FIRST SOLAR

Finding the Next Solar Advantage

Kevin Chang | Nicholyn Chen | Sida Lu | Kenneth Shih

First Solar's Key Success Factors

1) COST LEADERSHIP

Expertise in CdTe enabled industry **cost leadership**, bringing manufacturing costs to less than

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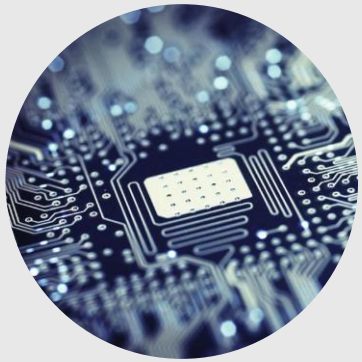

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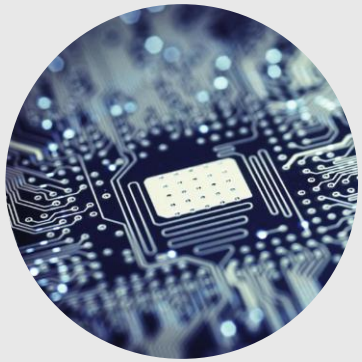

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Ability to control all parts of value chain to **transfer cost savings** on to customers and leverage scale to **service the largest clients** in the market

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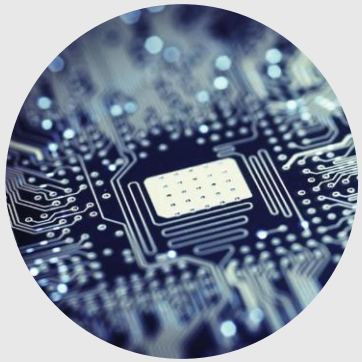

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4) FINANCIAL STABILITY

Having **positive cash flow** has allowed First Solar to pursue **sustainable growth** opportunities

Business model may no longer be sustainable in the face of new market forces

1) DISTRIBUTED GENERATION

2) WIDESPREAD GRID PARITY

3) INDUSTRY CONSOLIDATION

Traditionally, First Solar captured significant market share through securing **utility-scale projects**

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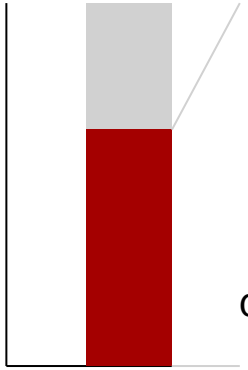
"Distributed power capacity additions grew by **300%** from 37 to **142 GW** per year"

"Investment in distributed increase **five-fold** from $30B to **$150B**"



65.6%

of global growth in solar PV in 2012-20 will come from the distributed generation

Source: *General Electric, McKinsey*

Business model may no longer be sustainable in the face of new market forces

1) DISTRIBUTED GENERATION

2) WIDESPREAD GRID PARITY

3) INDUSTRY CONSOLIDATION

Less subsidies granted as solar more commercially viable

Increased grid parity results in heightened competition

Source: *Deutsche Bank*

Business model may no longer be sustainable in the face of new market forces

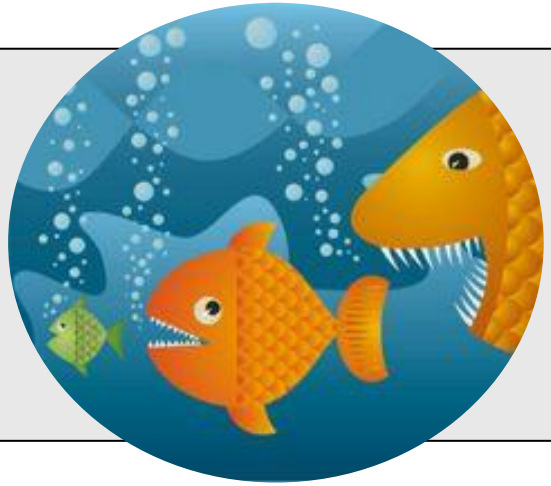
1) DISTRIBUTED GENERATION

2) WIDESPREAD GRID PARITY

3) INDUSTRY CONSOLIDATION

Projected that **70-80%** of domestic **demand in China** will be owned by **10 players**

US module manufacturing facilities shrunk from **51 in 2011 to 38 in 2013**



More players will enjoy the benefits of **scale production**, and will create **greater price competition** in upstream markets

Source: *International Energy Agency*

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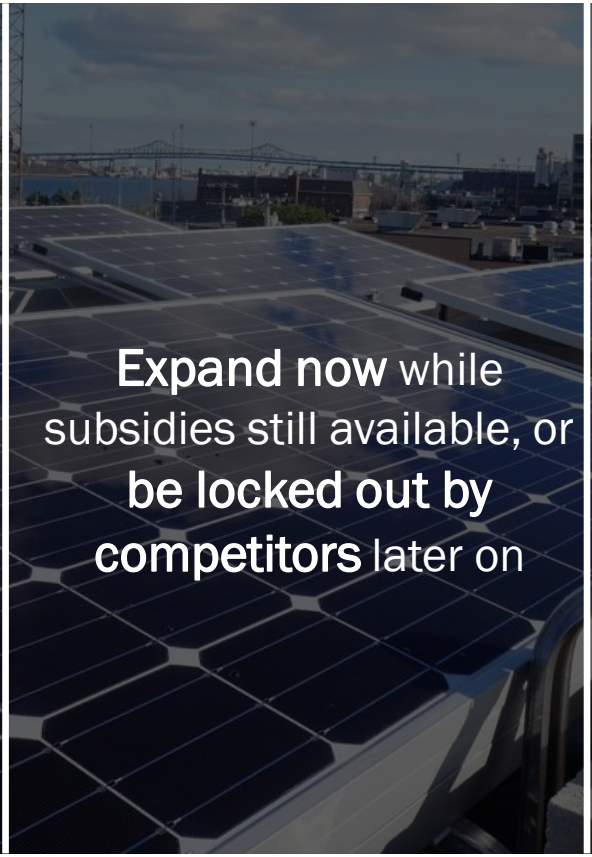
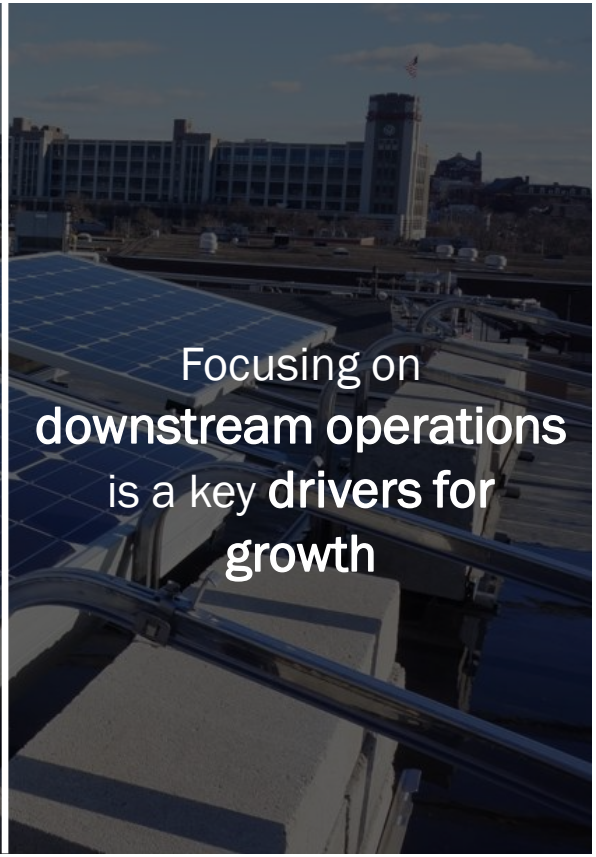


3) INDUSTRY CONSOLIDATION



Value Proposition

OBJECTIVE

What markets should First Solar enter in order to combat external factors disrupting their current solar business model?

EXTERNAL FACTORS

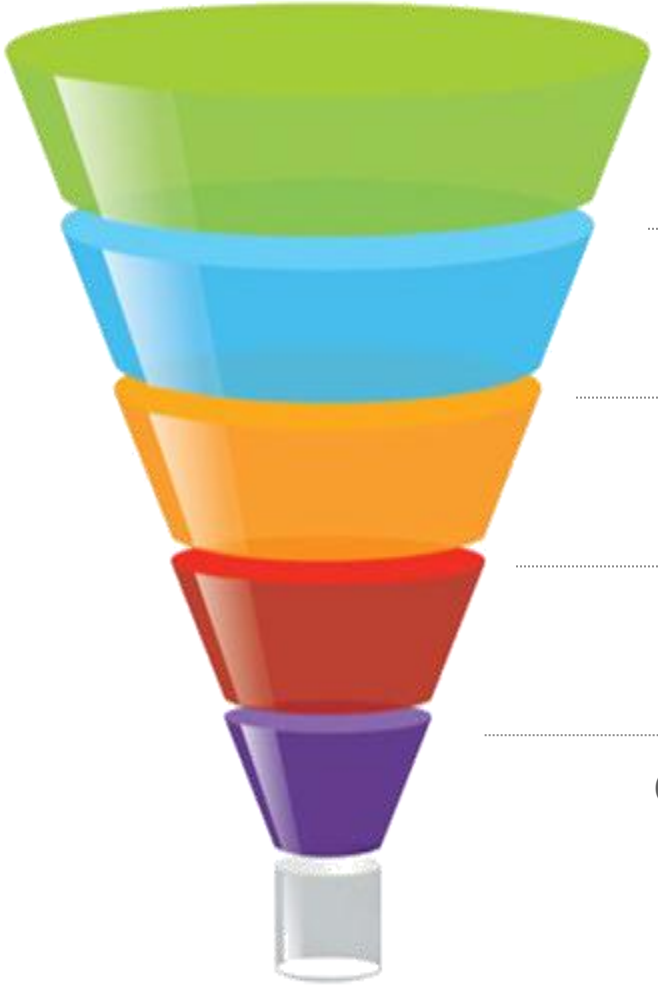
- Shift Toward Distributed Generation
- Widespread Grid Parity
- Industry Consolidation

RECOMMENDATIONS

IMPACT

Greater scale and scope by introducing entering new segments and geographies
Increased profitability of $200 million after 5 years

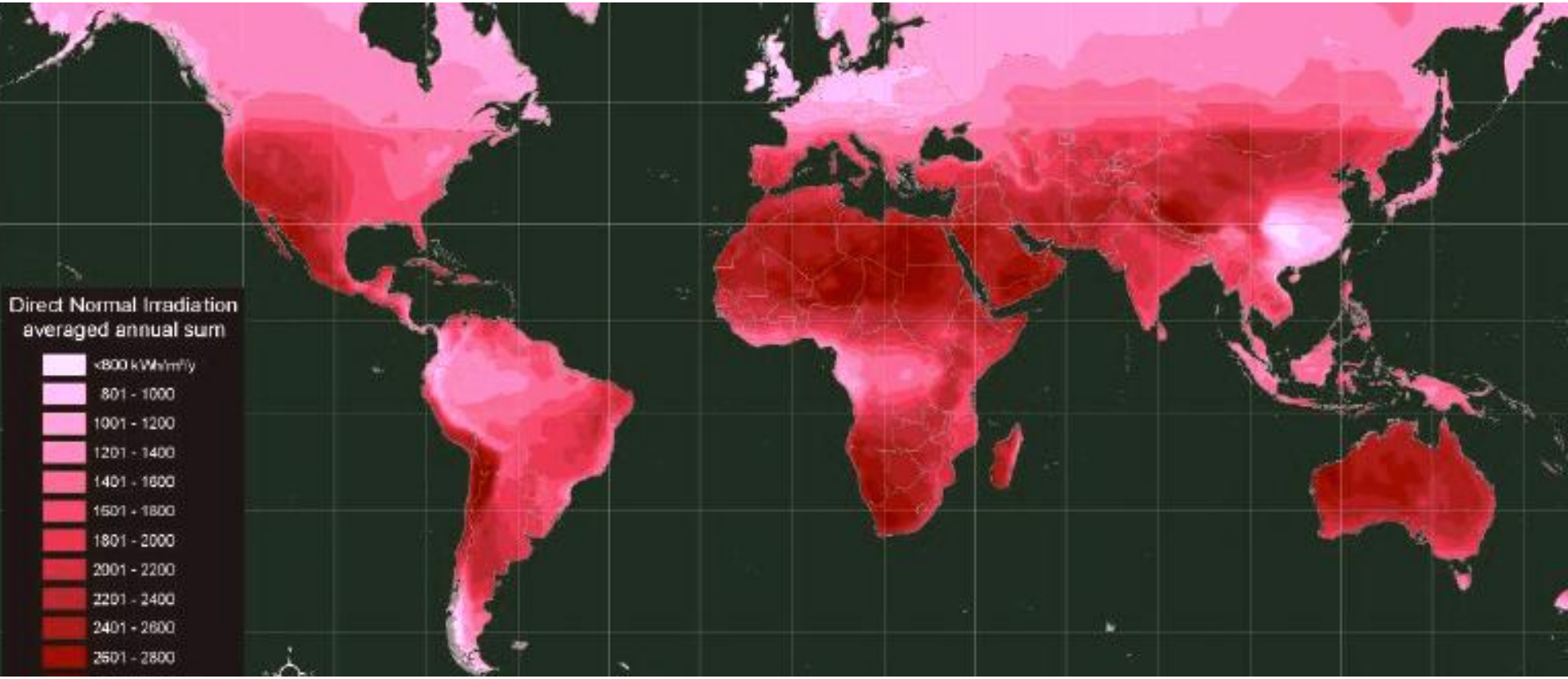
Criteria for New Markets



INSOLATION LEVELS	*Amount of sun light a country receives*
STATUS OF GRID PARITY	*Competitive solar prices with traditional energy forms*
GROWTH & MARKET DEMAND	*Size of the solar market and its future growth*
VERTICAL INTEGRATION POTENTIAL	*Ability to translate entire value chain to region*
GOVERNMENT POLICIES	*Favorable conditions set in place by the government*

High Insolation, Most Efficient Markets

When selecting regions for First Solar to target, it is crucial to target markets that have high degrees of insolation, representing markets where solar PV works most efficiently



