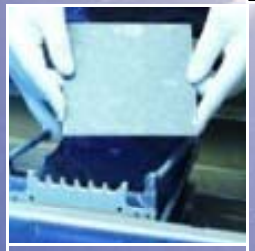
Silicon Materials

Analyst silicon field trip March 28, 2007

Renewable Energy Corporation



Wafers

Cells

Modules

REC

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The world's most integrated solar energy company

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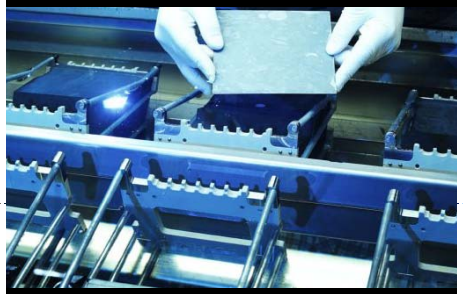
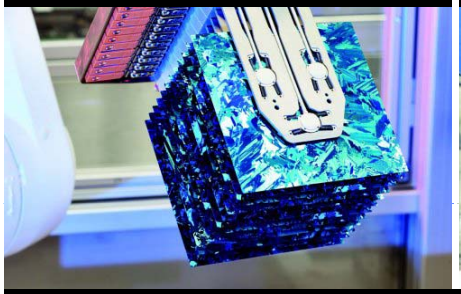
March
27-29, 2007

Silicon Materials	Wafers	Cells	Modules
			
Chemical process →	Casting and cutting →	Surface treatment → Assembly → Installation and operation	

REC Silicon

REC Wafer

REC Solar

REC

Full-year 2006 performance

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Divisions	REC Silicon	REC Wafer	REC Solar
2006 Production	**5 600 MT** polysilicon **8 000 MT** monosilane	**275 MW** multicrystalline **31 MW** monocrystalline	**37 MW** cells **33 MW** modules
2006 vs. 2005	**+6%**	**+37%**	**+100%**
2006:			
Revenues:	**NOK 2 128 mill**	**NOK 2 456 mill**	**NOK 873 mill**
EBITDA:	**NOK 1 063 mill**	**NOK 825 mill**	**NOK 194 mill**
2007 target production	**~6 000 MT** polysilicon **~9 000 MT** monosilane	**~465 MW** multicrystalline **~35 MW** monocrystalline	**~50 MW** cells **~45 MW** modules

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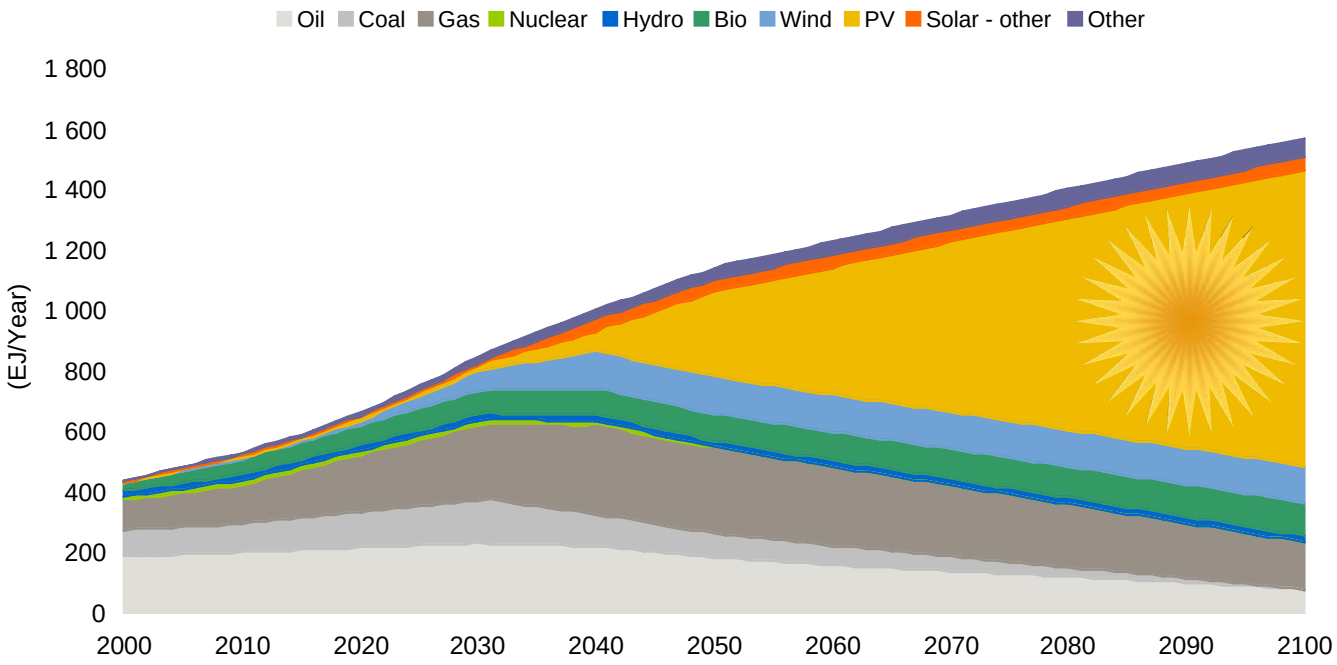
The Solar Industry

Solar energy development forecast



Source: solarwirtschaft.de

- Unlimited renewable source of supply
- Increasingly cost competitive
- Decentralized power source
- Peak power at peak time of usage
- Environmentally friendly

Declining stock of fossil fuels, climate changes and increasing competitiveness of PV systems will boost usage of solar energy over the next century

Cost competitiveness of PV electricity

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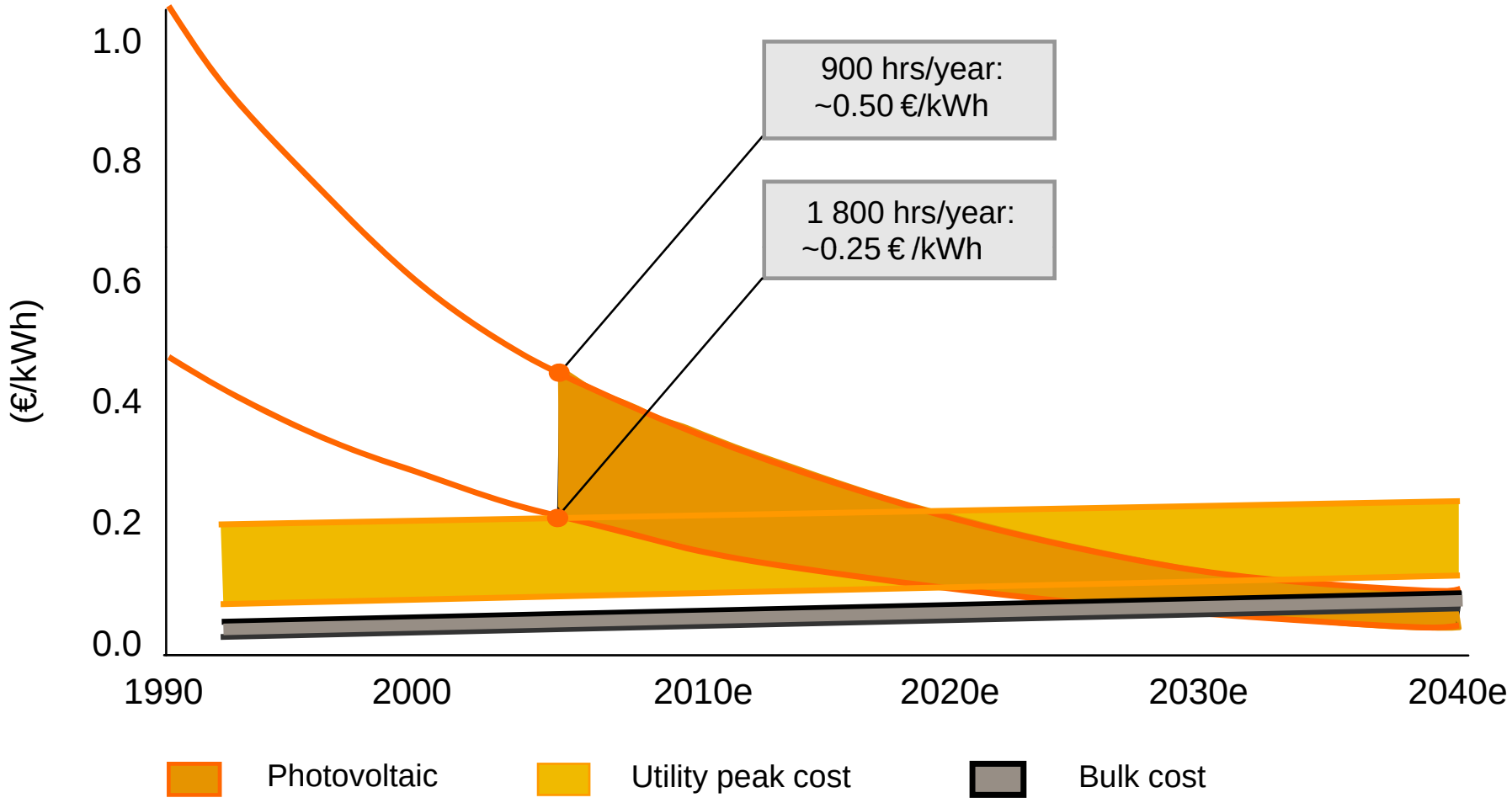

Source: REC, based on EC Vision Report 2005 (EPIA: Towards an Effective Industrial policy for PV (RWE Schott Solar))

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Energy price development triggers strong demand for solar energy

