

# Solar Markets ... Worldwide today and tomorrow

First German Conference  
Solar Energy in Korea

NH Hotel, Munich-Dornach,  
June, 11th 2008 in Munich, Germany

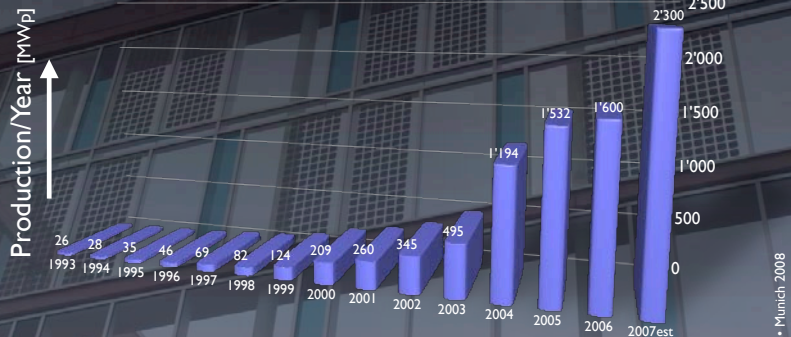
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# Overview

- The world PV market yesterday and today
- Financial engineering with rate-based incentives
- Development of PV 1990 – 2005: Cost and Performance
- How can you describe and analyse a PV system?
- From a rate-based incentive to a grid parity PV market
- PV comparisons between Korea and Germany
- Conclusions

# PV module production worldwide

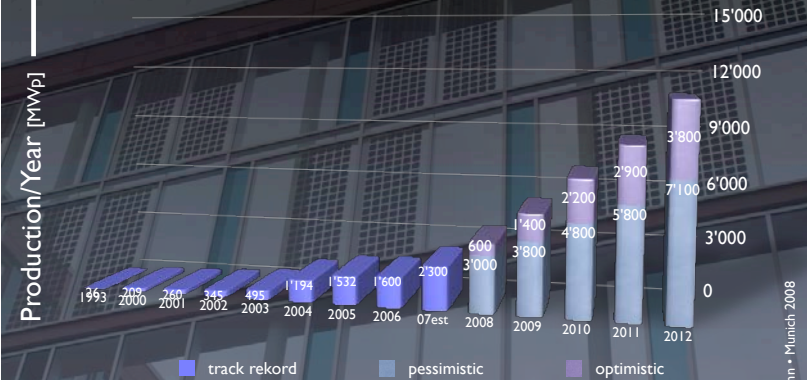
PV global turnover  
2006 ca. 10.5 Mia. €