Source: *NASA, DLR*

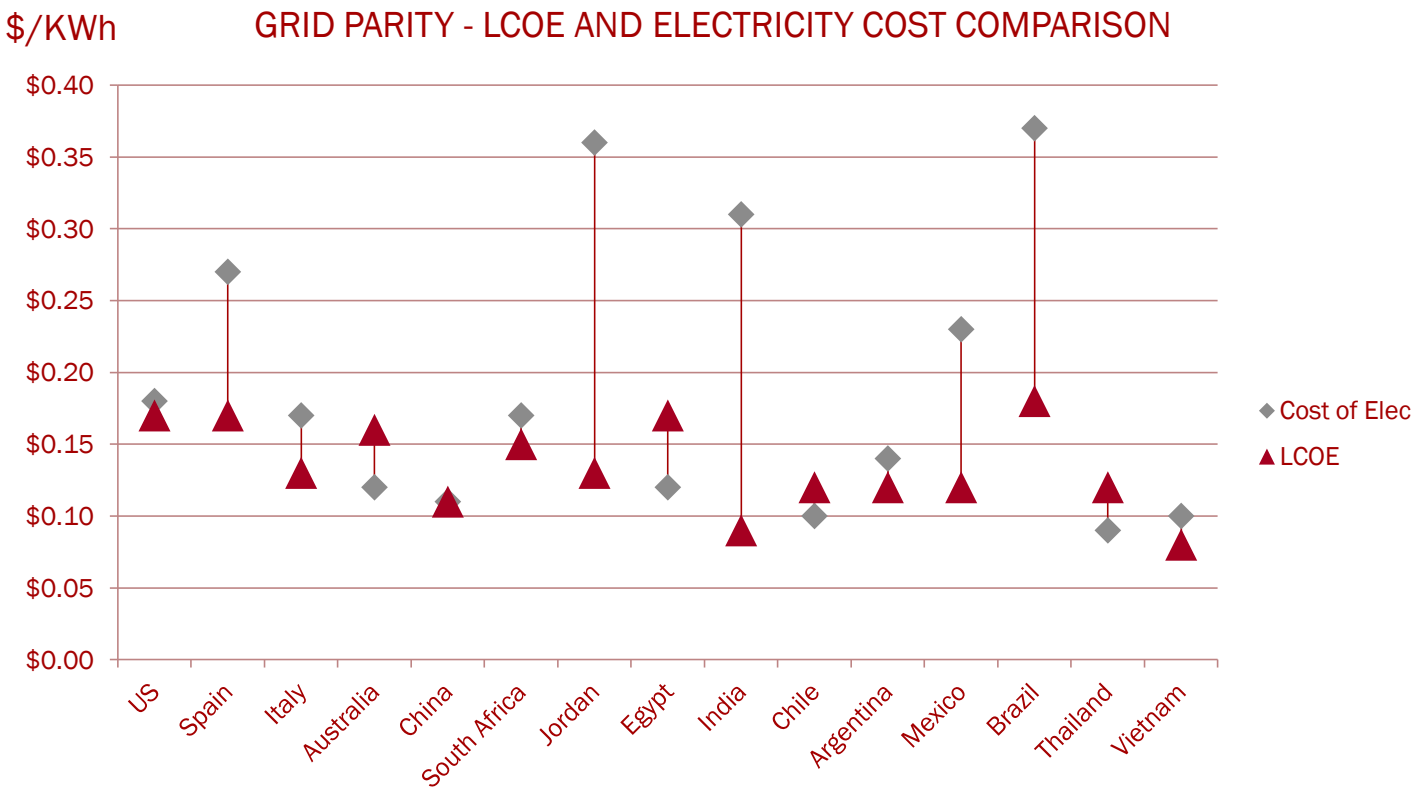
Grid Parity Correlated with Insolation

COUNTRIES

USA ESP ITA AUS CHN

ZAF JOR EGY IND CHL ARG MEX BRA THA VNM

All countries within regions of high insolation have either achieved grid parity, or on the cusp of doing so



Source: *Deutsche Bank*

Highest Installations, High Growth

COUNTRIES

By examining recent solar capacity investment, First Solar can best examine which markets can produce the greatest returns.

DEVELOPED

USA

6.2 GW

SPAIN

118 MW

ITALY

1.4 GW

AUSTRALIA

830 MW

CHINA

11.8 GW

Source: *GreenTech Media, EPIA*

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600 MW

EGYPT
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CHILE
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MEXICO
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THAILAND
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JORDAN
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INDIA
1 GW

ARGENTINA
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BRAZIL
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VIETNAM
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Vertical Integration, Most Advantage

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In order to successfully implement First Solar's model overseas, it is crucial that the benefits of vertical integration travel as well.

Source: *First Solar*

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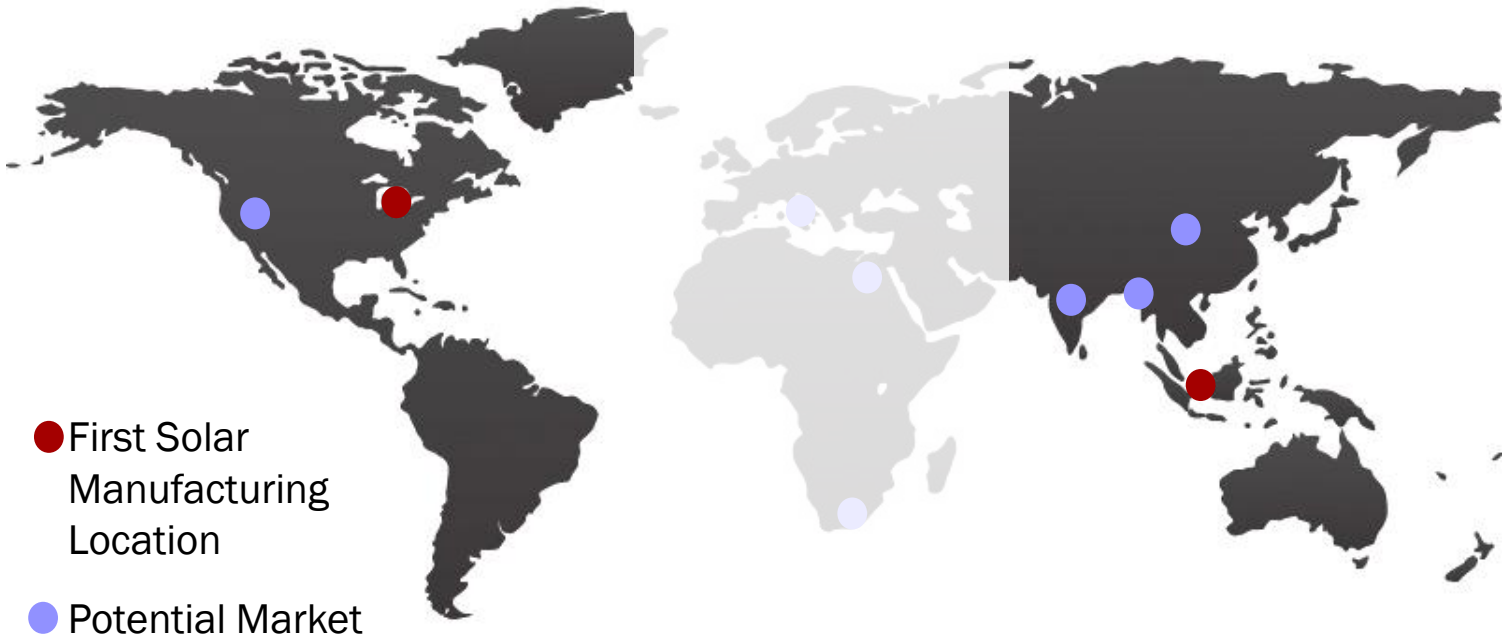

Source: *First Solar*

Government Support, Easy Penetration

COUNTRIES

UNITED STATES

- Anti dumping regulations that protect home market
- First Solar is already in the market, making it easy to further penetrate

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- $4B foreign investment from the US alone
- Feed-in-Tariff policy
- Government subsidies that total up to 30% customer facing discounts

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- Invested $1.5 B in the past year solely on solar
- Tax exemptions

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First Solar must take advantage of industry forces when focusing on Thailand, India, and US

STRATEGY OVERVIEW

First Solar should **enter Thailand and India** to leverage its current core competencies and then **reinvest** in next technology to focus **on US market**

ADDRESSING INDUSTRY TRENDS

Widespread Grid Parity

- Take advantage of **government subsidies/advantageous policies** while still available to penetrate new markets

Industry Consolidation

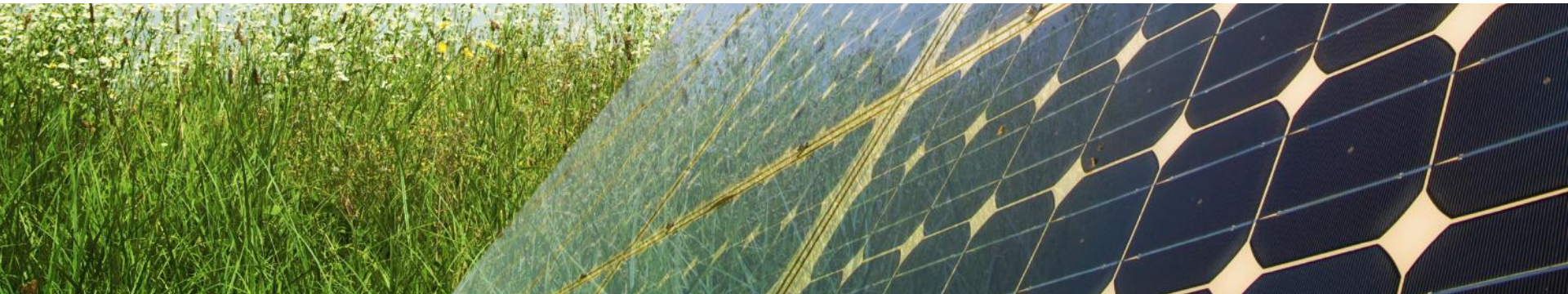
- **Bring vertically integrated value chain** capability to markets to beat out competitors

Distributed Generation

- Reinvest in R&D efforts in order to **better capture** the distributed generation market currently dominated by C-Si cells

1) RISING SUN

2) SUMMER SOLSTICE



Stage 1: Leverage government policies to reduce market entry costs

1. **Utilize government support**
2. New Projects
3. Sell to 8Point3 Energy Partners

THAILAND

Financial Incentive

- **Adder program**: guarantee attractive power purchasing rates for solar PV

Investment Incentives

- **Tax exemption** for corporate income
- **Duty exemption** for imported equipment

Source: Ministry of Energy, Thailand

INDIA

Financial Incentive

- **Accelerated depreciation** to save money on taxes

Investment Incentives

- **Customs and excise duties exemption** for equipment to set up renewable energy projects

Source: KPMG

Stage 2: Drive new projects in Thailand through cost leadership

1. Utilize government support
2. New Projects
3. Sell to 8Point3 Energy Partners

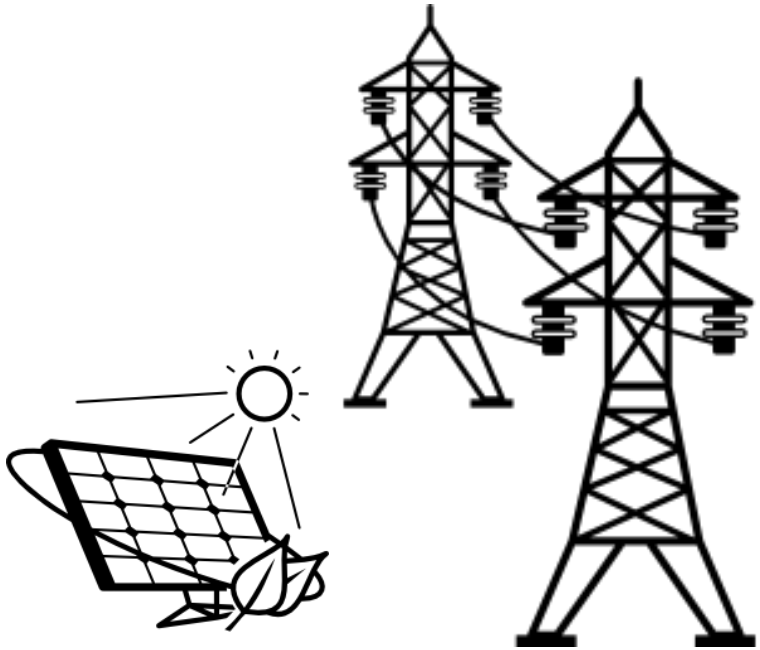
THAILAND – Winning on Price

Grid Parity Not Yet Achieved

$0.09/kW > $0.12/kW

Electric Cost LCOE

First Solar can leverage **cost leadership** to take advantage of market opportunity



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Source: Deutsche Bank

What Product?

- CdTe systems for commercial and utility-scale use

How?

- Purchase Power Agreements

Who to Target?

- Media companies
- 24/7 Emergency Services
- Utility Companies (Backup Power)

Stage 2: Address India's Supply Gap with large scale

1. Utilize government support
2. New Projects
3. Sell to 8Point3 Energy Partners

INDIA – Winning on Scale

India's Supply Gap

300-450

terrawatt hours unmet

First Solar can utilize its scale to provide a large, stable power source

Source: Ministry of Energy, India

What Product?

- CdTe centralized systems

How?

- Leverage Engineering, Procurement & Construction (EPC) advantages
- Purchase Power Agreements

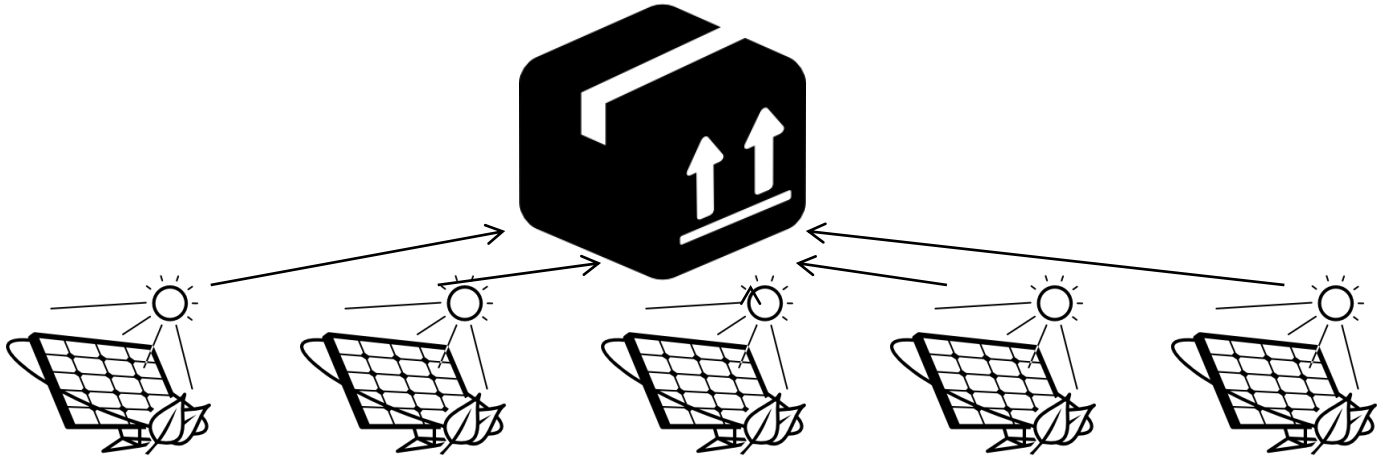
Who to Target?

