



ADVANCED SOLUTIONS FOR POLYSILICON PRODUCTION.
THE SOLAR INDUSTRY BEGINS WITH US.

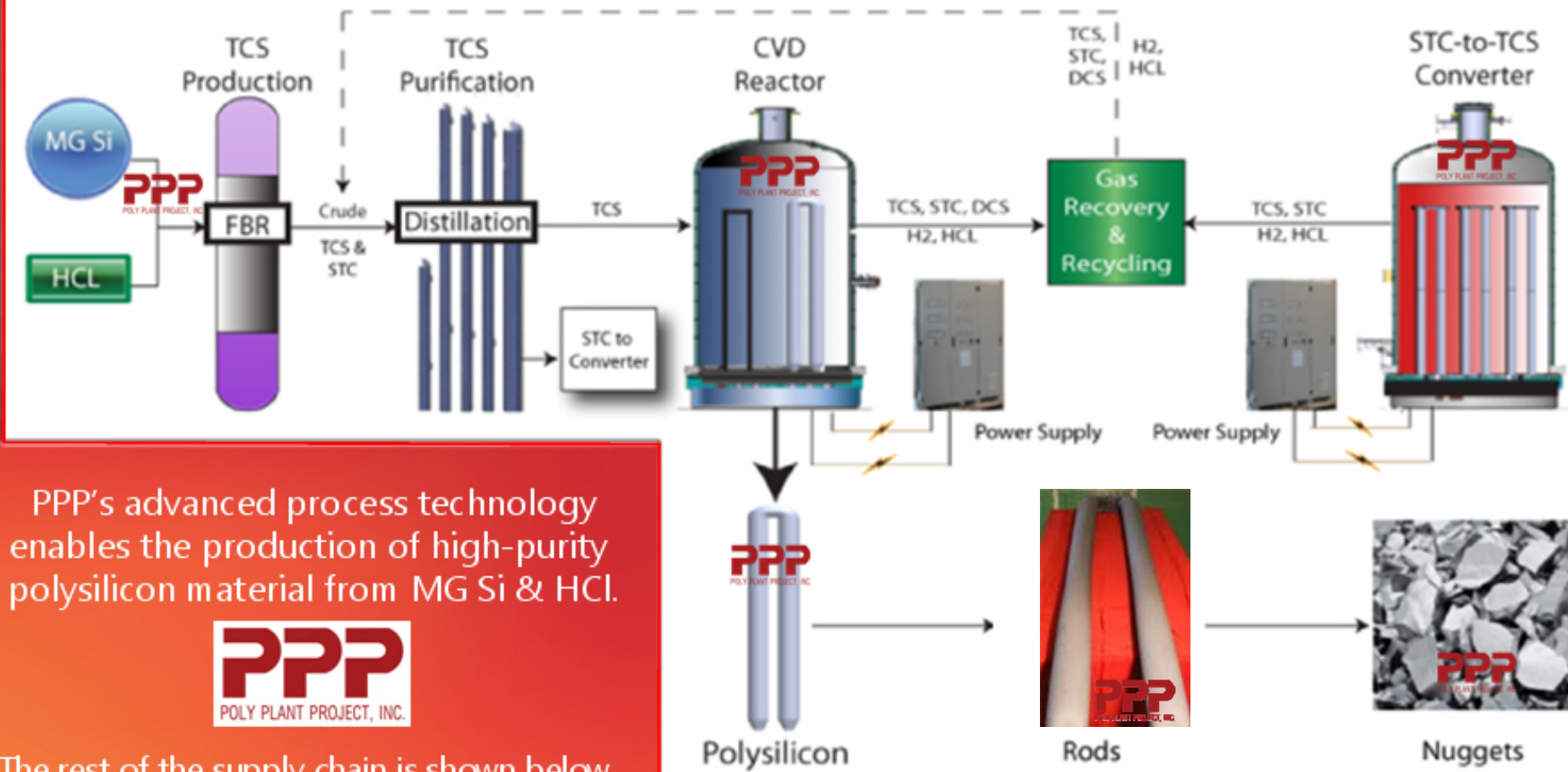
Reducing Production Costs of SOG Polysilicon

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SNEC Expo - May 7, 2010

SOG Polysilicon Price/Cost Goal

- Price \$ 55 per kg by 2011
- Price \$ 40 per kg by 2015
- Current Cost New Plants \$ 55 to \$ 100/ kg
- Major suppliers cost < \$ 25/kg
- Operating cost < \$ 30/kg to allow amortization and margin

