How fast can solar energy take over from fossil energy?

Anne Jorun Aas

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”If you can’t dream it,
you can’t do it”

Walt Disney

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Alf Bjørseth – a Norwegian solar dreamer and pioneer

- Established ScanWafer – a precursor to Renewable Energy Corporation (REC) – in 1994 (!)
- REC was the world's first fully integrated solar energy company
- REC went public in 2006, then valued at EUR 7.2 billion

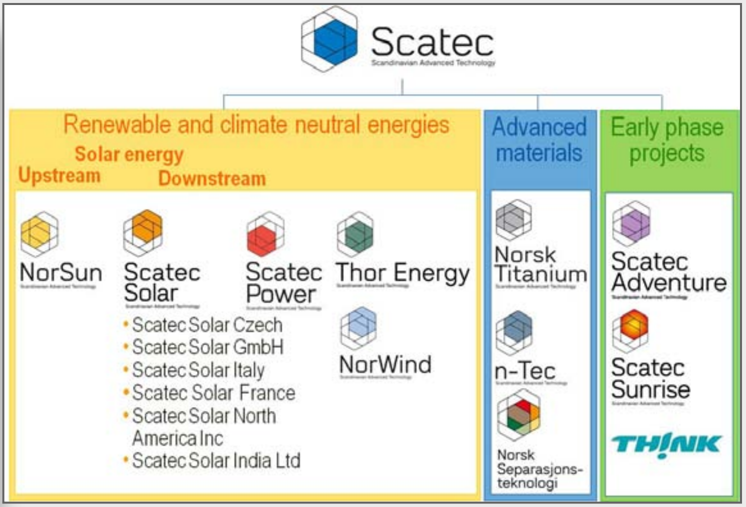
Further solar ambitions – through Scatec

Vision

To create value and make the world a *little* cleaner

Business Idea

Develop and industrialize new technology to produce renewable energy and advanced materials



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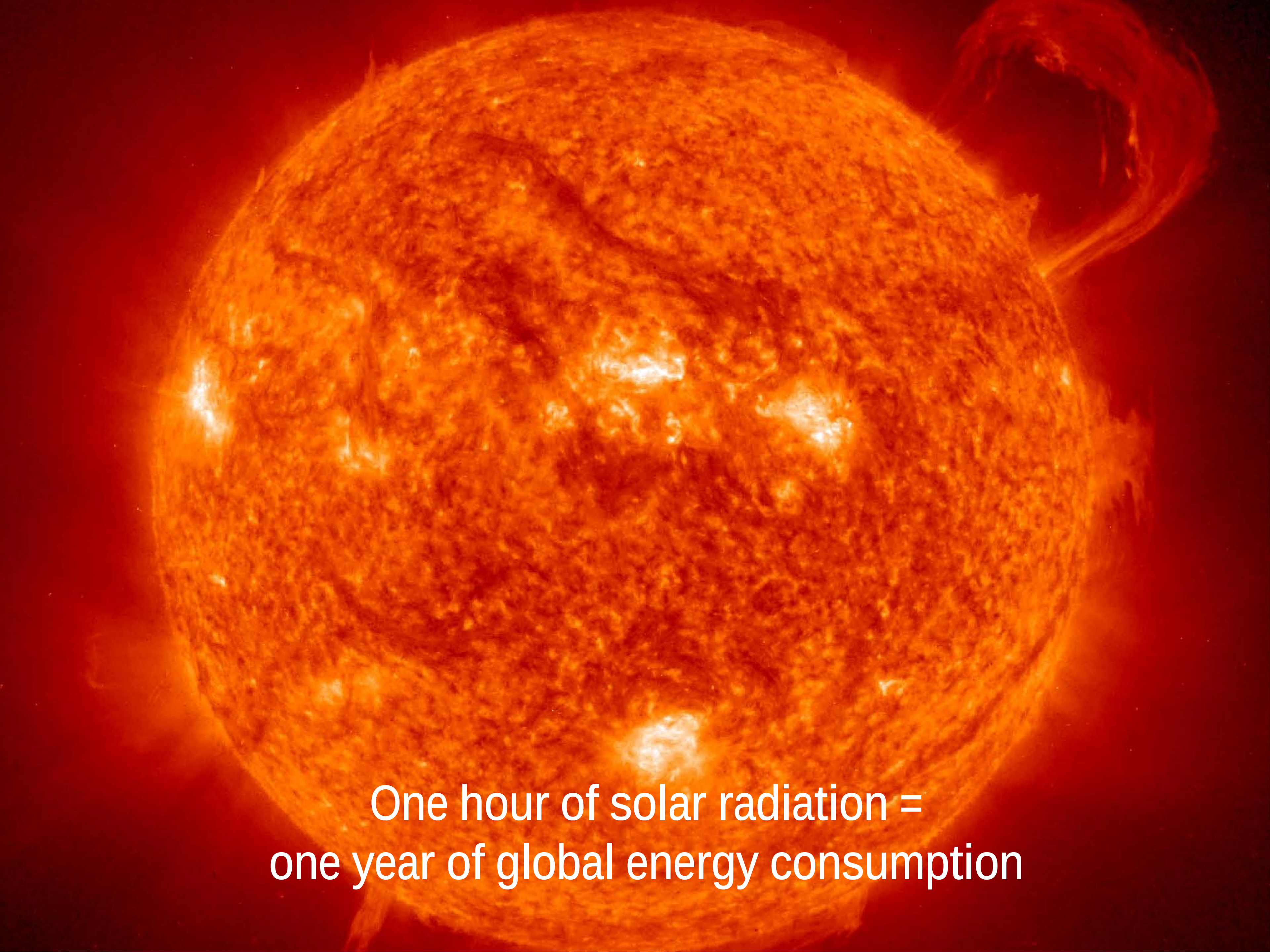

