

Poly-Silicon Development and Trends in Europe

China PV Industry and Poly-Silicon Conference
China New Energy Chamber of Commerce
Zhejiang, Shaoxing, June 26, 2008

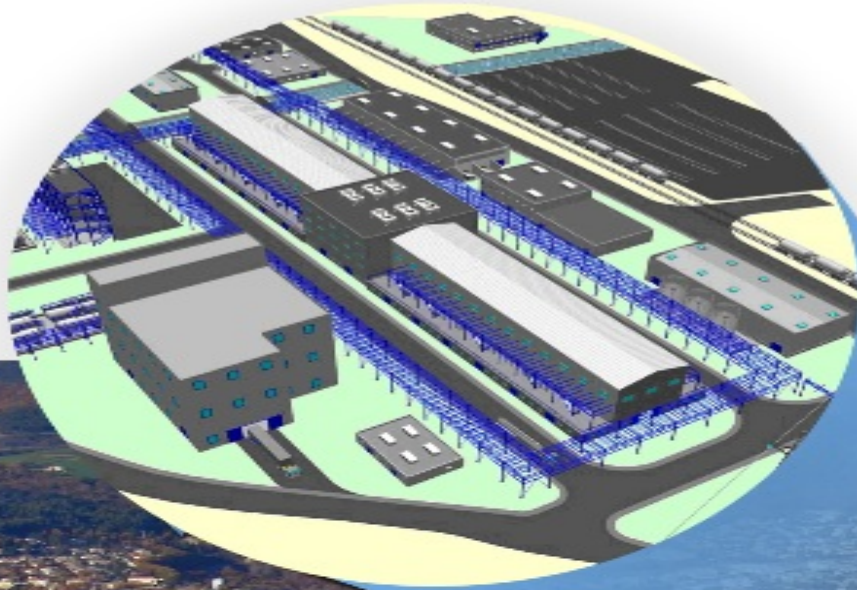
Frank Haugwitz



Russia – Nitol Solar

- Nitol Solar Limited (first Russian Co.)
- Siberia, Irkutsk region
- Schedule and Production Capacity
Phase 1: By 2009 / 3,700 mt
- Current contracts USD 1,5 Bill until 2015