- Utility Companies
- Government projects

Stage 3: Bundle energy producing assets for sale to Yield Co

1. Secure Financing
2. New Projects
3. Sell to 8Point3 Energy Partners

GLOBAL



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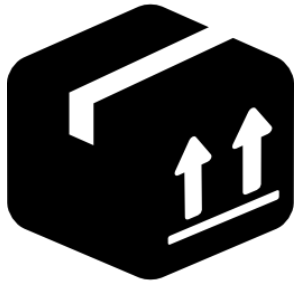

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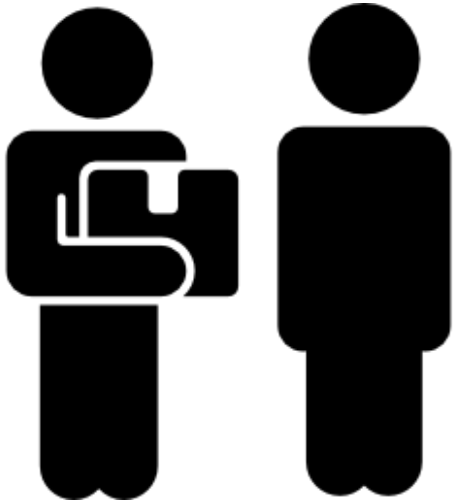

Yield Co sale generates upfront capital for immediate reinvestment

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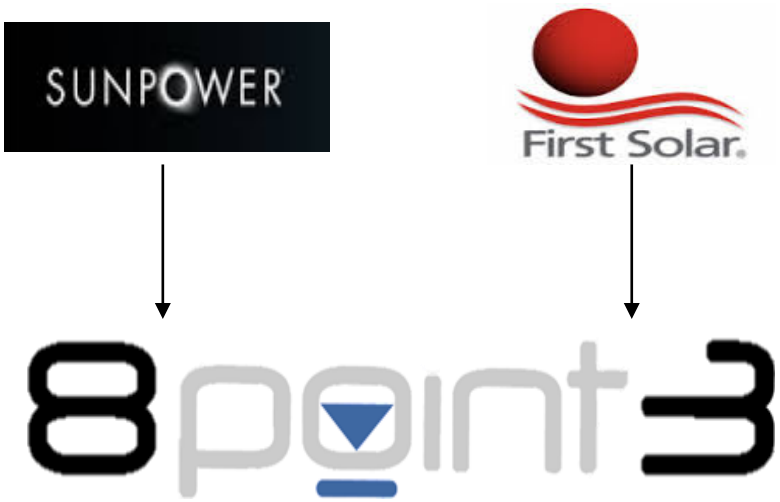

After securing projects, sell projects to **8Point3 Energy Partners**

Selling to own Yield Co allows First Solar to get more cash upfront to **expand into new markets** while still **earning dividends**

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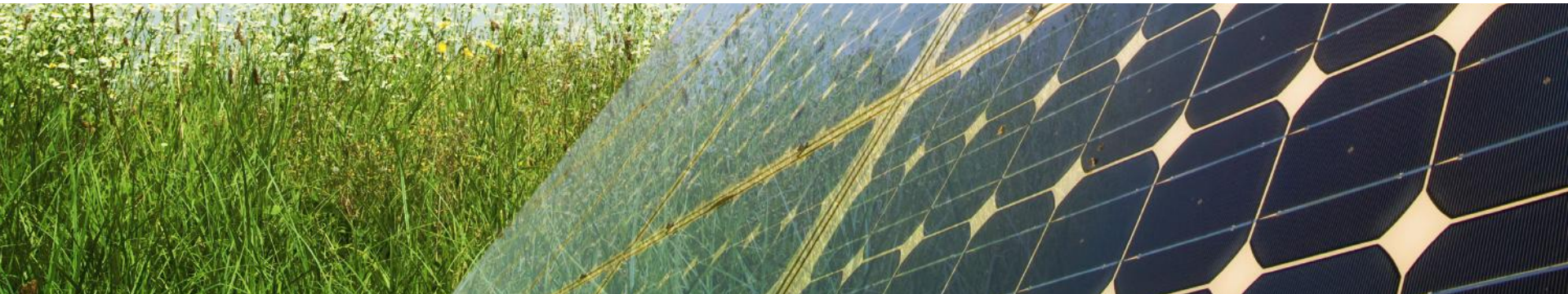
2) SUMMER SOLSTICE



Use cash to reinvest in technologies that will best serve DG markets

Trend towards distributed generation affects success in your largest market: the United States

Use money earned from Indian and Thailand markets to reinvest in R&D capabilities to serve DG market

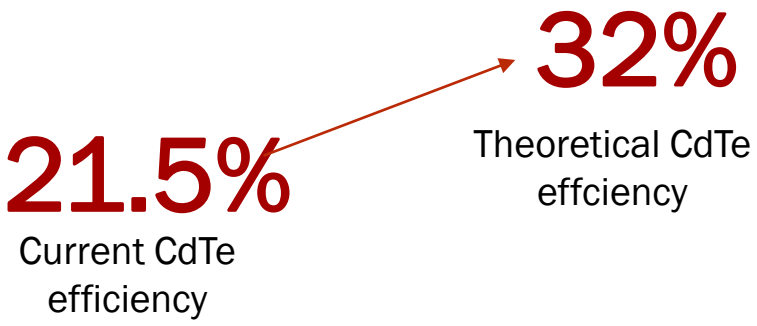
Two options for investment in R&D

OVERVIEW

Capture US market by reinvesting in R&D to maintain market leadership and hedge against shifts towards distributed generation

1 CdTe improvement

ROOM FOR GROWTH



Source: Institute of Electrical Engineers

Continue to develop more **efficient** and **cost effective** CdTe cells

2 3rd generation cells

PEROVSKITE SOLAR CELLS

40% CHEAPER

30% MORE EFFICIENT

Source: Exeter University

Investing in the **next generation** of solar cells to compete in the future

Entrance strategies into Thailand, India, and US have 3 key impacts

Acting on forecasted industry forces

Competitiveness

Understand trends and leverage competencies to succeed in the industry

Capturing new, growing markets

Growth

Diversify risks and enter markets with promising solar futures

Paving path for long term success

Innovation

Staying ahead of the game and investing in the future of solar technology

Feasibility Analysis

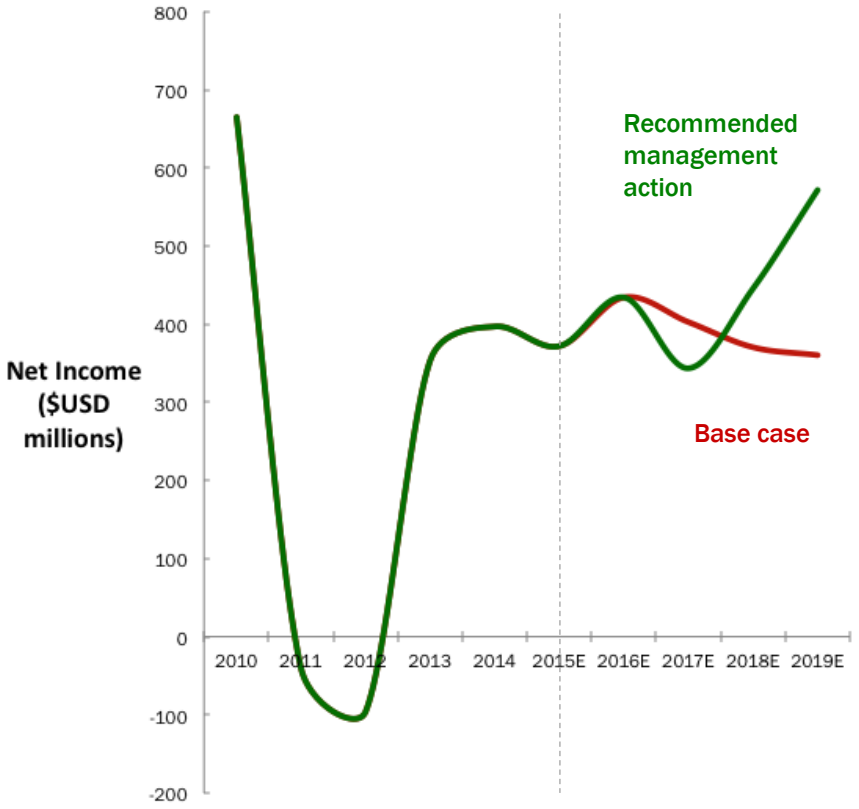
Financial Implication	Cost & Revenue Drivers	Risks & Mitigation

In order for First Solar to effectively focus on the Thai, Indian, and American markets, its strategy must be **financially sound** and **able to mitigate risk**.

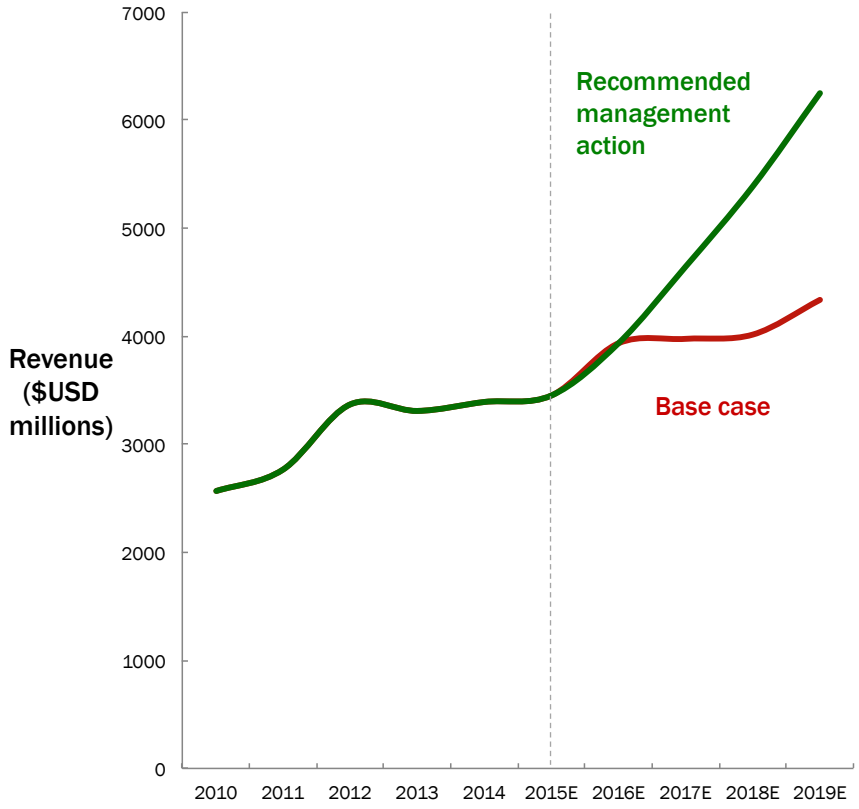
Feasibility Analysis

Financial Implication | Cost & Revenue Drivers | Risks & Mitigation

5 Year Projected Profitability



5 Year Projected Growth



Feasibility Analysis

Financial Implication | **Cost & Revenue Drivers** | Risks & Mitigation

Revenue Drivers

Entering emerging markets allows First Solar to develop a previously waning project pipeline (**600-800 MW**)

Shifting toward distributed generation capitalizes on growth in developed markets (**incremental 200 MW**)

Strategy Costs

Costs will not change drastically when entering new markets

Relationship between research costs and eventual cost savings is promising – we recommend **doubling R&D** to fund new technology

Impact

Geographically diverse project pipeline
Increased profitability of $200 million after 5 years
Positions your company for full-scale growth in residential systems

Feasibility Analysis

Financial Implication | Cost & Revenue Drivers | **Risks & Mitigation**

1

Risk: Incumbent solar companies in Thailand and India attempt to undercut First Solar's bids

Market your development and EPC arms aggressively to demonstrate reliability and speed of construction

Lead with a loss leader strategy to gain market share initially as YieldCo will ensure success in the long run

2

Risk: A new solar cell emerges that beats C-Si on efficiency and First Solar has researched the wrong technology

Evaluate whether or not CdTe will ever **match the new technology's efficiency**

Immediately **purchase the new technology** before your competitors or **partner** to gain access

Value Proposition

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RECOMMENDATIONS

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APPENDIX

Projected Revenue & Costs – Base Case

	Historical					Projected				
	2010	2011	2012	2013	2014	2015E	2016E	2017E	2018E	2019E
Total Revenue	2564	2766	3369	3309	3392	3451	3936	3976	4016	4337
Growth Over Prior Year	*24.1%*	*7.9%*	*21.8%*	*-1.8%*	*2.5%*	*1.8%*	*14.1%*	*1.0%*	*1.0%*	*8.0%*
Cost of Goods Sold	1379	1794	2516	2446	2565	2623	3031	3101	3172	3469
COGS %	*53.8%*	*64.9%*	*74.7%*	*73.9%*	*75.6%*	*76.0%*	*77.0%*	*78.0%*	*79.0%*	*80.0%*
Gross Profit	1185	972	853	863	827	828	905	875	843	867
Margin %	*46.2%*	*35.1%*	*25.3%*	*26.1%*	*24.4%*	*24.0%*	*23.0%*	*22.0%*	*21.0%*	*20.0%*
SG&A	320	413	281	270	254	242	276	278	281	304
% of Revenue	*12.5%*	*14.9%*	*8.3%*	*8.2%*	*7.5%*	*7.0%*	*7.0%*	*7.0%*	*7.0%*	*7.0%*
R&D	95	141	132	134	144	184	157	159	161	173
% of Revenue	*3.7%*	*5.1%*	*3.9%*	*4.1%*	*4.2%*	*4.0%*	*4.0%*	*4.0%*	*4.0%*	*4.0%*
Other Expenses	19	34	8	3	5	-	-	-	-	-
EBIT	751	385	432	455	424	403	472	437	402	390
Margin %	*29.3%*	*13.9%*	*12.8%*	*13.8%*	*12.5%*	*11.7%*	*12.0%*	*11.0%*	*10.0%*	*9.0%*
Interest Expense (Income)	(14)	(13)	1	(15)	(16)	(10)	(10)	(10)	(10)	(10)
EBT (Excluding Unusual Items)	765	398	430	470	440	413	482	447	412	400
EBT (Including Unusual Items)	762	(54)	(40)	378	427	413	482	447	412	400
Income Tax Expense (Benefit)	98	(14)	57	25	30	41	48	45	41	40
Tax Rate	*12.8%*	*NA*	*13.1%*	*5.4%*	*6.8%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*
Net Income (Excluding Unusual Items)	664	-40	-96	353	397	372	434	403	370	360
Margin %	*25.9%*	*-1.4%*	*-2.9%*	*10.7%*	*11.7%*	*10.8%*	*11.0%*	*10.1%*	*9.2%*	*8.3%*

