

# Solar Energy: Emerging from the Shadows

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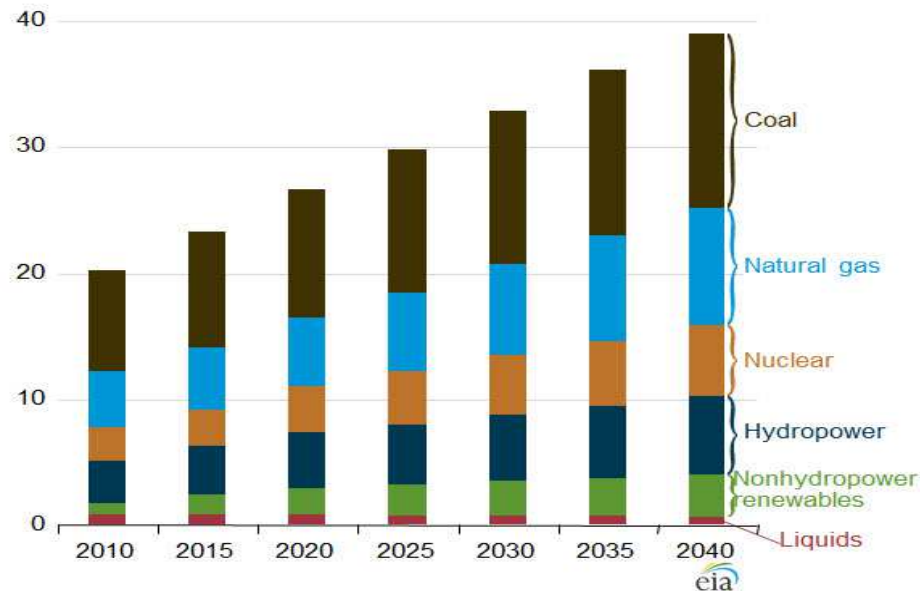
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# Renewables: The Global Perspective

Figure 6. World net electricity generation by energy source, 2010-2040

trillion kilowatthours



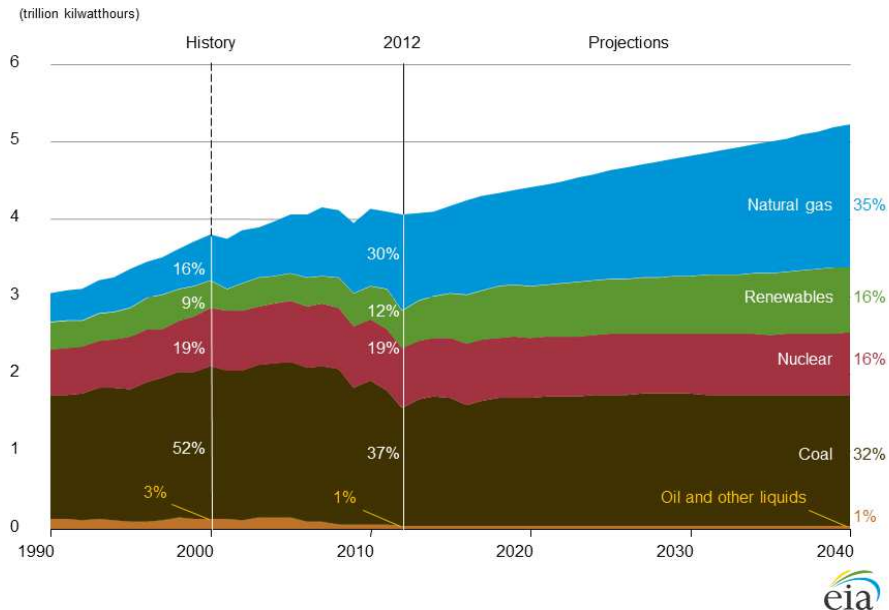
Source: *U.S. Energy Information Administration International Energy Outlook, July 2013*

## EIA Reference Case Profile for World Net Electricity Generation in 2040:

- ▶ Coal will remain the leading form of electricity generation
- ▶ Natural gas will become a more formidable challenger
- ▶ Non-hydropower renewables will generate about 9% of the world's electricity
- ▶ Contribution of renewables will increase 336% compared to 2010