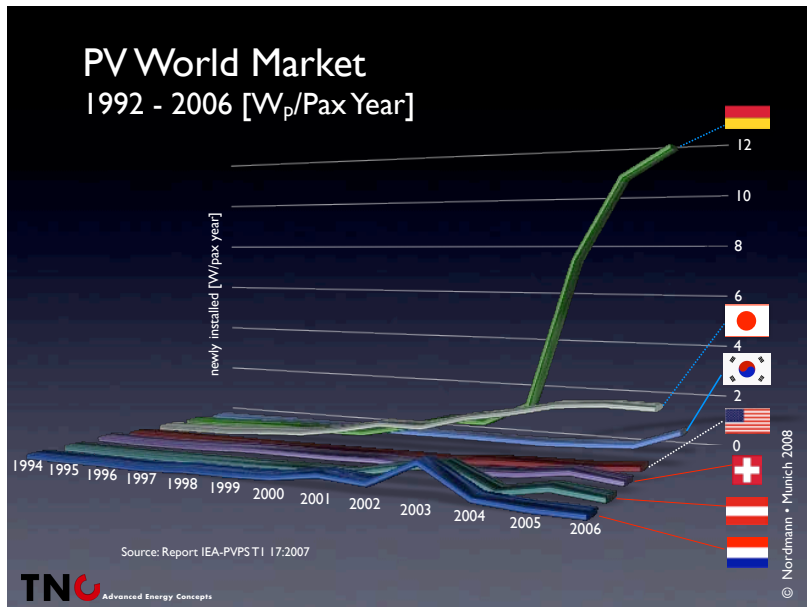


Quelle: Report IEA-PVPS T I 15:2006

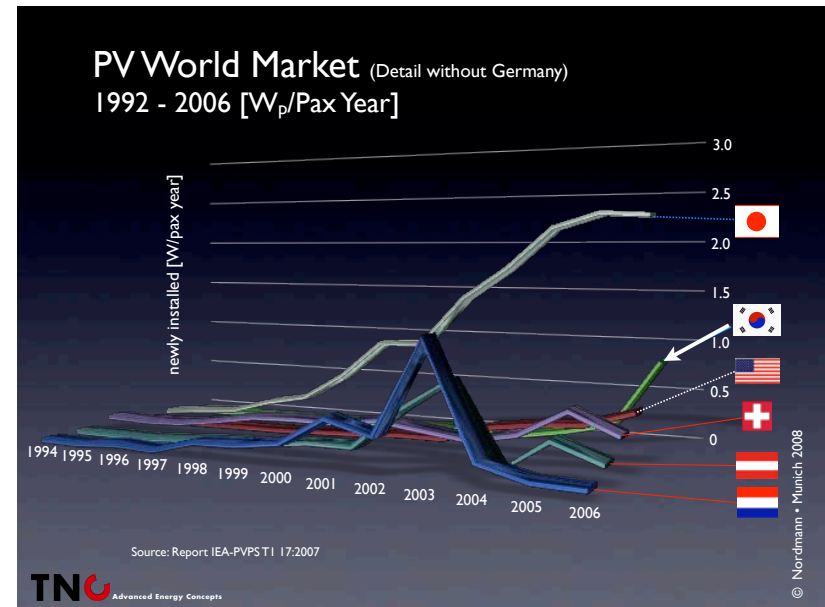
# Market development Outlook (EPIA 12/2007)

Ongoing annual growth rate ≈ 30%





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### Overcome - The dilemma of the Renewables

#### Addressing the high upfront-cost for investors!

1. Class Zurich -Genève <> € 133.-  
2. Class Zurich -Genève <> € 80.-

1. Class 4'600.- x 25 Jahre = € 71'875.-  
2. Class 2'900.- x 25 Jahre = € 45'300.-

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### PV is like selling a car with a full tank for life-time

Petrol for 50'000 km

Prius 107kW : Class A  
CO<sub>2</sub>-Emission: 104 g/km  
petrol 4.3 l/100 km  
2'150 l petrol à SFR 1.80 = € 2'400

VW Tuareg TDI V10: Class F  
CO<sub>2</sub>-Emission: 333 g/km  
petrol 12.6 l/100 km  
6'300 l petrol à SFR 1.80 = € 7'070

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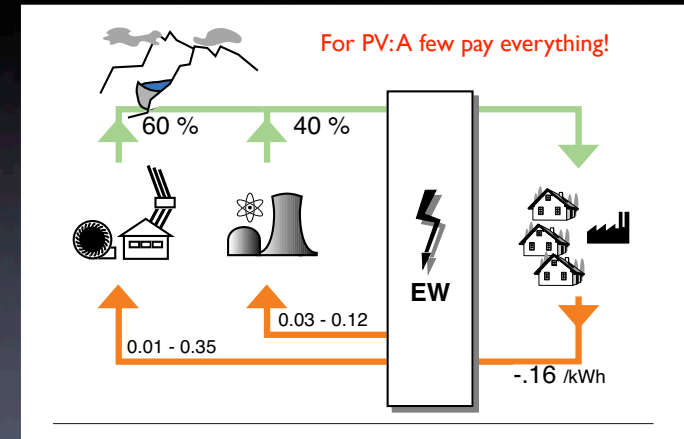
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## Spanish Truckers Block Border!