France – Silicium de Provence



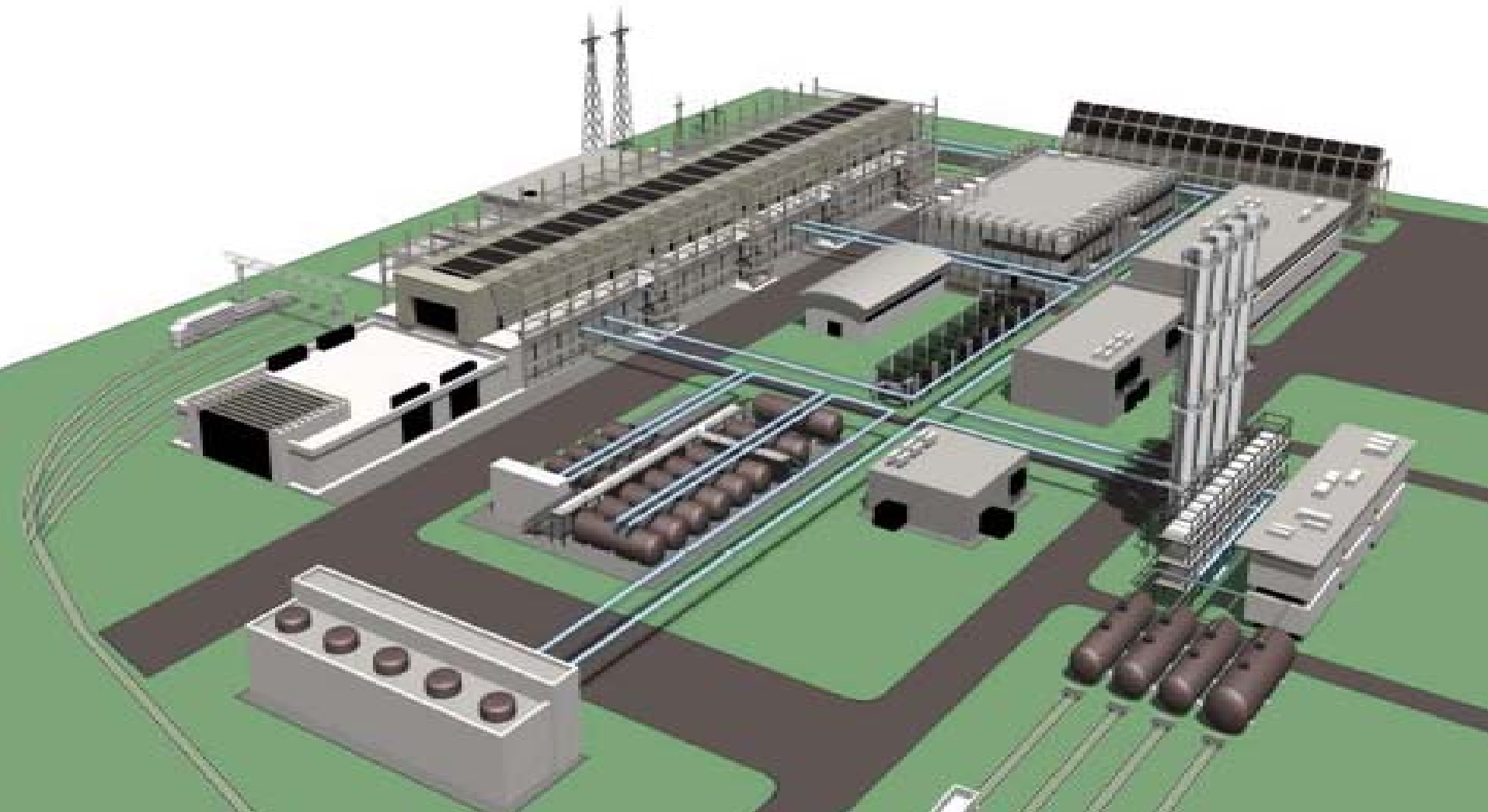
France – Silicium de Provence

- Announcement: August 2006
- Partner: Econcern and Solon (JV - SOL), Photon Power Technologies (EDF)
- Location: Saint Auban (Provence)
- Technology: Siemens
- Schedule and Production Capacity:
 - Phase 1: 2010 / 4500 mt/a
 - Phase 2: ??? / 9000 mt/a



Spain – Silicio Energía

- Silicio Energía S.A. consists of Endesa, Isofoton, Andalusia Govt.
- Investment: € 250 Mio.
- Technology: Siemens
Constructed by Centrotherm
- Schedule and Production Capacity
Phase 1: 1Q/2009 / 2500 mt/a
- Supply the Spanish PV Industry



Italy - Silfab

- Silfab Co. (first Italian start-up Co.)
- Location: Borgofranco d'Ivrea
- Technology: Siemens
- Schedule and Production Capacity
 - Phase 1: 3Q/2009 / 2500 mt/a
 - Phase 2: 4Q/2010 / 5000 mt/a
- Aim: Provide 9N solar grade poly-silicon with zero environmental impact !

100% of first 2500 mt are already booked !