Projected Revenue & Costs – With Recommendations

	Historical					Projected				
(All figures in millions)	2010	2011	2012	2013	2014	2015E	2016E	2017E	2018E	2019E
Total Revenue	2564	2766	3369	3309	3392	3451	3936	4645	5388	6250
Growth Over Prior Year	*24.1%*	*7.9%*	*21.8%*	*-1.8%*	*2.5%*	*1.8%*	*14.1%*	*18.0%*	*16.0%*	*16.0%*
Cost of Goods Sold	1379	1794	2516	2446	2565	2623	3031	3577	4095	4688
COGS %	*53.8%*	*64.9%*	*74.7%*	*73.9%*	*75.6%*	*76.0%*	*77.0%*	*77.0%*	*76.0%*	*75.0%*
Gross Profit	1185	972	853	863	827	828	905	1068	1293	1563
Margin %	*46.2%*	*35.1%*	*25.3%*	*26.1%*	*24.4%*	*24.0%*	*23.0%*	*23.0%*	*24.0%*	*25.0%*
SG&A	320	413	281	270	254	242	276	325	377	438
% of Revenue	*12.5%*	*14.9%*	*8.3%*	*8.2%*	*7.5%*	*7.0%*	*7.0%*	*7.0%*	*7.0%*	*7.0%*
R&D	95	141	132	134	144	184	157	372	431	500
% of Revenue	*3.7%*	*5.1%*	*3.9%*	*4.1%*	*4.2%*	*4.0%*	*4.0%*	*8.0%*	*8.0%*	*8.0%*
Other Expenses	19	34	8	3	5	-	-	-	-	-
EBIT	751	385	432	455	424	403	472	372	485	625
Margin %	*29.3%*	*13.9%*	*12.8%*	*13.8%*	*12.5%*	*11.7%*	*12.0%*	*8.0%*	*9.0%*	*10.0%*
Interest Expense (Income)	(14)	(13)	1	(15)	(16)	(10)	(10)	(10)	(10)	(10)
EBT (Excluding Unusual Items)	765	398	430	470	440	413	482	382	495	635
EBT (Including Unusual Items)	762	(54)	(40)	378	427	413	482	382	495	635
Income Tax Expense (Benefit)	98	(14)	57	25	30	41	48	38	49	64
Tax Rate	*12.8%*	*NA*	*13.1%*	*5.4%*	*6.8%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*	*10.0%*
Net Income (Excluding Unusual Items)	664	-40	-96	353	397	372	434	343	445	572
Margin %	*25.9%*	*-1.4%*	*-2.9%*	*10.7%*	*11.7%*	*10.8%*	*11.0%*	*7.4%*	*8.3%*	*9.1%*

Financials – Revenue Assumptions Abroad

200-250 MW in projects from Thailand, 700-800 MW in projects from India for years 2017, 2018, and 2019.
Given that the U.S. total market value of new installations was $13.7 billion USD in 2013 and equated to 4.7 billion GW new capacity, we find that every GW equals approximately 2.9 billion USD.
Taking into account the comparable costs of electricity across international markets, we see that the LCOE ratio is an indicator of how much energy is worth in another market.

Thailand's LCOE/US's LCOE = 0.12/0.17 = .706
India's LCOE/US's LCOE = 0.09/0.17 = .529

That means every GW in Thailand is worth $2.05 billion USD
Every GW in India is worth $1.53 billion USD

	Thailand	India
Current Solar PV Capacity (GW)	1.3	3
5-Year Goal	5	20
Implied Growth Every Year	0.74	3.4
Assume 25% market share	0.2	0.85

Assuming 250 MW in projects from Thailand every year, realized at a constant, delayed rate over the next few years equals $500 million in revenue for 2017-2019
Assuming 700-800 MW in projects from India, 1.2 billion in revenue for 2017-2019

Market value of PV installations in 2013 in the U.S. were $13.7 billion.
The U.S. also installed 4.7 GW of energy.
Source: GTM Research/SEIA U.S. Solar Market Insight

Financials – Revenue assumptions from shift toward distributed generation

According to NREL, the U.S. is shifting toward distributed generation to avoid a loss of energy during transmission. Given that the U.S. is set to grow at 22% over the next five years, this accounts for approximately 2.5 GW in projects every year (BCC Research).

If they can claim even 200 MW in projects every year (an easy task, considering their existing market share and the evergreen, growing market, it will greatly supplement their revenue.

Financials – Base Case Assumptions from First Solar's Backlog

Exhibit 1: First Solar project backlog as February 24

Backlog - Project Sold/Under Contract						
Project/Location	**Size MWac**	**PPA**	**Owner/Purchaser**	**Completion**	**% Complete**	**% Rev recognized**
McCoy, California	250	SCE	NextEra	2016	2.0%	2.0%
Silver State South, Nevada	250	SCE	NextEra	2016	9.0%	9.0%
Southern California	175	Various	Various	2016	0.0%	0.0%
AGL, Australia	155	AGL	AGL	2015	43.0%	43.0%
Imperial Solar Energy Center West, California	150	SDG&E	Tenaska	2016	2.0%	2.0%
Taylor, Georgia	130	Various	Southern Company	2016	0.0%	0.0%
Decatur Parkway Solar, Georgia	83	Georgia Power	Southern Company	2015	0.0%	0.0%
California (Multiple Locations) (9)	79	PG&E/ SCE	Various	2015	95.0%	95.0%
Copper Mountain 2, Nevada	58	PG&E	Sempra	2015	58.0%	58.0%
Shams Ma'an, Jordan	53	NEPCO	Various	2016	0.0%	0.0%
Seville, California	52	Seville Solar	Seville Solar	2015	0.0%	0.0%
CID Solar and Cottonwood, California	43	PG&E / Marin Clean Energy	EDF Renewable Energy	2015	55.0%	55.0%
Elm City, North Carolina	40	UOG	Duke	2015	0.0%	0.0%
PNM3, New Mexico	23	UOG	PNM	2015	77.0%	77.0%
Total	**1,541**				247	247

FSLR projects Not Sold/Not Contracted (with executed PPA)

as of Feb 24

Project/Location	**Size MWac**	**PPA**	**Fully Permitted**	**Completion**	**% Complete**	
Tribal Solar, California	310	SCE	No	2019	10.0%	
Stateline, California	300	SCE	Yes	2016	15.0%	
California Flats, California	280	PG&E / Apple	No	2016	0.0%	*incl Apple deal*
Moapa, Nevada	250	LADWP	Yes	2015	14.0%	
India (Multiple Locations)	145	TSSPDCL / APSPDCL	No	2016	0.0%	
Luz del Norte, Chile	141	Merchant plant	Yes	2015	23.0%	
North Star, California	60	PG&E	Yes	2015	42.0%	
Cuyama, California	40	PG&E	Yes	2015/2016	9.0%	
Kingbird, California	40	SCPPA / City of Pasadena	Yes	2015	5.0%	
Lost Hills, California	32	PG&E	Yes	2015	76.0%	
Portal Ridge, California	31	PG&E/SCE	Yes	2015	0.0%	
Barilla, Texas	30	Merchant plant	Yes	2015	73.0%	
Total	**1,659**				220	

Source: Company data, Credit Suisse estimates

Key takeaway: Base case assumption is that 2017-2019 project pipeline is not yet robust due to sole focus on American market

These reductions in price have come as a result of more experience, technological developments, process optimization and volume increases among other things. The initial investment cost in modules and BOS components represents the overwhelming majority of costs for PV generated electricity during the system´s 25-30 year lifetime, as such costs as maintenance and control are virtually negligible. Typically, module cost reductions have outpaced BOS cost reductions (with the exception of inverters which have followed a similar learning curve to that of modules). This is usually because BOS components, such as labor costs and commodity prices (steel, aluminum, copper) have not depreciated over time. A typical cost structure for a PV system is illustrated in Figure 17. In this rooftop installation, module costs represent 60% of the total system cost, whereas the BOS component amounts to 40%[51].

Cost Structure of a c-Si Rooftop PV system

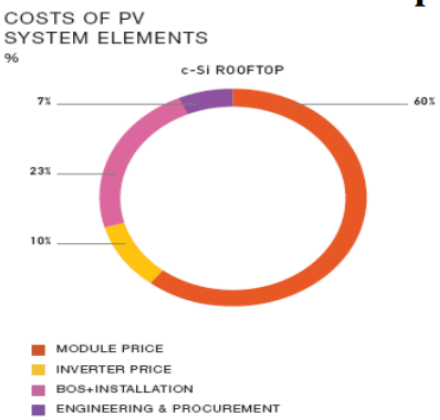


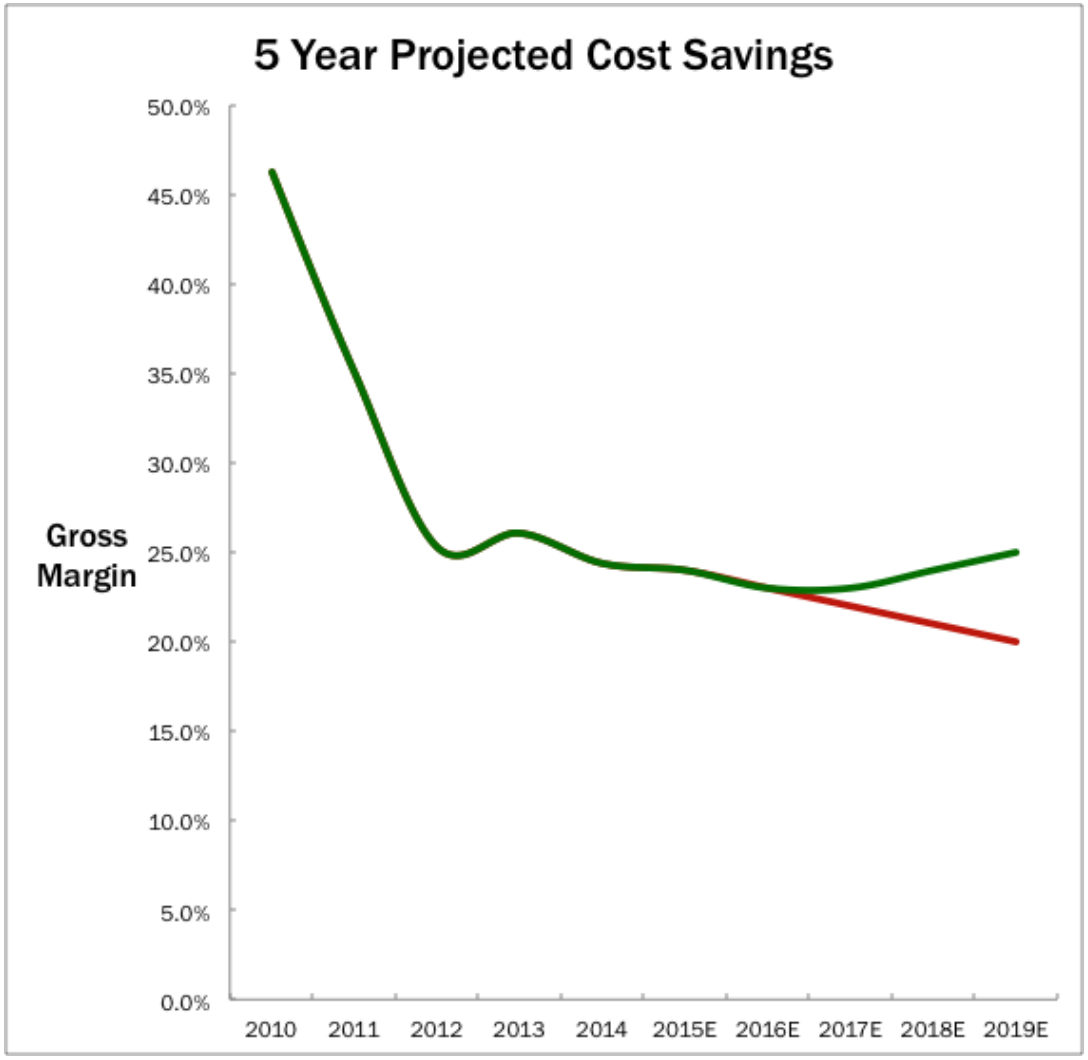
Figure 17: *This figure illustrates the various components of a PV system and their relative weights in terms of cost.*[52]

Financials – Cost Savings Assumptions

Arguably the most crucial factor for reduction of total system costs is through enhancement of module efficiency. Solar cell efficiency may be defined as the percentage of solar radiation that is converted into electricity. By increasing the cell efficiency, a solar cell will produce more electrical power per unit surface area. As a consequence, this will in turn decrease material costs and BOS costs per unit of electricity produced. An efficiency increase of 1% has been said to result in a reduction of up to 10% of the total system's cost/W_p[53]. Costs measured in $/$W_p$ are an effective portrayal of costs as they take into consideration the efficiency of cells. In this respect, PV producers can be interpreted as manufacturing a certain level of efficiency (at a certain cost), rather the more ambiguously defined "solar panel".

1% technology increase in efficiency can result in 10% reduction in system COGS.

If we assume the current trend of greater efficiency can increase by 50% due to doubling R&D (to 1.50% per year greater efficiency for CdTe), First Solar would re-buffer its gross margin.



