

# Presentation



## Sustainable Energy in Central Asia: Business Opportunities and Technology Transfer

6 November 2014

Brussels, Charlemagne Building, Room Mansholt

### **Semco Engineering:**

Developing Solar Technology in Kazakhstan

by Krister Olsson Project Manager

*Corporate Presentation*  
**2014**

# **SEMCO ENGINEERING**

Products & Services for the Photovoltaic Industry



# SEMCO Engineering Group

## Key Data

Business	Industrial Equipment, Engineering, Process
Sector	Photovoltaic and semiconductor materials
Legal Form	Limited Company with Supervisory Board
Foundation	1986
Capital	5 millions Euro
Structure	Founder/Employees/Private Equity (60/20/20)
Employees	145 (2013)
Turnover	40 millions Euro (2013)
R&D Share	Approximately 10% of turnover
Export Share	More than 90% of turnover
Industrial Property	12 patent families and 3 international protected trademarks
PV Cell Fab	10-MWp production + LabFab new cells
Turnkey fabrication lines	Yes, including integration services
Service Network	Global Worldwide

# Business Units



Industrial Equipment for  
the c-Si processing

- N & P-type doping
- Dry and Wet Oxidation
- Plasma Enhanced CVD
- Dry Texturization
- Automated transport of Silicon wafers.
- Process supervision
- Application Laboratory
- Process Physicochemistry



PV Cell Manufacturing  
Fabrication Laboratory

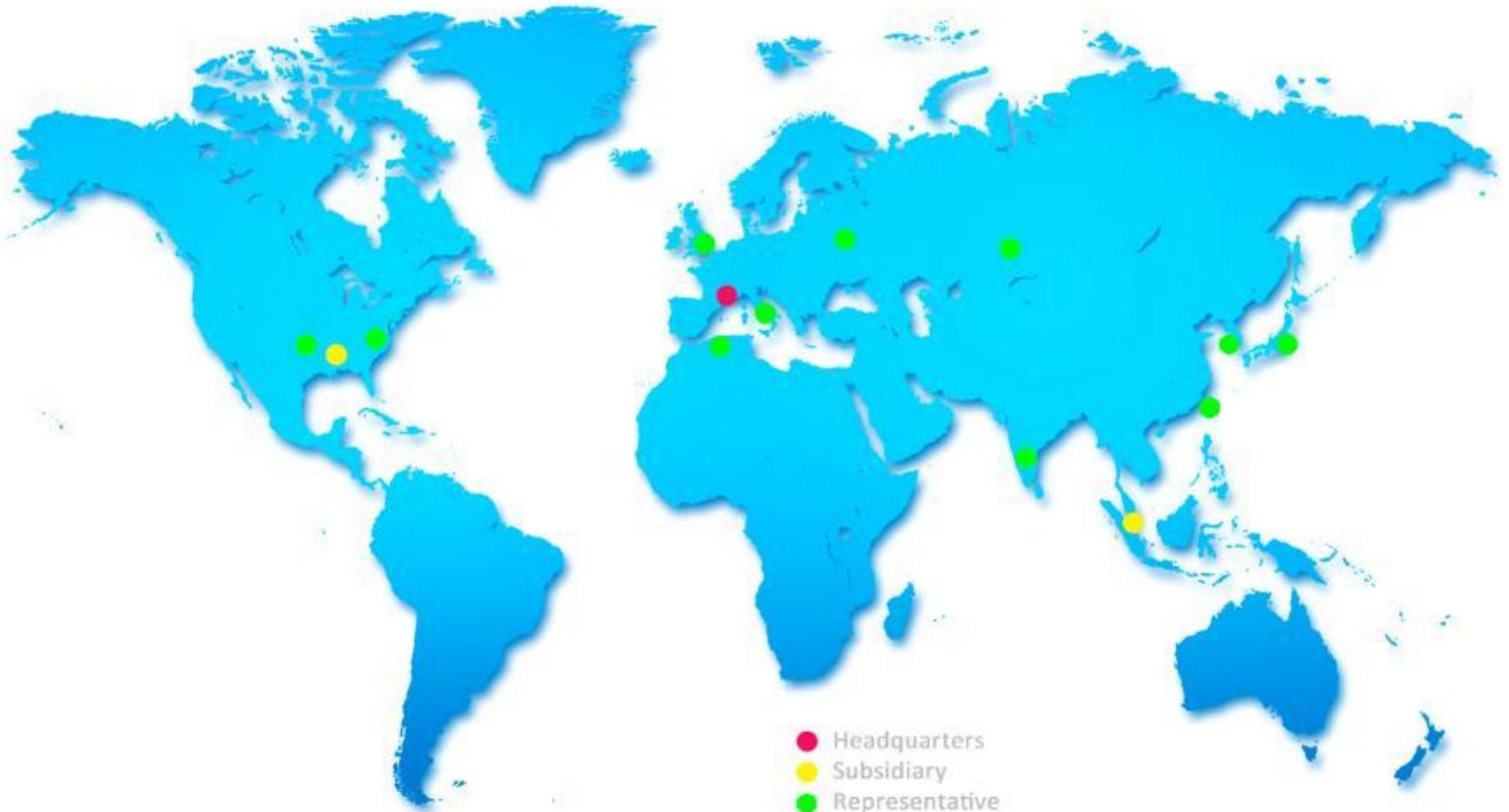
- 24/7 working
- Multicrystalline PV Cells
- Monocrystalline PV Cells
- N-type PERT Cells
- Process qualification
- PV Foundry
- Outsourced Industrial R&D
- Training Center
- PV Materials Qualification