One hour of solar radiation =
one year of global energy consumption

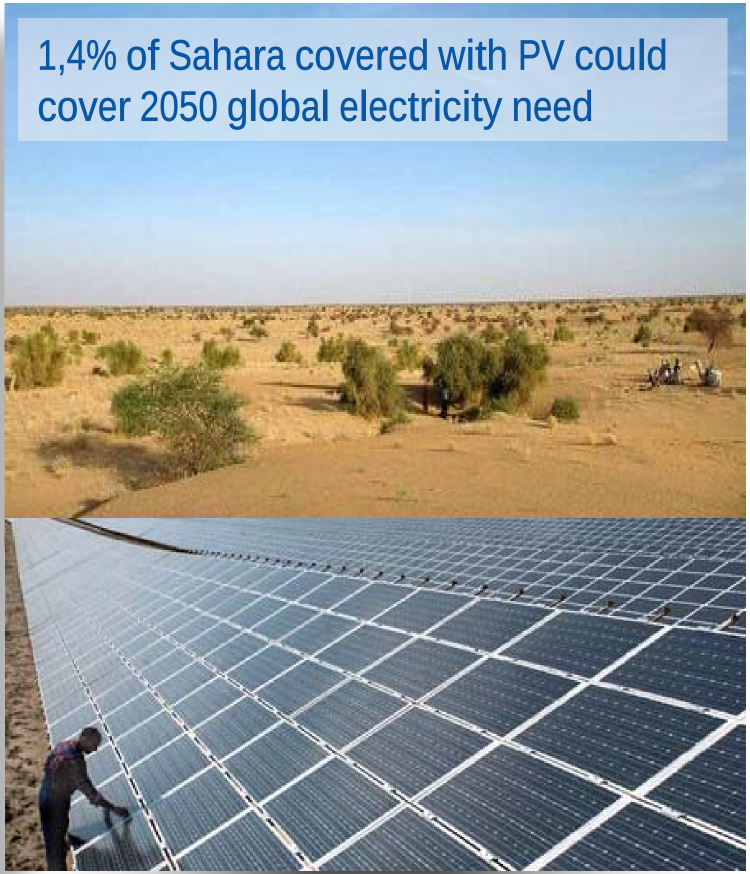
Photovoltaics produces electricity directly and has some unique advantages

Sustainable
- No fuel, no emissions
- No moving parts, no noise
- Low to no maintenance

Modular
- Fast installation
- Fast production start
- Easy to expand with demand

Distributed
- Grid independent
- Suitable for remote areas

Energy security



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Key requirements for PV to take over