Italy - Estelux

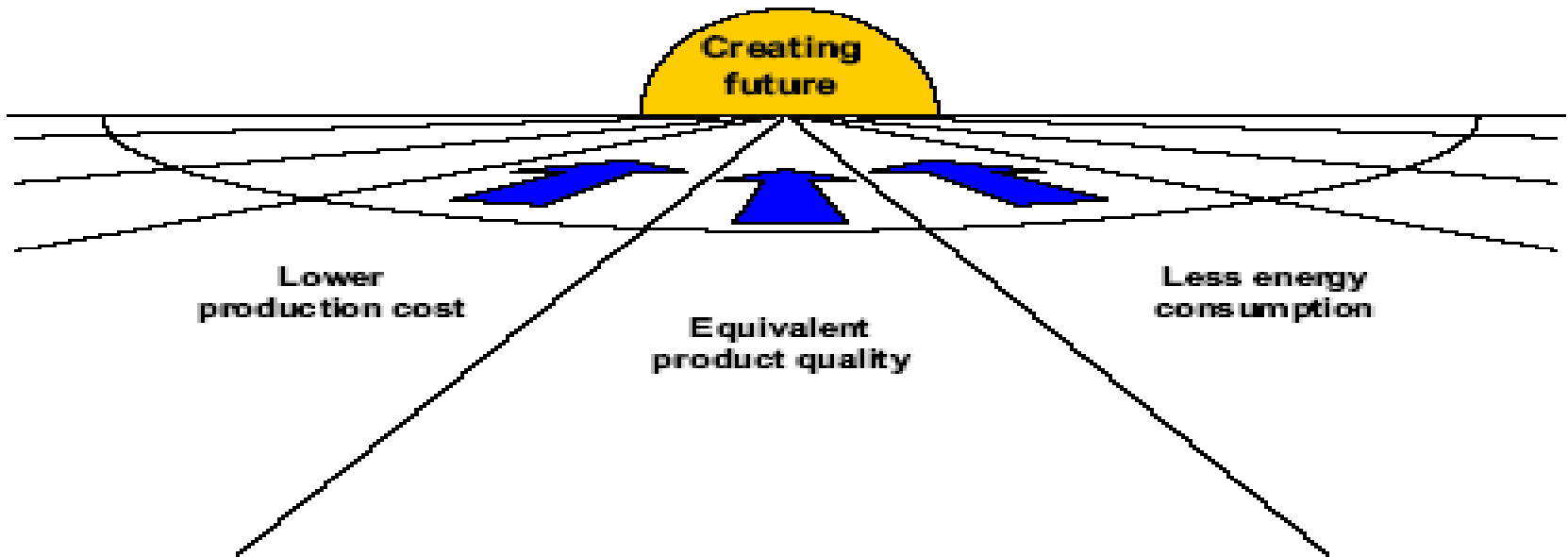
- Estelux Co. (Italian start-up Co.)
- Location: Ferrara
- Investment: € 360 Mio.
- Technology: Siemens
- Schedule and
Production
Capacity:
By 2010 / 4000 mt/a





Norway – Elkem Solar

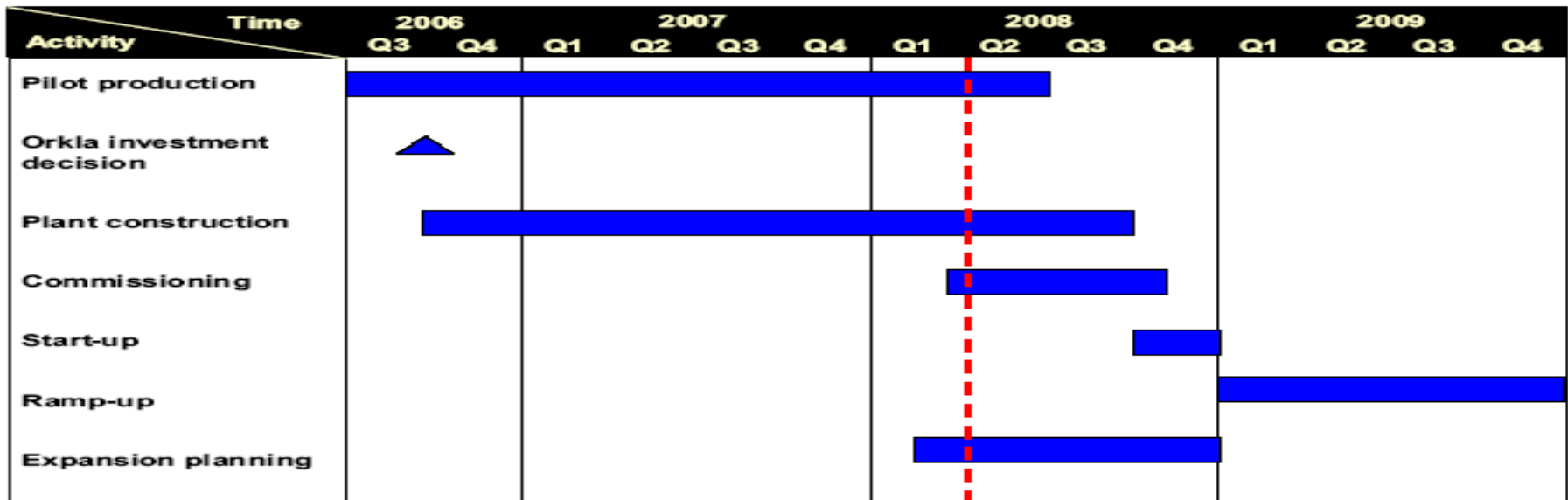




- Location: Elkem Fiskaa in Kristiansand
- New Tech.: Lower Power Consumption and no transition to silane gas → below USD 20/kg based on Solar-grade silicon from metallurgical silicon

