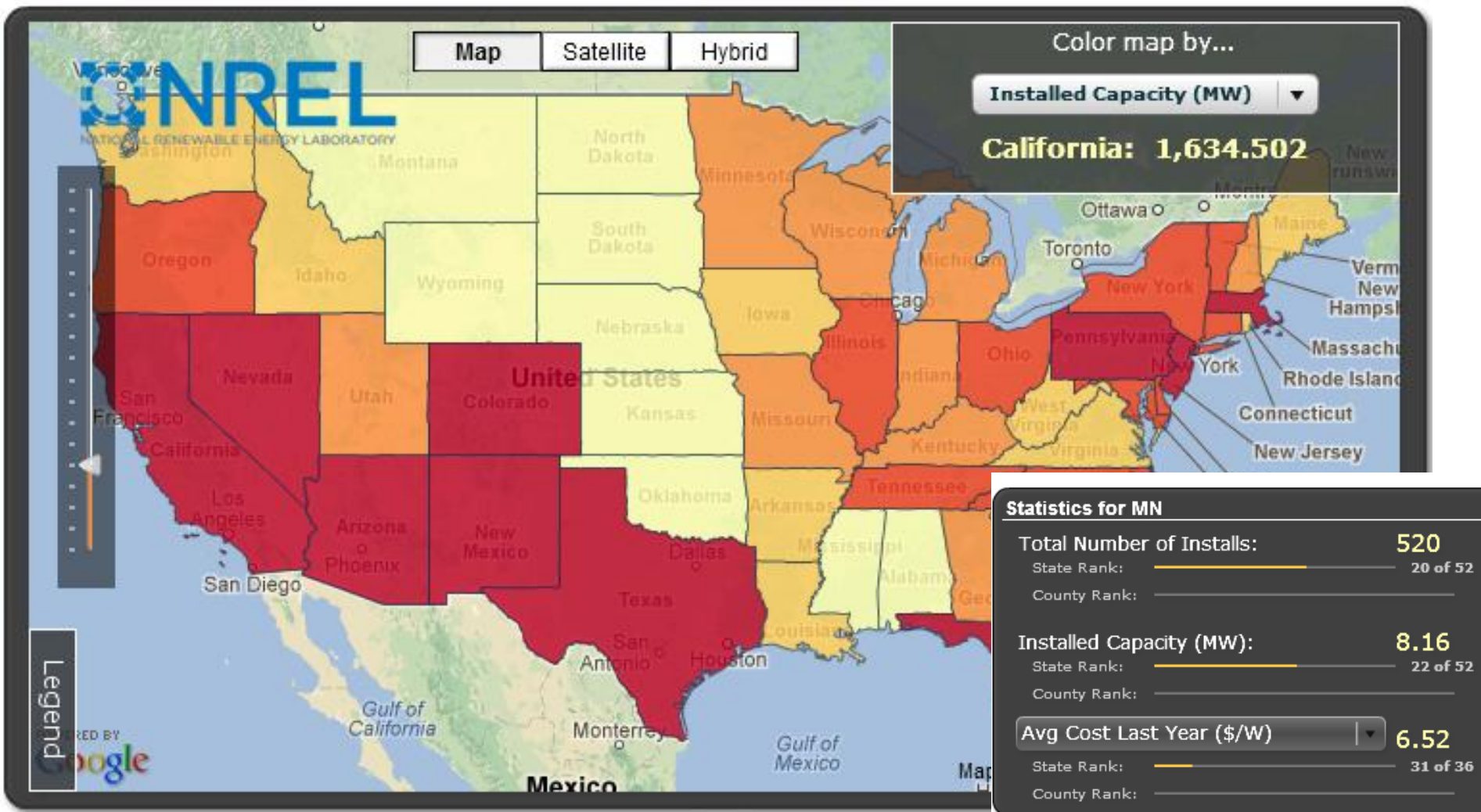


**Proven at Scale** (10% of demand for Germany, May 2012)

Consumer prices for solar has declined by 45% since 2011. Becoming competitive with conventional energy in many locations



# PV installations in the U.S. has grown from 1GW in 2010 to 4GW in 2012 and is projected to more than double by 2015



The U.S. one was a leader in solar panel manufacturing. Today less than 5% of worlds solar panels are produced in the U.S.



# 3M is a materials supplier to the solar industry



*Encapsulants*



*Backsheets*



*Ultra Barrier*



*EPE Films*



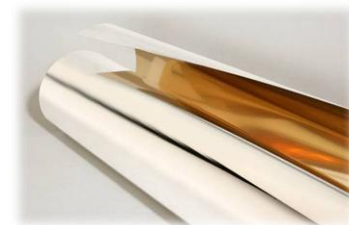
*Frameless Modules*



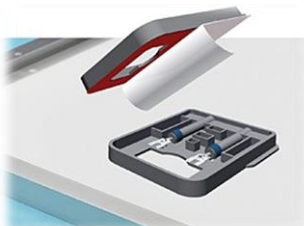
*Anti-reflective &  
Anti-soil Coatings*