Fundamentals must be in place

Competitive Costs

Large Scale

No barriers for rapid deployment

Access to Financing

Infrastructure capabilities

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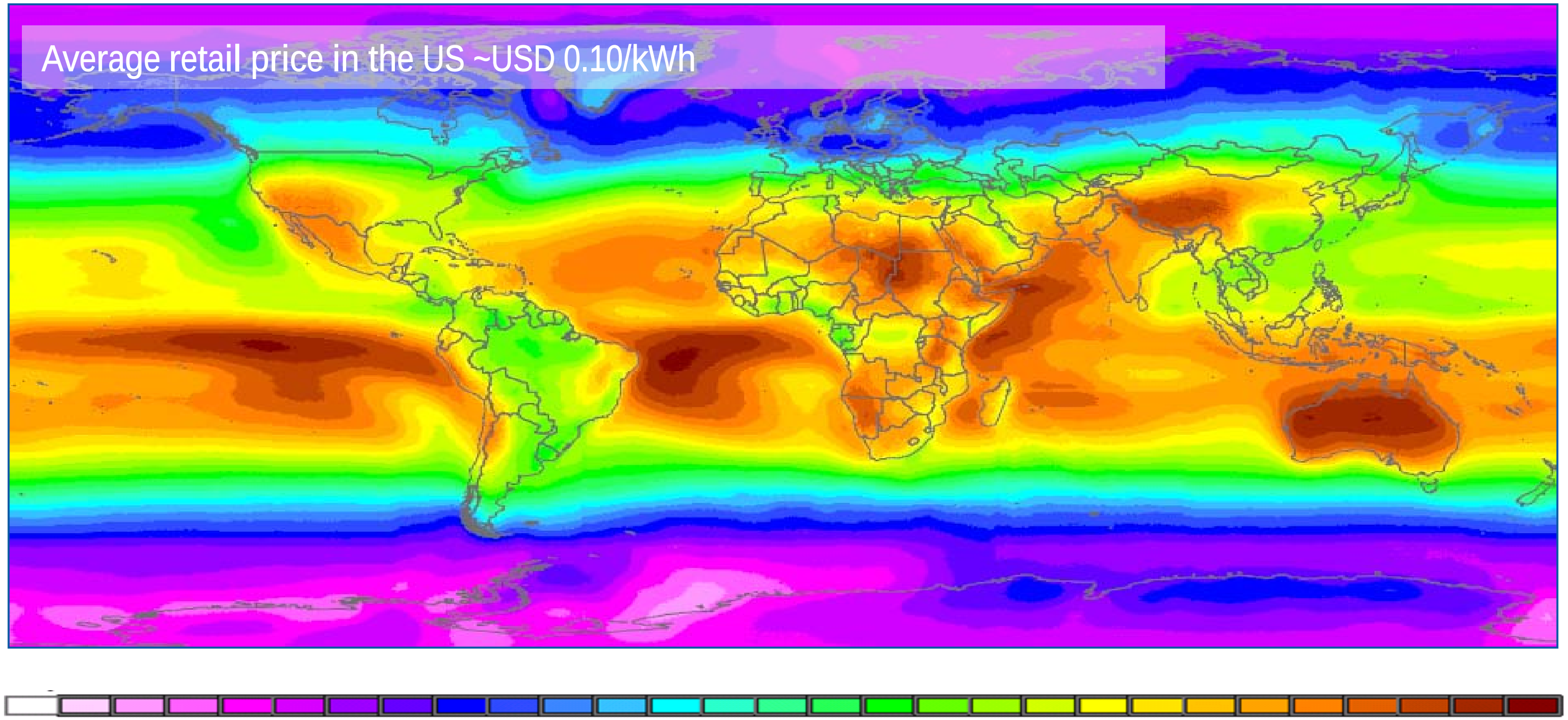
Costs: PV needs to be competitive in most segments

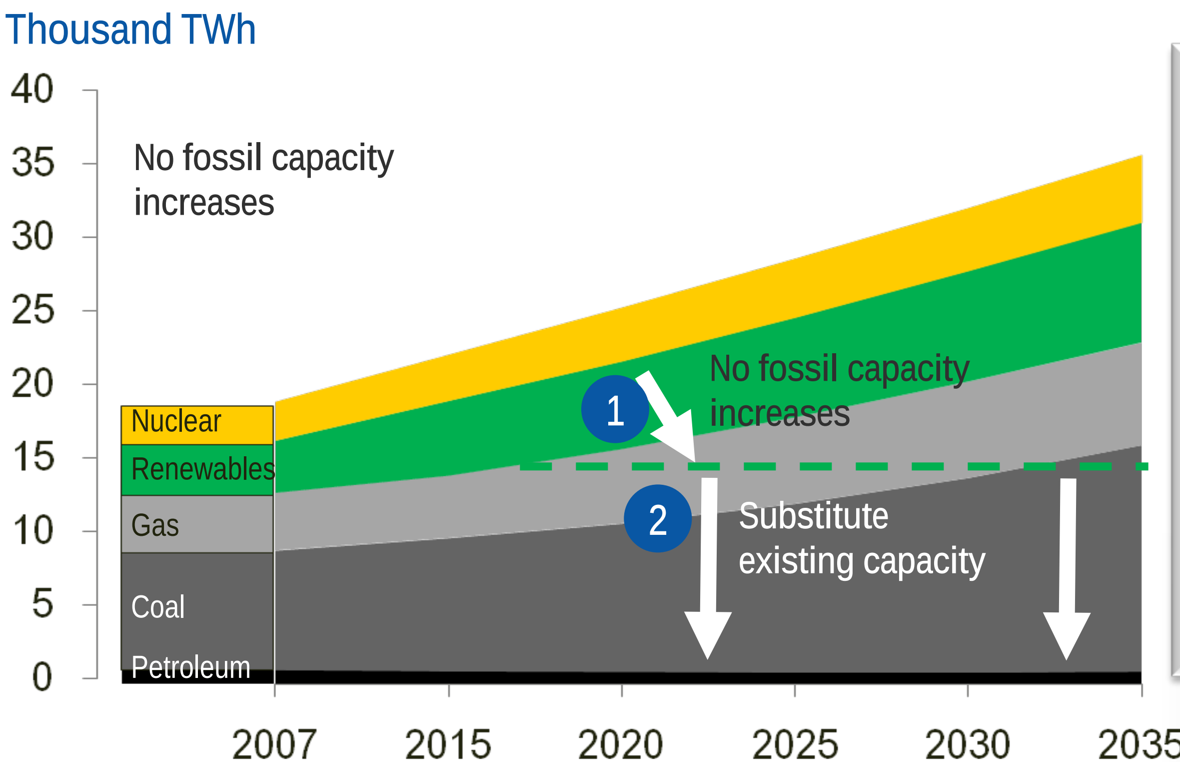
System cost ~2 USD/Wp= 0.10 USD/kWh in best locations