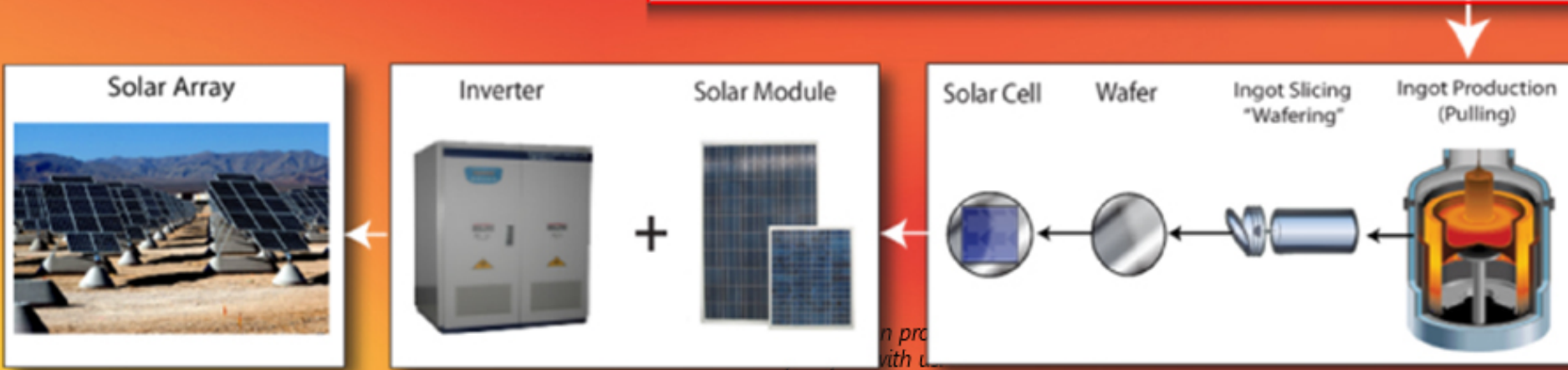




PPP's advanced process technology enables the production of high-purity polysilicon material from MG Si & HCL.



The rest of the supply chain is shown below



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Cost Reduction Elements

- SOG Plant Design
- Advanced, Energy Efficient Equipment
- Co-Products and Gases Recycle
- Operation at Nameplate Capacity
- Trained Operators and Engineers
- Safe Operation
- Infrastructure Support

SOG Plant Design

- SOG Purity Specifications
- Energy Conservation
- Location
 - Electrical Power Costs
 - Availability of Hydrogen, HCl, Nitrogen, Water
- Plant Size (5000 MTY)
- Optimum Yields

SOG Purity Specifications

Element	U.S. P V Roadmap	Milan Conf. Prop.	SOG A	SOG B	SOG C	EG
Boron ppba	500	10	< 200	< 3	< 0.8	< 0.8 – 0.05
Phos ppba	50	10	< 1	< 2	< 0.8	< 0.8 – < 0.1
Carbon ppma	0.5 – 10	2	< 1	< 2	< 1	< 1 – < 0.2
Metals ppbw	100	---	< 100	< 100	< 30	< 100 – < 15

Polysilicon Rod Specifications



PPP EG (Electronic Grade) Mat'l	SOG (Solar Grade) Material
Slower production	Faster production
Denser structure – harder to break	Popcorn morphology
Automatic breaking	Manual breaking OK
Clean Room	Clean Area
Surface etch	No etch
Standard packaging	Bulk packaging
Much more costly	Less costly
Difficult market	Larger market available