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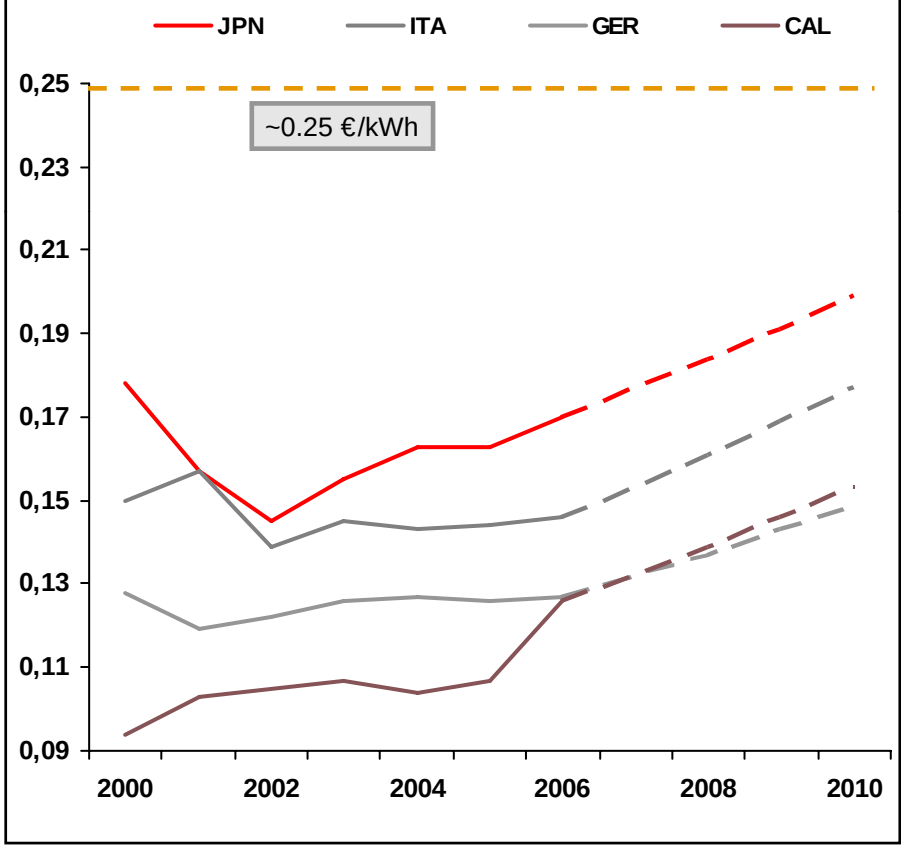
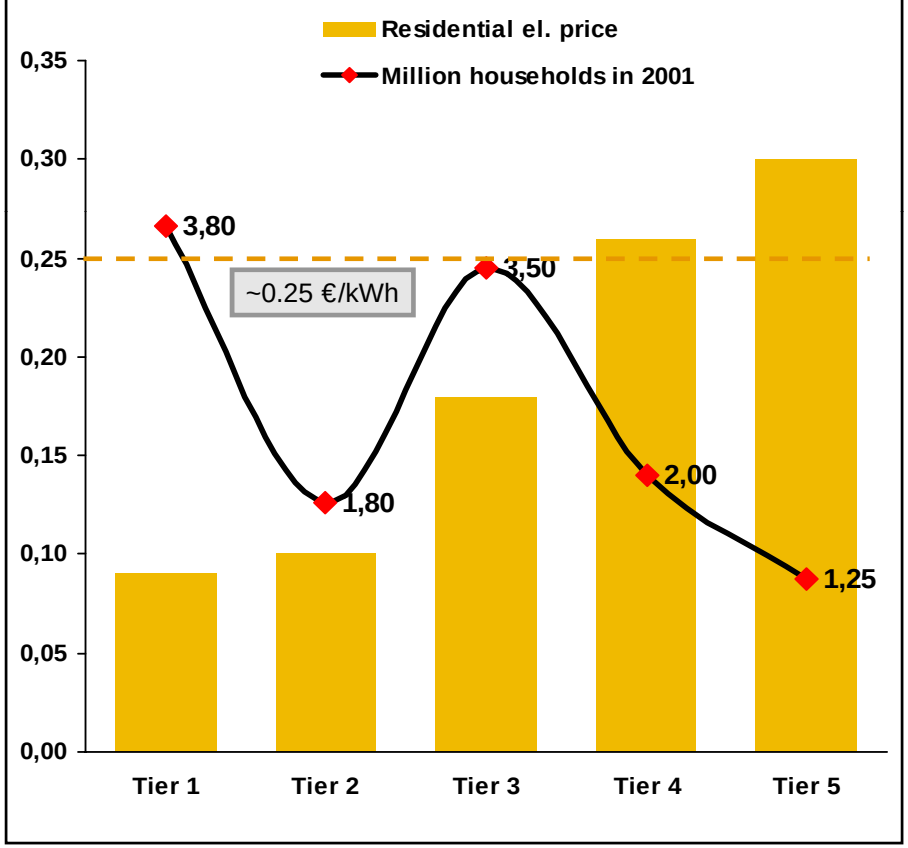
Average electricity prices for retail customers (€/kwh)



Source: Respective national energy departments, REC estimates

CA residential electricity price (€/kwh) and demand



Source: PGE, CEC

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REC Group

Our ambition is to generate strong and profitable growth, at least in line with the high-growth photovoltaic solar market. REC aims to achieve this by further expanding capacity and introducing new technologies across all our businesses

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Three main focus areas…

1. Aggressive growth ambitions - view of ~2010

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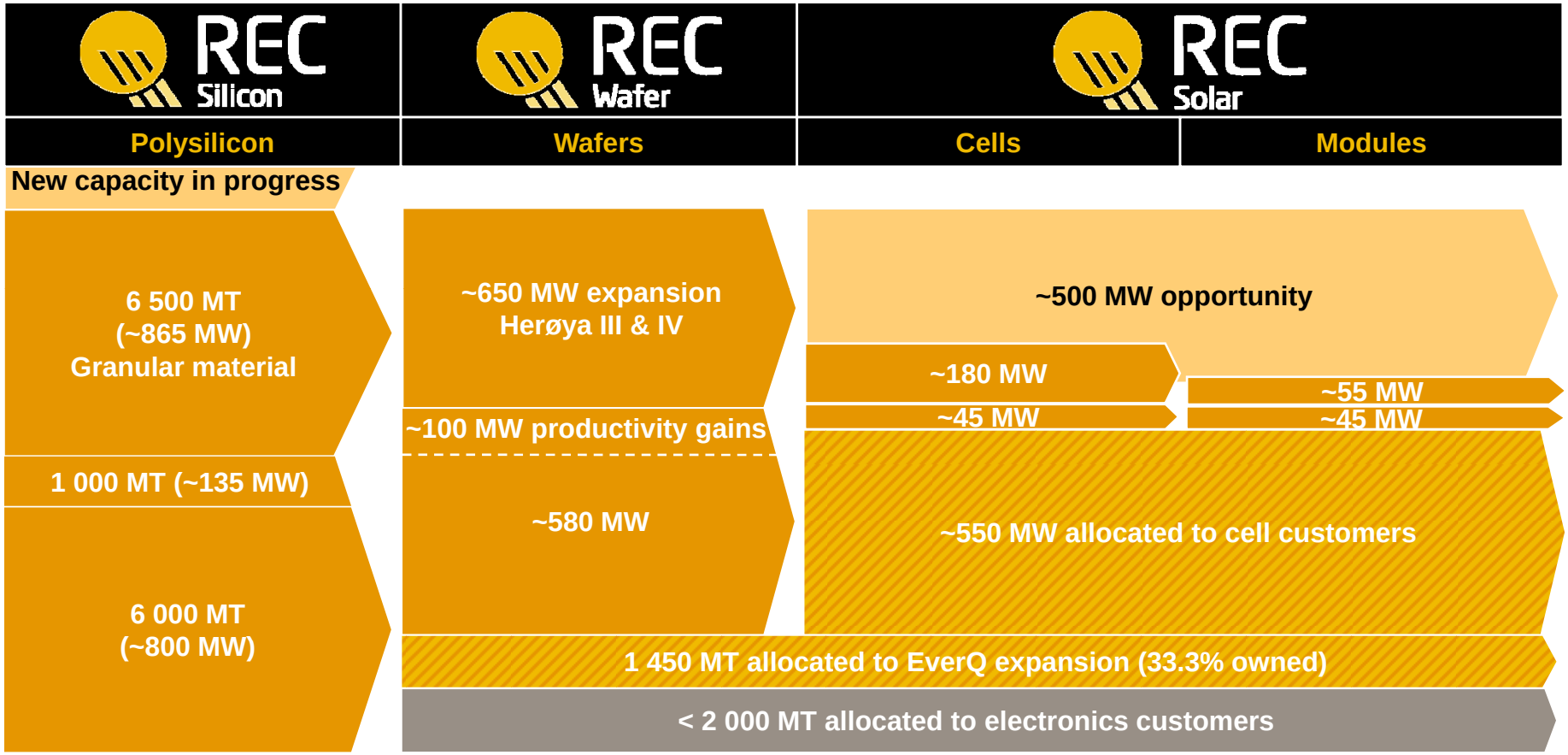
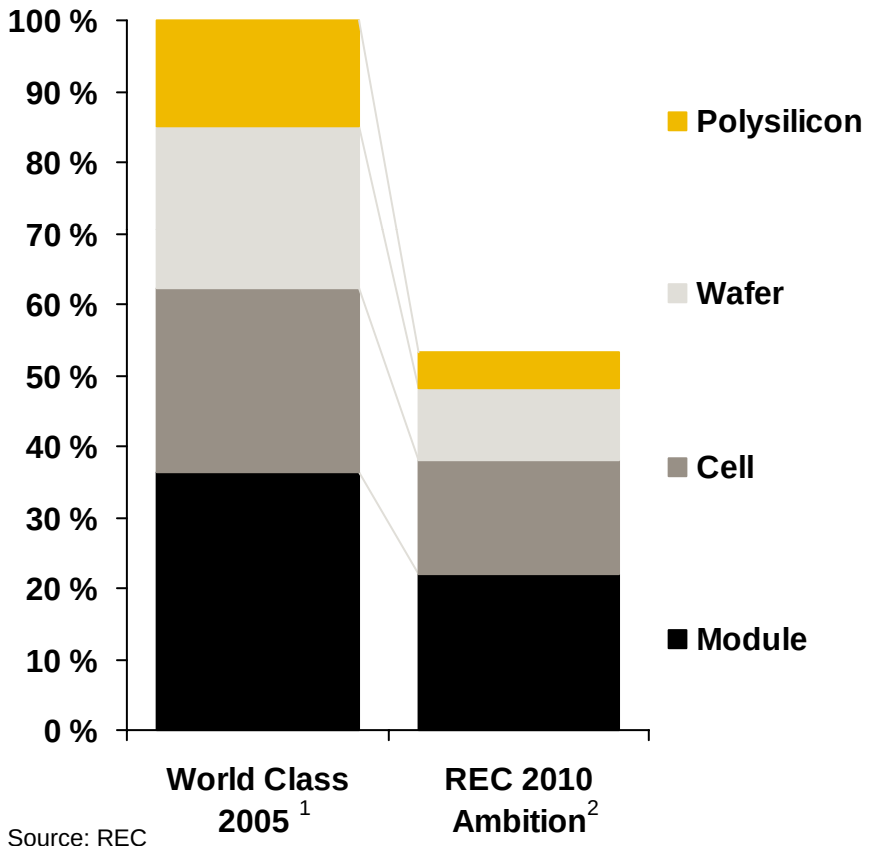