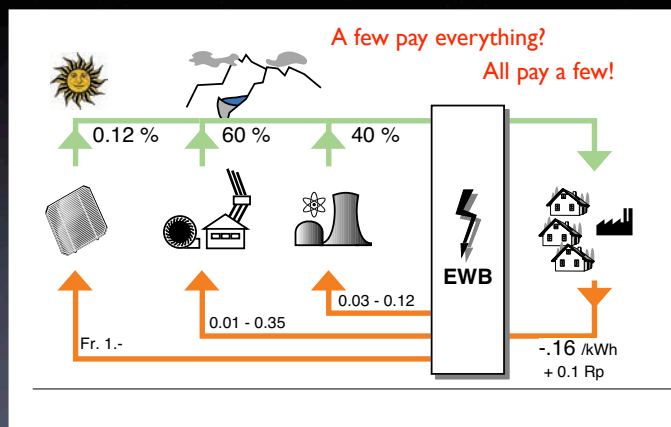


Trucks massed at a toll plaza near Barcelona on Monday as drivers joined a nationwide strike against the rising cost of fuel.

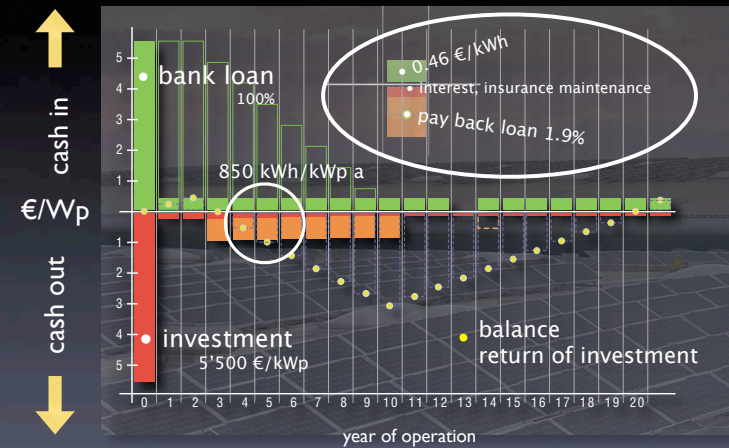
## Past: Mix of power production in Switzerland



## Today: Rate-based incentives for renewables



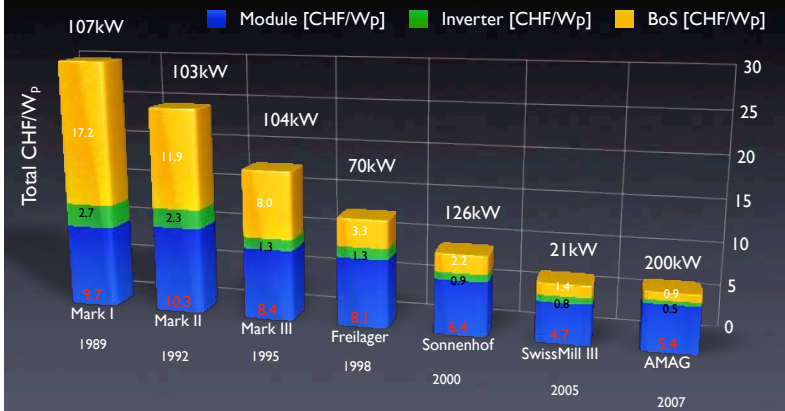
## Cash Flow Analyses rate-based incentives



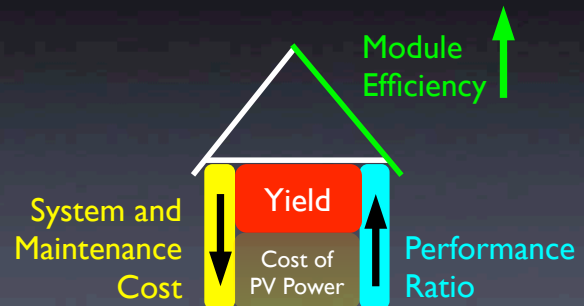
# When will PV power become cheaper?



