

**Solar Power**

*PRELIMINARY*

# **New England in the global PV market context**

*September 2011*

PHOTON Consulting, LLC

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# Redacted version (Disclaimer)

*PRELIMINARY*

This file contains a redacted version of a presentation delivered to the New England Electricity Restructuring Roundtable on September 16<sup>th</sup>, 2011.

Please see slide 36 for presenter contact details if you would like more information.

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Redacted version of presentation made to the New England Electricity Restructuring Roundtable on September 16th, 2011**

# Agenda

## (Overview)

*PRELIMINARY*

- Recent history of the PV sector
- What's changing and what does it mean for the sector?
- Implications for New England energy policy

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Three topics for discussion**

# Agenda

## (Overview)

*PRELIMINARY*

- Recent history of the PV sector
- What's changing and what does it mean for the sector?
- Implications for New England energy policy

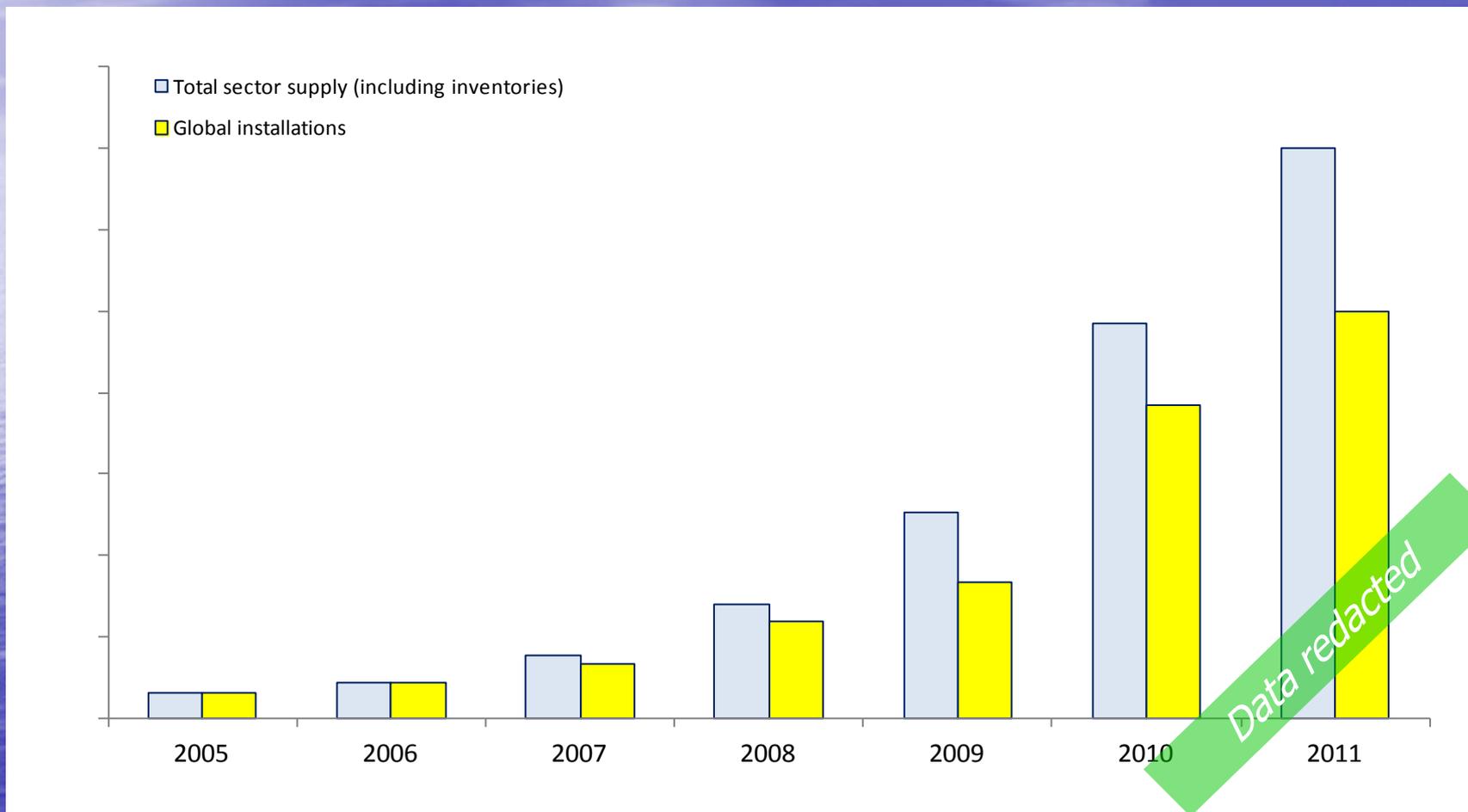
Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Three topics for discussion**

# Recent history of PV sector

(Supply and installations, GW/yr)

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Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

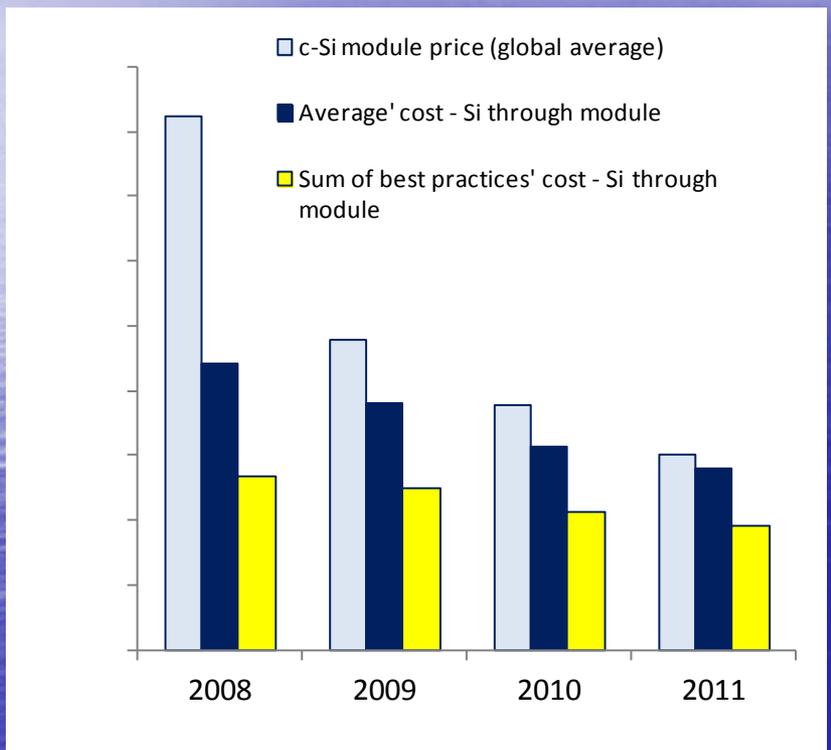
**16x installation volume growth, 2005-2011**  
**Growth constrained by supply-side ability to respond to sector demand**

# Price vs. cost

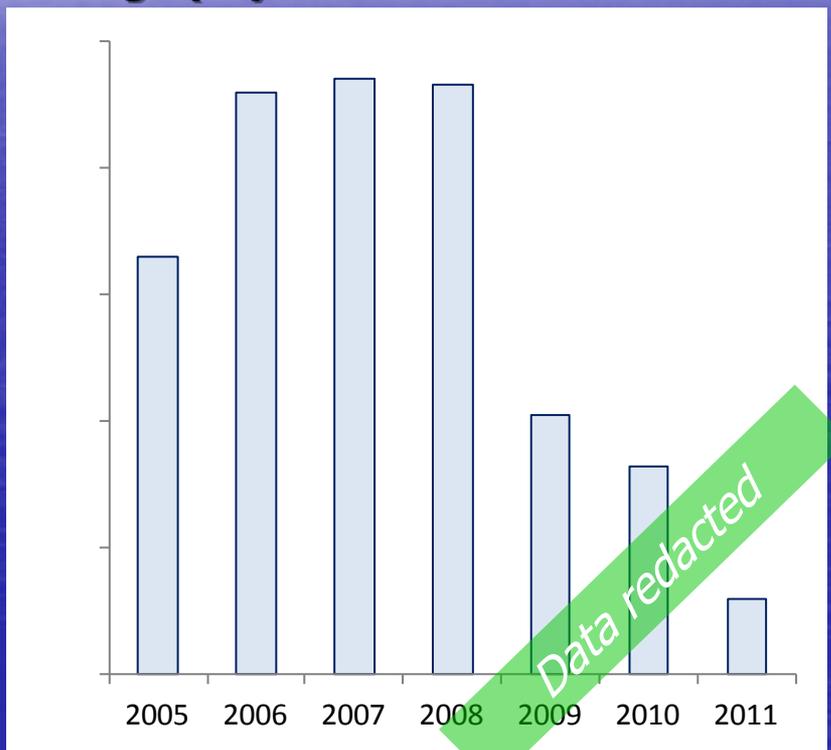
## (Overview)