Discount rate	Cost of electricity ($/kWh) with module cost = 1.00 $/Wp + non-module cost = 1.00 $/Wp				
5%	0.47	0.22	0.14	0.10	0.08

Key assumptions: Plant operation period: 20 yrs, Annual degradation: 0.2 %, Opex: 50 $/kWp per yr, Corporate tax rate 30 %

Scale: Must be sufficient to first capture fossil growth – and then substitute existing capacity



Annual PV capacity required:

1 ~200 GW

2 ~400 GW

Key assumptions

- PV takes 50% of fossil capacity, other renewables the rest
- Fossil is phased out over 25 years

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Source: EIA; Key assumptions: Total CAGR: 2.3%, PV take 50% of the growth, wind, hydro and other renewbles the rest, 1500 solar hours

How close are we to “taking over”?

Cost, USD2/Wp

Scale, 200/400GW

Financing

Infrastructure

On the verge of competitiveness

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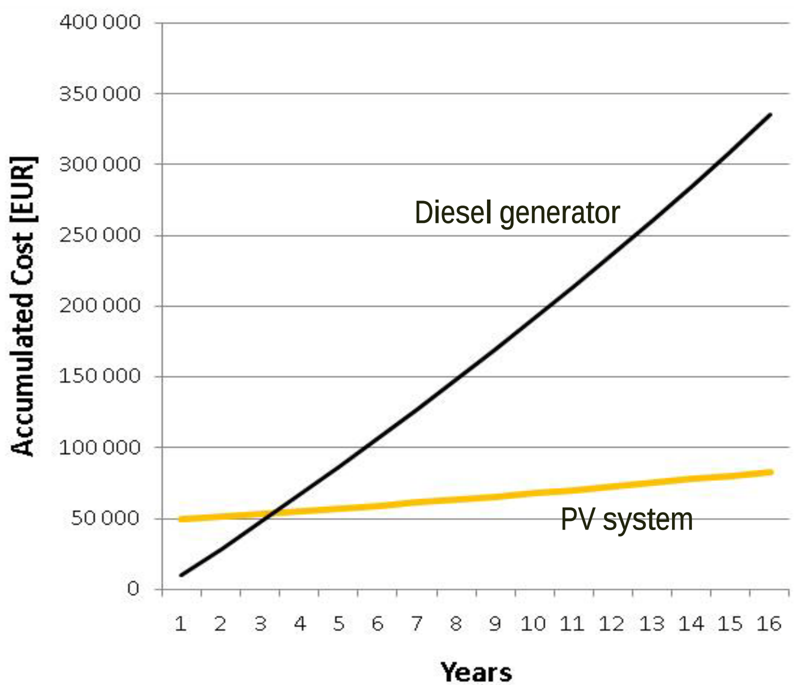
PV is already competitive in niche markets

Cost comparison, PV off grid versus Diesel Generator



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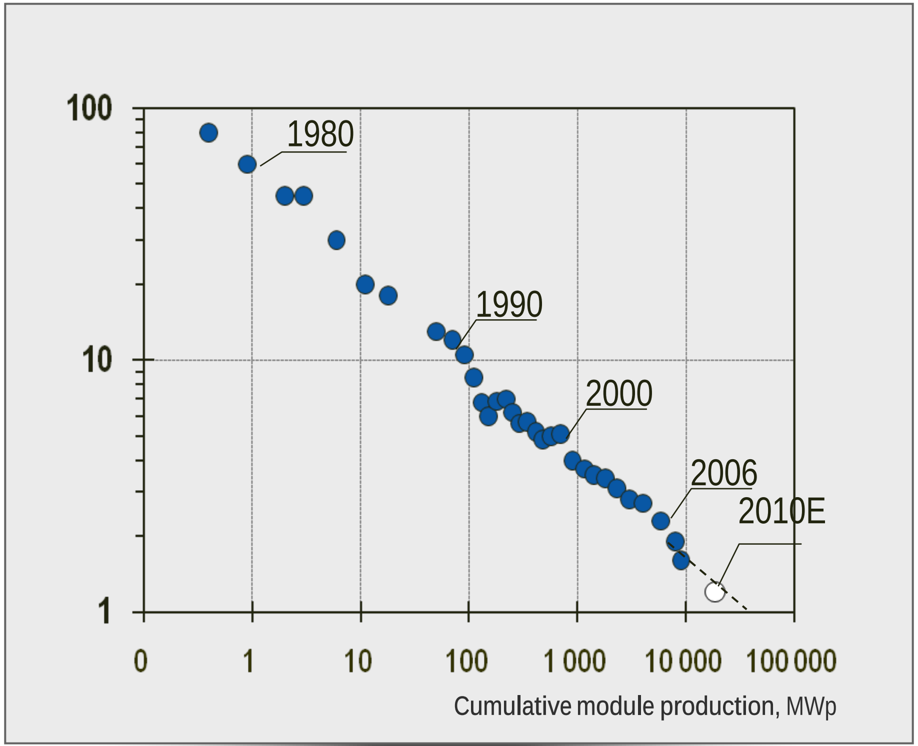
Key assumptions