Additional revenue and profit growth contributed by increased silane gas sales

2. On track with the targeted cost program

REC 2010 cost road map
Figures in %



Source: REC

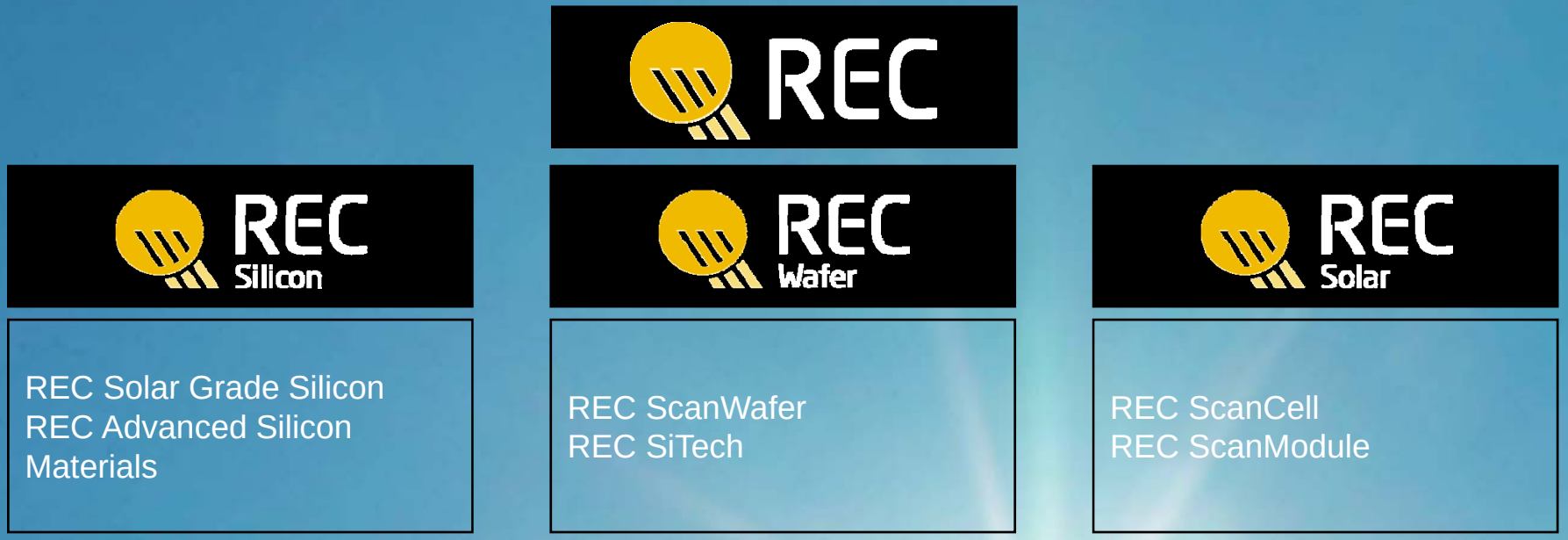
- REC Silicon targets ~60 percent reduction in polysilicon cost input
  - Main benefits will be derived from the FBR-plant and lower consumption
- REC Wafer targets ~50 percent reduction in wafer conversion cost
  - Achieved ~15 percent in 2006
  - Further advanced technologies to be implemented in new production lines
- REC Solar targets significant reduction in cell and module cost input
  - Achieved ~10 percent in cell and ~5 percent in module in 2006
  - Further advanced technologies to be implemented in new production lines

Note 1: Cost structure as cost per watt of modules, based on world class production 2005

Note 2: Cost structure as cost per watt of modules, relative to 2005 level

3. REC Group organization development

4th quarter presentation



➔ BU focus and organization build up in each division to ensure autonomy and growth

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REC Group outlook – 2007 targets

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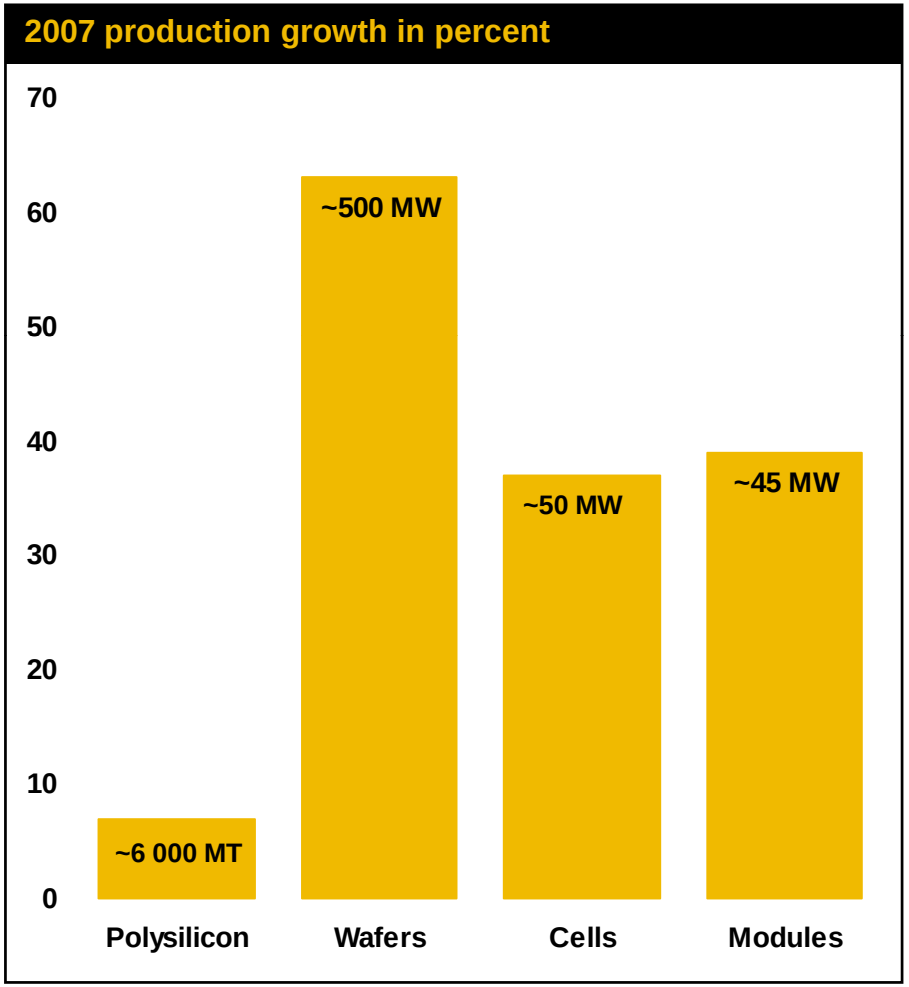
- Continued focus on cost improvements
- Execution of expansion programs
  - **REC Silicon**: Construction of FBR-plant; de-bottlenecking program at Butte
  - **REC Wafer**: Continue ramp-up of the new 200 MW plant; begin construction of the two new plants of 650 MW
  - **REC Solar**: Ramp-up first phase of 180 MW cell expansion in Narvik and 55 MW module expansion in Glava
  - **EverQ**: Complete ramp-up of additional 60 MW expansion
- Pricing outlook on a full year basis
  - REC Silicon – increase of above 15 percent
  - REC Wafer – increase of above 10 percent
  - REC Solar – reduction of up to 5 percent



Note: Polysilicon production measured in MT. Wafers, cells and modules in MW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REC Silicon

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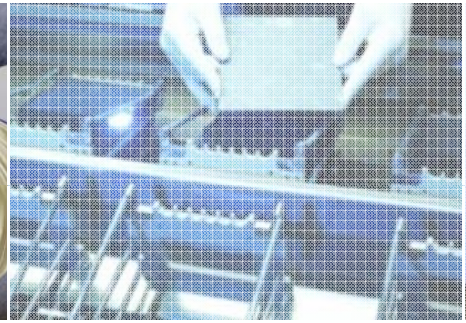
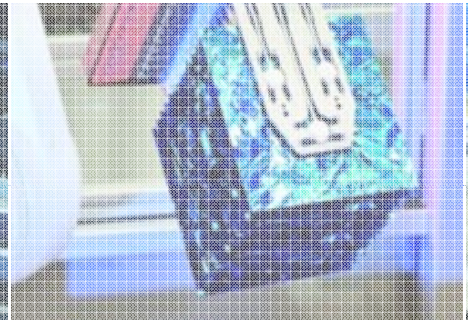
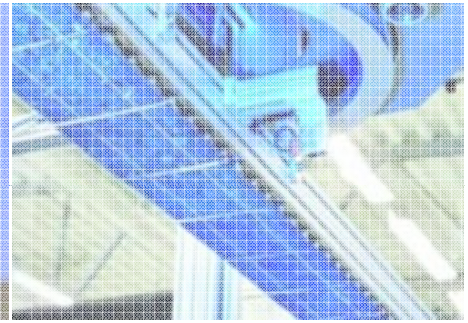
REC Silicon	REC Wafer	REC Solar	
		Cells	Modules
			