PRELIMINARY

**\$/W**



**OPM, PV c-Si manufacturing sector average (%)**



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

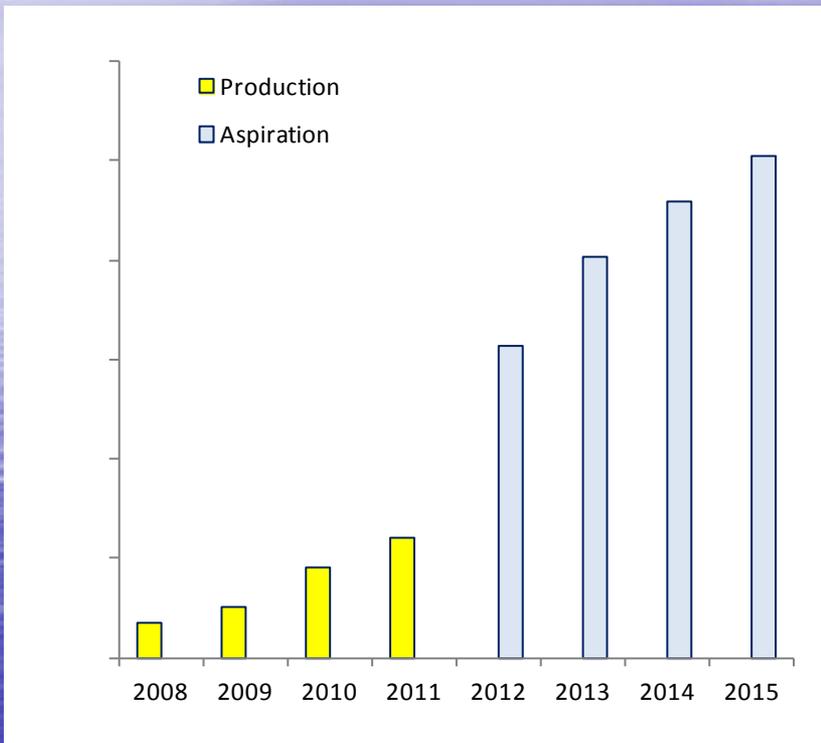
**Prices have been set by global market forces, until recently disconnected from cost  
Costs have declined, even when prices have hidden this from end-customers**

# Manufacturing margin --> supply growth

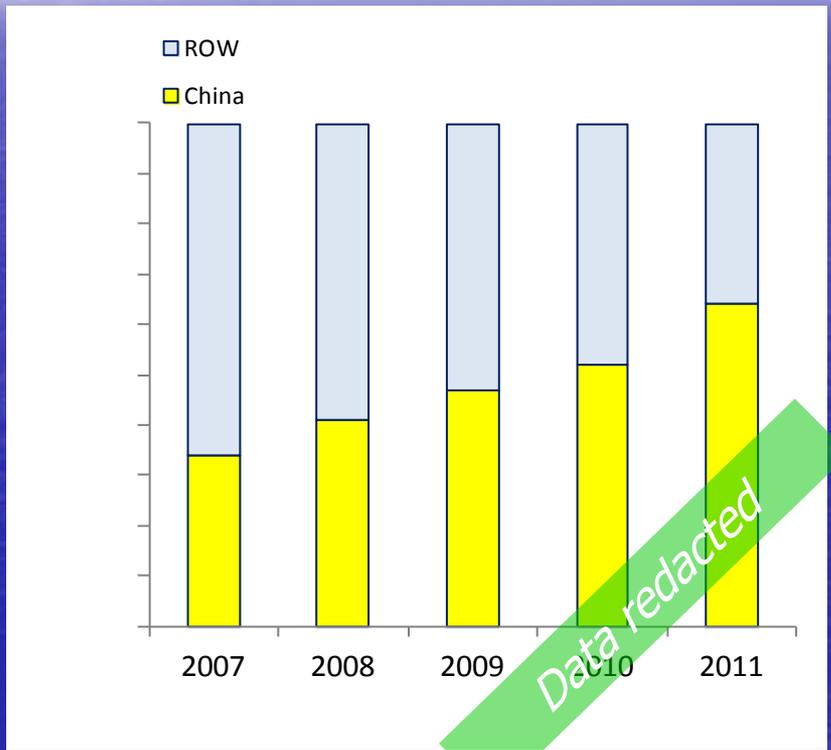
(Overview)

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### Si production and "aspiration" ('000 tons/yr)



### Share of global module production (% by year)



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

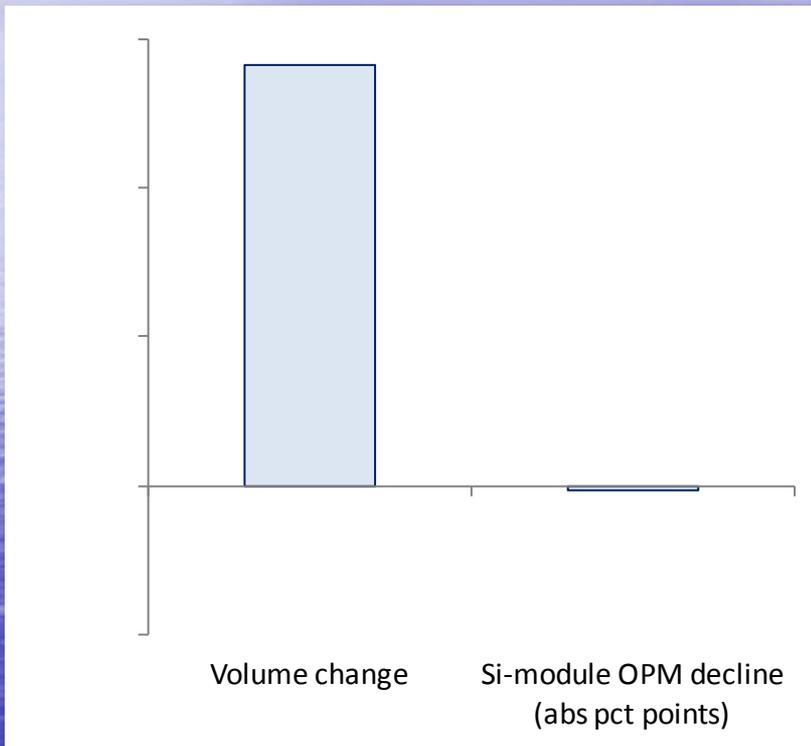
**Policy-driven manufacturing profits have been reinvested in capacity growth, particularly in polysilicon, in midstream in low-cost manufacturing centers**

# Sustainable 15x supply growth?

(Overview)

PRELIMINARY

## Volume vs. mfg margin, 2005 vs. 2010



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

## Drivers

- Strong price elasticity of demand in many markets
- Local market cycles mitigated by global portfolios
- The German backstop

Data redacted

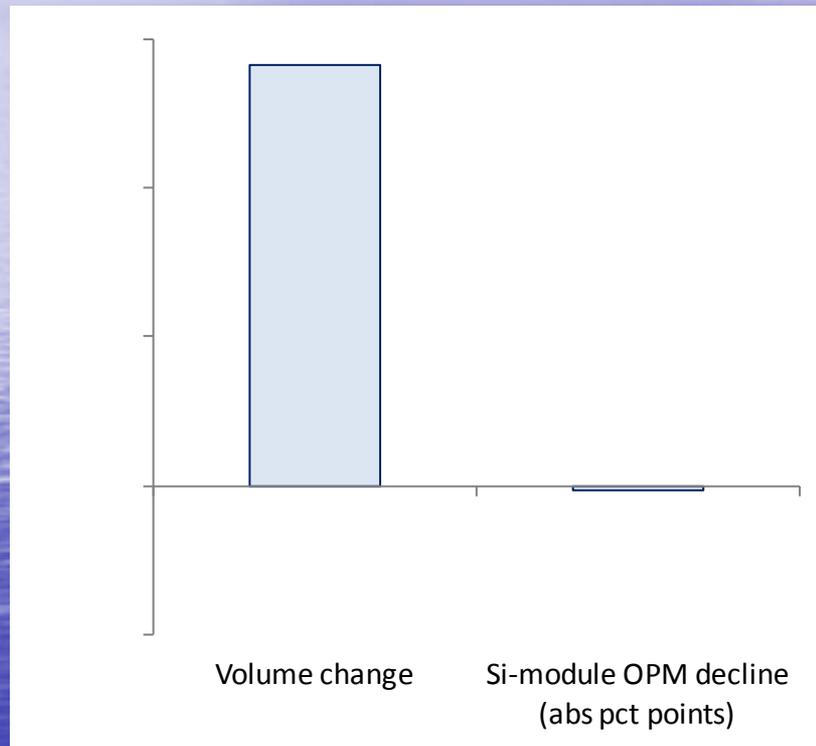
**3 core drivers behind sector profitability despite 15x supply growth in 5 years**