Norway – Elkem Solar

- Investment 3,1 – 3,5 Billion NOK
- Prod.-Cap. 5000 mt/a
- First shipments by 4Q/2008
- 100% sold to Q-Cells & another player until 2012

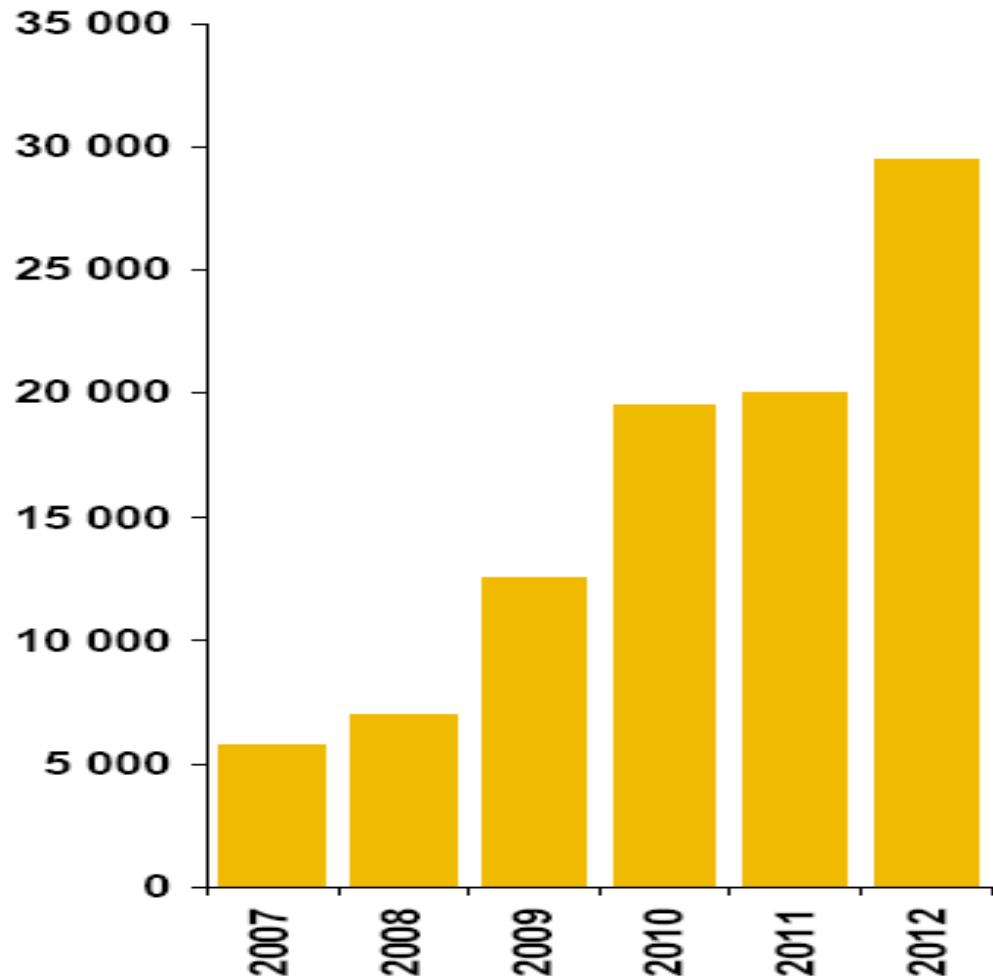




Norway - REC

- REC Co.
- 3 Locations in USA
- Siemens Tech.
- Scenarios until 2015 estimates an annual prod.-cap. of 45,000 mt

Production of Polysilicon (MT)





TSM

The Netherlands – The Solar Mine





TSM

The Netherlands – The Solar Mine

- The Netherlands first Silicon Plant
- Location: Sittard/Geleen
- Sept. 2007: € 400 Mio investment
- Technology: Siemens
- Schedule and Production Capacity
Phase 1: 4Q/2010 / 4000 mt/a
- Mid-Term Target: 9000 mt/a
- Long-Term Target: 14000 mt/a