Chemical process (purification)	Casting and cutting	Surface treatment →	Assembly →

- REC Silicon produces silicon materials for the electronics and the photovoltaic markets
- REC Silicon is a large player in the global silicon materials industry
  - # 1 producer of polysilicon for photovoltaic applications
  - # 1 in monosilane gas production
  - # 3 in overall polysilicon production

REC Silicon – organization

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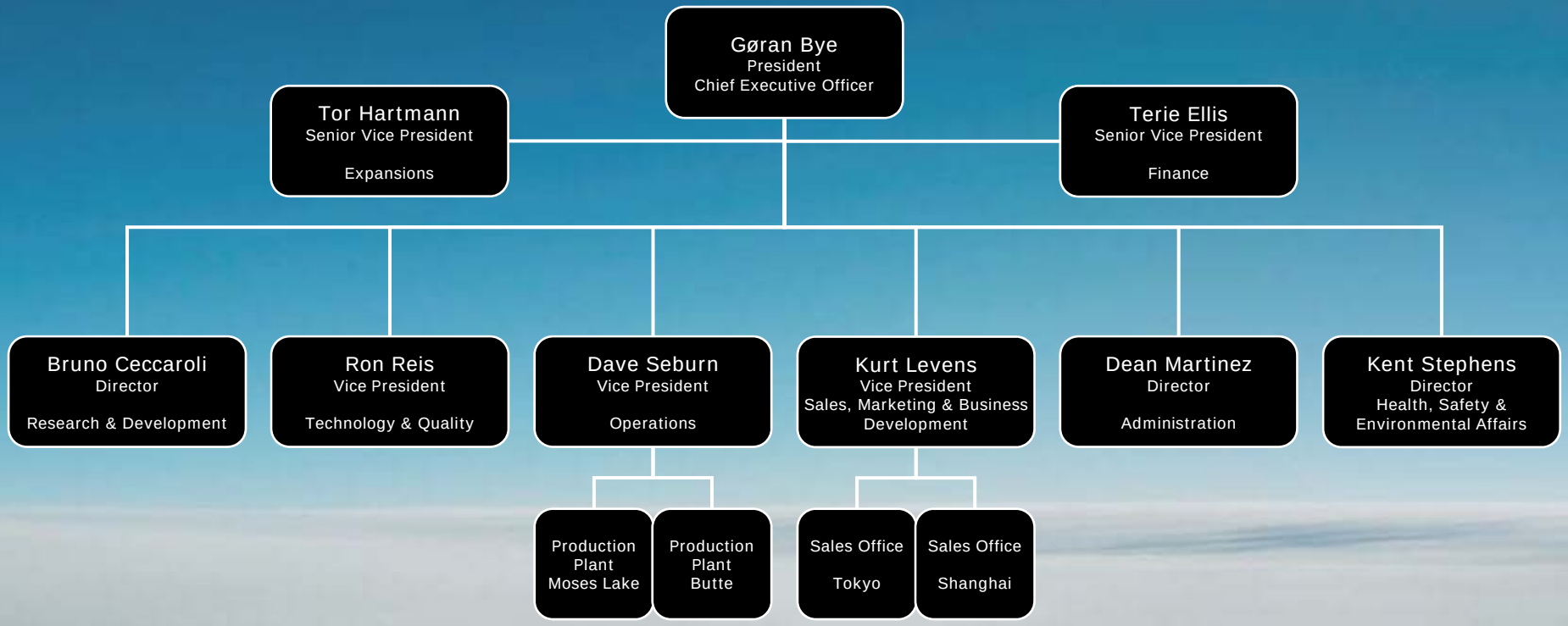

Employees
2006 ~500
2007 ~600

REC Silicon – history

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1983 to 1984	Construction of Moses Lake Plant by Union Carbide Corp.
1990	Moses Lake Plant purchased by Komatsu Ltd., creating Advanced Silicon Materials Inc. (ASiMI)
1996 to 1998	Construction of Butte Plant
2002	Moses Lake plant becomes Solar Grade Silicon LLC via Joint Venture between Komatsu and REC
2005	ASiMI purchased by REC, creating REC Silicon
2006	REC Silicon breaks ground on third polysilicon plant, Moses Lake, USD 600 million, and decides to invest USD 50 million in Butte plant
2007	REC Silicon decides to invest USD 50 million in long lead items for further expansion

Current polysilicon production process

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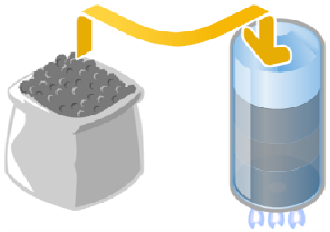
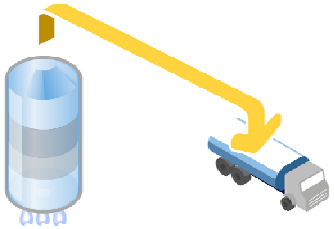
1: Mg-Si

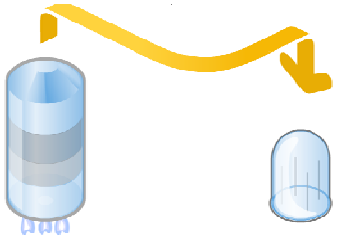
2: Silane



3: Silane sold to PV, LCD, thin film



4: Most silane used for polysilicon

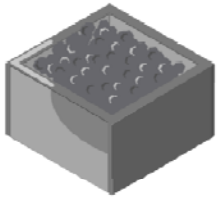


5: Siemens process at high temperature

6: Rods

7: Rod pieces

8: Loaded ingot crucible



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Value creation at REC Silicon

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Metallurgical Grade Silicon
98 to 99% pure

Silane gas refinery

SiH4

Gas distributors

- Electronic semiconductor manufacturers
- LCD panel manufacturers
- Thin-film cell manufacturers
- Crystalline silicon cells manufacturers

Ingot & wafer manufacturers

Ingot & wafer manufacturers

Polycrystalline silicon
99.9999999% pure

Monosilane gas (SiH4)

Siemens reactor based polycrystalline silicon deposition process

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Growth & cost initiatives: New granular polysilicon plant

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- Plant capacity ~ 9,000MT Silane and ~ 6,500 MT granular polysilicon
- Project is on plan
  - Ground-breaking in August 2006, construction commenced in 2007
  - Online in second half 2008

Growth & cost initiatives: New granular polysilicon plant

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Growth & cost initiatives: De-bottlenecking in the Butte plant

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- Increasing peak capacity and reliability of the silane unit
- Modifying around 1/3 of the poly deposition reactors (Siemens)
  - Increased polysilicon deposition rate through rebuild of gas circulation
- Investment: USD 50 million
- Additional 2,000 MT of silane gas
  - ~1/3 dedicated to the merchant market
- ~1,000 MT additional polysilicon
- Reducing cost significantly
  - Up to 50% lower electricity consumption in the polysilicon deposition
  - Close to 20% reduction on total cost
- Full effect from the end of Q2 2008