# Sustainable 15x supply growth?

(Overview)

PRELIMINARY

## Volume vs. price, 2005 vs. 2010



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

## Drivers

- Strong price elasticity of demand in many markets
- Local market cycles mitigated by global portfolios
- The German backstop

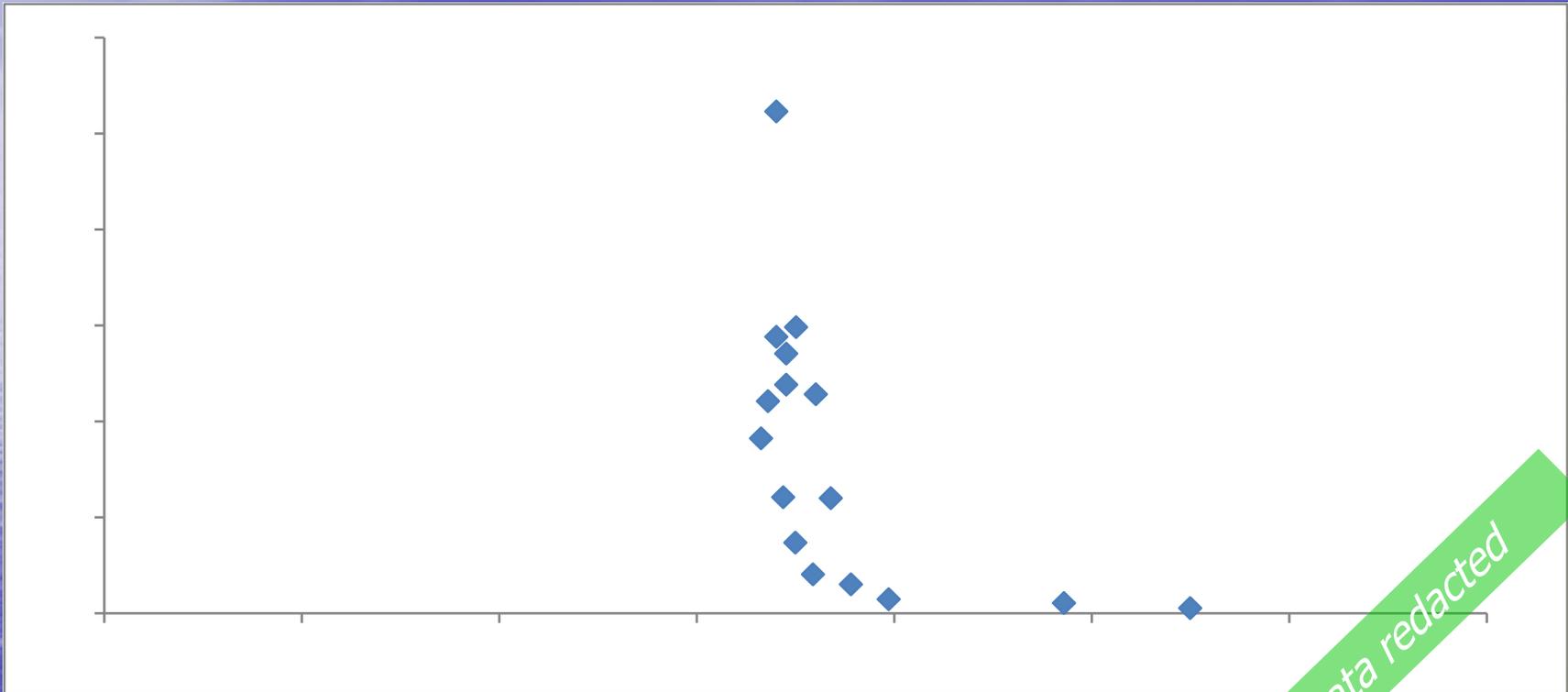
Data redacted

**3 core drivers behind sector profitability despite 15x supply growth in 5 years**

# PV price & demand in Japan

(US cents/kWh and MW/yr installations)

*PRELIMINARY*



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

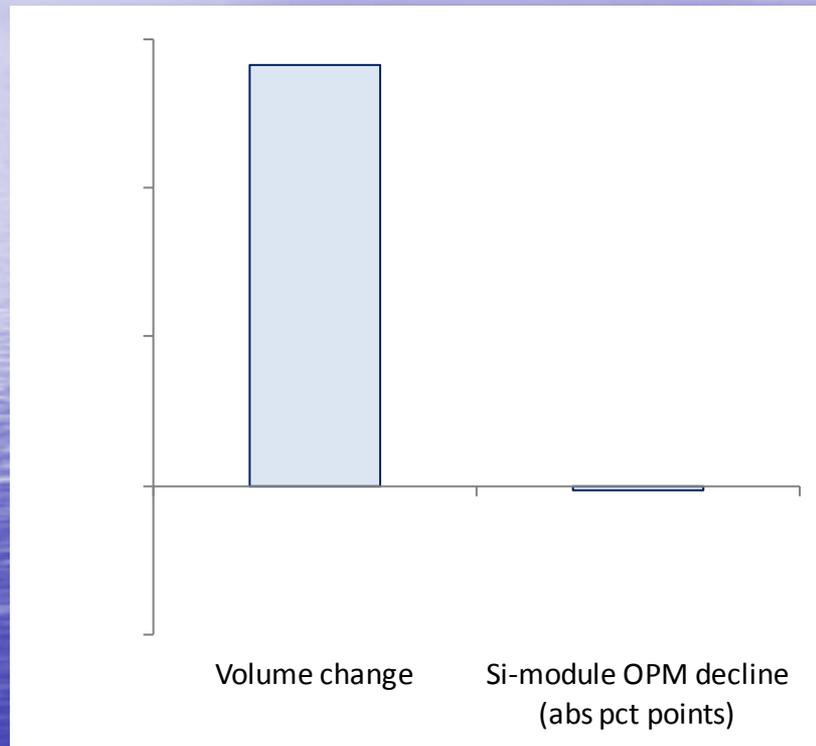
**History: Solar power demand driven by substitution economics  
Right angle in Japan at ~\$0.30/kWh  
Slow 2004-2008 not due to demand in Japan but to Germany & Spain**

# Sustainable 15x supply growth?

(Overview)