# Renewables: The U.S. Perspective

Figure 13. Electricity generation by fuel, 1990-2040



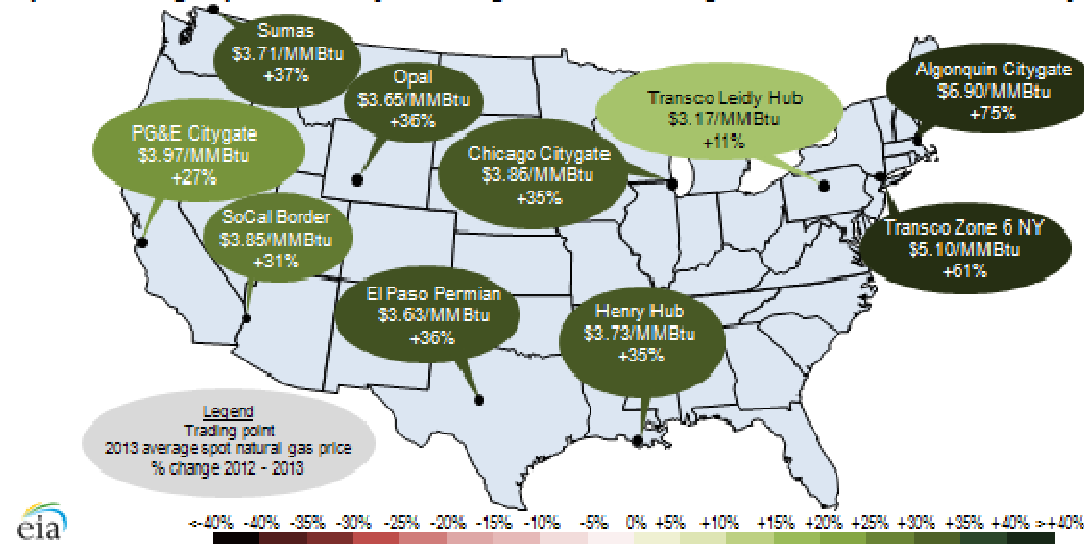
Source: *U.S. Energy Information Administration 2014 Annual Energy Outlook, April 2014*

## EIA Reference Case Profile for U.S. Net Electricity Generation in 2040:

- ▶ Natural gas will supplant coal as the leading form of electricity generation (35% of total generation)
- ▶ Coal will remain a major source of electricity (32%)
- ▶ Renewable energy (including hydropower) will represent 16% of total generation
- ▶ Renewable energy (excluding hydropower) will account for 28% of overall growth in electricity generation

# Is Natural Gas Really the Answer?

Spot natural gas prices at major trading locations through December 31, 2013 delivery date



Source: *U.S. Energy Information Administration 2014 Annual Energy Outlook, January 2014*

Volatility of NG prices jeopardizes its ability to be a cheap bridge to a sustainable energy future

## Recent U.S. Natural Gas (NG) Pricing:

- ▶ NG prices have risen rapidly from 2012 low of \$2/MMBtu
- ▶ Average NG price have risen to approximately \$4.50/MMBtu in 2014
- ▶ U.S. Northeast NG prices were much higher than average in 2013 due to pipeline constraints and cold weather demand
- ▶ At \$4 to \$5/MMBtu NG prices, coal pricing for power generation can be competitive or even cheaper
- ▶ Coal use for power generation actually rose 2% in 2013 and slightly more than 2% so far in 2014; NG use has dropped by about 3% in that time period
- ▶ U.S. CO<sub>2</sub> emissions rose 2% in 2013 commensurate with the increase in coal use

# Can Solar Capacity Top Projections?

2015 Projected Installed Solar Capacity (GW)	EIA 2013	Deutsche Bank 2014
Europe	64	73
USA	19	30
China	14	39
Japan	7	28
World Total	113	>200