Polysilicon cost roadmap 2005 - 2010

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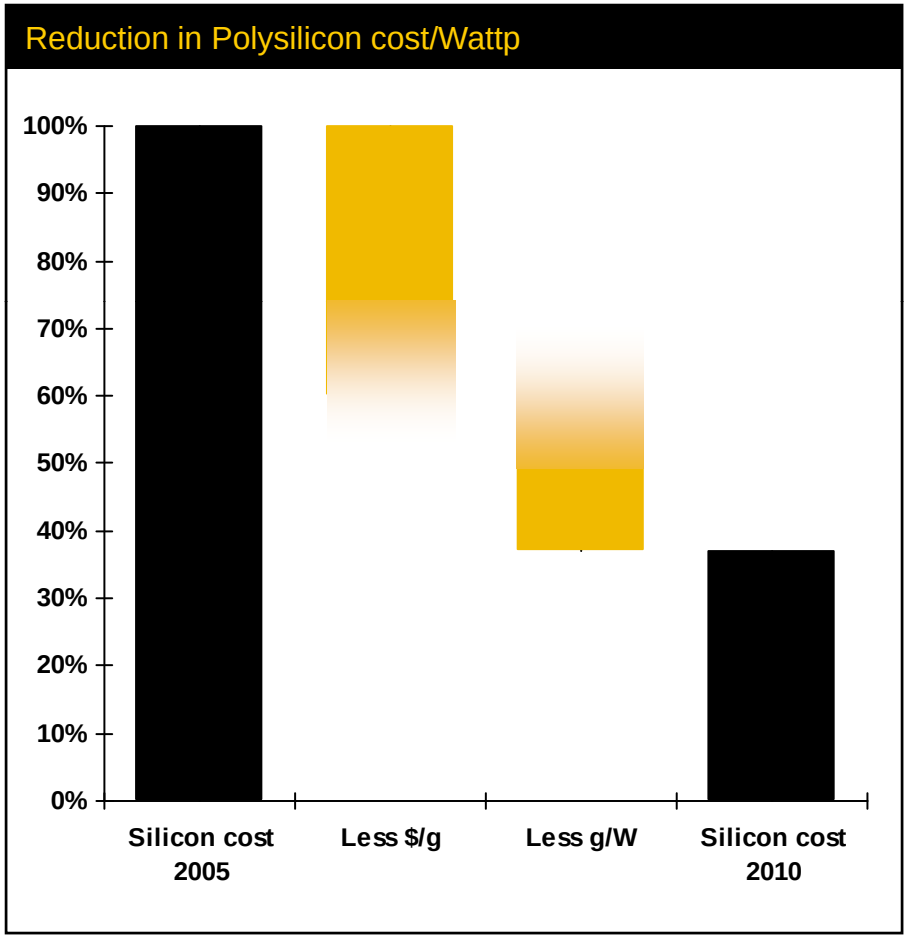
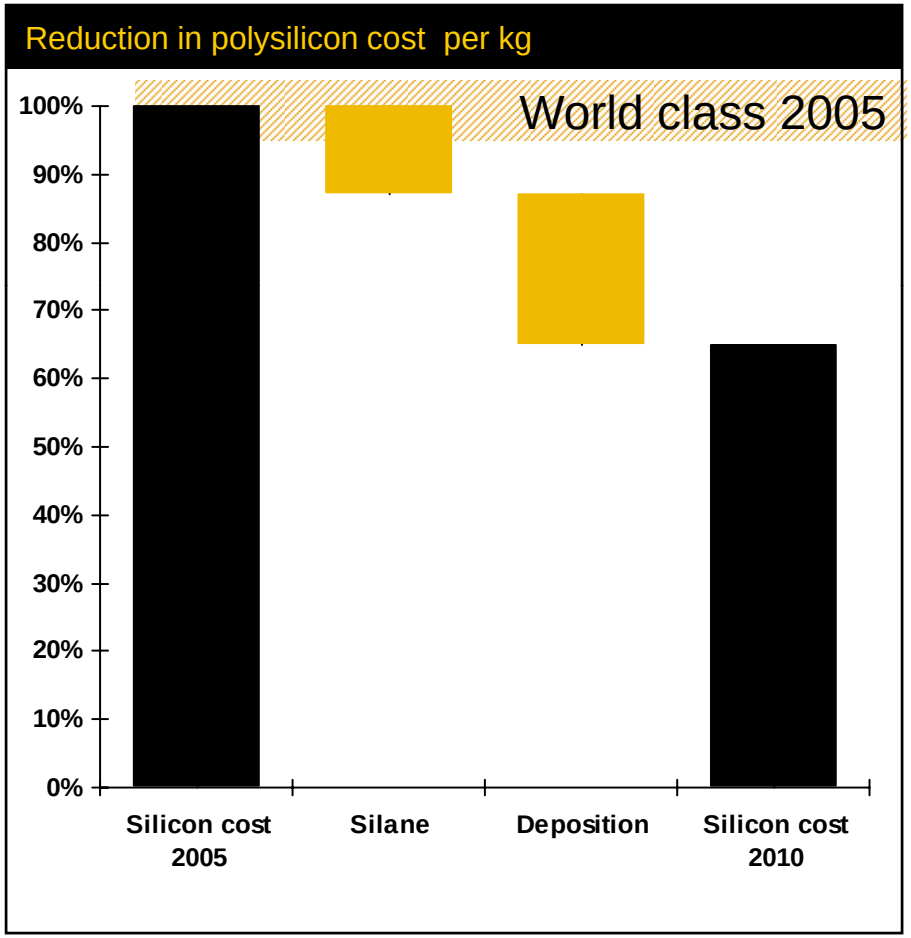
- New plant with granular and scaled-up silane processes will almost halve the (full) cost
- Thinner wafer, thinner wire and higher cell efficiency contribute further
- Status
  - FBR plant currently being built
  - Group's silicon consumption per Wp rapidly declining
  - Potential beyond "2010 roadmap" identified



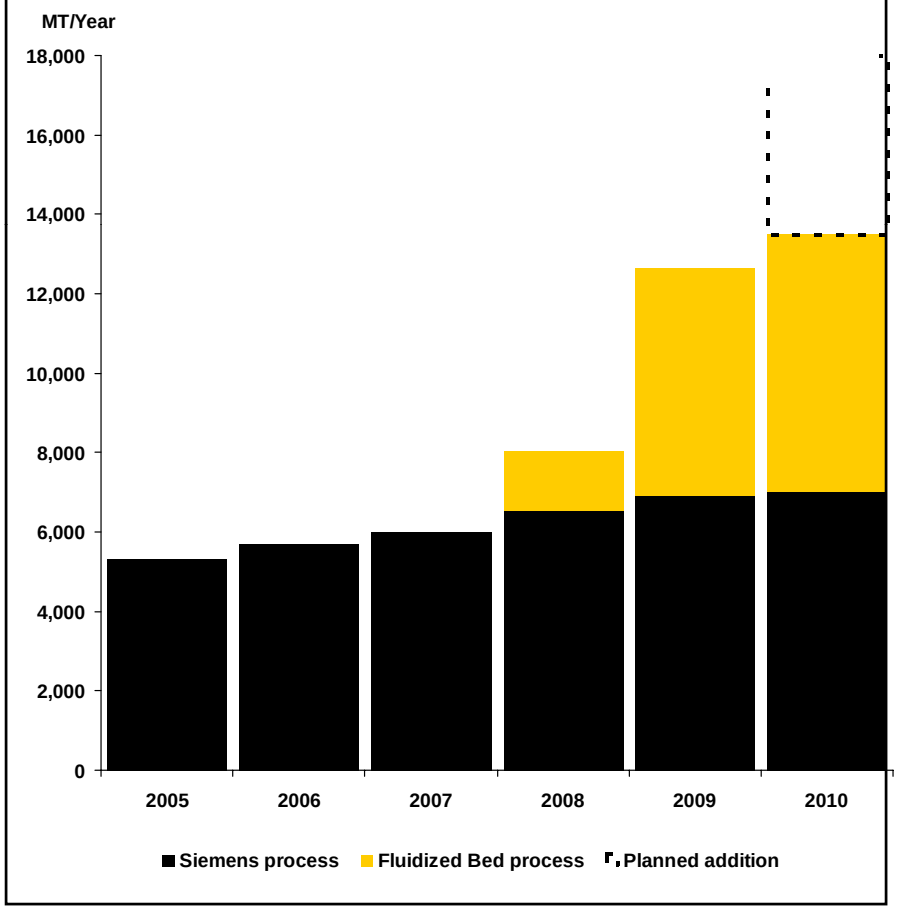
Large savings in both silane and FBR process

- Silane costs declining due to scale and optimization
- Granular energy consumption is 80-90 % below typical Siemens process
  - Hot wall design versus cold wall which draws off energy
  - Granular cost saving is increasing with increasing electricity prices
- Capital and labor cost reduced due to continuous processes



Result of the growth strategy

Polysilicon production



- De-bottlenecking and construction will continue 2007 – 2009
- Impact on performance
  - Start-up and ramp-up cost
  - 'Unusual' timing of smaller production shut-downs to accommodate tie-ins and implementation of new technology
  - Difficult to guide on exact timing
- Additional capacity extensions in progress
  - Ordered long lead items (USD 50m)
  - Additional silane gas production
  - Further modification of Siemens Rxs
  - Exploit demonstrated increased productivity and yield in FB Rxs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Silicon Technologies

➔ Several technologies are in play today for producing PV wafers/cells

- Upgraded MGS
  - Elkem, Dow Corning, JFE, Nippon Steel, Becancour, Ferro Atlantica, Scheuten, Solar Value…
- Siemens:
  - Silane: REC Silicon
  - Trichlorosilane: Hemlock, Wacker, Tokuyama, MEMC, numerous new entrants
- Fluid Bed:
  - Silane: MEMC, REC Silicon – in production / building full scale plant
  - Trichlorosilane: Hemlock, Wacker – status is uncertain
- Thin Films
  - Silane based: Applied Materials, Oerlikon, UniSolar, Kaneka, Mitsubishi Heavy Industries, CSG Solar…
  - Copper Indium Gallium diSelenide based: Nanosolar, Heliovolt…
  - Cadmium Telluride based: First Solar…
  - Organic: in development

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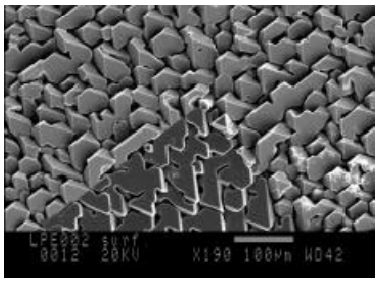
➔ Upgraded MGS

- Cost Projection: <USD 20/kg[1]
- Quality Projection: Typical resultant cell efficiency around 15% [1]
- Global Capacity Projection: 5,000 MT/year mid 2008; 35,000 MT indicated in 2011

Slag Refining

Leaching

Solidification



— [1] From ORKLA Investors Presentation 27-October-2006 on Elkem Solar

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Silicon Technologies

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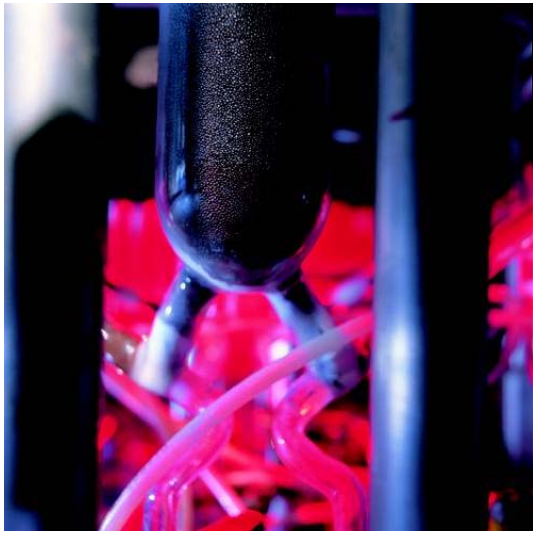
➔ Siemens

- Cost: Ranges USD 25 – USD 45/kg (what will cost be for new entrants?)
- Quality: Highest purity polysilicon, basis for typical and high efficiency cells
- Capacity: Roughly 35,000 MT globally in 2006;
  growing significantly by 2011: 175,000 MT announced, planned and rumored

Silicon Technologies

➔ Fluid Bed

- Cost: <70% of Siemens/kg (REC Silicon)
- Quality: Demonstrated commercial cell efficiency both internally and externally (REC Silicon); also potential for electronics use (already used by MEMC)
- Capacity: ~13,000 MT worldwide by 2009