*Large Aperture  
Troughs (CSP)*



*Broadband Reflective  
Films*



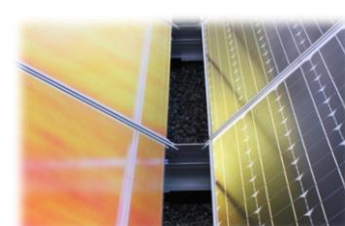
*J-box Attachment*



*Frame Bonding*



*Charge-Collection*

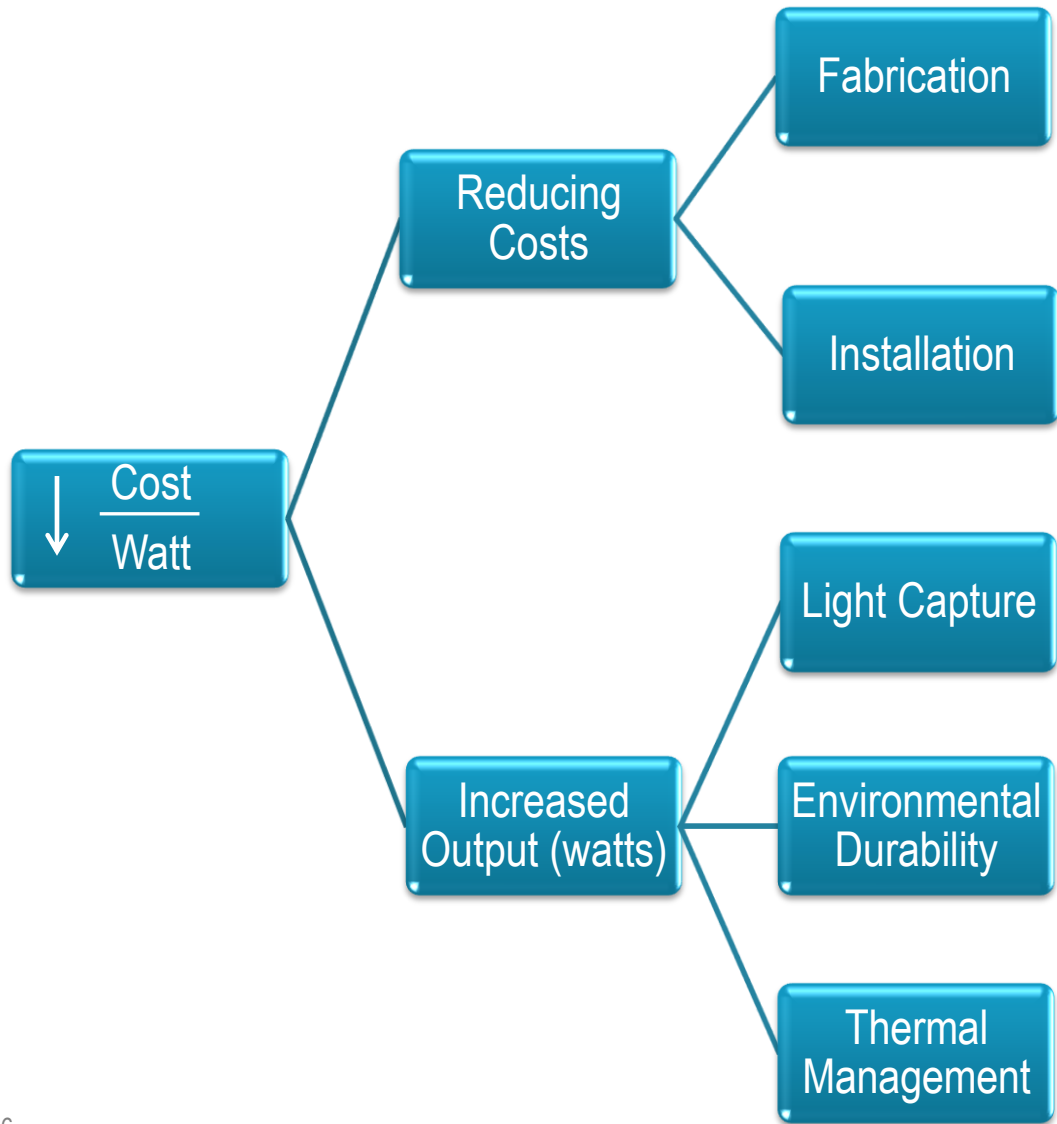


*Cool Mirror (Low X)*

While the solar panel manufacturers are currently experiencing challenges of oversupply and profitability, the long term outlook remains positive



# Leveraging a century of innovation, 3M is helping to the reduce the cost for solar energy



## Pain Points

Number of parts  
Cure cycle  
Lamination cycle  
Silicon handling issues

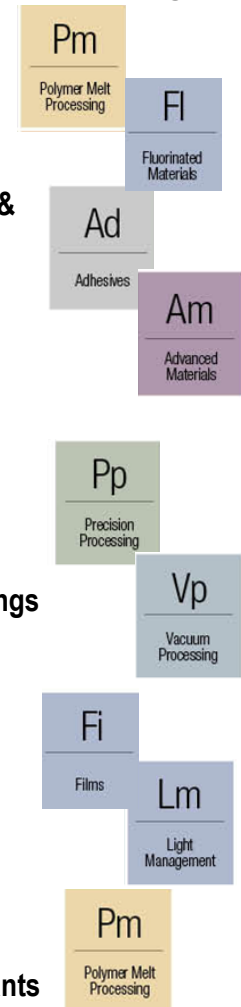
Weight  
Glass handling  
Mirror footings  
Balance of system costs  
Low packing factors

Dirt build-up  
Surface reflection  
Transmission losses  
Lens efficiency  
Acceptance angles

Encapsulant stability  
Moisture  
Surface scratches  
Outgassing adhesives  
Yellowing/cracking  
Corrosion of contacts

Cell efficiency  
Material degradation  
IR absorbance  
Fluid temperature

## 3M Technologies



### Adhesives & Tapes

### Coatings

### Films

### Encapsulants



# Summary

- Rapidly growing industry worldwide
- Strong drivers including
  - Energy diversity (fuel mix)
  - Distributed
  - Sustainability
  - Jobs
- Minnesota is early on with less than 10 MW of PV panels installed, yet its solar resource is equal to or better than in Germany where over 31,000 MW of PV is installed
- Also represents good business opportunity for Minnesota based companies.