- JV Scheuten Solar with SolarWorld
"Scheuten SolarWorld Solizium GmbH"
- Technology: Metallurgical prod. process
- Location: Freiberg, Germany
- Schedule: 2010
- Capacity: 1000 mt/a
- Main driver: Self supplier

Germany - Solarvalue AG



Arc Furnace for
Metallurgical Silicon
Production

Laboratory

Future Solar Grade Silicon
Production Building

Office Building



Germany - Solarvalue AG

- Production Facility in Ruse, Solvenia
- Existing infrastructure helps to reduce time and costs, i.e. no greenfield investment, 60 specialized staff
- Technology: Solar-Grade Silicon from metallurgical silicon
- Target to produce sgs for €20/kg
- Schedule and Production Capacity
By 2009 / 4400 mt/a
- Long-term goal – to be full vertically integrated



Germany - PrimeSolar

- HQ in Australia – Invest in Germany due to favorable fiscal incentives, incl. up to 50% non-refundable grants from the State Government of Saxony-Anhalt and the Federal Government of Germany
- Location: near Leipzig, East-Germany
- Technology: Metallurgical Silicon
- Schedule and Production Capacity
 - Phase 1: 2Q/2010 / 5,000 mt/a
 - Phase 2: 2011-2012 / 10,000 mt/a

Germany

JV of Degussa & SolarWorld

- Joint Solar Silicon GmbH & Co. KG (JSSi)
- Location: Rheinfelden/Germany
- A novel production process
 - manufacture solar silicon from silane gas
 - only 10 % of the energies used to date in other prod. process
- Schedule and Production Capacity
In 2008 / 850 mt/a



Germany – PV Crystalox





Germany – PV Crystalox

- PV Silicon AG
- 2007/05 decision to set-up poly-silicon plant
- Location: Bitterfeld, Germany
- Investment: € 80 Mio.
- Technology: Siemens, but reduced complexity
- Schedule and Production Capacities
 - 2009 / 900 mt/a
 - 2011 / 1800 mt/a
- Existing plant has space to double production cap.
- Driver: Secured supply, keep cost low



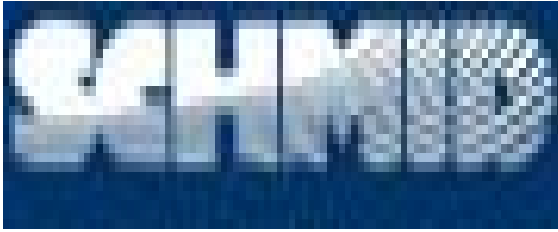
Germany - Wacker

- More than 50 years of experience
- Germany's largest producer / No. 2 worldwide with global market share of approx. 20%
- € 500 Mio investment to rise present production capacity 10,000 mt/a to 22,000 mt/a by 4Q/2010
 - 80 % already sold until 2010
 - € 70 Mio for each 1000 mt / capacity
- Long-term supply contract on average 10 years with a prepayment of € 10 / kg