PRELIMINARY

## Volume vs. price, 2005 vs. 2010



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

## Drivers

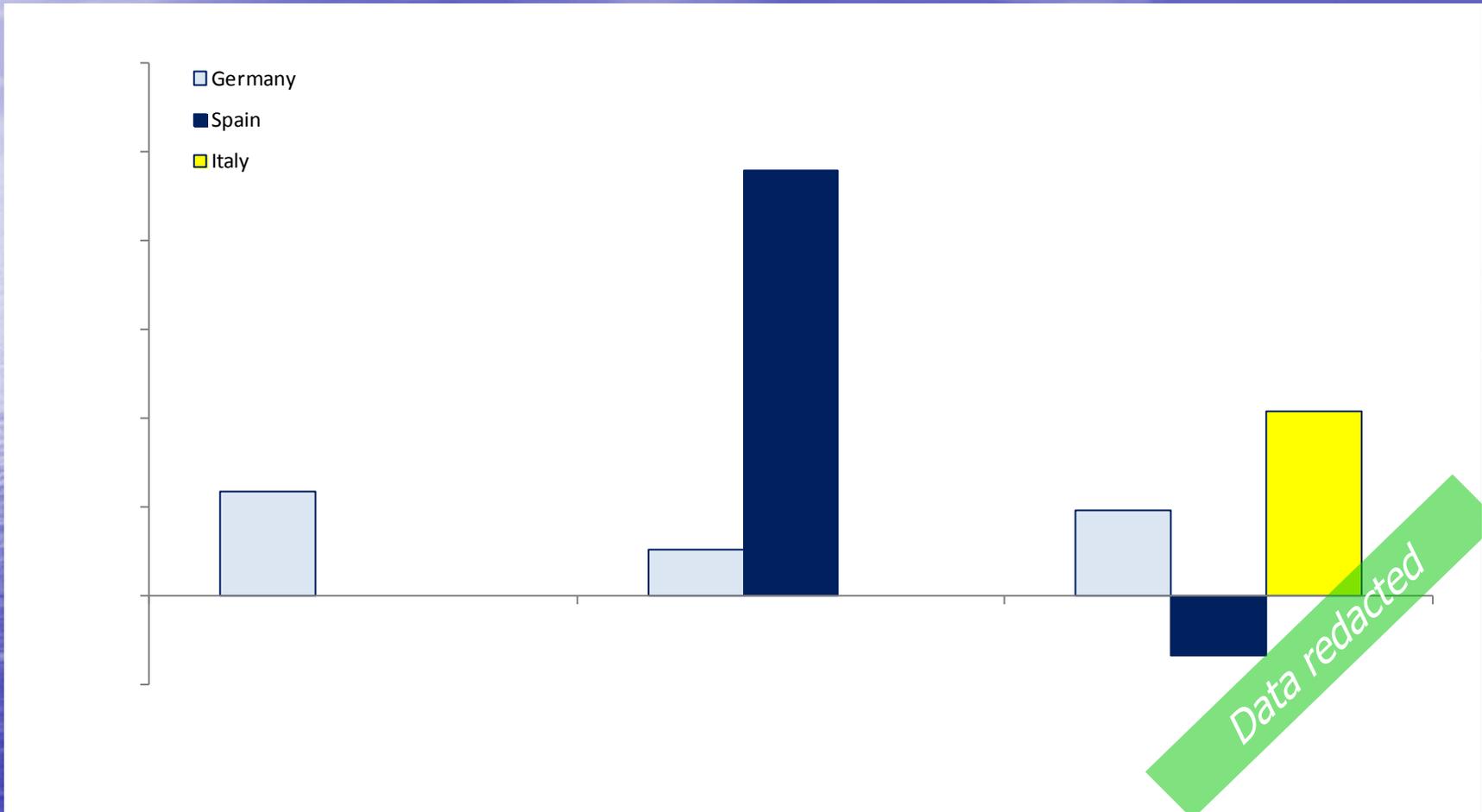
- Strong price elasticity of demand in many markets
- Local market cycles mitigated by global portfolios
- The German backstop

Data redacted

**3 core drivers behind sector profitability despite 15x supply growth in 5 years**

# Annual PV installation growth (% CAGR)

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Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

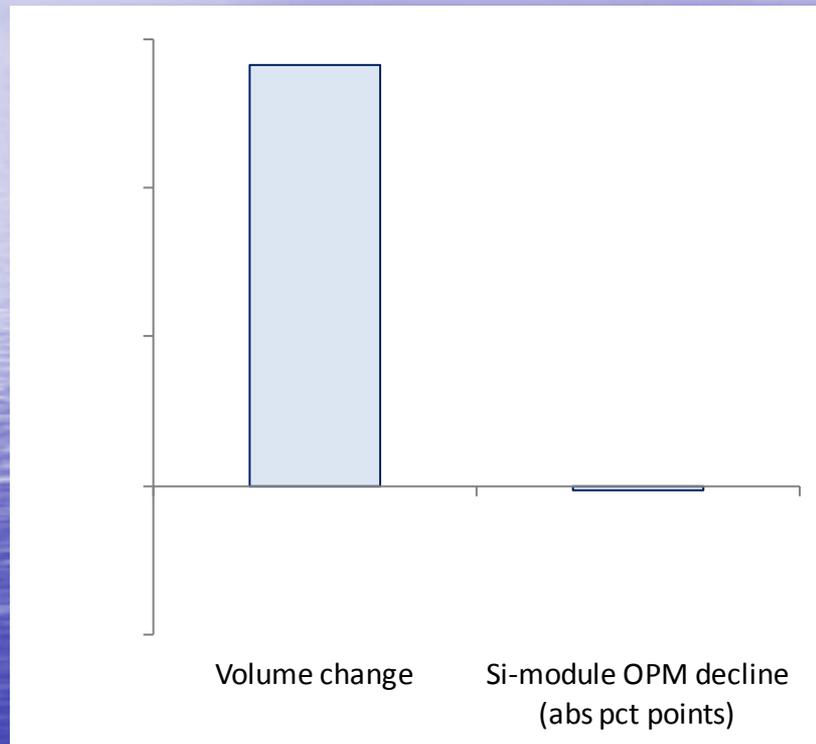
**First the Germans....then the Spaniards....then the Italians**

# Sustainable 15x supply growth?

(Overview)

PRELIMINARY

## Volume vs. price, 2005 vs. 2010



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

## Drivers

- Strong price elasticity of demand in many markets
- Local market cycles mitigated by global portfolios
- The German backstop

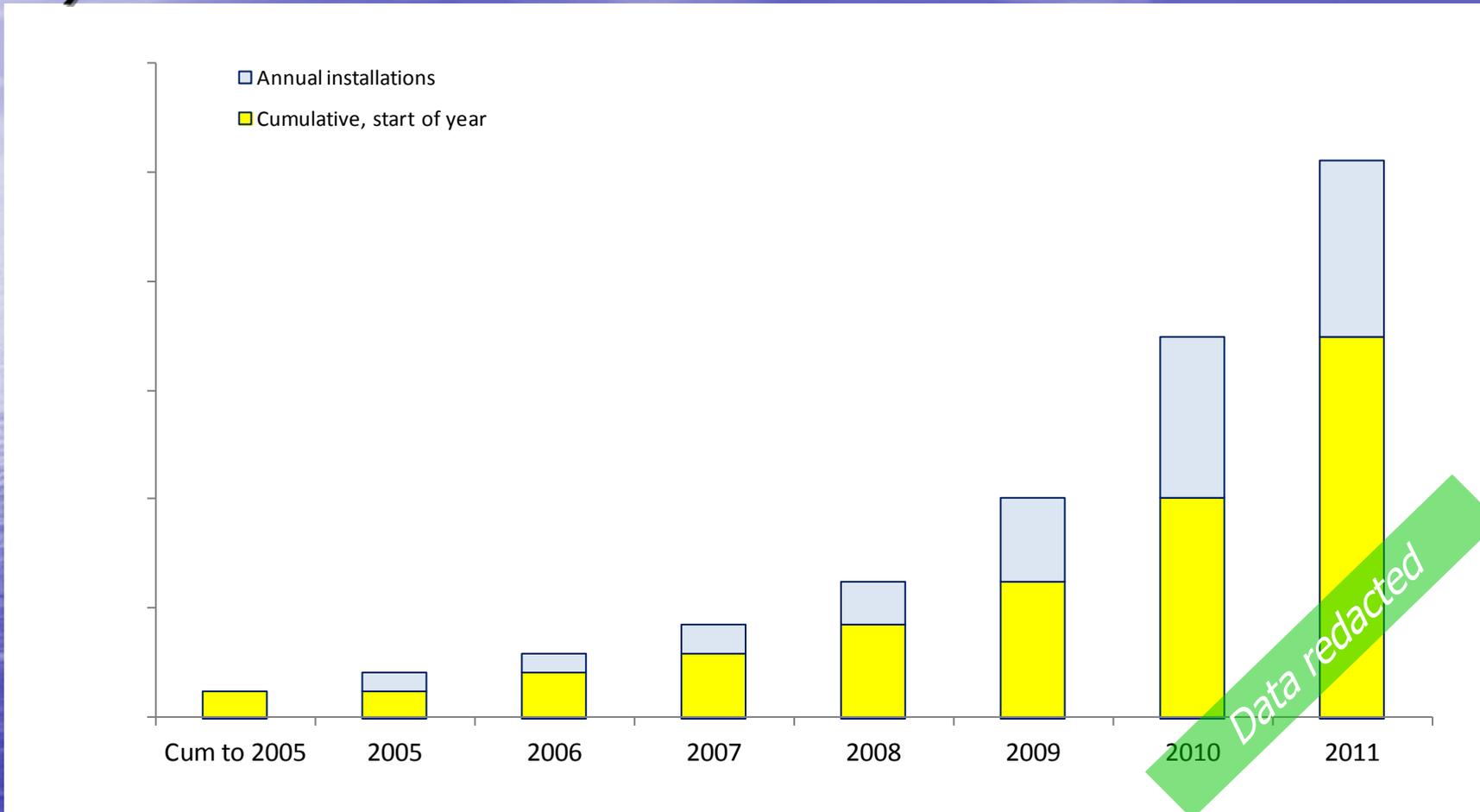
Data redacted

3 core drivers behind ongoing sector profitability despite 15x supply growth in 5 years

# Installed PV capacity in Germany

(MW)

PRELIMINARY



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Steady growth to >25GW of installed PV capacity by year-end 2011**