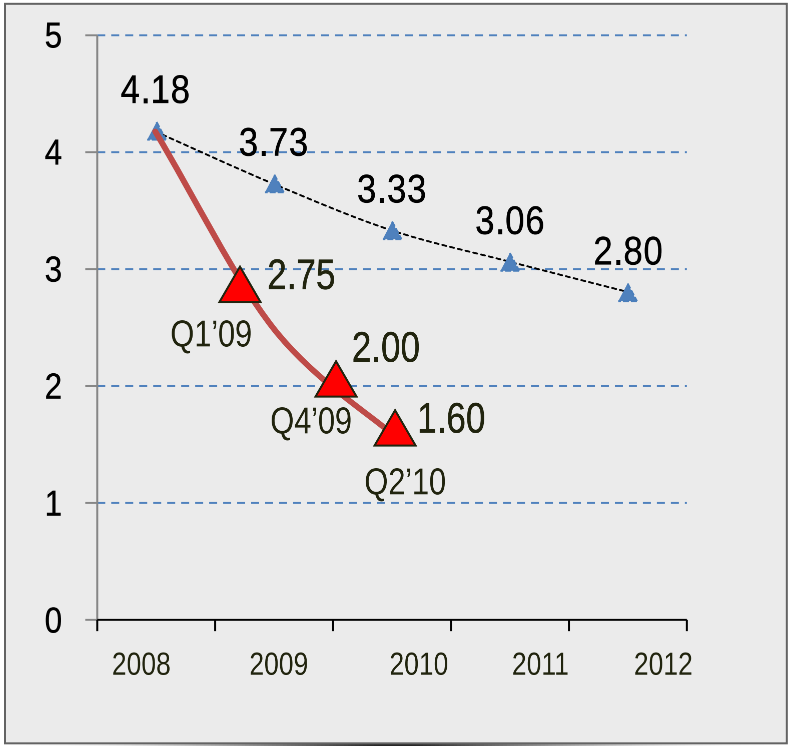
- Capex PV System: 50 kEUR
- Capex Diesel Generator System: 10 kEUR
- Diesel price: 0.7 EUR/ltr, 2 % yearly increase
- Diesel Generator running 24/7

PV has gone through steep learning curve and increasing price pressure

Learning curve – module cost vs. cumulative installed capacity, USD/Wp



Forecasted (June 08) vs. actual module prices USD/Wp



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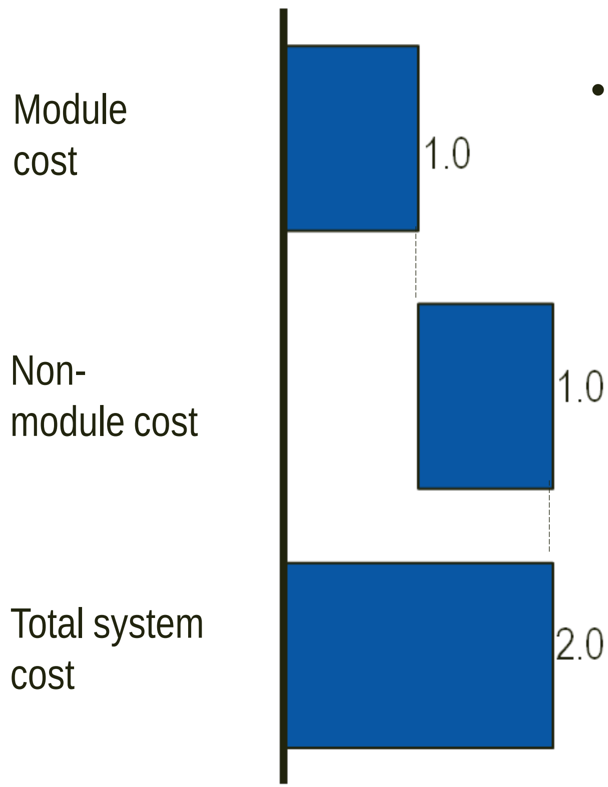
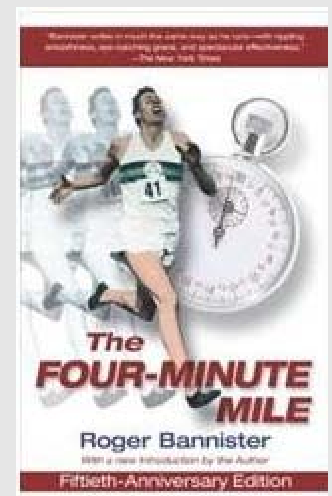
Sources: Solar Annual 2008 (Photon Consulting) – module ASP forecasts; Deutsche Bank 2009.01.29 report; Lux Research February 2009 report; Lazard Capital Market 2009.01.15 repor;t Morgan Stanley report March 2009; Barclays Capital; Reuters; Jefferies & Company; Photon 01/2010