Silicon Technologies

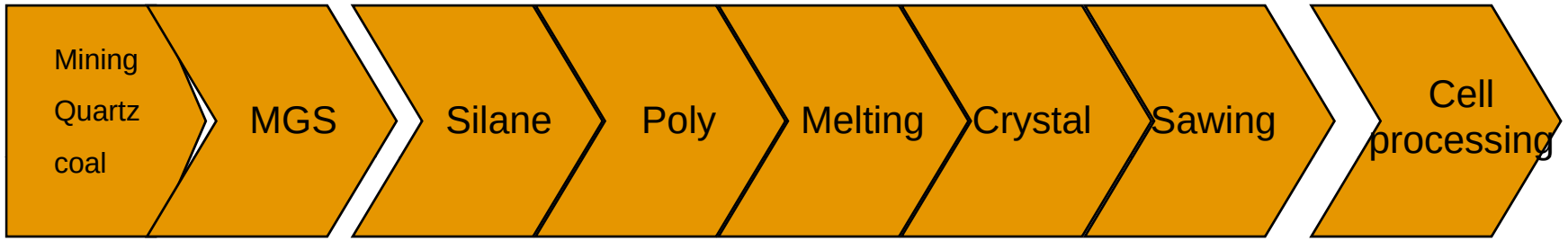
➔ Thin Film

- Cost: Averages 800 kg of silicon per MWp
- Quality: Scale demonstrated efficiencies at 10%, CSG Solar micro-crystalline module
- Capacity: 2006: ~125 MW per year, but larger facilities under construction: >1 GW in 2011

- Photo courtesy of CSG Solar

Silicon Technologies – why so many different initiatives?

Process steps in the value chain



- Current technology (and business) chain is fragmented
- Batch to batch, not continuous
- Considerable loss of energy and materials (within and between the steps)
- Cost decrease calls for simplification and re-engineering

REC Silicon's technology is superbly positioned

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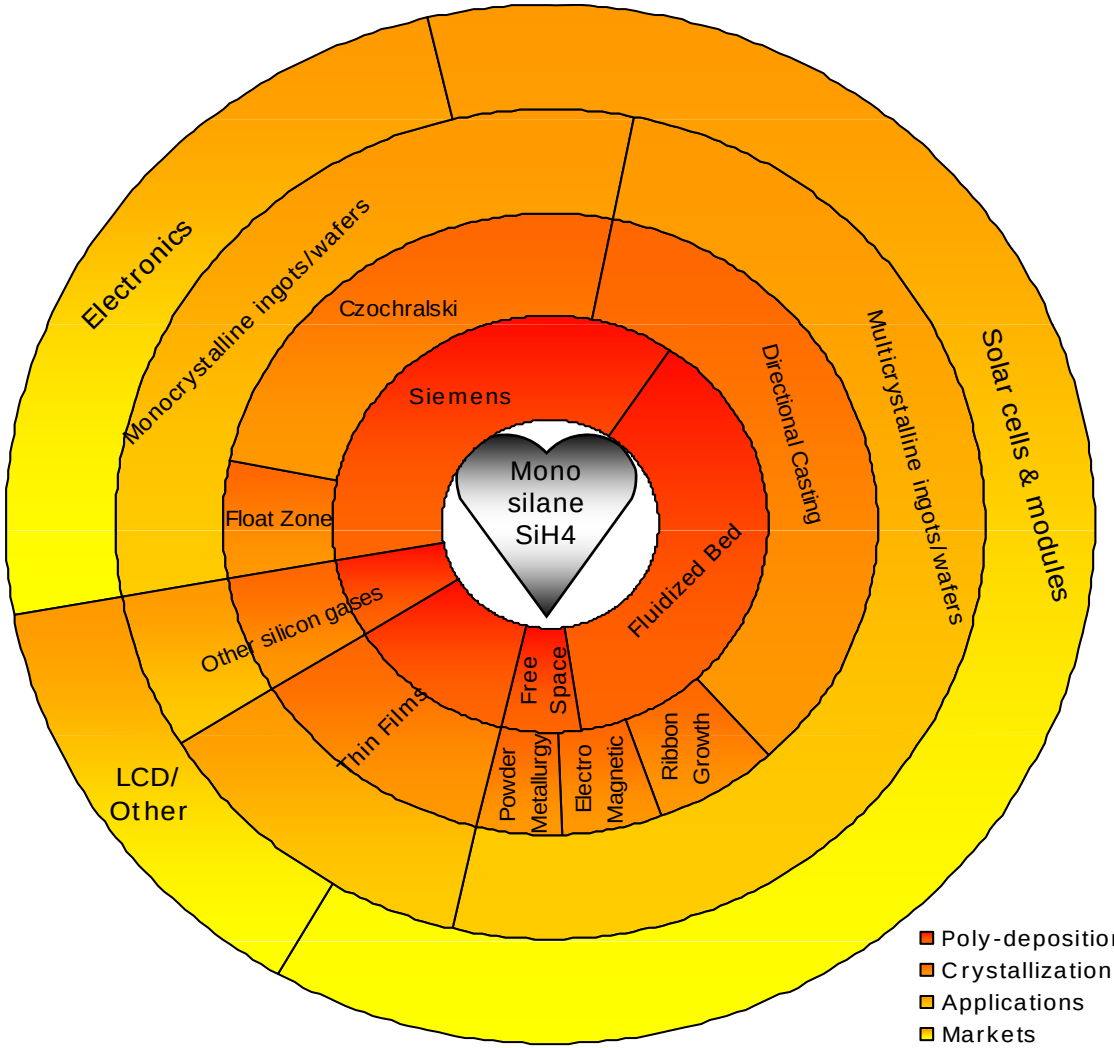
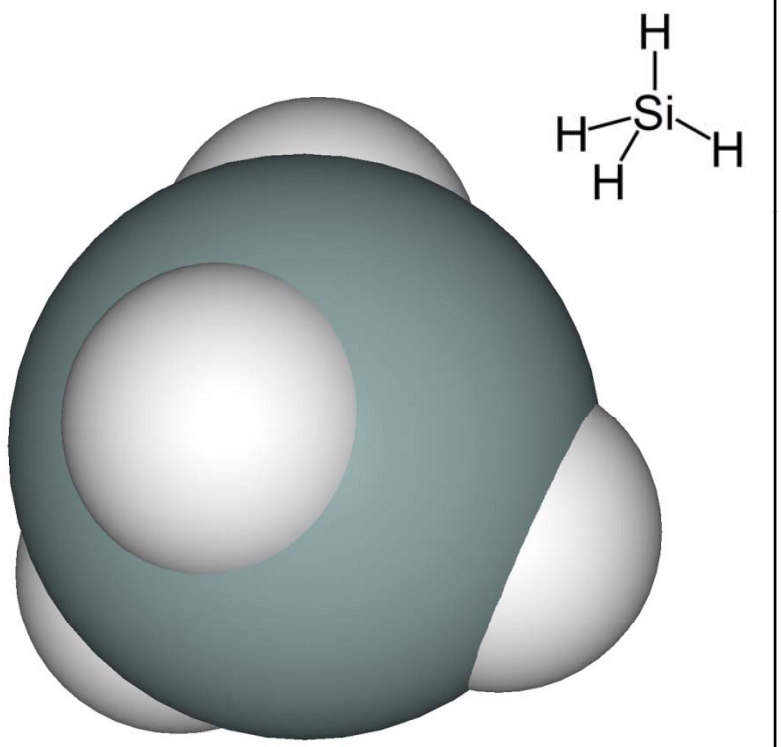


Silane gas is the starting point

- Silane: one silicon atom attached to four hydrogen atoms
- Purest form of silicon in the world. Purity measured to single digit parts per trillion for some elements (phosphorous, boron, etc)
- Our process chemistry seems simple, and is:
  - Si (98% pure) + STC + H2 → TCS
  - TCS → SiH4 (internally recycles chlorosilanes)
  - SiH4 → Si (pure) + 2 H2

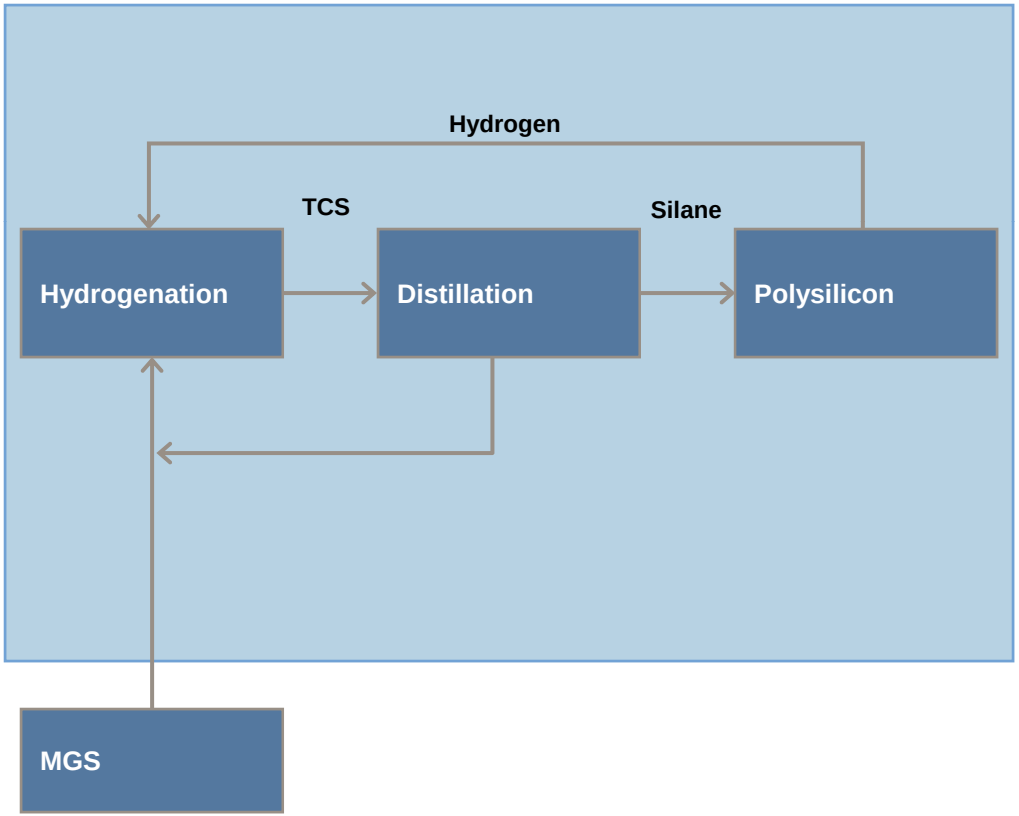
Silane Molecule



Silane to polysilicon technology

- Silane closed loop and ”green” process
- **Input:**
  - Metallurgical silicon
- **Output:**
  - Silane gas
- **Recycles**
  - Chlorosilanes
  - Hydrogen
- Highly efficient, consumes all raw materials with no need for off site reprocessing