Market Demand and Growth for PV in Thailand

PHOTON News

Markets

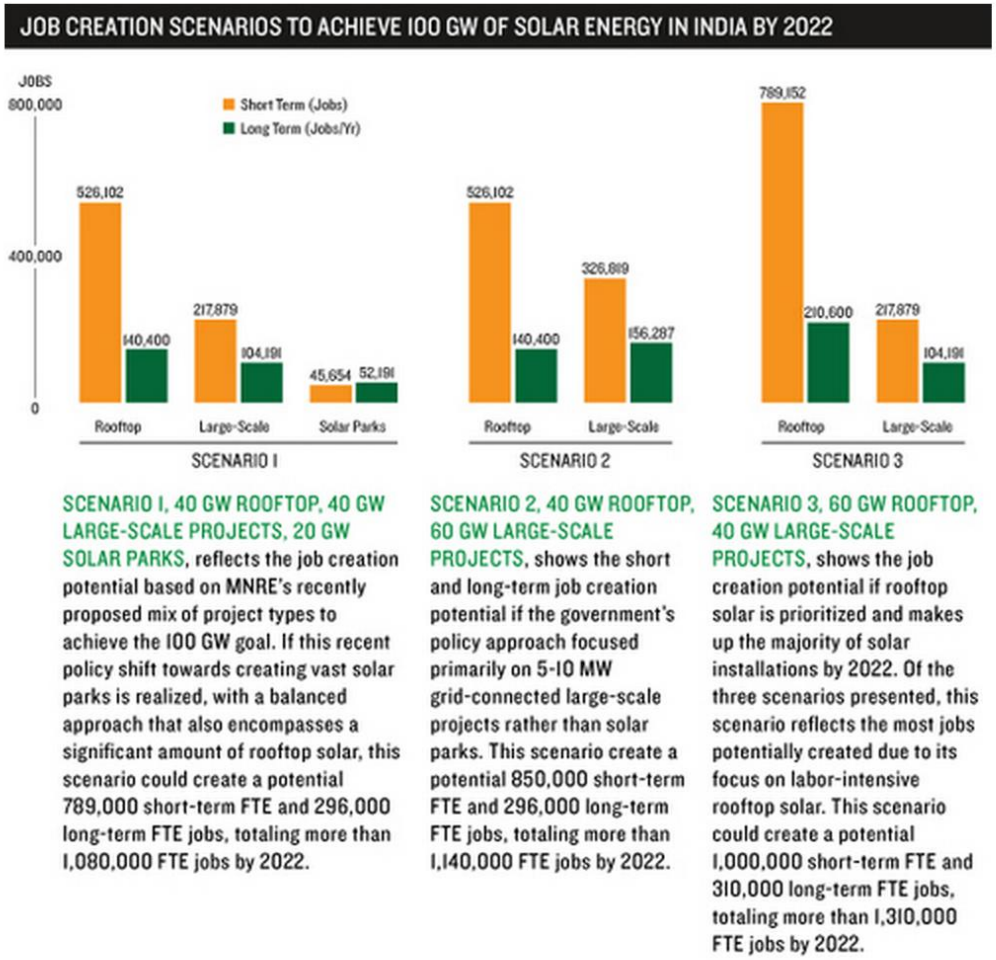
12/23/2014 - Markets 18,517 subscribers

Thailand tops 1.3 GW of PV capacity

Thailand reached a cumulative installed solar capacity of 1.32 GW, according to local newspaper The Nation, which cites a statement from the country's Energy Minister Narongchai Akrasanee. According to official statistics, Thailand had 823.4 MW of installed PV power at the end of 2013 This means that the country has added new PV systems with a combined capacity of approximately 500 MW in 2014. Furthermore, the minister said that there are still 296 MW of PV plants under construction and 1.01 GW that have applied for a FIT contract. Moreover, the minister said that Thailand is now targeting between 4.5 GW and 5 GW of installed solar capacity by 2021. The previous target was of 3.8 GW. © PHOTON

Thailand's projected goal is 5 GW by 2021, which equates to a 3.7 GW demand for solar PV over the next 4.5 years ~ 800 MW in projects a year. Assuming First Solar is able to replicate its 25% (3 GW/12 GW) market share in the U.S., this equates to 200 MW in Thailand alone.

Market Demand and Growth for PV in India



SCENARIO 1, 40 GW ROOFTOP, 40 GW LARGE-SCALE PROJECTS, 20 GW SOLAR PARKS, reflects the job creation potential based on MNRE's recently proposed mix of project types to achieve the 100 GW goal. If this recent policy shift towards creating vast solar parks is realized, with a balanced approach that also encompasses a significant amount of rooftop solar, this scenario could create a potential 789,000 short-term FTE and 296,000 long-term FTE jobs, totaling more than 1,080,000 FTE jobs by 2022.

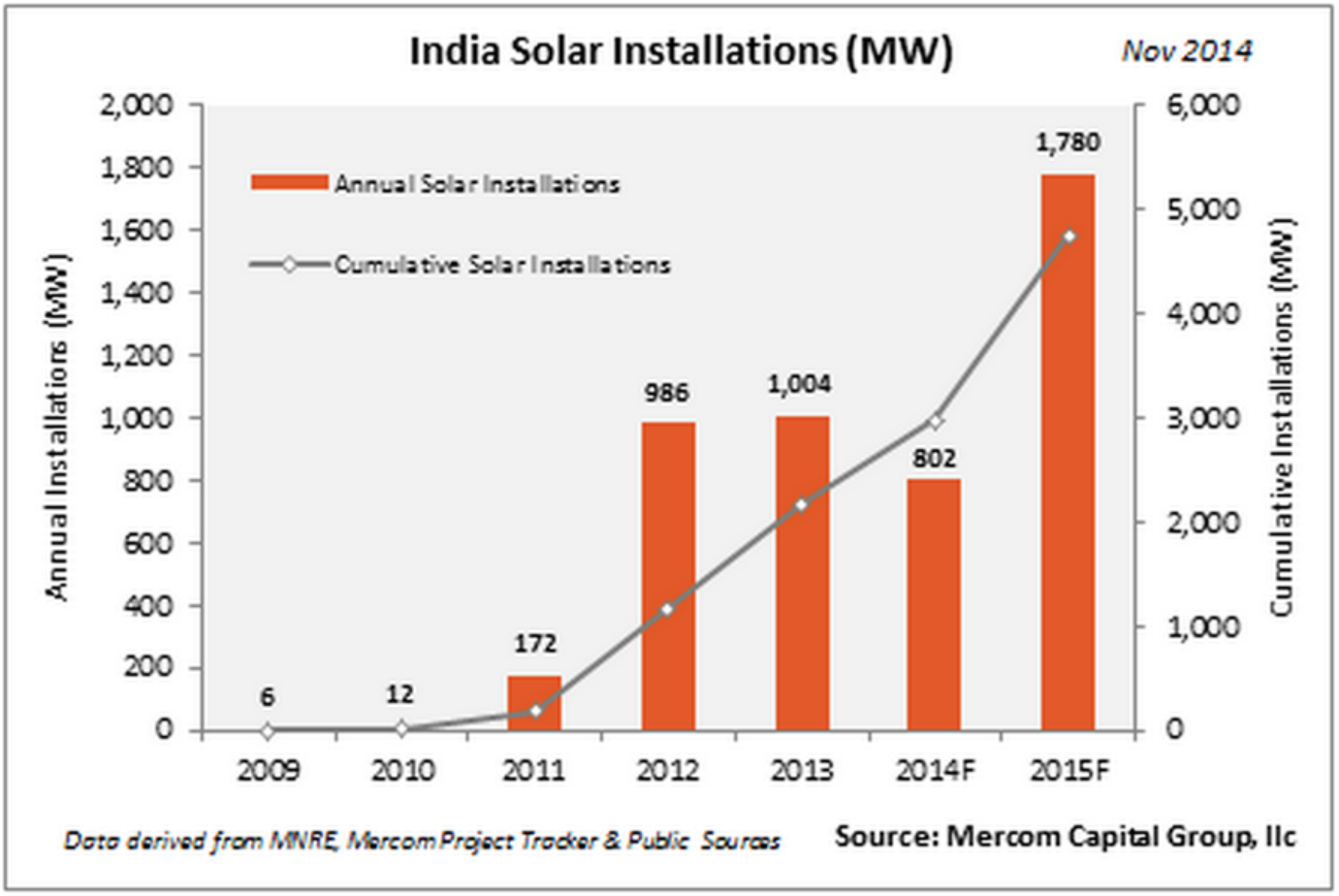
SCENARIO 2, 40 GW ROOFTOP, 60 GW LARGE-SCALE PROJECTS, shows the short and long-term job creation potential if the government's policy approach focused primarily on 5-10 MW grid-connected large-scale projects rather than solar parks. This scenario create a potential 850,000 short-term FTE and 296,000 long-term FTE jobs, totaling more than 1,140,000 FTE jobs by 2022.

SCENARIO 3, 60 GW ROOFTOP, 40 GW LARGE-SCALE PROJECTS, shows the job creation potential if rooftop solar is prioritized and makes up the majority of solar installations by 2022. Of the three scenarios presented, this scenario reflects the most jobs potentially created due to its focus on labor-intensive rooftop solar. This scenario could create a potential 1,000,000 short-term FTE and 310,000 long-term FTE jobs, totaling more than 1,310,000 FTE jobs by 2022.

India is shooting for 100 GW in solar capacity by 2022. Of the 100 GW, 20 GW will be fully focused on large solar parks, while the majority of the remainder will be distributed generation. 20 GW equates to 17 GW in capacity over the next 6 years, ~2.8 GW in solar installations every year. Assuming 25% again, approximately 700 MW in projects every year.

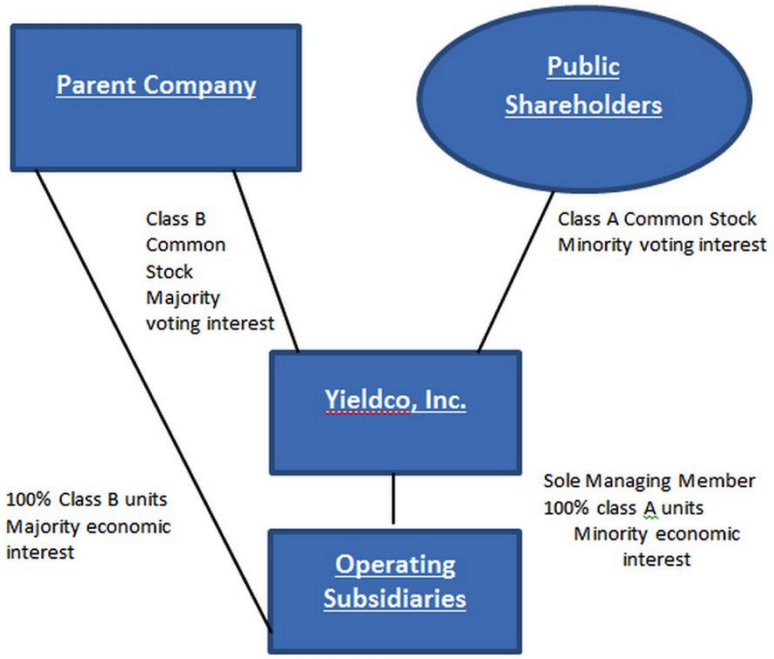
In addition, by entering India, your company can further tap into the distributed generation markets and capitalize on at least another GW in projects (staggered after utility scale).

Market Demand and Growth for PV in India



What is a YieldCo?

A YieldCo is spin-off company that bundles various renewable energy projects in order to generate predictable cash flows. The projects originate from the majority owner of the YieldCo, the parent company (i.e. First Solar). YieldCos will pay shareholders out any of its a dividend to avoid double taxations, similar to MLPs or REITS.



How will YieldCos drive value for your company?

YieldCos allow companies to tap into public markets, which can then be used to pay down expensive debt or fund new projects at rates lower than those available through tax equity (private) financing, which usually exceed 8%.

The generation of cash can also theoretically be used to drive further innovation or cost cutting measures.

YieldCos have rights-of-first-offer to buy projects from the Operating Company.

Source: NREL.gov

Who else has formed a YieldCo?

Only companies that are large industry players and have the capital necessary to buy third party assets or develop projects themselves can form YieldCos. They can be pure solar or a mix of renewable energy assets. They can also be comprised of small to medium sized distributed generation projects (Terraform) or purely large utility scale projects (NRG).

	Portfolio	Renewable Assets (MW-electric)	Total Assets (MW)	Total Capital Raised	Market Cap	Yield (Annual)
NRG Yield, Inc.	Conventional, solar, wind, thermal	1401	2984	$840 million	$3.9 billion	5.45%
Pattern Energy Group, Inc.	Wind	1932	1932	$938 million	$1.9 billion	6.25 %
Abengoa Yield Plc.	Solar, wind, conventional, electric transmission	710	1010; 1018 mi	$829 million	$3.0 billion	3.6 %
TransAlta Renewables, Inc.	Wind,hydro	1378	1378	C$346million (US$323)	$1.3 billion	7.5 %
NextEra Energy Partners, LP	Wind, Solar	989	989	$406 million	$3.1 billion	6.25%
TerraForm Power, Inc.	Solar	523	523	$500 million	$3.0 billion	4.5% (expected)

How to sustain YieldCo success?

Companies must fuel these YieldCos with more projects – again in line with our idea of needing more projects to grow your business. A larger pipeline allows for sustained success, and your company should continue to find distributed projects (with SunPower) and large scale utility projects.

(Source: NREL.gov)

Global Production Shifts

The creation of incentives for solar installations in several countries around 2004 led many companies to enter the PV industry. More recently, the industry has entered a phase of rapid consolidation on a global basis. According to an estimate by SEIA, the number of module manufacturing facilities in the United States shrank from 51 in 2011 to 38 in 2013. Chinese cell production has been relatively flat because demand in some countries has declined and prices have weakened (see **Figure 5**). According to the International Energy Agency, there are now fewer than 100 Chinese PV module and cell manufacturers, compared with more than 300 companies in 2011.[59] By the end of 2017, China aims to reduce the number to 10 major producers that would supply 70%-80% of domestic demand.[60] Price pressures have driven a number of manufacturers, including the U.S. firms Evergreen Solar and Solyndra and the German companies Solon and Q-Cells, into bankruptcy, and have led others to lay off workers.

Consolidation of Major Players

Ten firms now control nearly half of global solar module production. Of these, six are based in China, two in Japan, one in South Korea, and one in the United States (see **Table 3**).