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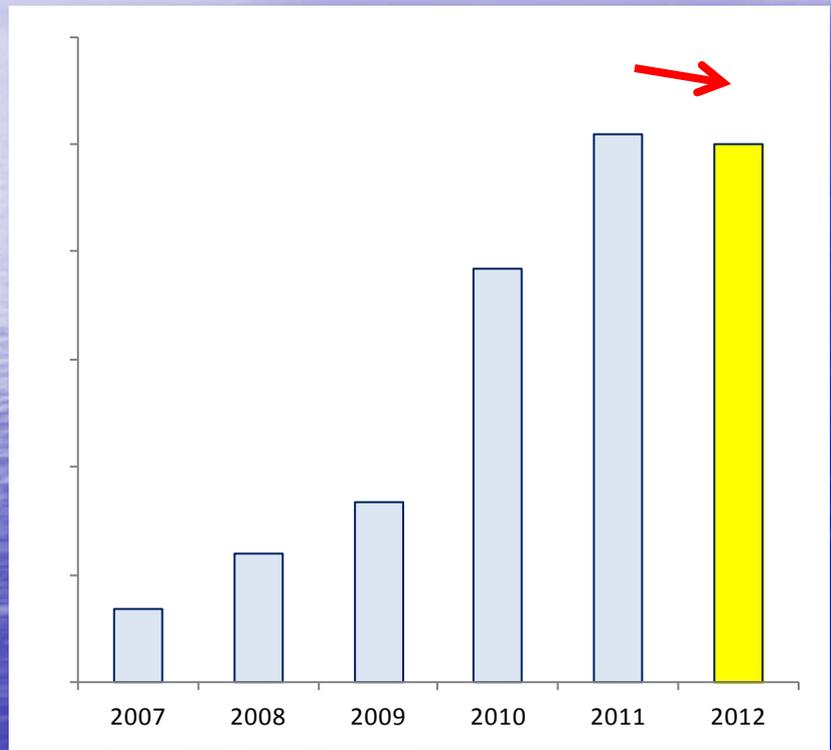
**Three topics for discussion**

# Global installations and module price

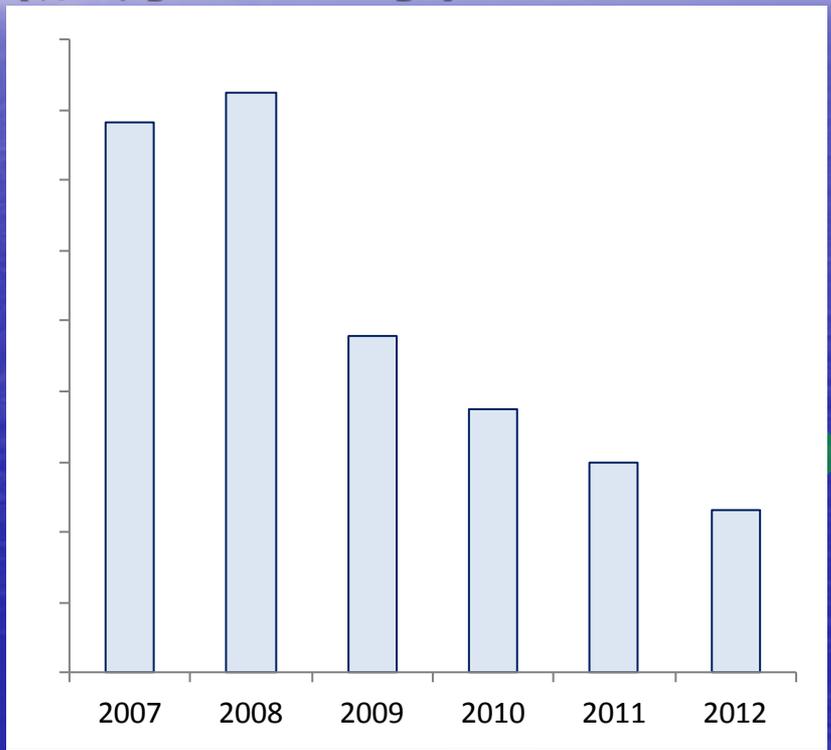
(GW, \$/W)

*PRELIMINARY*

### Annual PV installations (GW)



### c-Si module price, factory-gate (\$/W, global average)



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

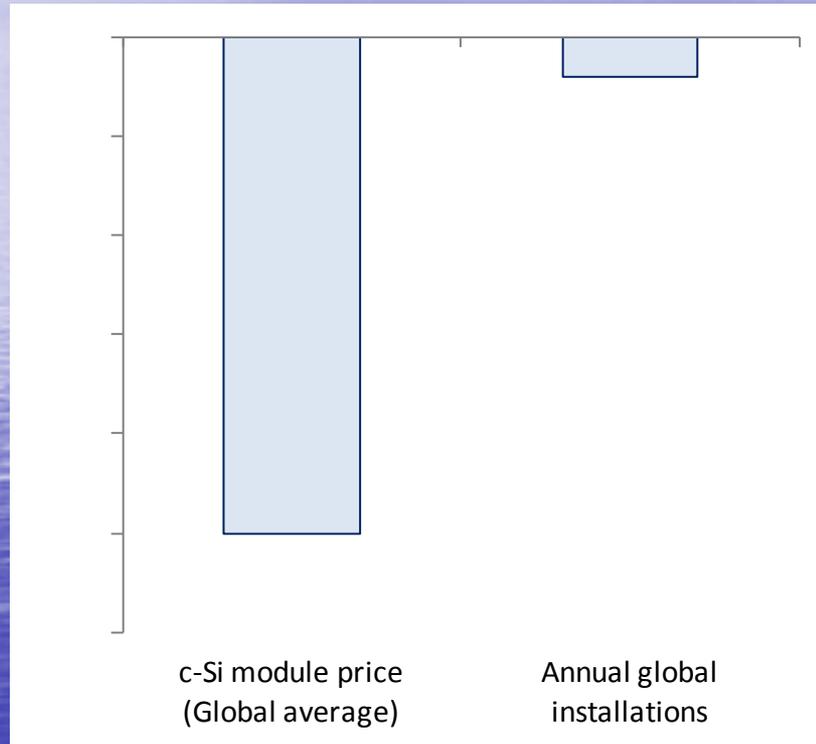
**2012 – German policy changes expected to shift market from 'supply constrained' to 'demand limited' market dynamic**

# 2012 "crash"

## (Overview)

*PRELIMINARY*

Global installations, module price  
(YoY change, 2011-2012)



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

## Drivers

- Enormous pipeline of capacity additions coming on line
- German saturation
- Not enough Europeans left to pick up the tab

Data redacted

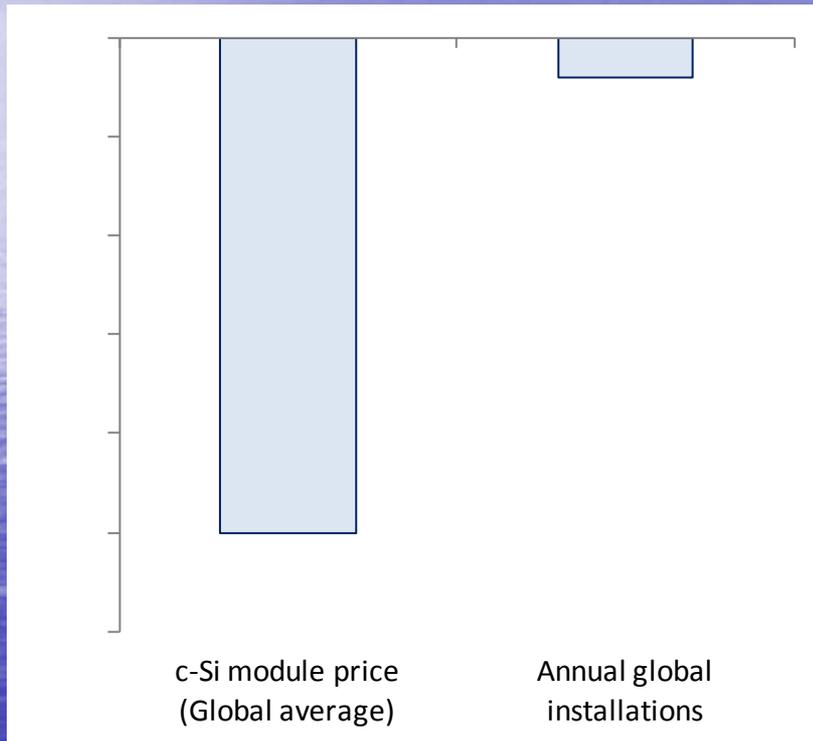
**3 core drivers behind anticipated near-term market global disruptions**