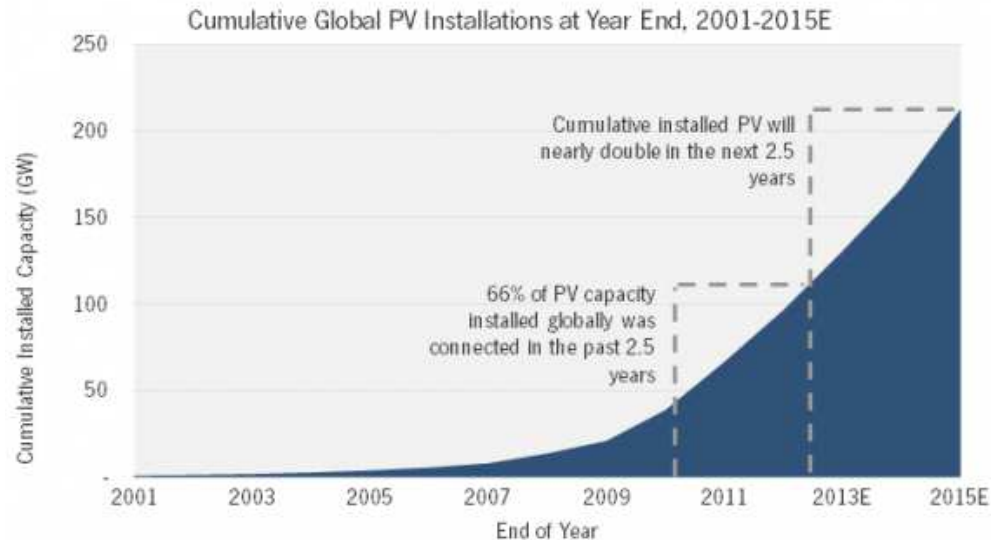
*Source: US Energy Information Administration International Energy Outlook 2013, July 2013  
Deutsche Bank Energy Sector Report, January 2014*

Installed solar capacity is following a more rapid trajectory than U.S. EIA projected due to plummeting prices and unforeseen world events

## Deutsche Bank Solar Capacity Projections Far Exceed U.S. EIA Projections:

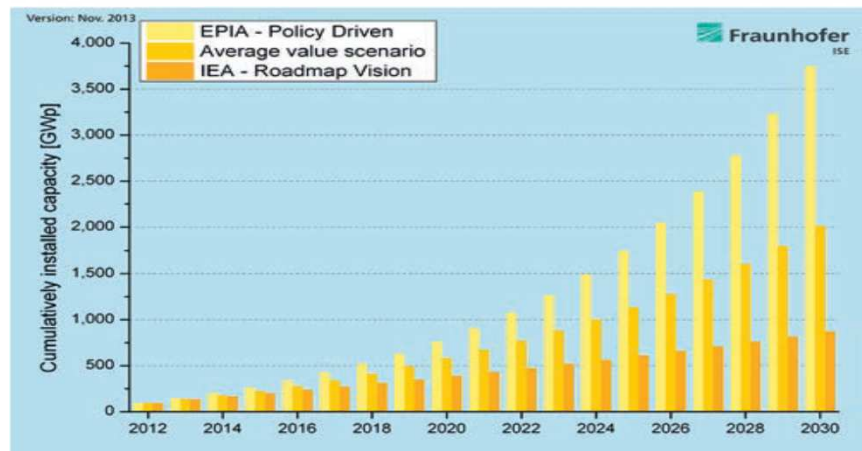
- ▶ DB estimating slower turndown of European market
- ▶ Lower all-in costs and potential elimination of tax incentives in 2017 are increasing US deployments
- ▶ EIA report significantly underestimated Japanese increase in solar usage resulting from nuclear turndown and generous solar incentives
- ▶ Recent Chinese incentives have spurred solar deployments in that country
- ▶ Maturing of the solar industry and rapidly declining all-in costs are driving solar deployments worldwide

# Solar Industry is Definitely Growing



## Global PV Capacity Findings:

- ▶ Deployment of the first 100GW of global PV capacity required about 12 years
- ▶ Deployment of the second 100GW of global PV capacity could be completed in the next 2.5 years
- ▶ Installed PV Capacity could increase globally by 20X to 2000GW by 2030



*EPIA=European Photovoltaic Industry Association 2013 Forecast, IEA=International Energy Agency 2010 Forecast*

*Sources: Greentech Media Research,  
Fraunhofer ISE Renewable Energy LCOE Study, Nov 2013*