Silicon from Silane process



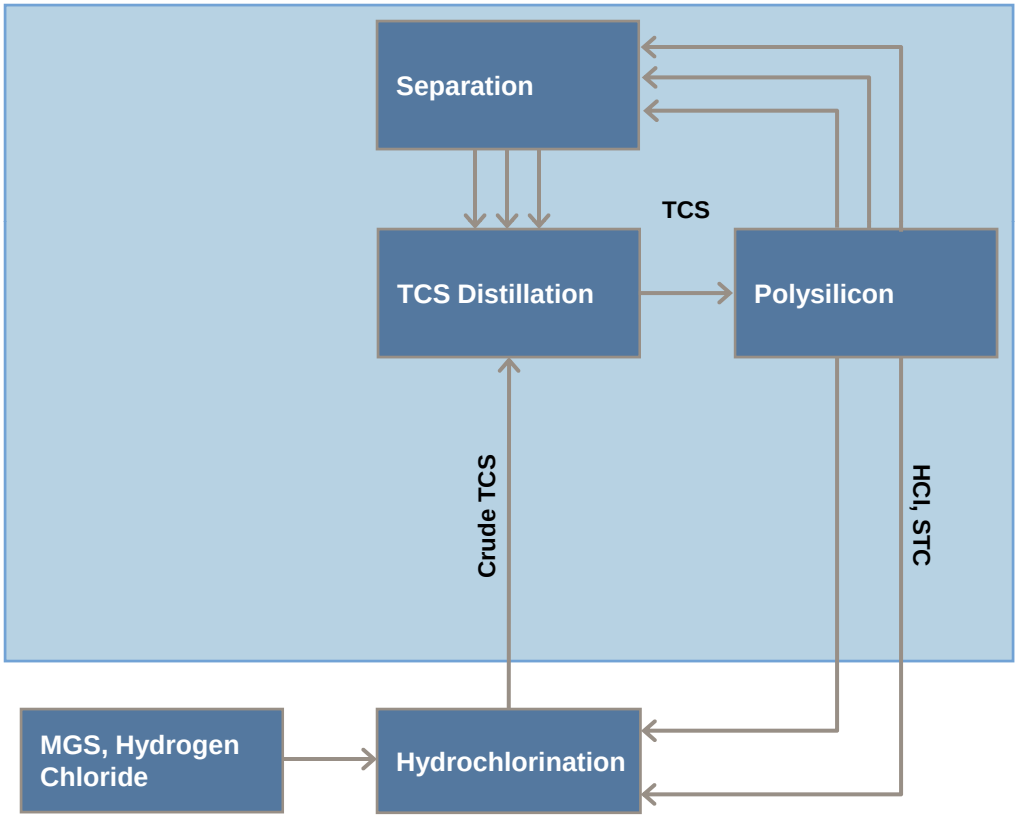
Trichlorosilane to polysilicon technology

- TCS open loop process

- **Input:**
  - Metalurgical silicon, hydrocloric acid (HCL)
- **Output:**
  - 1 part silicon
  - 1 part hydrochloric acid
  - 1 part silicon tetrachloride

- Less efficient, typically external recycling of byproducts

Silicon from Trichlorosilane process



REC Silicon's silane technology is based upon knowledge

➔ Intellectual Property

Effect	Impact
Over 85 issued or pending patents for silane and silane based polysilicon technology	Freedom to operate = lowest cost
On-going research into core technology: US and Norway	Lowest manufacturing cost, new silane derivatives
Proprietary operational and maintenance practices	Reliability, safety, lowest cost
Experience: Over 25 years operating silane to polysilicon plants and >500 trained, knowledgable employees	Reliability, safety, lowest cost

Silane requires careful handling

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- Safety issues:
  - Silane is an pyrophoric gas.
  - Chlorosilane intermediaries (TCS; DCS; MCS) are corrosive and flammable

- Safety focus :
  - 25 years of experience, including some very difficult lessons in the hazards of this business
  - Full compliance with US government regulations for chemical manufacturing: Process Safety Management (PSM)
  - On going research into materials characteristics, fundamentals of reactivity and product safety
  - Provide support services to all customers on silane safety and product handling
  - Proprietary knowledge in equipment design and operation for silane and polysilicon manufacturing are being incorporated into REC Silicon III plant
  - Awarded 2006 Air Liquide Global Supplier of the Year for Safety

Indirect sales channel for Silane

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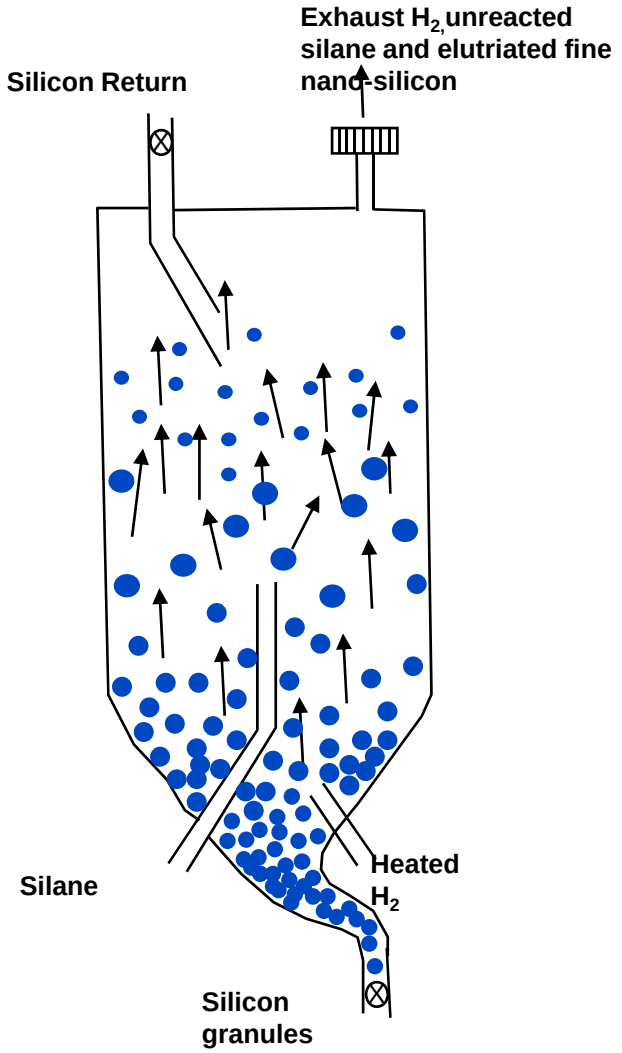
- REC Silicon's silane sales is a small part of the gas companies' overall business but a healthy 10-20% of their specialty gas trade
  - The silane gas is sold in bulk (3-6 MT) to the specialty gas operations of major gas companies, which trans-fill the gas to smaller containers (1-250 Kg)
  - Silane and other specialty gases, chemicals and services are sold to end-users as a "package"
- Pricing strategies have encouraged gas companies to buy from REC Silicon while entry barriers have discouraged new competitors from entering
  - Unique competitive advantages: Scale and delivery ability, precision and technical support

Polysilicon Deposition Technology

- Fluid Bed energy consumption is significantly less than Siemens process:
  - Continuous process versus batch processing
  - Hot Wall design versus cold wall which draws off energy
- Demonstrated pilot unit, qualified by PV customers
- REC has invested over 10 years of research in silane based fluid bed deposition, culminating in a successful process.



Fluidized Bed Reactor less favorable with TCS

Field trip
March
27-29, 2007

- Silane is a preferred choice for fluidized bed polysilicon deposition reaction
  - Readily decomposes with low energy demand to silicon and hydrogen only
  - No competing counter reactions such as can be found with TCS: hydrochloric acid gas resulting from TCS decomposition can attack formed silicon, lowering total yields
- Granular polysilicon quality can be very pure, even acceptable for semiconductor purposes