# 2012 "crash"

## (Overview)

*PRELIMINARY*

### Global installations, module price (YoY change, 2011-2012)



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

### Drivers

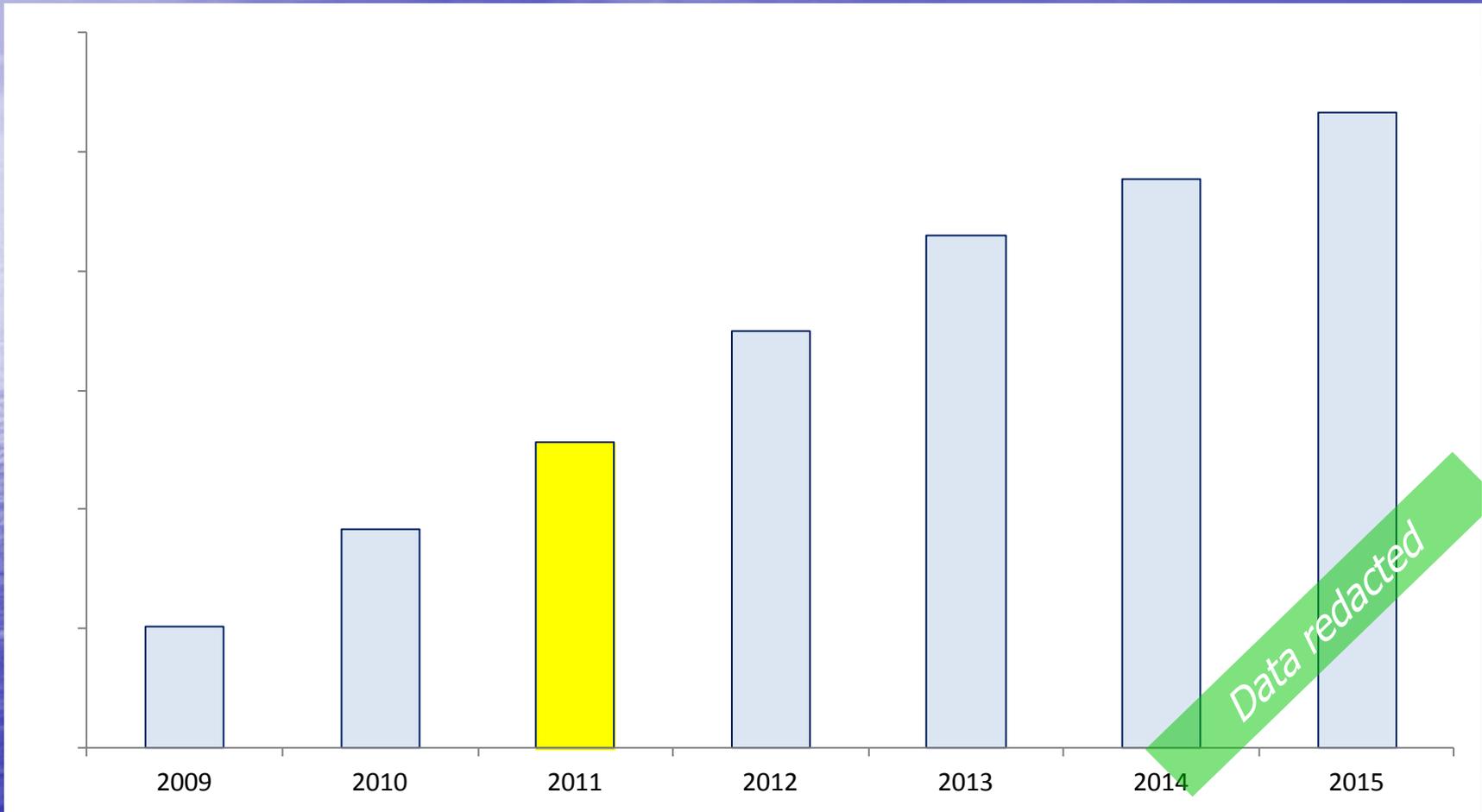
- Enormous pipeline of capacity additions coming on line
- German saturation
- Not enough Europeans left to pick up the tab

Data redacted

**3 core drivers behind anticipated near-term market global disruptions**

# Si production capacity (Thousand tons/yr)

PRELIMINARY



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

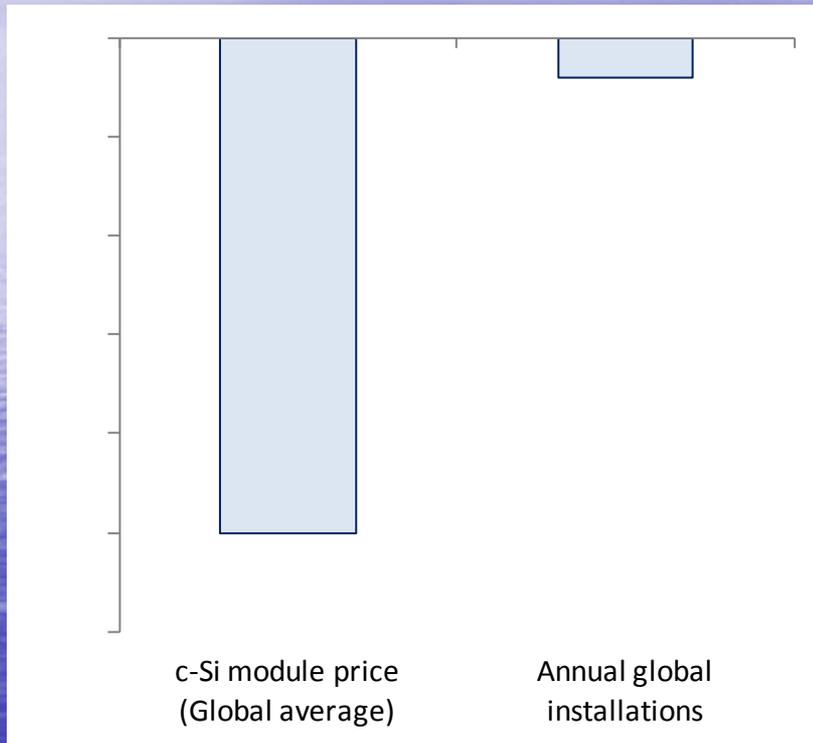
**Si production capacity grows 5.2X 2009-2015**

# 2012 "crash"

## (Overview)

PRELIMINARY

Global installations, module price  
(YoY change, 2011-2012)



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

## Drivers

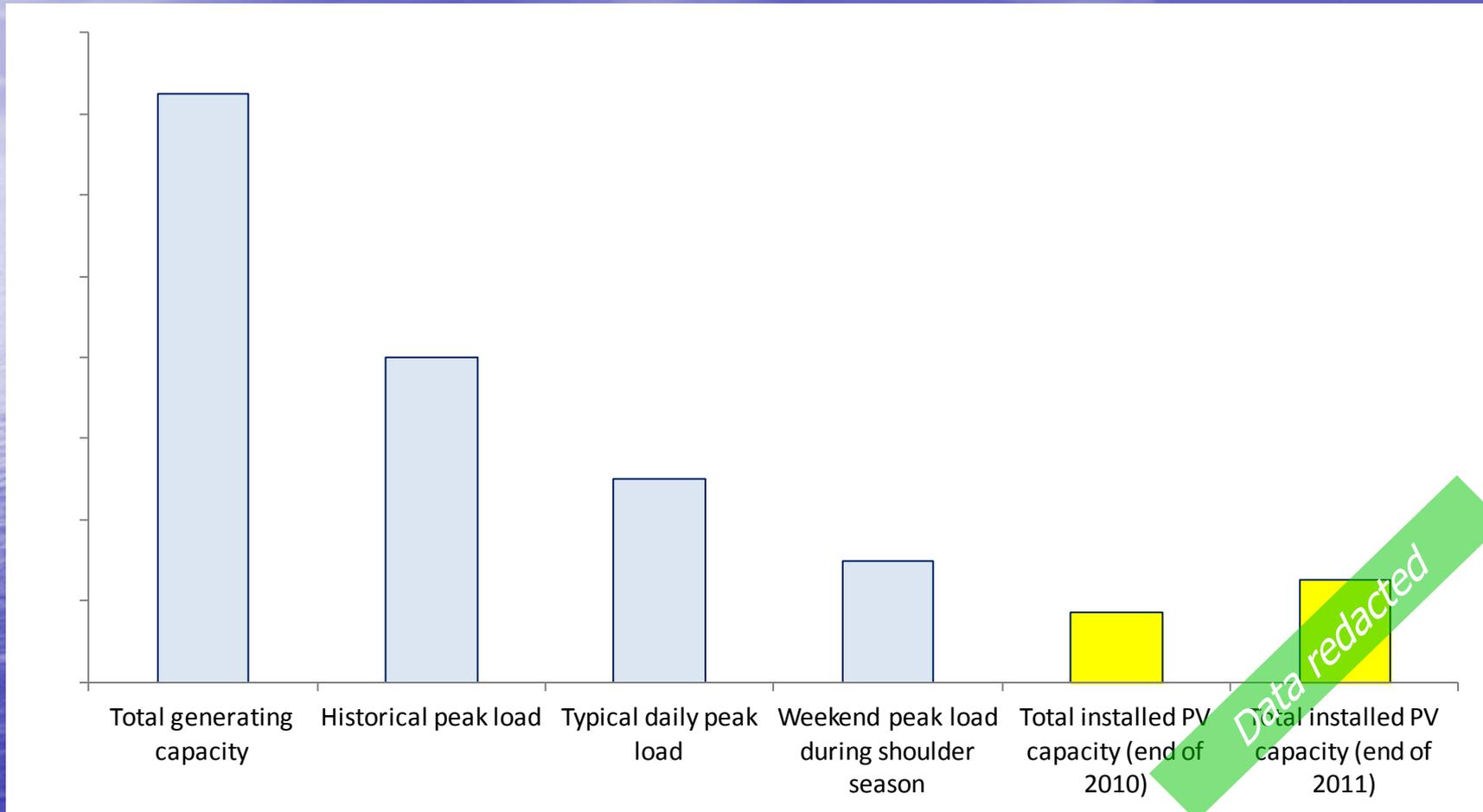
- Enormous pipeline of capacity additions coming on line
- German saturation
- Not enough Europeans left to pick up the tab