# Solar Demand: Global Outlook

Figure 3: Demand Outlook

MW	2010	2011	2012	2013E	2014E	2015E
China	520	2,000	3,510	8,000	12,000	13,800
y/y (%)	128%	285%	76%	128%	50%	15%
Japan	991	1,298	2,088	7,000	8,000	8,800
y/y (%)	105%	31%	61%	236%	14%	10%
Germany	7,216	7,485	7,604	3,502	2,801	2,801
y/y (%)	90%	4%	2%	-54%	-20%	0%
Italy	2,321	8,971	3,337	1,500	750	788
y/y (%)	224%	287%	-63%	-55%	-50%	5%
Spain	369	400	276	276	276	304
y/y (%)	515%	8%	-31%	0%	0%	10%
France	719	1,500	1,079	1,079	1,349	1,619
y/y (%)	228%	109%	-28%	0%	25%	20%
Rest of Europe	658	2,007	3,190	3,127	3,127	3,847
y/y (%)	370%	205%	59%	-2%	0%	23%
USA	878	1,800	3,313	5,000	8,000	12,000
y/y (%)	85%	82%	107%	51%	60%	50%
Canada	186	297	268	223	268	295
y/y (%)	119%	59%	-10%	-17%	20%	10%
India	158	190	980	990	1,980	2,771
y/y (%)	120%	20%	416%	1%	100%	40%
Others	1,012	1,194	2,312	5,800	7,560	9,072
y/y (%)	141%	18%	94%	142%	35%	20%
<b>Total</b>	<b>15,028</b>	<b>26,940</b>	<b>27,955</b>	<b>36,297</b>	<b>46,111</b>	<b>56,096</b>
y/y (%)	124%	79%	4%	30%	27%	22%

Source: Deutsche Bank; Official Country Sources where available for historicals

## Deutsche Bank Forecast Indicates Solar Markets are Shifting:

- ▶ European Domination is Rapidly Waning
- ▶ Asia Demand, led by China and Japan, is Surging
- ▶ US Demand is Projected to Be Second Only to China by 2015
- ▶ Approximately 25% Annual Solar Growth Rate Globally

# Industry Economics are Improving

Installation Type	Projected 2014 All-in Cost (\$/W)	Projected 2017 All-in Cost (\$/W)
Residential Rooftop	\$3.00	\$2.15
Commercial Rooftop	\$2.50	\$1.85
<1MW Ground-Mounted	\$2.00	\$1.60
>2MW Ground-Mounted	\$1.60	\$1.35

▶ All-in Costs of U.S. Solar Installations are Plunging:

▶ Solar Power Can Offer Competitive Retail Electricity Rates in 15 to 20 States in the US by 2017\*

\*Assumes 10% Investment Tax Credit and 6.5% Project Cost of Capital

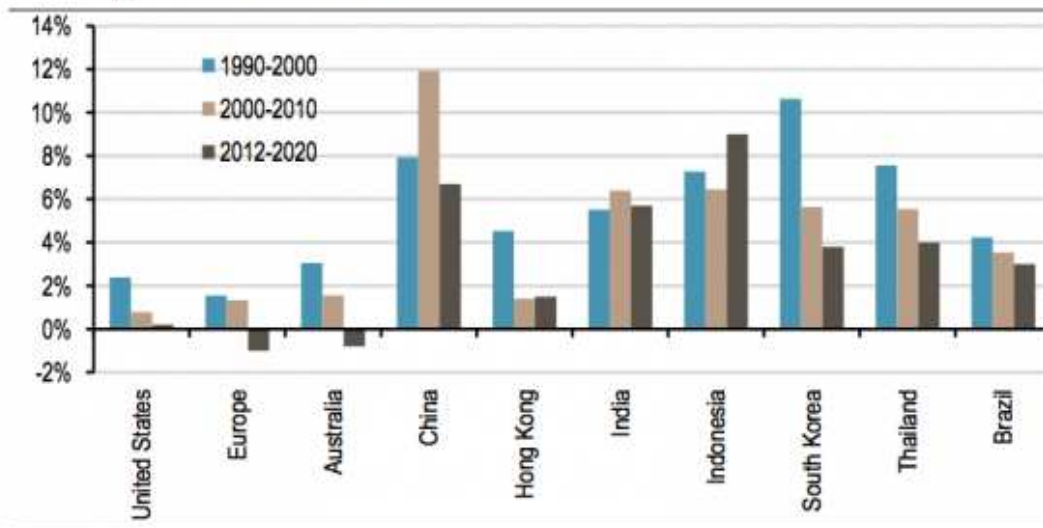
Source: *Sol Systems, Bloomberg New Energy Finance, Greentech Media*