# TNC PV installations learning-curve: 1989 - 2007



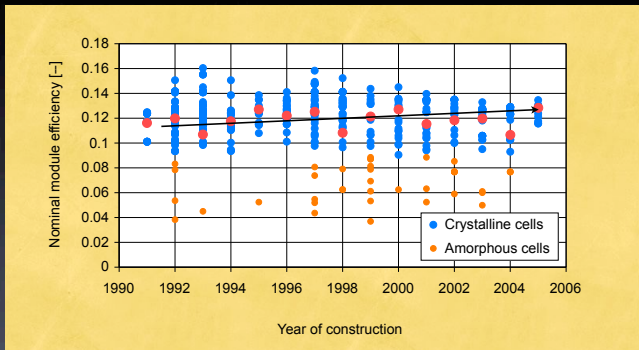
To Describe and Analyse a PV System: you need several Elements of Data ...





## The Evolution of the nominal Module Efficiency (N = 461)

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1991  $\bar{\eta} = 11.5\% \rightarrow 2005 \bar{\eta} = 13\%$

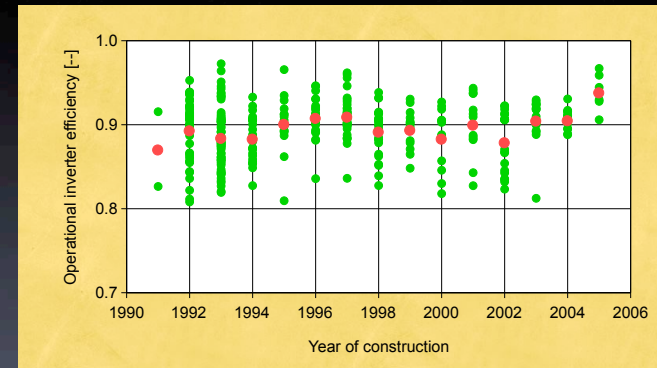
IEA International Energy Agency Photovoltaic Power Systems Programme - PVPS -Task 2

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## The Evolution of the Inverter Efficiency

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1991  $\bar{PR} = 0.89 \rightarrow 2005 \bar{PR} = 0.94 = \text{Best Case}$

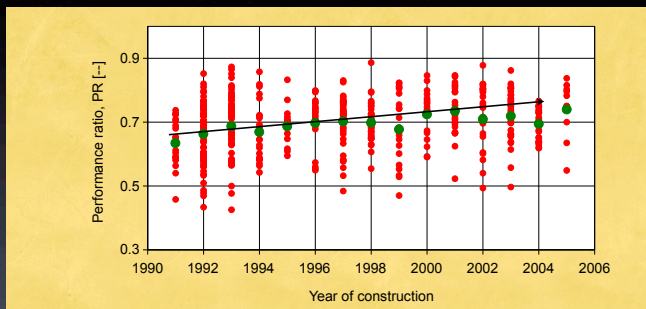
IEA International Energy Agency Photovoltaic Power Systems Programme - PVPS -Task 2

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## The Evolution of the Performance Ratio (N = 461)

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1991  $\bar{PR} = 0.64 \rightarrow 2005 \bar{PR} = 0.74$

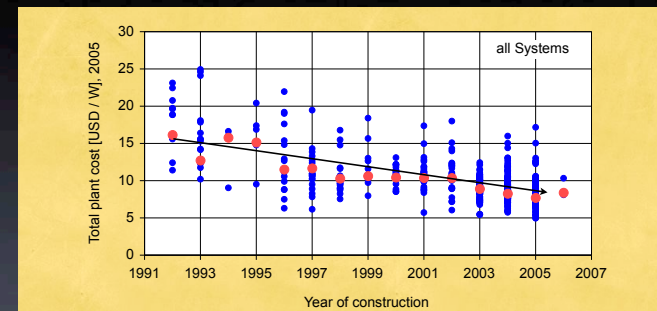
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## The Evolution of the System cost (N = 527)

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1992  $\bar{C} = 16 \text{ USD/W} \rightarrow 2006 \bar{C} = 8 \text{ USD/W} -50\%$

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## A typical gridconnected PV system ø 1991 and ø 2005 and best case 2005.