Data redacted

**3 core drivers behind anticipated near-term market global disruptions**

# Installed capacity in Germany (GW)

PRELIMINARY

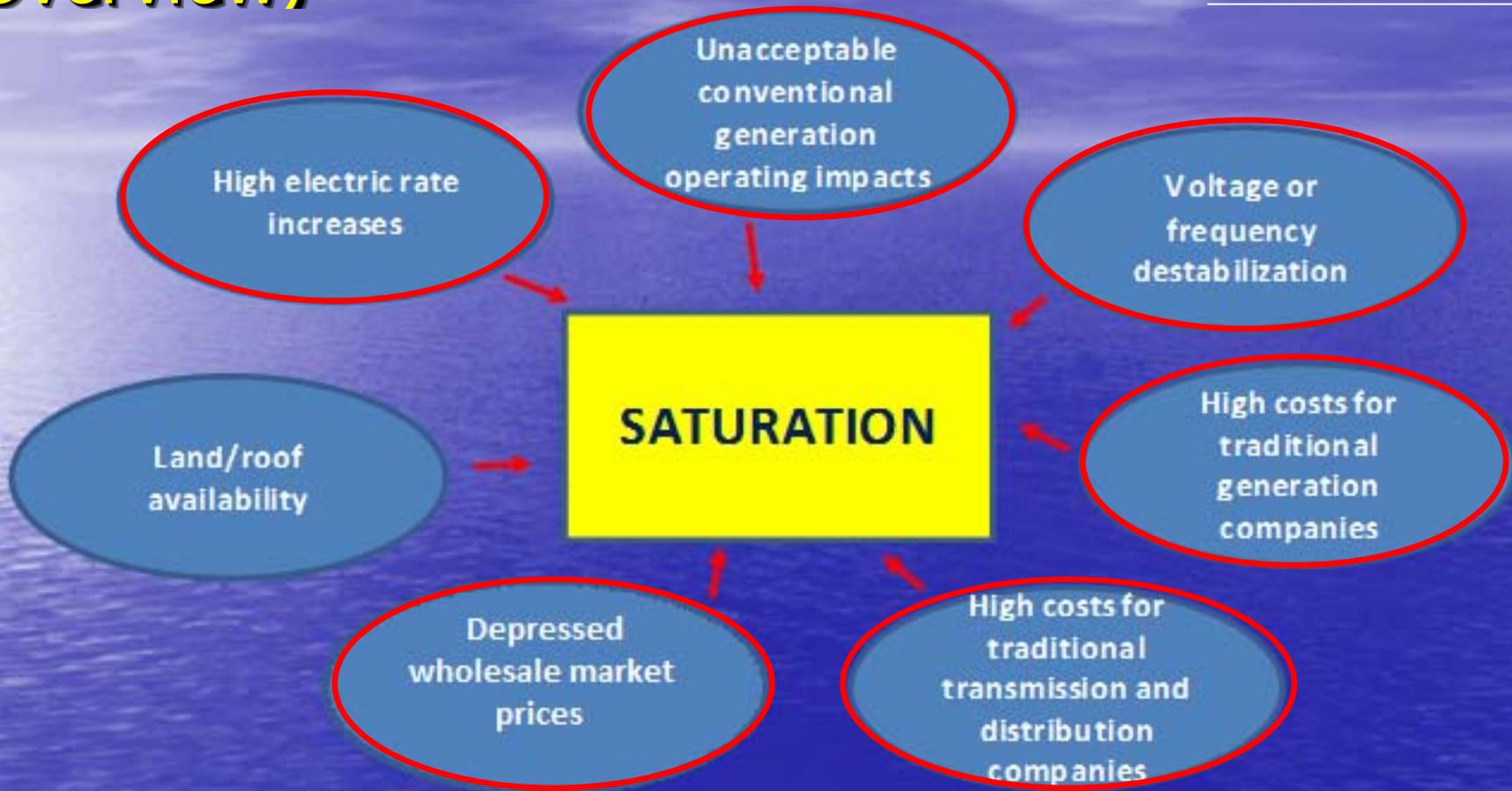


Source: PHOTON Consulting, LLC, DOE, EEX. Note: All data are rough estimates.

**Installed PV capacity by YE2011: 25GW equates to ~15-20% of German generating capacity and ~30% of peak load**

# German saturation (Overview)

*PRELIMINARY*



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

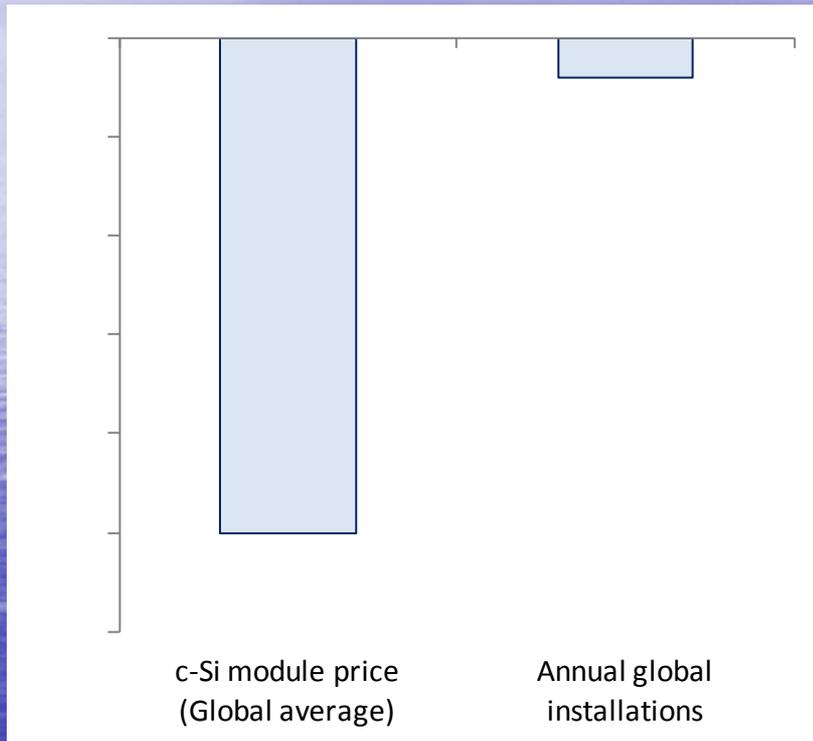
**Nuclear shutdown may delay 2012 firm cap implementation,  
but will not prevent the inevitable**

# 2012 "crash"

## (Overview)

PRELIMINARY

### Global installations, module price (YoY change, 2011-2012)



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

### Drivers

- Enormous pipeline of capacity additions coming on line
- German saturation
- Not enough Europeans left to pick up the tab