The “holy grail” of PV, USD 2/W, is achievable with current technology, setting a new industry standard

Cost (USD/Wp)



- Sum of “best-in-class” per step in value chain (no one-producer yet here)
- Best-in-class (huge variation)



Roger Bannister:
First to run one English mile under four minutes

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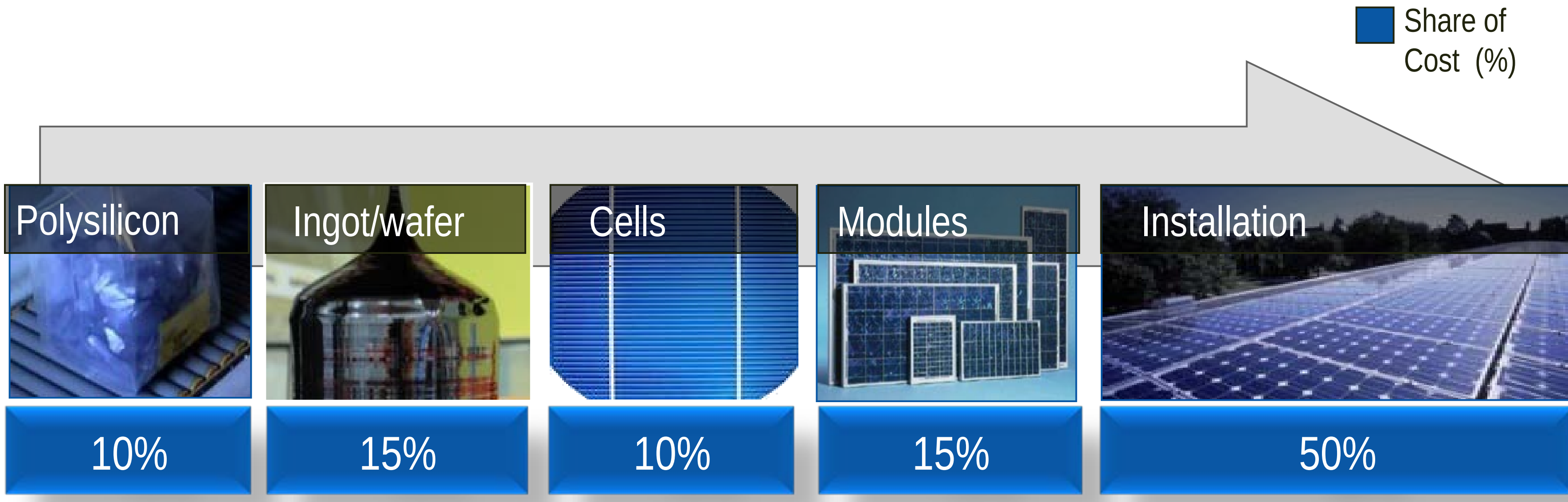
Sources: Deutsche Bank (Feb 2010); Macquire (Apr 2010); Morgan Stanley (Mar 2010)

Further cost reductions visible in all parts of the value chain



~50% of high value material wasted

Only 10-20% of sunlight converted to electricity

Immature and fragmented industry – several options for standardization and tailoring of system design

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How close are we to “taking over”

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On the verge of competitiveness

- PV is already cost competitive in selective segments
- Visibility of reaching cost target with *existing technology*
- Further cost reductions likely in all parts of the value chain

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How close are we to "taking over?"