Table 3. Top PV Solar Module Manufacturers by Production
(2013)

Rank	Manufacturer	Location of Headquarters	% of Module Production	Founded	Plant Locations (current and planned)
1	Yingli[a]	China	8.3%	1998	China
2	Trina Solar	China	6.7%	1997	China
3	Sharp[b]	Japan	5.4%	1959	Japan
4	Canadian Solar[c]	China	4.9%	2001	China
5	Jinko Solar	China	4.6%	2006	China
6	Renesola	China	4.5%	2005	China
7	First Solar[d]	United States	4.2%	1990	United States, Malaysia
8	Hanwha SolarOne[e]	South Korea	3.3%	2004	China, Malaysia, Germany
9	JA Solar	China	3.2%	2005	China
10	Kyocera	Japan	3.1%	1996	Japan, China, Czech Republic, Mexico

Countries with the largest amount of electricity consumption

RANK	COUNTRY	(KWH)	DATE OF INFORMATION
1	CHINA	4,831,000,000,000	UP TO NOVEMBER 2013
2	UNITED STATES	3,883,000,000,000	2011 EST.
3	EUROPEAN UNION	2,798,000,000,000	2012 EST.
4	RUSSIA	1,037,000,000,000	2013 EST.
5	JAPAN	859,700,000,000	2012 EST.
6	INDIA	757,900,000,000	2011 EST.
7	GERMANY	582,500,000,000	2012 EST.
8	CANADA	551,600,000,000	2011 EST.
9	BRAZIL	478,800,000,000	2011 EST.
10	KOREA, SOUTH	472,200,000,000	2011 EST.
11	FRANCE	462,900,000,000	2012 EST.
12	UNITED KINGDOM	320,800,000,000	2011 EST.
13	ITALY	307,200,000,000	2012 EST.
14	SPAIN	243,900,000,000	2011 EST.
15	SOUTH AFRICA	234,200,000,000	2012 EST.
16	MEXICO	232,300,000,000	2011 EST.
17	AUSTRALIA	226,900,000,000	2011 EST.
18	TAIWAN	224,800,000,000	2011 EST.
19	SAUDI ARABIA	211,600,000,000	2011 EST.
20	TURKEY	187,100,000,000	2011 EST.
21	IRAN	185,800,000,000	2011 EST.
22	UKRAINE	175,300,000,000	2012 EST.
23	THAILAND	169,400,000,000	2012 EST.
24	INDONESIA	156,000,000,000	2011 EST.

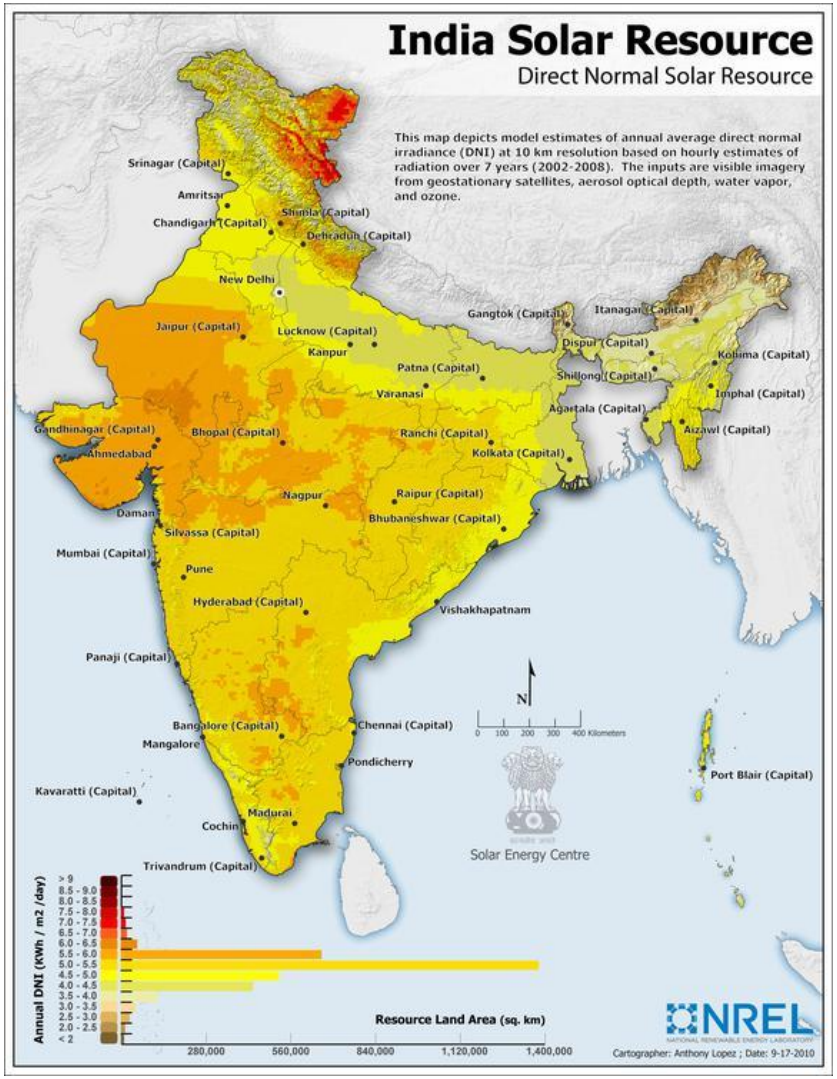
Source: World Factbook

Most Polluted Countries in the World

1. China
2. United States
3. Russia
4. India
5. Japan
6. Germany
7. Canada
8. United Kingdom
9. South Korea
10. Iran

Source: Action for our Planet

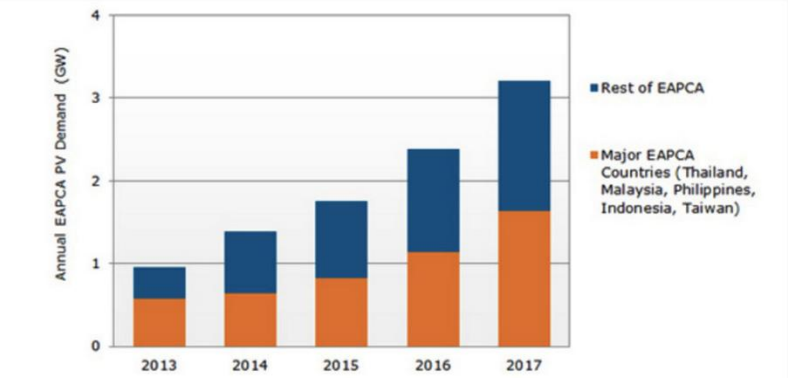
Insolation in India



Jaipur could be viable due to the proximity to Delhi and the high insolation of the region.

Why Thailand?

Asia-Pacific and Central Asian nations will install more than 3,000 megawatts of photovoltaic power by 2017, up from 723 megawatts last year, according to a projection by NPD SolarBuzz, a New York-based market research firm. That's an annual growth rate of 28%, and the region will comprise 5% of global demand in 2017, up from 2% today.



Source: NPD Solarbuzz *Emerging PV Markets: Asia Pacific and Central Asia Report*

Of these countries, Thailand is poised to become the biggest photovoltaic market, according to the report, as it grapples with growing electricity demand and promotes policies to reduce the country's dependence on imported energy. Indonesia plans to install 1,000 megawatts by 2025, though that will still only be 0.3% of the country's energy production. Even impoverished Bangladesh has solar ambitions, with plans to put a million photovoltaic systems in villages not connected to the national power grid by 2016.

Why not Japan?

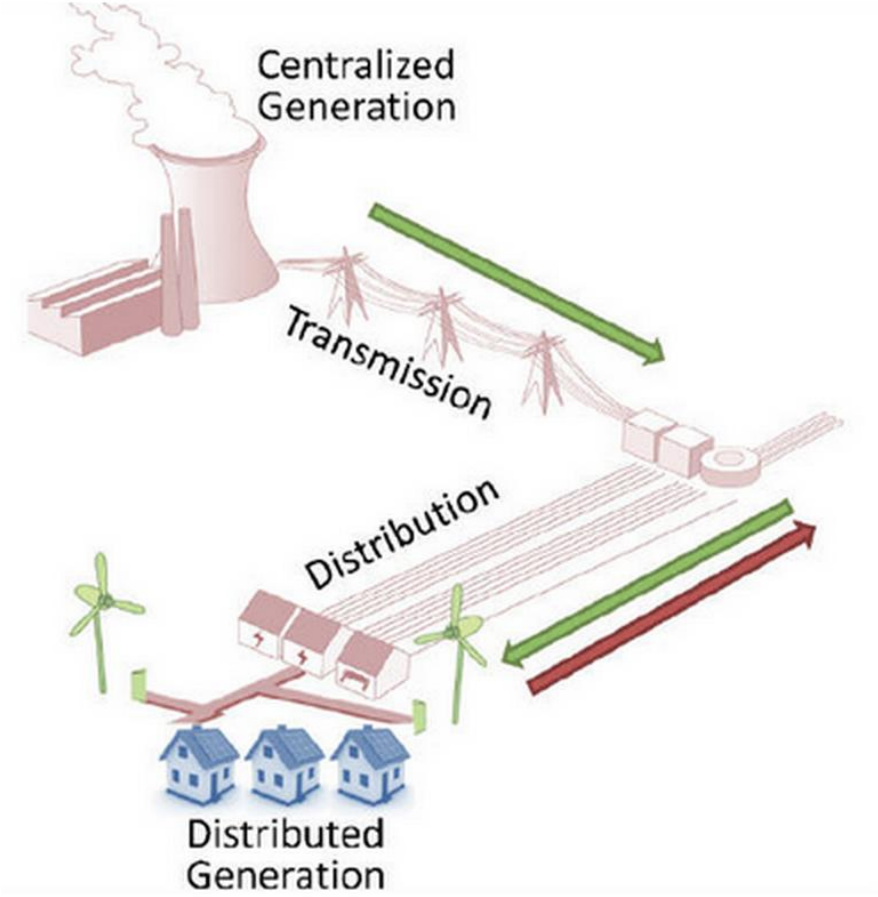
Solar: Japan METI announced cut to solar feed-in tariff rate

Sentiment Indicator : neutral

Posted by Mahesh Sanganeria on Thursday, March 19 2015, 10:27 AM ET

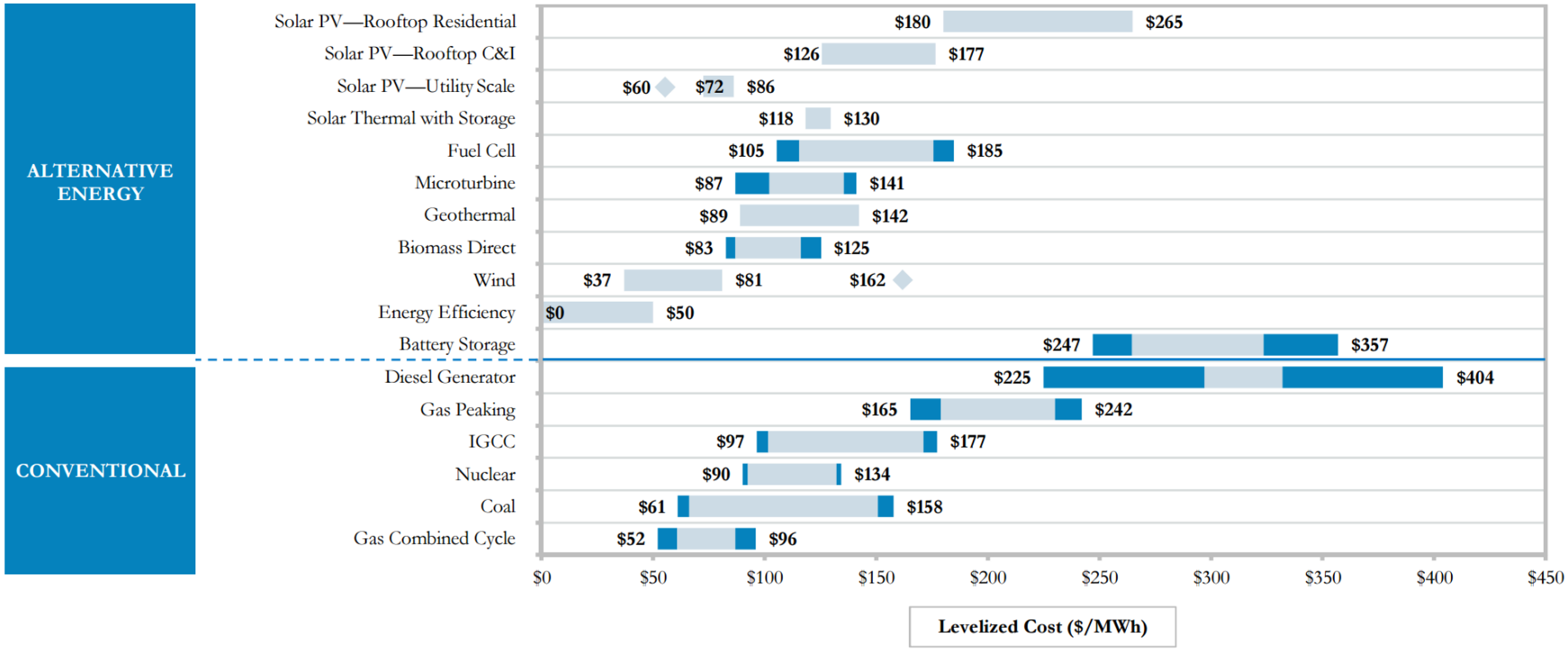
Overnight, Japan Ministry of Economy, Trade and Industry announced a cut to solar feed-in tariff rate. FiT rate for non-residential solar projects (projects larger than 10kw) will first be reduced to JPY29/kwh from current JPY 32/kwh level from April 1 to June 30. Starting July 1, the rate will be further cut to JPY 27/kwh. The length of the FiT payment remains at 20 years. For residential projects (projects smaller than 10kw), the FiT rate will decrease from current JPY 37/kwh to JPY33/kwh starting April 1 and will be effective for 10 years. In areas served by Hokkaido, Tohoku, Hokuriku, Chugoku, Shikoku, Kyushu and Okinawa, residential projects will enjoy a slightly higher FiT rate of JPY 35/kwh if the projects are required to install output control equipment due to curtailment. The Japanese announcement can be found *here* while the English translation is not yet available on METI website.