TCS Synthesis FBR



Higher Cost Process

60 – 80% Yield TCS

<10,000 tons capacity

2-3 kwhr/kg power

< 85 % uptime

Advanced Process

> 88 % Yield TCS

30,000 tons capacity

~1 kwhr/kg power

> 90 % uptime



TCS Purification

Higher Cost Process



8-19:1 TCS:Poly Ratio

1.6-4:1 MGSi:Poly Ratio

Inadequate Simulation

>40% TCS Loss

16-32 Columns

Advanced Process

6:1 TCS:Poly Ratio

1.2:1 MGSi:Poly Ratio

Simulation Based on
Speciation

<20% TCS Loss

7 Tray Columns

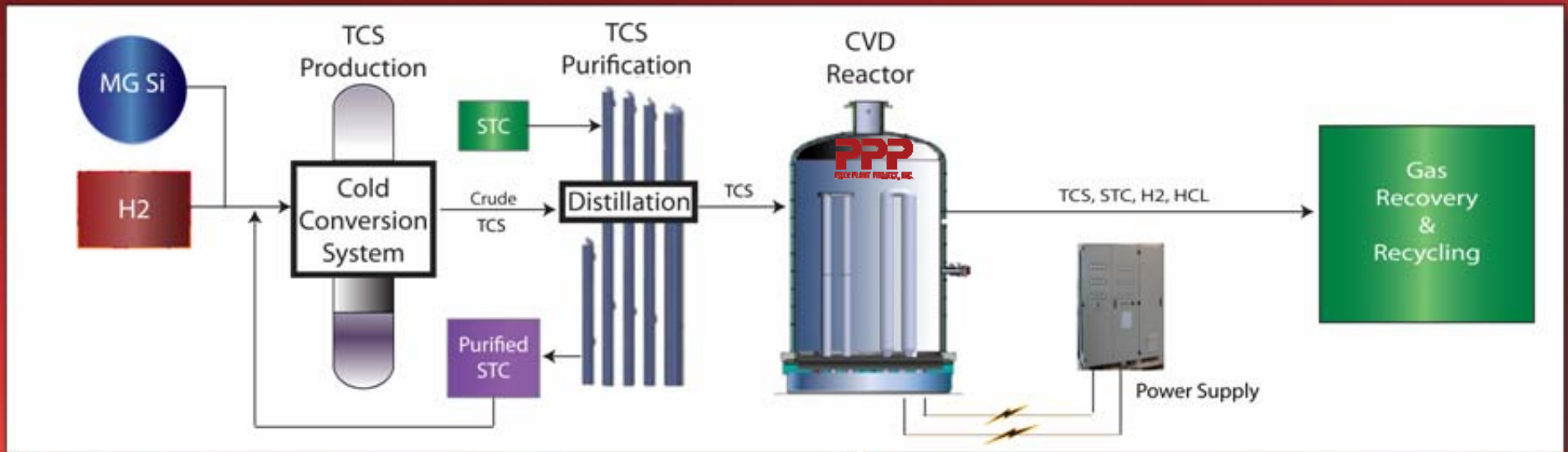


Polysilicon Deposition

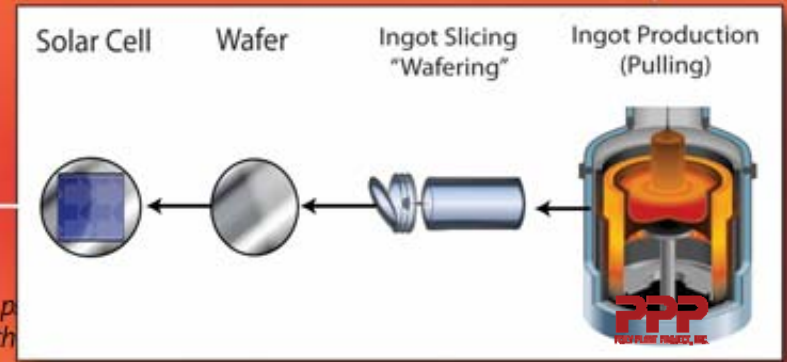
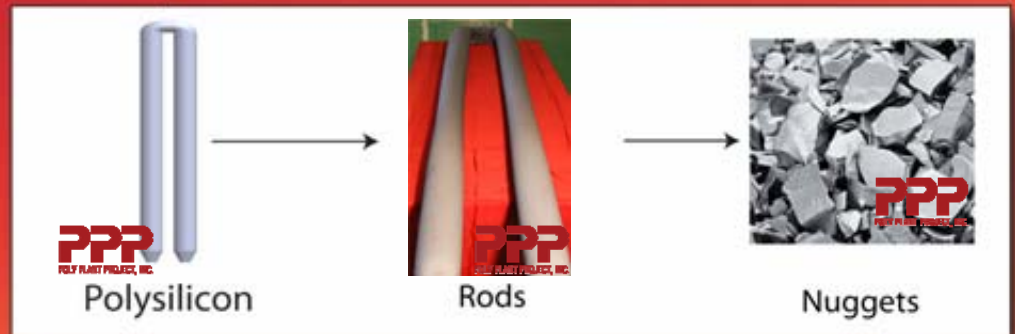
Higher Cost	Advanced	Advanced
12 -24 Rods	36 Rods	54 Rods
20-25 kg/hr	30 – 40 kg/hr	69 kg/hr
90–200 kwhr/kg	65 – 70 kwhr/kg	< 65 kwhr/kg
80 – 150 T/yr	150 – 200 T/yr	365 Tons/yr

STC-to-TCS Conversion

- Thermal Converter
 - Operation >1100 C, 6 Bar(g)
 - Same Design as Deposition Reactor
 - 5-10% Conversion with Poor Design
 - 22% Conversion with Advanced Design
 - 25 to 30 kwhr/kg Electrical Consumption
 - One Converter for Two Deposition Reactors



Cold Conversion Process (Front End)



STC-to-TCS Conversion


- Hydrogenation Converter
 - Operation ~500 C, 30 Bar(g)
 - Hydrogen, MG Silicon, STC
 - 18 to 30% Conversion
 - 3.5 to 6 kwhr/kg Electrical Consumption
 - Replaces Thermal Converters
 - Higher Safety Risk



Achieving Nameplate Capacity

- Materials Supplies
 - Incoming Materials
 - Chemicals Storage
- Trained Operators and Engineers
- Key Equipment Redundancy
- Reliable Electrical Supply
- Safe Operation
- Infrastructure Support

Estimated Operating Costs

- TCS production at 6:1 TCS:Poly  \$ 9 - 11
- 140 kwhr/kg, \$0.03-0.05/kwhr \$ 4 - 7
- Labor cost  \$ 7 - 8
- Utilities \$ 3 - 5
- Maintenance  \$ 2 - 4
- Total \$ 25 – \$35/kg 

Thank You

Jan Maurits, Vice Chairman
Poly Plant Project, Inc.



*Advanced solutions for polysilicon production
The solar industry begins with us.*