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Still small, but fast growing and no show stoppers

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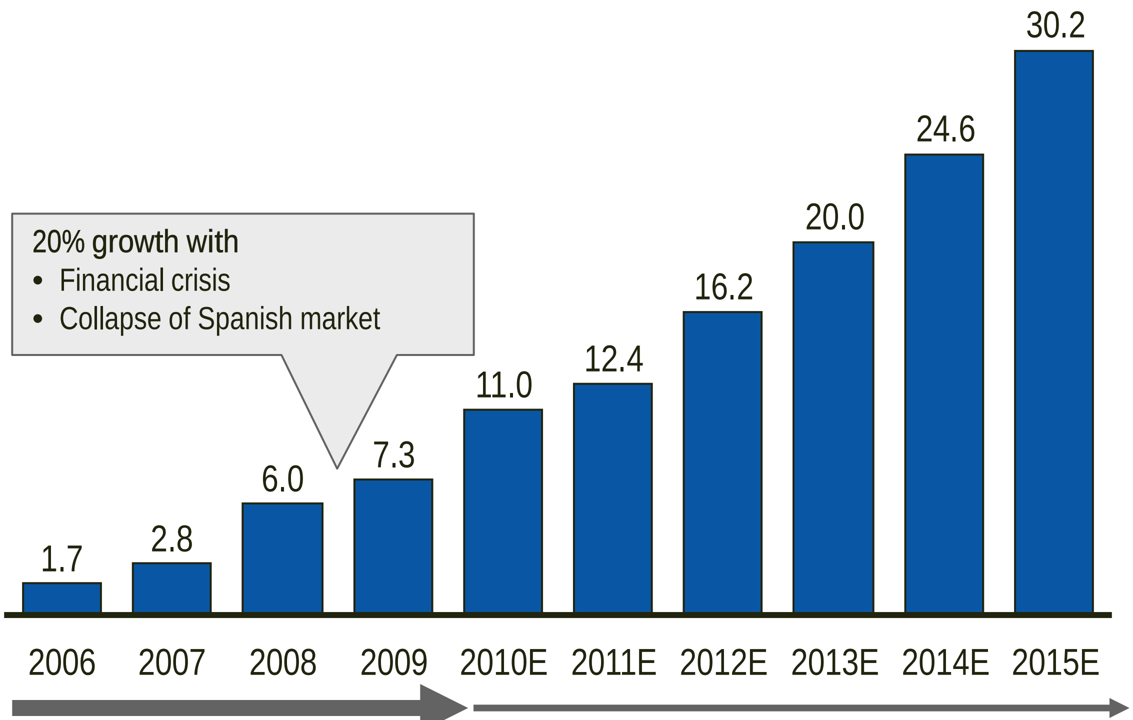
Installed volumes have grown quickly over the past few years with a lot more coming

Annual world PV installations (GW)



Historic annual growth 2006-09: 63%

Estimated annual growth 2010-2015: 23%

Capacity additions making a difference

Cumulative installed capacity
-Today : 23 GW
-2015: 137 GW

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Source: Solarbuzz; Deutsche Bank (Feb 2010); Morgan Stanley (March 2010); Photon International (March 2010) ; Nomura Bible Solar 04/10

Appearance of giant markets and players will boost volumes and further professionalize the industry

New PV markets emerging

China
- Ambitions: 20 GW PV by 2020
- Building up a strong domestic PV industry
- *Scatec Solar & Datang intend to realize 2500 MW of PV plants in 2011-2016*

India
- Ambitions: 20GW PV by 2020
- *Scatec Solar building tens of off-grid PV systems for rural electrification*

Other regions
- *Brazil*
- *North America*
- *South Africa*

Giant players entering

SAMSUNG

"We aim to become the world's leading provider of solar power by 2015"

Choi Dong-wook,
VP Solar Energy at Samsung

"Solar is definitely the next wind for us. It's not there yet, but it's moving very rapidly"

Michael Idelchik,
VP at GE Global Research

No fundamental barriers for massive growth

Abundant raw material

Silicon makes up 25.7% of the Earths crust and is the second most abundant element

Managable production volumes

Total weight of 400GW of PV ~ 50 million ton, equal to 2008 annual flat glass production

Short energy pay-back time

Energy payback time for today’s best PV technology is below 1 year (making 100% growth rates self sustainable)

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How close are we to “taking over?”

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Still small but fast growing and no show stoppers

- Installed volumes have grown quickly with a lot more supply coming
- New markets emerging and giant players entering
- No fundamental barriers for growth in the value chain

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Increased knowledge and predictability is key

High upfront investment costs requires long term predictability and stability

Currently very time consuming in new markets due to

- New industry for financial institutions increase perceived risk
- Unclear regulations

Therefore critical to have

- Predictability from governments - on financials and regulations
-

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How can it be done: Case example from Norway

- Portfolio financing of EUR 85 mill for 9 solar parks in the Czech Republic
- Requires 30% Norwegian content

EKSPORT FINANS NORWAY

Provide loans under commercial interest rates conditions

GIEK Garanti-instituttet for eksportkreditt

Guarantees for 70% of the loans, covers commercial and political risk

Scatec Solar
Improving our future™

Main benefits

- Reduces uncertainties and time spent on financing issues
- Ensures rapid and successful development of solar parks – financing is key
- Competitive terms and guarantees ensure profitability

How close are we to “taking over”?