Centralized vs Distributed



Levelized Cost of Energy Comparison—Sensitivity to Fuel Prices

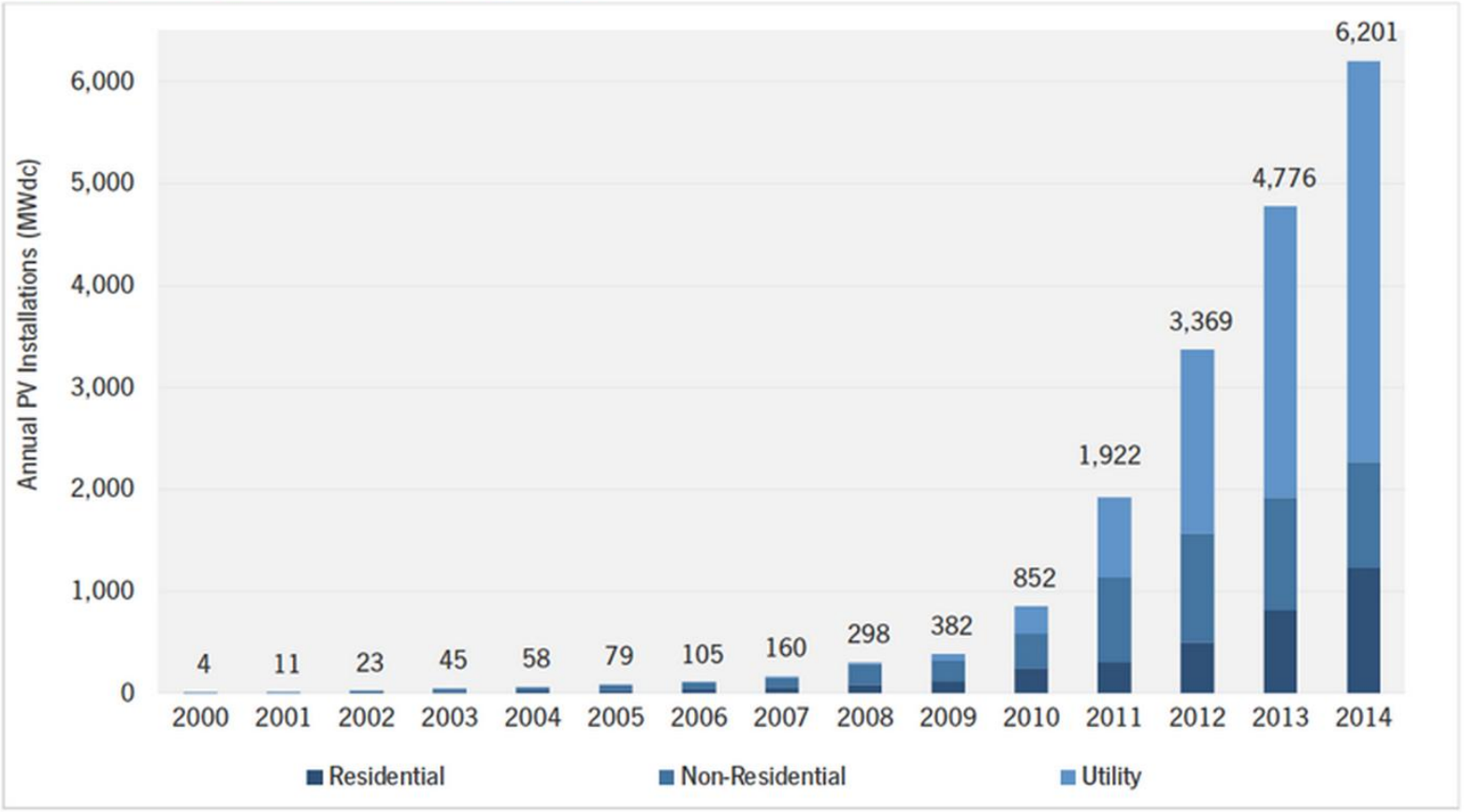
Variations in fuel prices can materially affect the levelized cost of energy for conventional generation technologies, but direct comparisons against "competing" Alternative Energy generation technologies must take into account issues such as dispatch characteristics (e.g., baseload and/or dispatchable intermediate load vs. peaking or intermittent technologies)



US Solar PV Installation

Source: SEIA

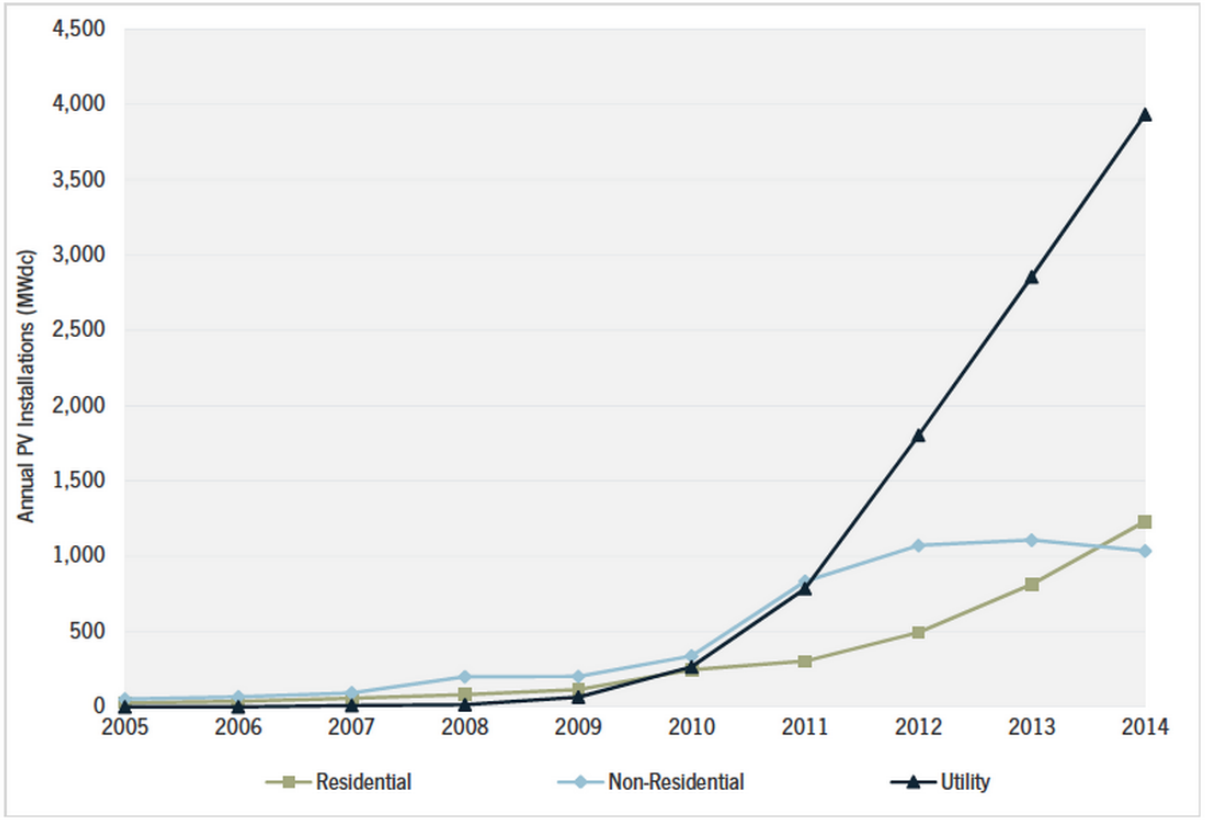
Figure 1.1 Annual U.S. Solar PV Installations, 2000-2014



US PV Installation by Segment

Source: SEIA

Figure 1.3 U.S. PV Installations by Segment, 2005-2014



Comparison of C-Si vs Thin Film

PROS of C-Si

High efficiency rate of 12%-24%
High stability
Ease of fabrication/manufacturing
Very reliable
High resistance to heat
Lower installation (BOS) costs
Silicon is more environmentally friendly

CONS of C-Si

Rigid and fragile
Most expensive solar cells in terms of upfront cost

PROS of Thin Film

Less expensive
Flexible and easier to handle
Less susceptible to damage

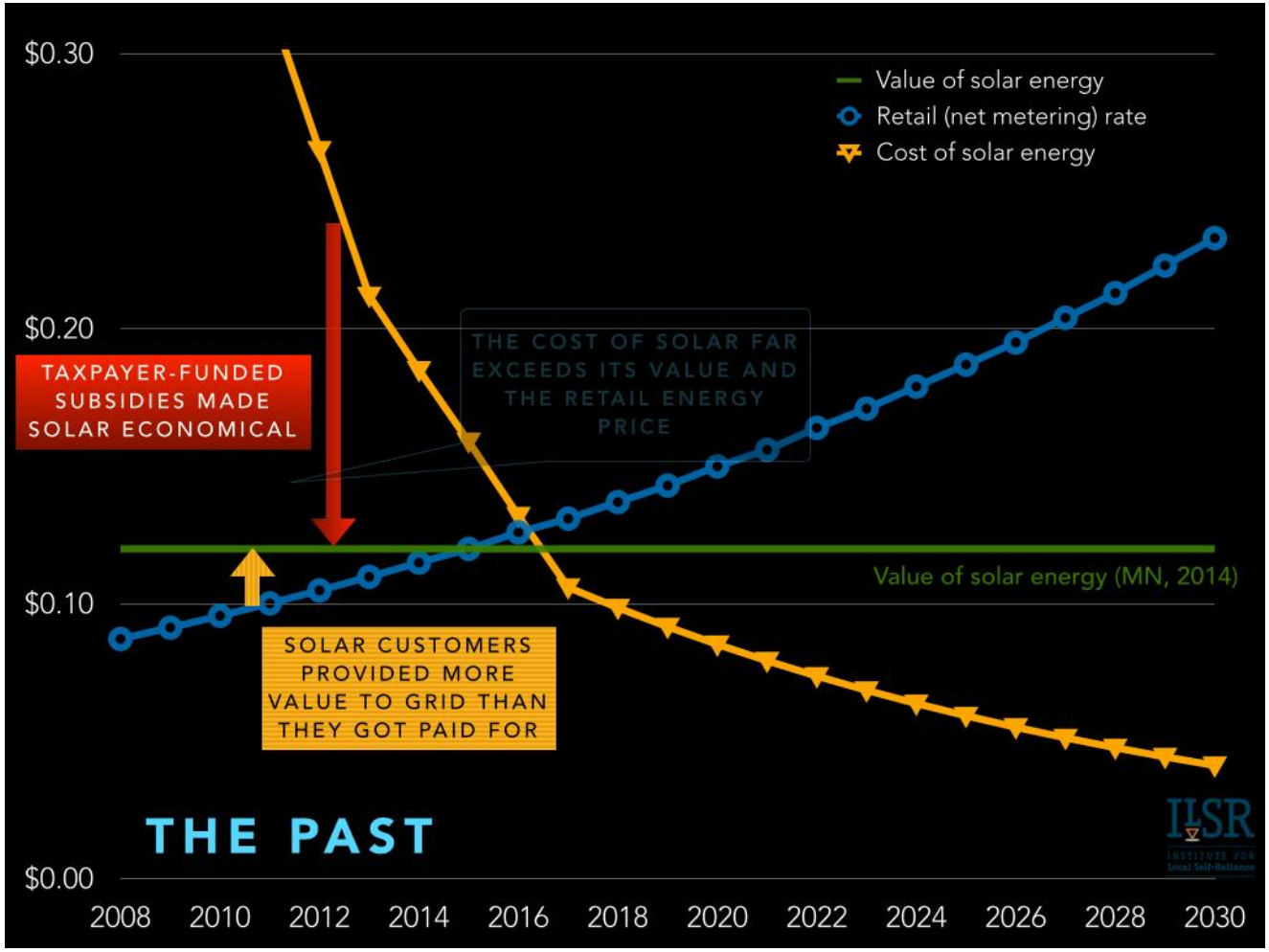
CONS of C-Si

Lower efficiency, which can offset price advantages
Require additional installation costs & expertise

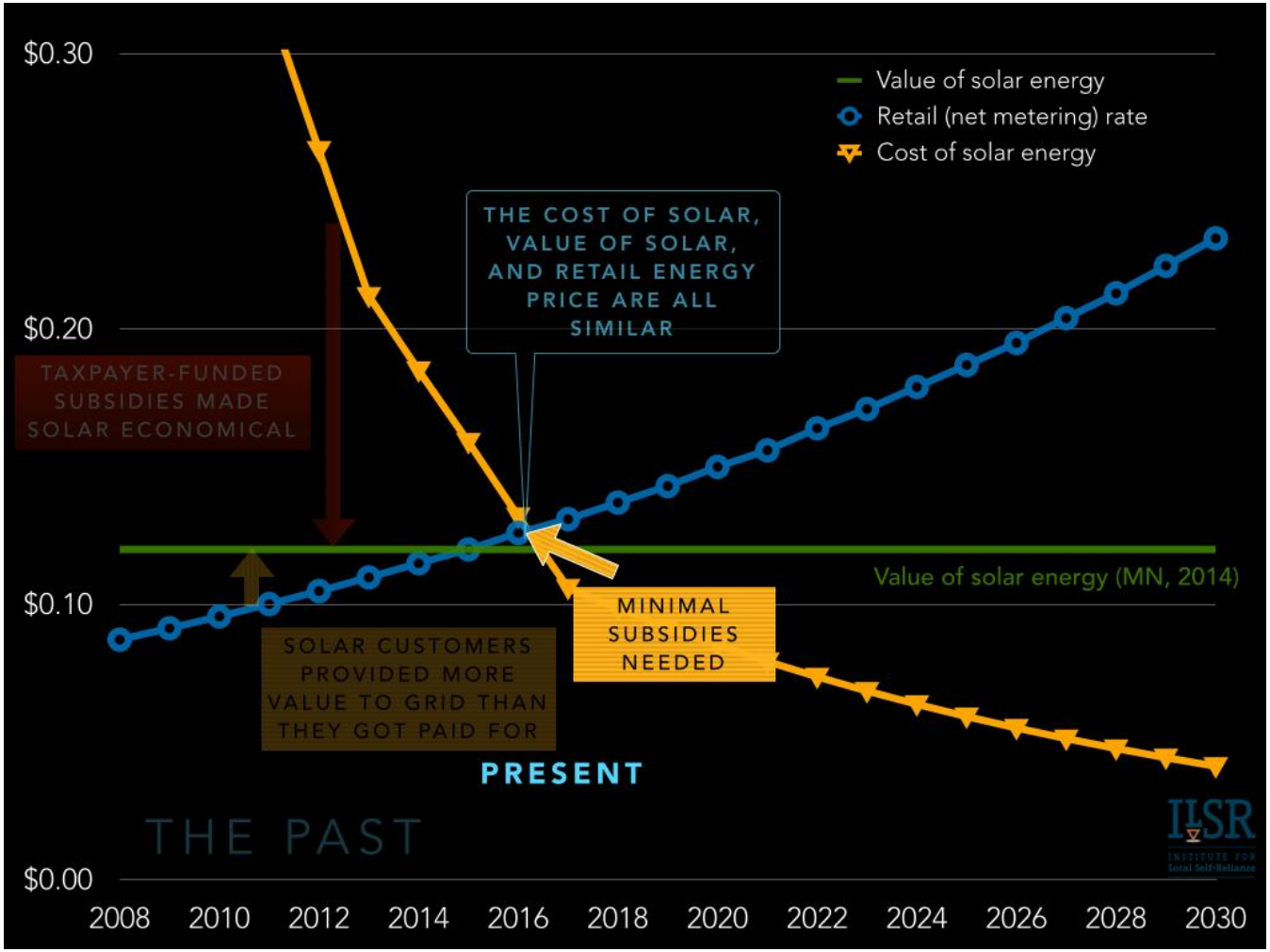
Source: http://electronicdesign.com/power-sources/what-s-difference-between-thin-film-and-crystalline-silicon-solar-panels