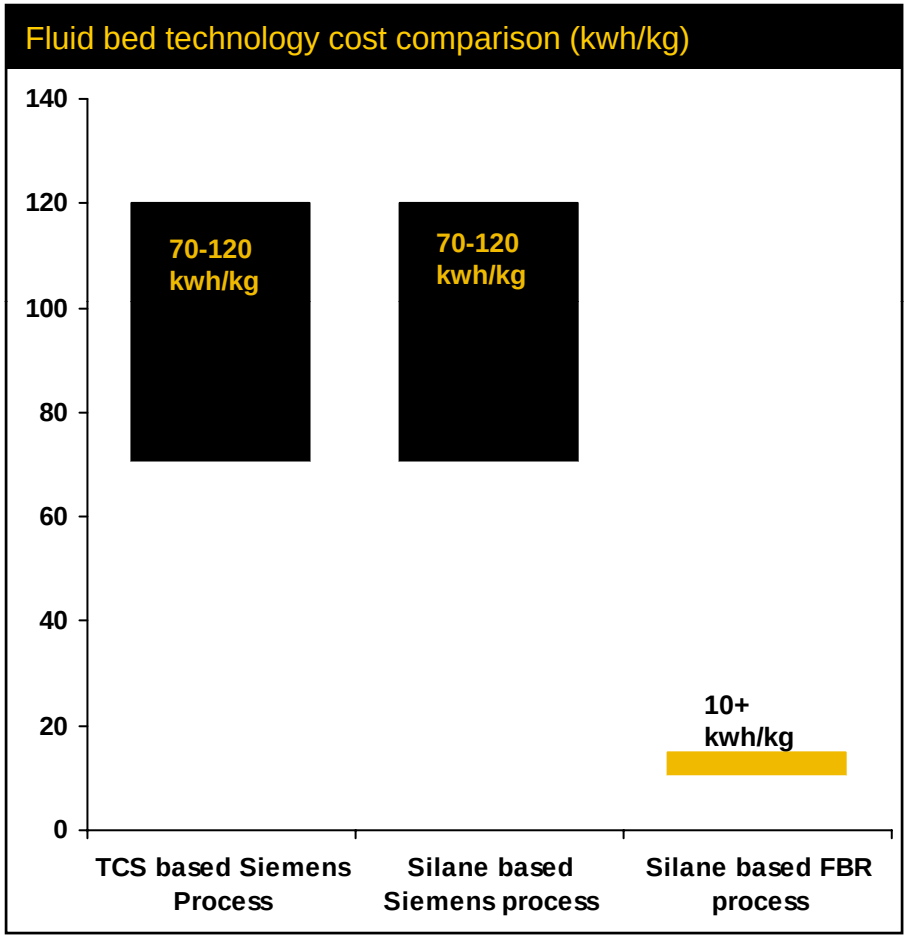
Critical success factors - fluidized bed development

Field trip
March
27-29, 2007

Success factors	Approach	Impact
Control powder formation to avoid plugging	Nozzles optimized and patented	**Productivity**
Control powder formation to maximise yield	Nozzles optimized and patented	**Yield**
Pure, low cost seeding of small granules	Self-seeding technology developing.	**Cost and product purity**
Long production runs	Continuous optimisation	**Productivity and yield**
Purity	Careful material choices & procedures	**Product purity**

Silane based FBR : World lowest energy consumption

- Energy costs are major factor in polysilicon deposition technologies
- Fluid Bed technology reduces this cost by approximately a factor of 10, because:
  - No need for traditional Siemens “cold wall” design which draws energy out of the process and results in inefficiencies
  - Continuous process versus batch which more efficiently utilizes input energy



FBR Technology at REC Silicon

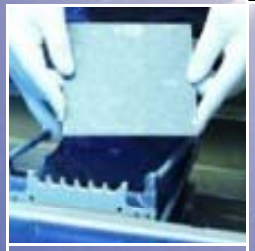
Field trip
March
27-29, 2007

- REC Silicon continues to run granular test production
  - More process experience gained while producing qualifying material through 2007
  - Final verification of product quality achieved with very good results
  - Maintaining development program to improve this core technology
- Construction of the new plant is progressing on schedule
  - The plant will have a capacity of ~ 9,000MT Silane and ~ 6,500 MT polysilicon
  - The plant will come online in 2008 Q3 with six to nine months of ramp-up
- REC Silicon and its predecessor have worked on developing the technology since mid 1990's
  - It is a proven technology
  - REC is already working on next generation FBR

Silicon Materials

Silicon Materials – the supply side

Renewable Energy Corporation



Wafers

Cells

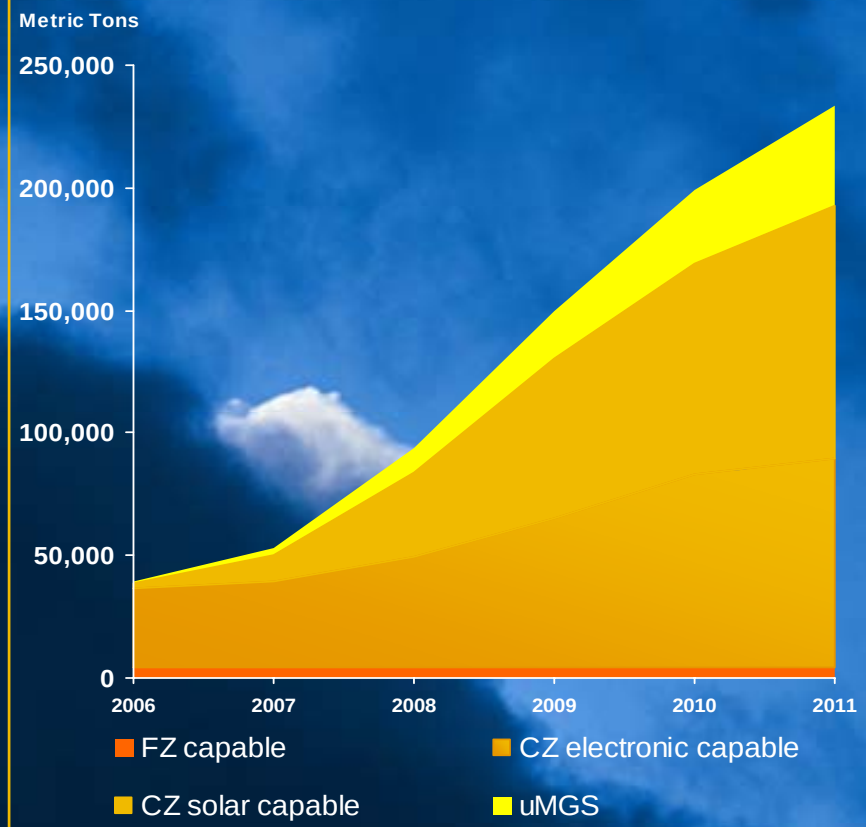
Modules

REC

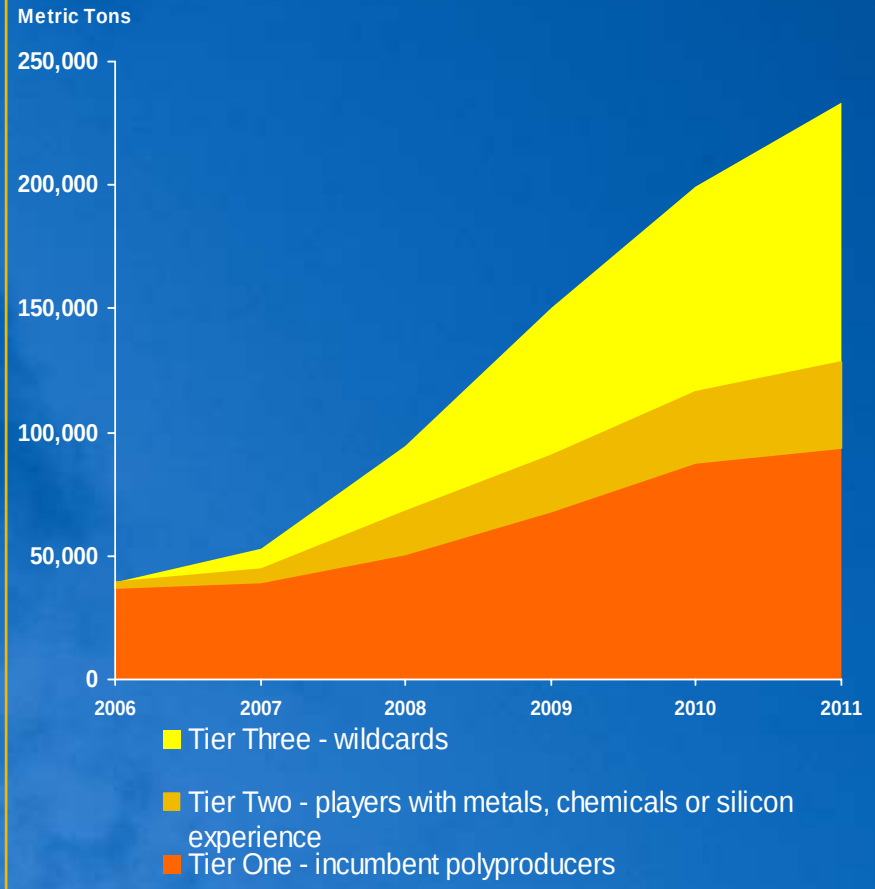
Announced, planned and rumored supply of silicon materials until 2011

Field trip
March
27-29, 2007

Polysilicon supply by type of product



Polysilicon supply by industrial player



Silicon materials fungibility

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March
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			Multi Cast	Mono	Multi emc	Ribbon	Spheral Cells	Thick Films	Thin Films
uMGS			YES	?	?	no	Yes	no	no
REC Silicon	Silane TCS	Chunk Poly	YES	YES	yes	no	no	no	no
	Silane (TCS?)	Granu-lar Poly	yes	YES (replenish)	YES	YES	yes	yes	no
	Silane	Powder	no	no	yes	yes	yes	YES	no
	Silane	as gas	no	no	no	no	no	yes	YES
TCS/DCS as gas			no	no	no	no	no	yes	no

REC

Silicon materials demand development

Field trip
March
27-29, 2007

- Strongest driver will continue to be the growth of PV
  - Long term growth dependent on solar power becoming competitive
  - Potentially very large demand for silicon materials even though Si g/Wp will continue to decrease
  - Relationship between short term PV-growth and demand for silicon materials will be “non-linear” due to value chain inefficiencies
    - Large underutilized downstream capacity
    - Close to non-existent silicon inventories
    - Contracted volumes versus actual timing of new production and financial viability of purchasers
- But don’t forget the electronic segment
  - Prognosticators say electronics demand will be higher than earlier expected
  - Accelerated blurring of the borders between electronics and PV
- Increasing importance of materials purity
  - The quest for higher efficiency cells and modules will trickle down to silicon purity
- Silicon value chain as well as silicon “form factor” likely to evolve
  - Polysilicon chunk versus particulate silicon versus silicon gases

Competitive advantages in silicon materials

Field trip
March
27-29, 2007

- The best positioned suppliers will be characterized by:
  - Cost of production
  - Quality of customers and relationships
  - Contract structure
  - State of technology and IPR
  - Fungibility of the silicon products

Thank you