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Key when PV and other renewables dominate energy supply - solutions exist but planning must start now

Solutions involve

- Increasing inter-regional network
- Developing storage solutions
- Facilitating demand response (smart grids)

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So where do we stand?

Cost, USD2/Wp

Scale, 200/400GW

Fundamentals largely in place – PV getting close to self sufficiency, with massive growth potential

- Already cost competitive in some segments
- Grid parity within reach
- Industry prepared to scale

Financing

Infrastructure

Important to remove barriers towards rapid deployment

- Facilitating financing, getting experience and minimizing risk through predictable support schemes and regulations are key
- Planning of infrastructure must start now

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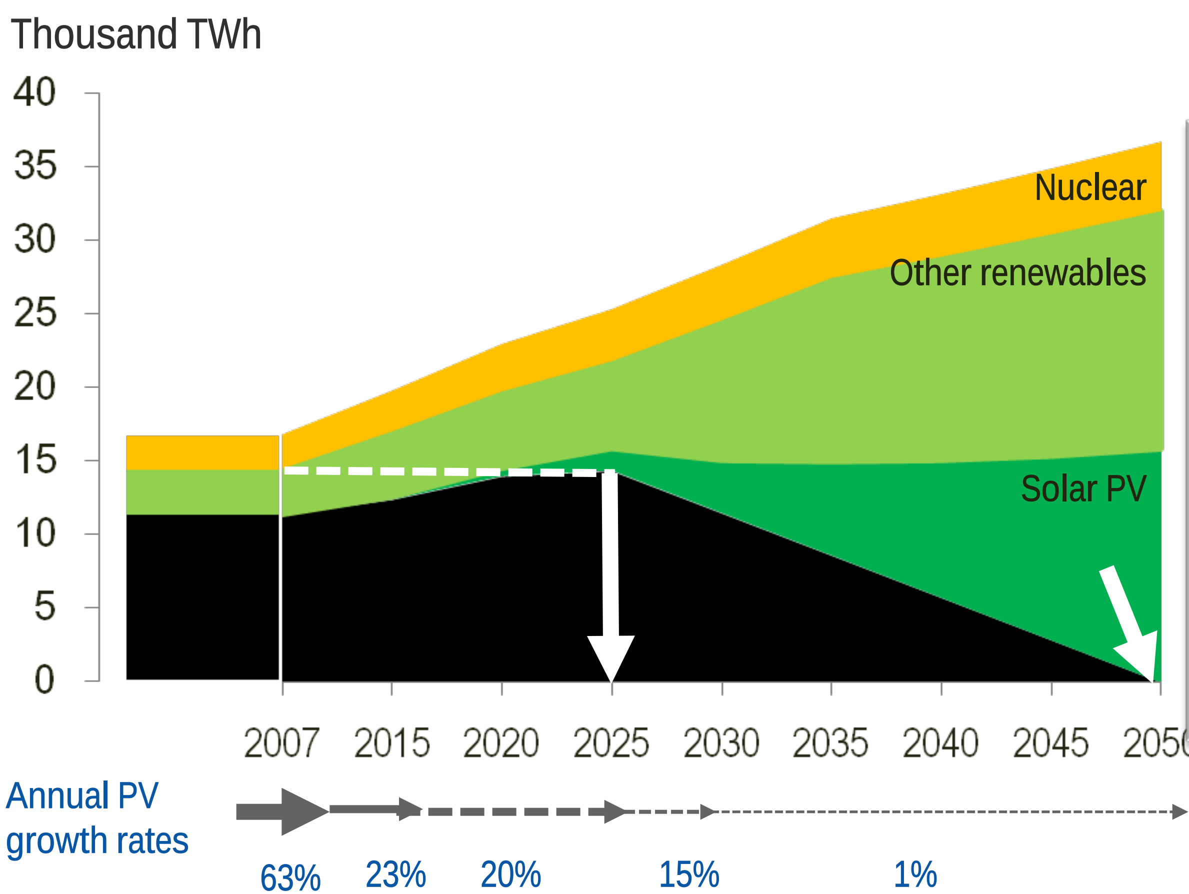
When can PV take over?



Faster than you think!

With realistic growth rates:

- No fossil capacity increase from 2025 – PV and other renewables starts replacing capacity being phased out
- Fossil fuels for electricity phased out in 2050

Source: EIA; Key assumptions: Total CAGR: 2.3%, PV take 50% of the growth, ther renewables the rest, 1500 solar hours

Solar Energy – If not now, then when?

"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait till oil and coal run out before we tackle that."

Thomas Edison to his friends Henry Ford and Harvey Firestone (1931)