Data redacted

**3 core drivers behind anticipated near-term market global disruptions**

# European policy backlash

## (Overview)

*PRELIMINARY*

Market	Original policy expectation	Market reality	Policy reaction
<b>Spain</b>	400MW by 2010 target	3GW installed from 2007-3Q08	Firm cap enacted, incentives slashed by as much as 70%, retroactive changes applied to existing assets – market essentially frozen
<b>Italy</b>	3GW of incremental installs from 2010-2013, 8 GW total through 2020	>4GW of installations in 2010 with significant 'spillover' into early 2011	Firm annual caps for large systems, dramatic staggered reductions in FIT rates from mid-2011
<b>Czech</b>	No formal targets	30x market growth between 2008 and 2010	Elimination of incentives for ground-mount systems, retroactive tax on existing PV assets - market essentially frozen
<b>France</b>	5.4GW by 2020	~750MW of 2010 installations, outstanding application queue of 3.4GW as of year-end 2010	Tariffs slashed by up to 60%, firm annual volume cap of 500MW implemented in 2011
<b>Belgium</b>	No formal targets	550MW of installations from 2008-2010	Elimination of incentive in large-system segment
<b>UK</b>	No formal targets	Program launched in April, 2010, 185MW installed in first 15 months	~70% one-time cut in large system incentives

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Will the last one to leave please turn out the lights?**

# Sector implications for PV in New England

(Overview)

*PRELIMINARY*

- European developers coming West
- New downstream entrants from parallel energy fields
- Northeastern US more attractive than most assume

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Global market dynamics will drive development efforts in New England**

# Head West, young man!

(Specific company examples)

*ILLUSTRATIVE  
NON-EXHAUSTIVE*



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Numerous examples of large developers leveraging capabilities developed in home European markets with US expansion plans**

# Non-PV developers increasingly looking at PV

(Specific company examples)

*ILLUSTRATIVE  
NON-EXHAUSTIVE*



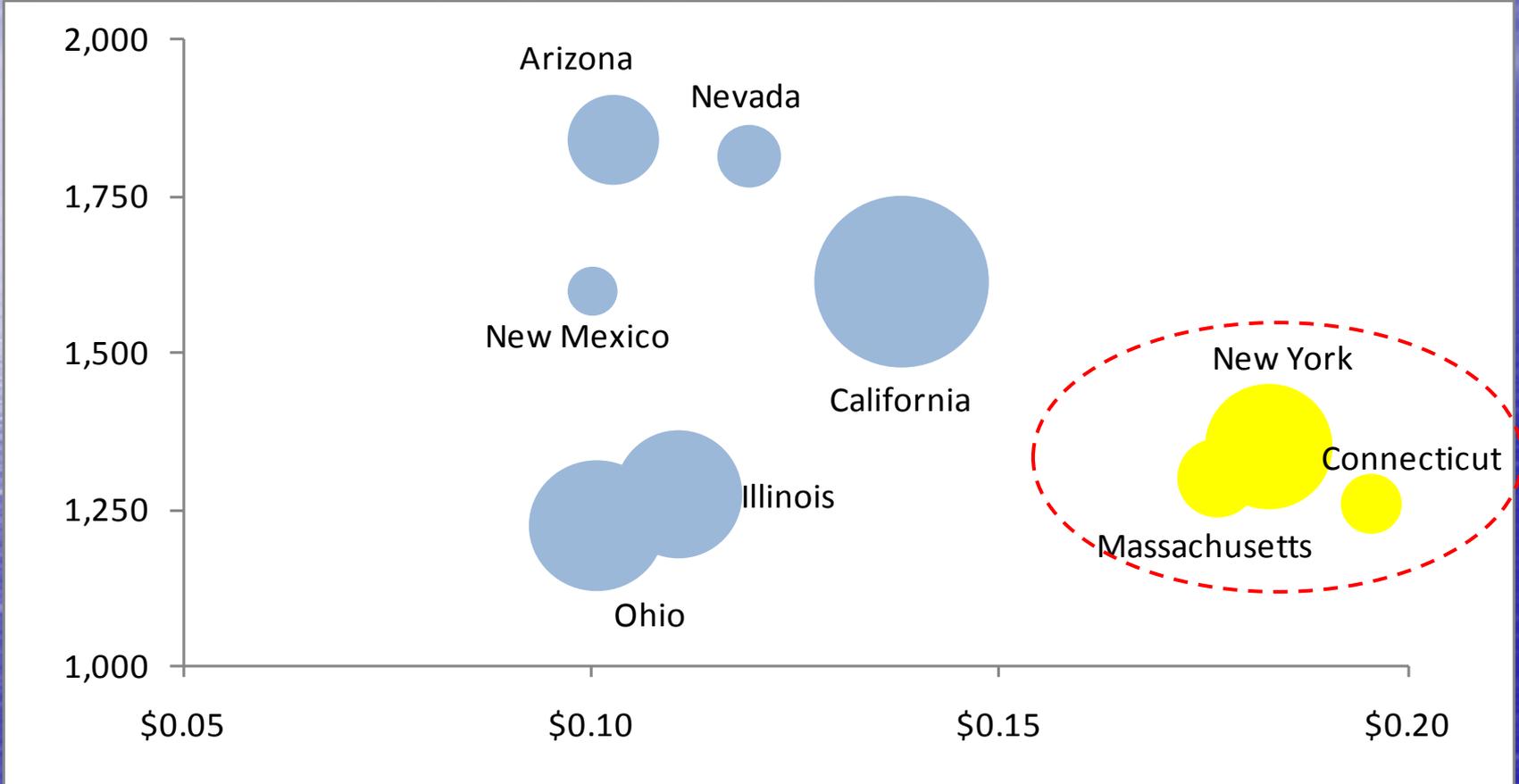
Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Improving relative economics for large-scale PV vs. CSP and wind driving increasing attention from IPPs and developers traditionally focused on other technologies**

# U.S. PV market opportunities

(kWh/kW/yr PV system output, average \$/kWh residential electricity price, annual electricity market size)

*PRELIMINARY*



Source: PHOTON Consulting, LLC an analysis based on EIA, NREL data, prior analysis by McKinsey. based. Note: All data are rough estimates.

**Northeast represents an attractive PV geographic sub-market within the US**

# Agenda

## (Overview)

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- Recent history of the PV sector
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Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Three topics for discussion**

# Implications for New England

(Overview)

*PRELIMINARY*

- Significant potential for faster than you think, cheaper than you think
- Local factors will be an increasingly important driver of cost reductions
- Getting incentive levels right is important....and hard

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**3 implications for New England energy policy**

# Faster than you think...

(Key points)

*PRELIMINARY*

## Why?

- Policy-maker, utility track records in other markets
- Global market dynamics likely to accelerate downstream PV activity in New England

## What to do about it?

- Maintain self-adjusting features in subsidy programs, look for incremental market-driven opportunities
- Plan for faster than anticipated growth
- Push utilities to do same
- Beware of unintended consequences

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Prepare today for potential for accelerated interest in the Northeastern US**

# Cheaper than you think...

(Key points)

*PRELIMINARY*

## Why?

- Historically, strong global demand and pricing environment have masked manufacturing cost reductions
- Increasingly, installed PV cost reduction opportunities will need to be driven by local factors

## What to do about it?

- Local cost reductions in other markets have been 'earned' through the development of long-term, stable market mechanisms
- Encourage knowledge transfer from global downstream cost leaders increasingly looking to the Northeastern US
- Financing costs are important – seek out opportunities for 'free' cost reductions through increased certainty

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Component cost reductions ongoing (and out of your control)  
Focus on increasingly important role of local, market-specific cost drivers**

# The 'Goldilocks' problem (Overview)

*PRELIMINARY*



Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Getting markets “too hot” is just as much  
of a problem as getting them “too cold”**

# The 'Goldilocks' problem

## (Overview)

*PRELIMINARY*

### "Too hot"

- Learn from mistakes in Spain (and Czech and Italy and France and....)
- Inevitable backlash from out-sized returns will ultimately lead to below-optimal levels of market development at above-optimal cost

### "Too cold"

- Emulate best aspects of Germany and California programs:
  - Sufficient returns to drive investment, compete for globally fungible components
  - Long-term market development commitments in order to drive downstream investment
- Mitigate risks of policy uncertainty, 'stop and start' programs through planning for growth
- Where possible, use (or at least monitor) market forces to optimize incentive levels

Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Aim to use market forces to achieve 'just right' incentive levels  
Focus policy efforts on reducing uncertainties, reducing frictions**

# Contact information

## (Contact details)

*PRELIMINARY*

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Lead Downstream Analyst

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Source: PHOTON Consulting, LLC. Note: All data are rough estimates.

**Contact details**

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