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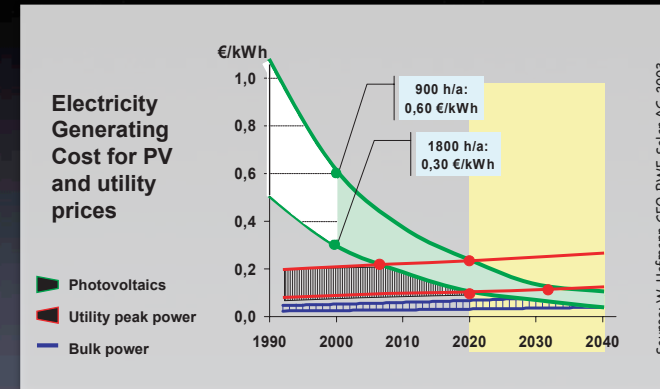
Typical system tech.   econom.	ø 1991	ø 2005	2005 best case	unit
Nominal module efficiency [ $\eta_{A0}$ ]	11.6	12.9	14	%
Operational inverter efficiency [ $\eta$ ]	89	94	94	%
Outage (O)	0.03	0.01	0	/a
Performance ratio (PR)	0.64	0.74	0.84	PR/a
Overall PV plant efficiency [ $\eta_{tot}$ ]	7.4	9.5	11.8	%
Improvement	100	129	158	%
Cost	16	6	-62%	US\$/W

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## The next target of the PV industry: Grid parity



Source: W. Hofmann CEO RWE Solar AG 2003

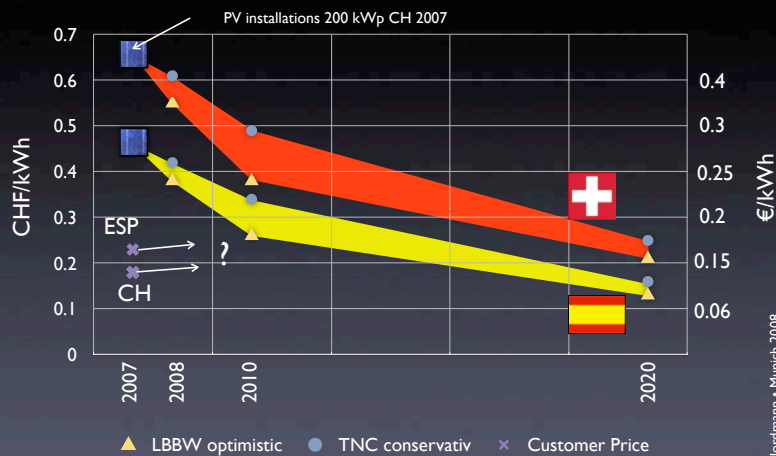
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## TNC Cost corridor PV installations Switzerland and Spain 2007 - 2020



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## The European Sunbelt first...



- Portugal, 10.0 Mio
- Spain, 39.45 Mio
- Italy, 57.68 Mio
- Greece, 10.56 Mio
- Turkey 65.3 Mio

Total: 183 Mio Inhabitants

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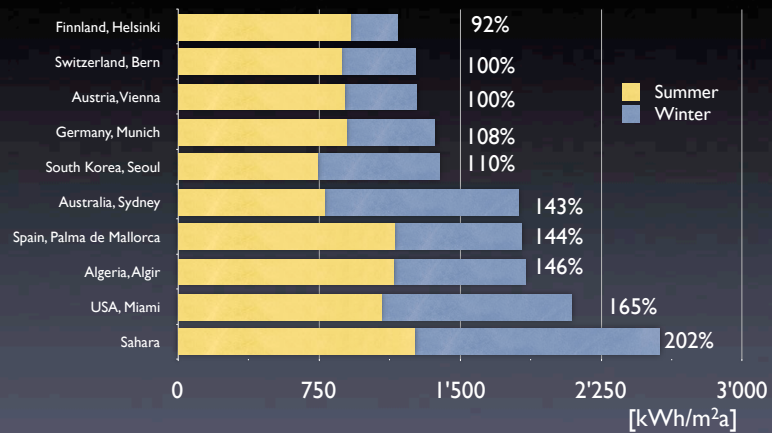
# Research about South Korea and Germany general statistic and PV market potential