Source: *Sol Systems, Bloomberg New Energy Finance, Greentech Media*



# Power Demands are Trending Down

Figure 13: Power demand CAGR for select countries over different periods: declining trends for most markets

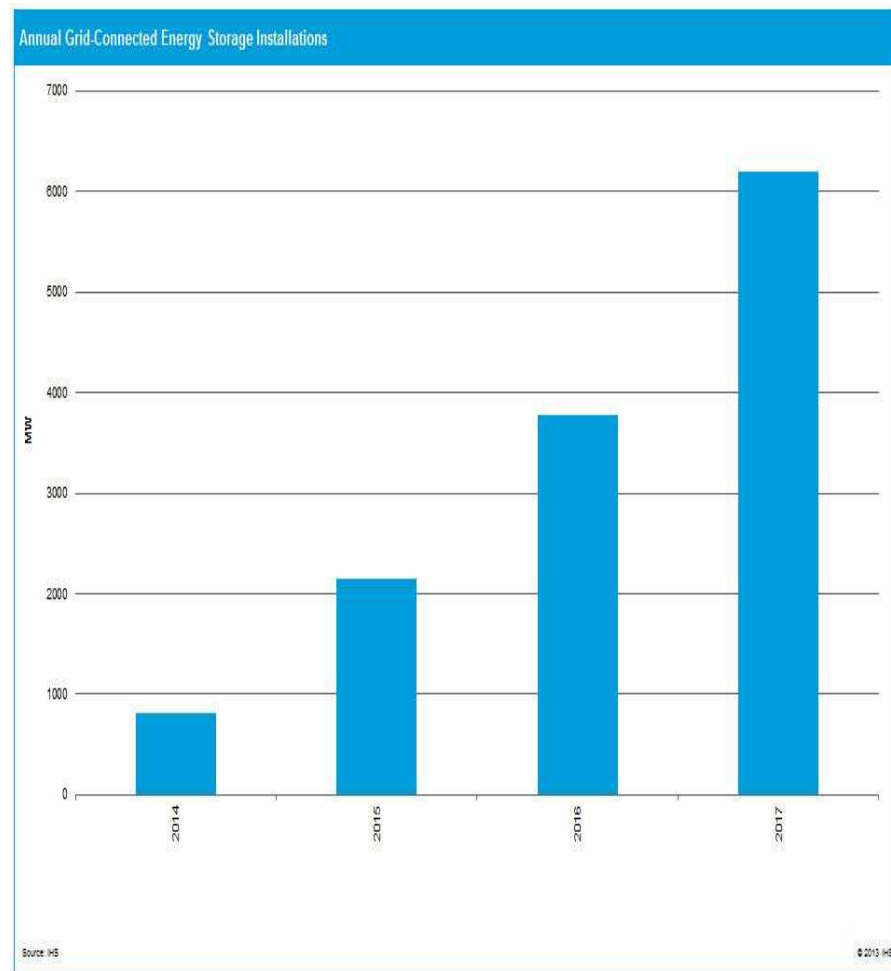


Source: EIA, UBS estimates

## Implications on Future Power Generation:

- ▶ Developed Countries Will Need Less Centralized Power Plants
- ▶ Emerging Countries Could Adopt More Localized or Distributed Generation
- ▶ Utility Focus will Switch from Adding Capacity to Managing Time-of-Use
- ▶ Renewable Power Could Provide an Increasing Share of Future Distributed Electricity Generation