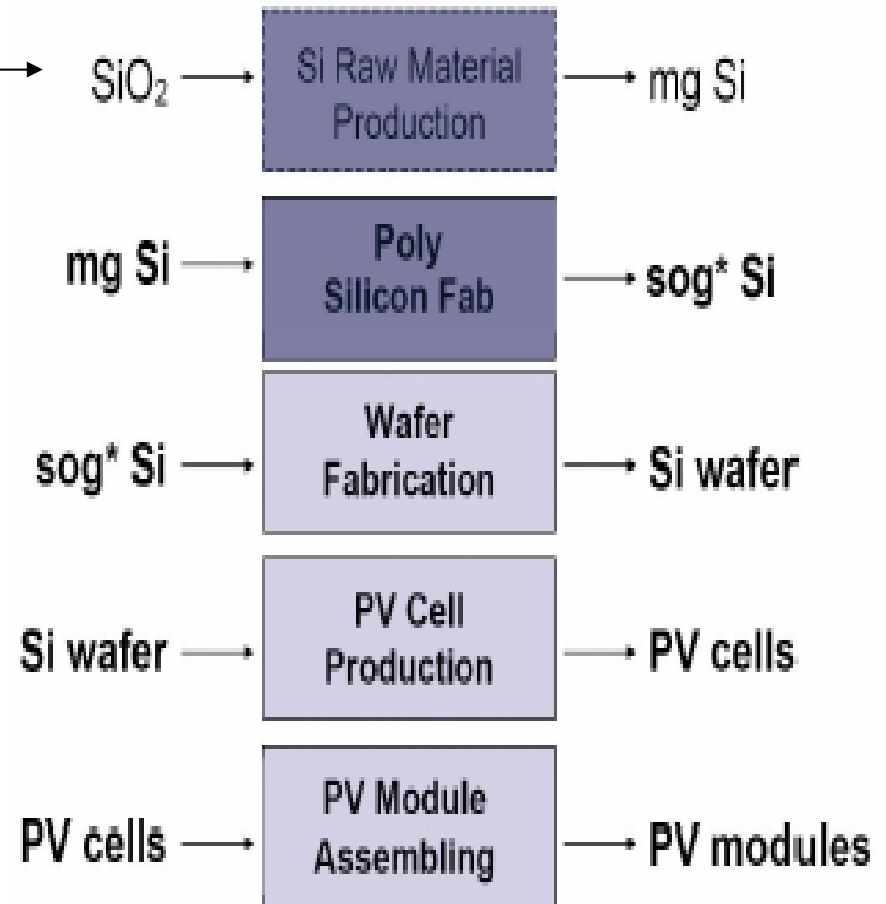
Germany - Wacker

- 2000 – 2006 cost reduction of 46% achieved
- Est. below 100 kWh / kg produced (est. energy input by newcomers may double that amount)
- Fluidized bed reactor (disposition of silicon) technology for granular polysilicon available 3Q/2008 with 650 mt/a capacity
- 20 kg of recycled silicon tetrachloride (trichlorsilane) will lead to 1kg high-purity silicon and 19 kg by-products



Germany – Schmidt Solar Technology

JV in Kazakhstan
Investment :€ 150 Mio.



**Aim: Fully vertically
integrated PV company!**



Germany – Schmidt Solar Technology

- Announcement: 3Q 2007
- Location: Bitterfeld, East Germany
- Technology: Schmid Solar Technology
- Investment: € 300 Mio.
- Schedule and Prod. – Capacity:
4Q 2009 / 2000 mt/a
- 1000 mt Cluster Strategy:
Potential to extend to 6000 mt/a
- Sunways announced to invest in 1000 mt/a

Outlook - Poly-Sil. Prod.-Cap.

Company	Country	Process	Production Capacity			
			2008	2009	2010	2011
Nitol	Russia	GT Solar		3700	3700	3700
Silicio Energia	Spain	Siemens		400	1500	2500
Silfab	Italy	Siemens		2500	2500	5000
Estelux	Italy	Siemens			4000	4000
Elkem	Norway	Upgrade MG-Si	2500	5000	5000	5000
REC	Norway	Siemens	6000	12000	19000	21000
Silicium de Provence	France	Siemens		4500	4500	9000
TSM	NL	Siemens			4000	4000
Solizim	Germany	Upgrade MG-Si			1000	1000
Solarvalue	Germany	Upgrade MG-Si		4400	4400	4400
PrimeSolar	Germany	Upgrade MG-Si			5000	10000
JSSI	Germany	Upgrade MG-Si	850	1200	1600	1600
PV Crystalox	Germany	Siemens		900	1100	1800
Schmidt Solar Technology	Germany	SST		2000	2000	2000
Wacker	Germany	Siemens	12500	14500	21500	21500
Total Capacity			21850	51100	80800	92800

Summary

- Investment amounts to x-100 Mio €
Long-term supply agreement and substantial down-payment € 10 / kg secure funding for expansion
- Majority of manufacturer use Siemens technologies
- Increasing number of metallurgical silicon manufacturer, aiming at to reduce costs
 - costs for raw material doubled within 1 year
- Largest number of prod.-facilities in Germany
- More to come ... in West-EU (7) in East-EU incl. Russia (10) production facilities are planned to be fully vertically integrated
- Over supply vs. develop along with the demand ...

**Thank you for your
attention !**

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