# South Korea and Germany in comparison

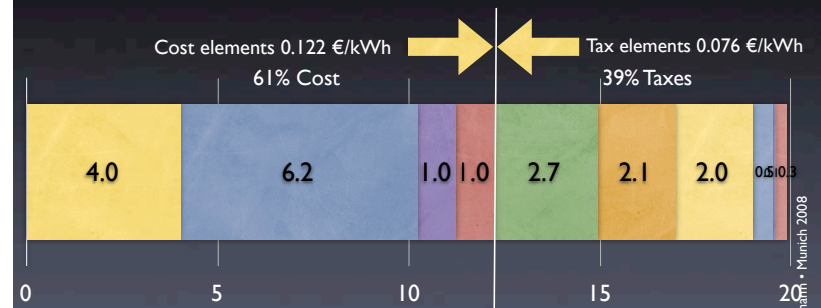
	Inhabitants Mio	Area [k km <sup>2</sup> ]	Inhabitants /km <sup>2</sup>	BIP/capita [k \$]	MW PV (2006)	W PV/capita
South Korea	49.0	99.4	493	24.8	21.2	0.85
Germany	82.2	357.1	230	34.2	953	11.58
Switzerland	7.6	41.3	184	41.1	2.6	0.35

# Solar irradiation available for optimally tilted surface

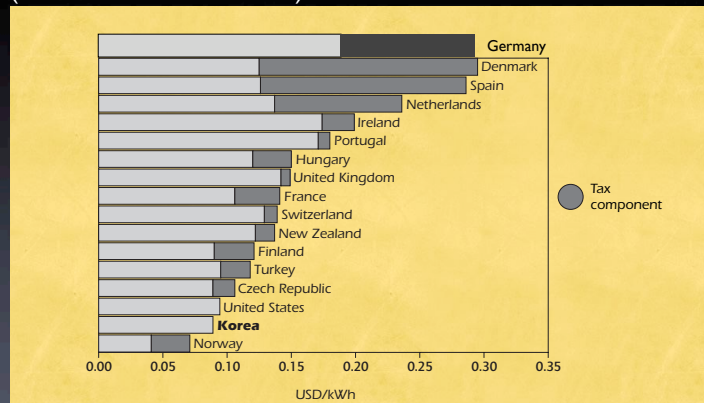


# Cost elements of household power in Germany 0.197 €/kWh 2005 (0.3 USD)

- Production
- Grid
- Marketing
- Measurement
- VAT
- Power Tax
- license
- EEG 0.54
- Solar PV 0.06
- KWK



## High retail prices for electric power This helps PV in the domestic market (source IEA/OECD 2006)



## Conclusions

- Monday  
PV is one of the fastest growing sector in the energy world today. An annual growth rate beyond 30% has been achieved. Even conservative outlooks show a similar growthrate for the future.
- Tuesday  
The dramatic growth of the market is achieved only been a few front-runner countries. Germany has taken the lead ahead of Japan with the concept of rate-based incentives.
- Wednesday  
The cost of installed PV capacity has been dramatically reduced since 1990 by 60%. Good PV installations need modules and inverters with good efficiency, high stabile performance ratio and low investments in €/W.

## Conclusions

- Thursday  
The next strategic target of the PV industry is to establish grid parity for private utility customers. With a liberalised electricity market PV becomes a self-running market and no longer policy driven industry.
- Friday  
The comparison between the PV environment in Germany and Korea shows similarities. The success of the Korea high-tec industry in the electronic sector is the key element to build up an own successful PV industry.
- Saturday  
The key element for the German successful PV industry is the solid established home market and its close interaction between customers and the industry.

## Conclusions

- Sunday  
PV is a globalised business today! Successful trade relations are needed for fast PV industry development worldwide. A sustainable relation between supplier and customer, demand and supply is mandatory.  
  
If South Korea is establishing similar environment as Germany, South Korea becomes the new front-runner!