Viability of C-Si vs CdTe

No Need for Subsidies



No Need for Subsidies



The Impact of Scale

"As of 2011, manufacturers in China accounted for 63 percent of all solar-panel production worldwide. But a detailed analysis of all costs associated with PV production shows that the main contributors to that country's **lower PV prices are economies of scale and well-developed supply chains** *— not cheap labor."*

Source: MIT

Chinese market poses strong competitive barriers

The 10 Largest Solar "Module" Manufacturers - 2013

Rank	Company	Technology	MW-dc
1	Yingli Green, China	c-Si	3,300
2	Trina Solar, China	c-Si	2,600
3	Canadian Solar, China	c-Si	1,894
4	Sharp Solar, Japan	c-Si, Thin Film Si	1,865
5	Jinko Solar, China	c-Si	1,800
6	ReneSola, China	c-Si	1,750
7	First Solar, USA	CdTe	1,600
8	Hanwha Solar, China	a-Si	1,300
9	Kyocera, Japan	c-Si	1,200
10	JA Solar, China	c-Si	1,200
c-Si = Crystalline Silicon, a-Si = Amorphous Silicon, CdTe = Cadmium Telluride			

Source: Solarbuzz

Most of the largest solar module manufacturers are in China and could take away from First Solar's cost advantages enjoyed in other markets

Additionally, China wants to restructure subsidies for smaller projects, which would further detract from First Solar's scale advantages.

Source: Bloomberg Business 2014

Unsubsidized markets are in the longer term

Unsubsidized solar market boom is occurring in European countries in household and commercial uses – these are competencies that First Solar must continue to develop in the future – C Si technologies are popular for these uses

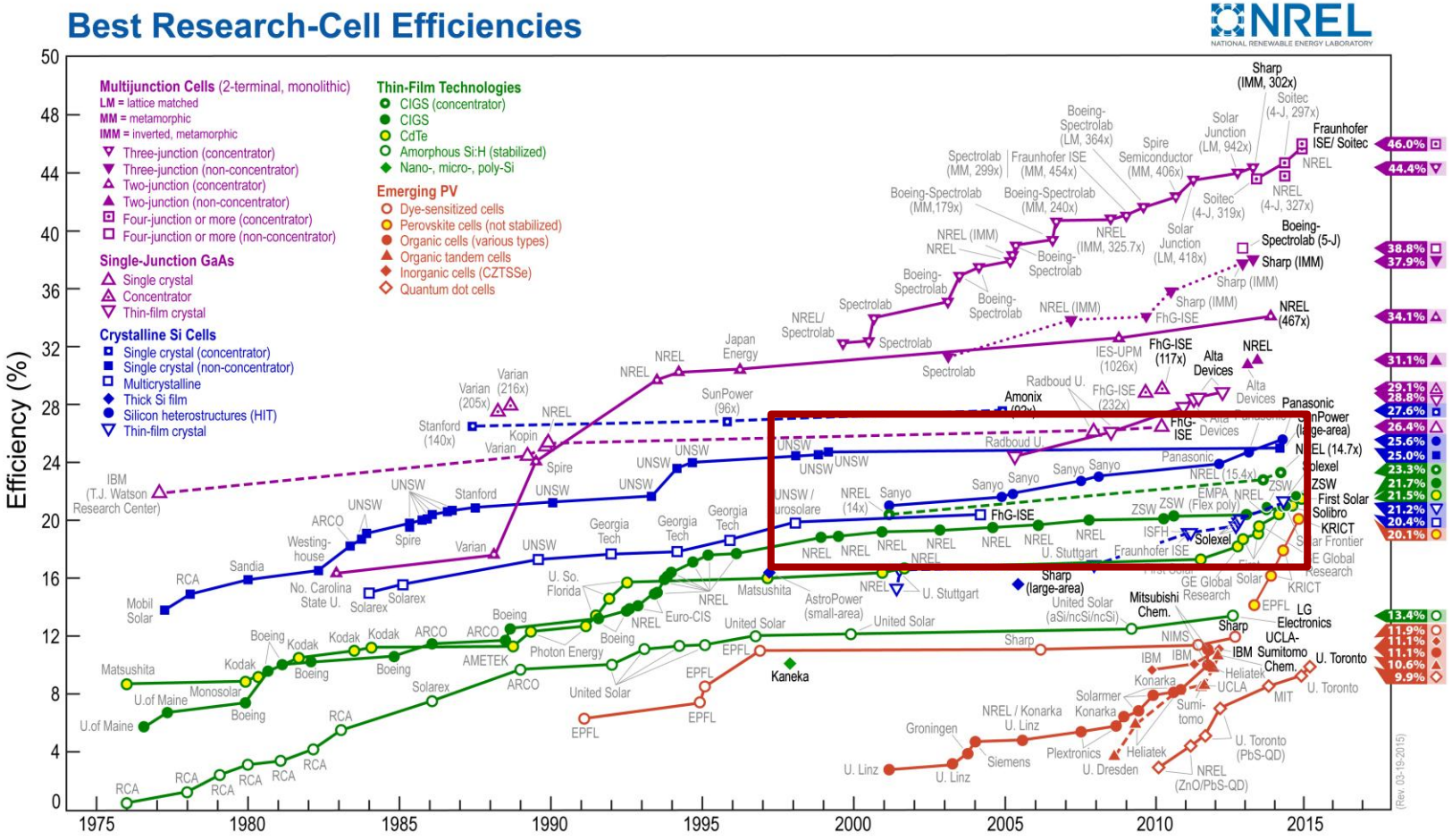
Table 1: Economical solar self-production in % of total demand (2020E)

	Industry	Transport	Households	Commercial	Total
Germany	4%	0%	29%	18%	14%
France	0%	0%	5%	3%	3%
Italy	5%	0%	25%	28%	17%
Spain	5%	0%	21%	26%	18%

Source: UBS estimates

C-Si technology is tapering off, reaching upper bound

C-Si has only a theoretical maximum of 29% and is quickly tapering off in comparison to Cd-Te technology

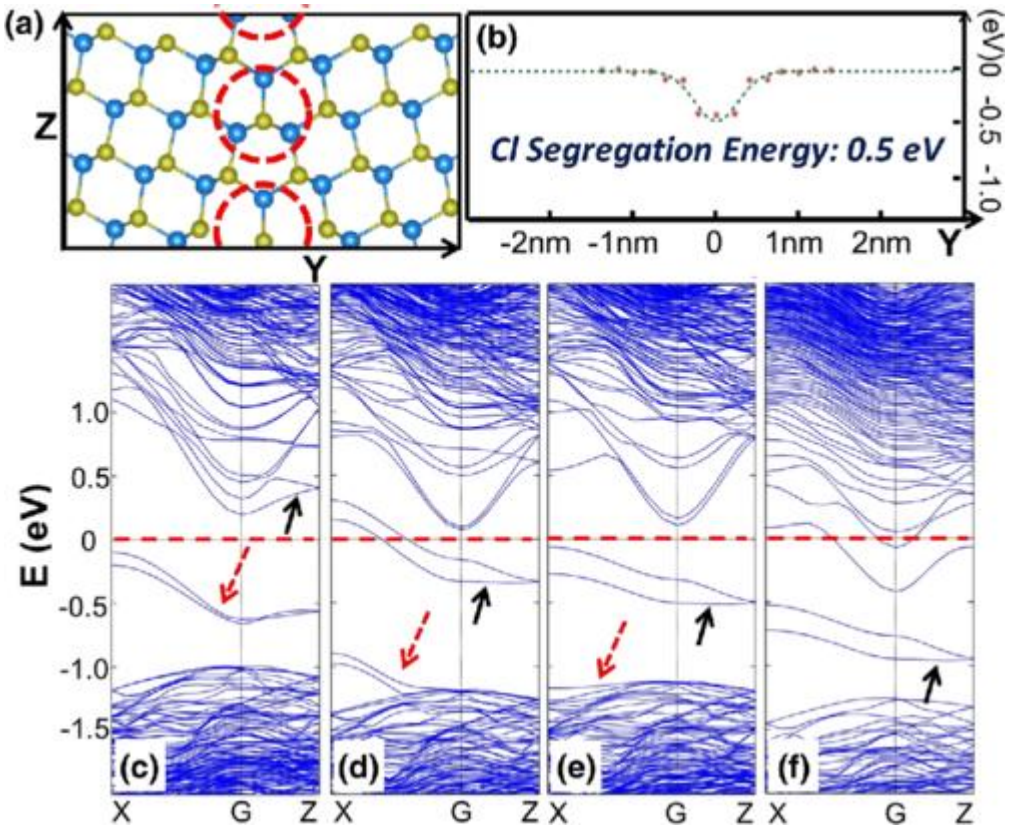


Is it really feasible for further efficiency improvements in CdTe?

"Grain-Boundary-Enhanced Carrier Collection in CdTe Solar Cells"

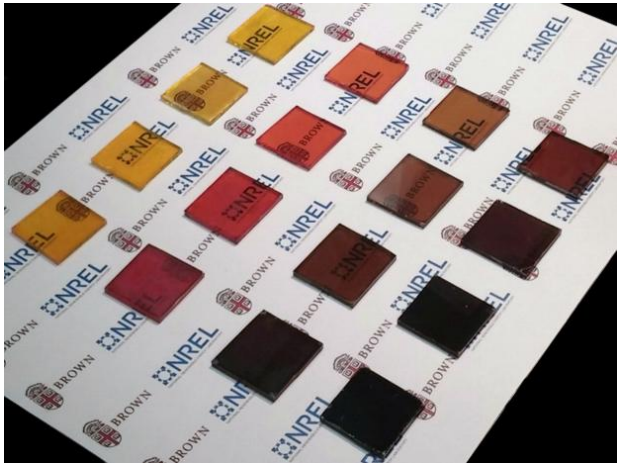
- Team discovered atom-scale grain boundaries (tiny defects)
- Chlorine substituting tellurium atoms in grain boundaries that increase photovoltaic improvements, not worsen

As scientists understand this process, will be able to move even closer to theoretical efficiency (32%)

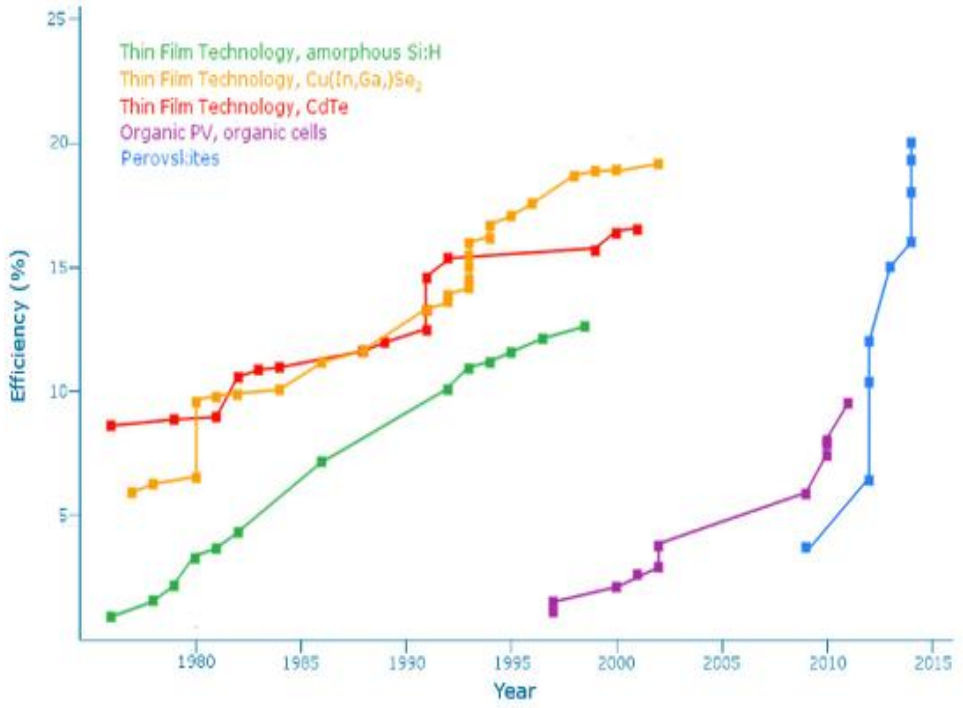


Why Perovskite cells?

"Darling of the photovoltaic world"



- Can be stuck on windows and plastered on walls
- Do not need direct sunlight
- Efficiencies soared from 4% to 20% within 5 years
- Cheaper to make than silicon wafers



Source: IEEE

What other 3rd generation cell technologies were considered?

1 Quantum Dot Solar Cells

ADVANTAGES

- Theoretical efficiency: 45%
- Inexpensive production
- Processing technique more stable

DISADVANTAGES

- Currently not viable commercially
- Only 9% efficiency

2 Carbon Nanotube Solar Cells

ADVANTAGES

- Lighter
- Flexible
- Cheaper

DISADVANTAGES

- Still a long pipeline
- Only 4% efficiency
- Only recently had a breakthrough

Source: MIT

Transportation Advantages in Vertical Integration

"International transport costs for finished modules are in the range of 1-3% of total value." This is extremely important in a highly price competitive industry

Source: *Congressional Research Service – US Solar Manufacturing*