# Energy Storage: Key PV Enabler?



Source: *IHS*

## Battery Storage Prospects:

- ▶ Can help reduce or eliminate grid intermittency effects
- ▶ Facilitates use of stored solar energy at night
- ▶ Mitigates commercial peak demand charges
- ▶ Adoption of technology highly dependent on \$/kWh price of stored energy which is currently too high, but predicted to trend down at about 10% to 15% annually
- ▶ Subsidies or regulations may be required for the foreseeable future to surmount current cost challenges and permit industry to scale
- ▶ IHS predicts cumulative installed global storage capacity of 6GW by 2017 and 40GW by 2022
- ▶ Early adopters include Germany, Japan, UK, California, Hawaii, and Puerto Rico driven by subsidies, regulation, or high electricity rates

# Trends Influencing Solar Growth

## Inhibitors

- ▶ Potential of long-term natural gas prices below \$4/MMbtu could slow the growth rate of solar in U.S.
- ▶ Significant reduction in subsidies, and imposition of self-consumption taxes will slow solar growth in Europe
- ▶ Transmission and distribution grid capacity constraints could slow deployment of utility-scale solar plants

## Igniters

- ▶ Increasing global demand and decreasing system costs will help lower the Levelized Cost of Energy for solar generation
- ▶ Renewable energy contributed over 50% of net additions to new electric generating capacity globally in 2012
- ▶ Introduction of cost-competitive energy storage technology will help mitigate solar intermittency limitations

Sources: Solar Energy Industries Association, European Photovoltaic Industry Association, California Solar Initiative, Greentech Media

# 2014 Solar Landscape

## Positives

- ▶ Solar PV generation exceeds 100GW globally with 66% of new global PV installed in the past 2.5 years
- ▶ Solar module pricing is beginning to stabilize and should level out below \$0.50/W
- ▶ All-in Costs continue to decrease and are now below \$3.00/W in the US
- ▶ China and the US will represent over 40% of worldwide demand for the projected 50GW+ new solar capacity in 2015
- ▶ New entrants such as South Africa, India, Brazil, Chile, Mexico, Turkey and the Middle East could create substantial new demand for solar

## Negatives

- ▶ Solar module shakeout still causing jitters in the financing industry
- ▶ All-in costs must decrease further to compete globally without subsidies
- ▶ Feed-in Tariffs are decreasing rapidly, and solar self-consumption taxes are being imposed in Europe
- ▶ No US national energy policy is in the works, and renewable initiatives will be driven at the state level
- ▶ Venture financing for US solar technology is slowing considerably
- ▶ Despite impressive growth rates, solar production currently provides less than 1% of global electricity needs

Sources: EU Joint Research Center, SEIA, European Photovoltaic Industry Association, Lawrence Berkeley National Laboratory, Greentech Media

# Summary

- ▶ The first 100GW of solar growth took over 12 years, the second 100GW could occur in 2 years (2014–2015)
- ▶ By 2015, solar projects will spread around the world with Asia and the US representing over 60% of all of the new installed capacity
- ▶ By 2017, solar should be able to compete more widely on price with other world energy sources as system and installation costs continue to decrease, and conversion efficiencies increase
- ▶ Natural gas is a serious competitor to renewable energy for new U.S. electricity generation, but price volatility and GHG regulations could slow the projected migration to natural gas

Sources: EU Joint Research Center, SEIA, European Photovoltaic Industry Association, Greentech Media

# Outlook

The companies that will thrive in the solar industry will demonstrate the following characteristics:

- ▶ More system-oriented product offerings with higher system efficiencies
- ▶ More vertical-integration from a project implementation standpoint
- ▶ Increased emphasis on project integration and monitoring services revenue rather than equipment sales
- ▶ Lower Balance of System (BOS), customer acquisition, and soft costs
- ▶ Greater global presence either directly or through strategic partnerships
- ▶ Strong financing partners

# The RevGen Group assists high technology clients to

- ▶ Bring products to market and through transitions in the life-cycle
- ▶ Develop business based on objective, customized intelligence
- ▶ Perform technology assessment and validation
- ▶ Manage due diligence

## Fields of expertise:

- ▶ Solar energy
- ▶ Wireless communications
- ▶ PC software, Web 2.0, enterprise networking
- ▶ Semiconductor equipment and technology

## We deliver:

- ▶ Advice, strategies, models and tools, alternatives
- ▶ Research, analysis, evaluation, validation
- ▶ Operational assistance