Vertically-integrated PV  
Manufacturing Plant

- Wafers, Cells & Modules
- Project Management
- Engineering, Procurement
- Commissioning
- Staff Training
- Technology Transfer
- Process Guarantee
- *3BB monofacial*
- *N-type bifacial*

# *A Global Worldwide Presence*



# Some References

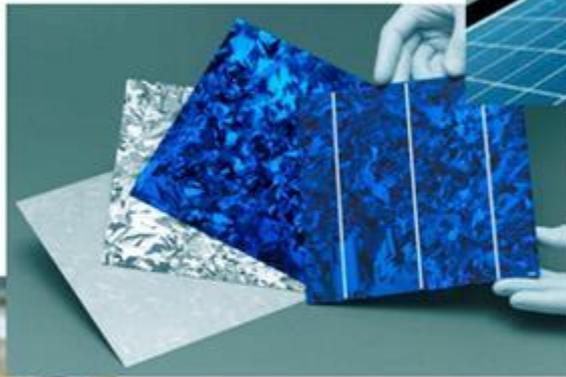
- Photovoltaic Industry / Mono and Multi c-Si from Wafering to PV Modules



- R&D / Casting, purification / PERT, n-type bifacial technologies



# Creating a National Solar Industry



MODULE → SYSTEM



WAFER → CELL



# Creation of a National Photovoltaic Industry



PV Modules & Systems



PV Wafers & Cells



Quartz Mine



Universities



Feedstock & Purification

# Material before Purification (09-Dec-11)



- Excellent quality of QUARTZ™ material
  - B: 1.3 ppmw
  - Al: 45 ppmw
  - P: 1.2 ppmw
  - Fe: 7 ppmw



- |                       |                |
|-----------------------|----------------|
| ■ Silicon Metal KazSi | ■ Si Mg SEMCO  |
| — B: 15.8 ppmw        | — B: < 3 ppmw  |
| — Al: 400 ppmw        | — Al: 800 ppmw |
| — P: 7.2 ppmw         | — P: 8 ppmw    |
| — Fe: 650 ppmw        | — Fe: 650 ppmw |

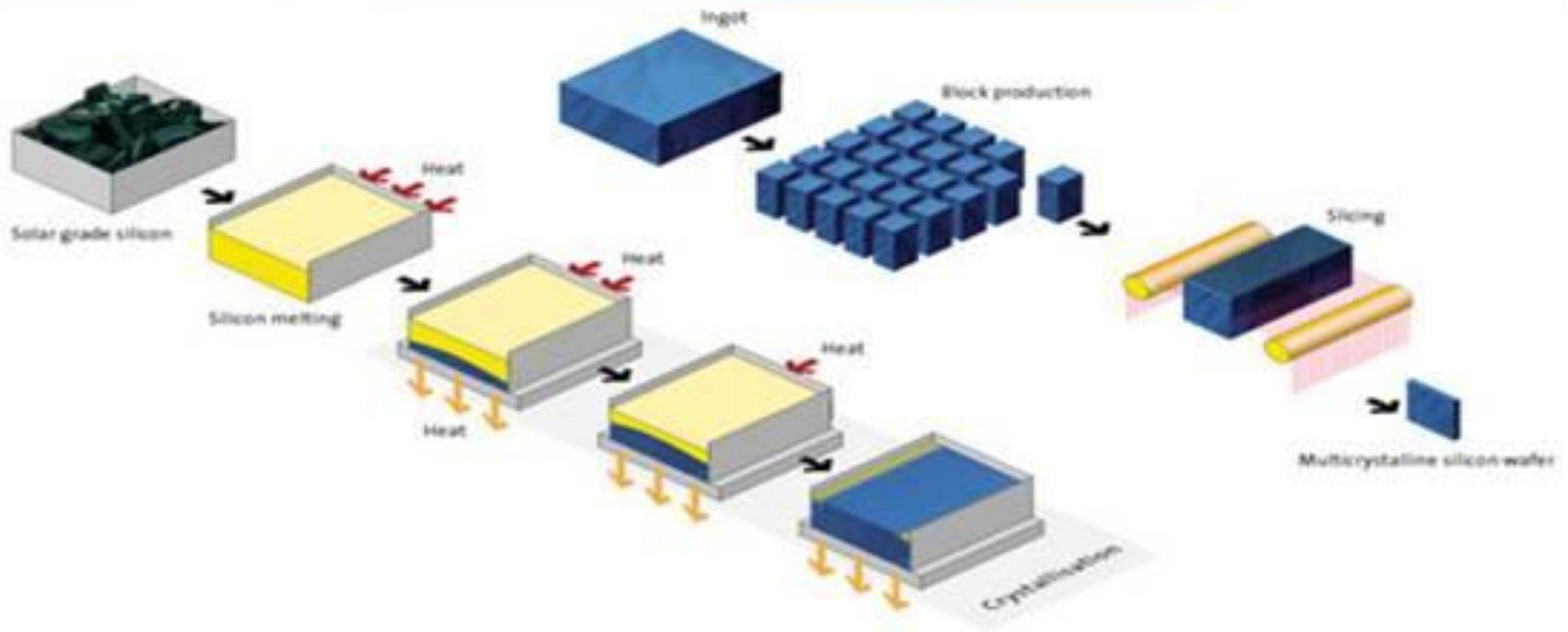
# *KazSilicon at SEMCO*

*Contract signed 09/2011 First delivery 05/2012*



# KazSilicon at SEMCO

05/2012



# Wafering Composition



Ingot D0106S01  
13.07.2012

SOG Silicon provided by SEMCO, presented as blocks, and then etched (KOH-based) to clean the surface of the pieces. The blocks were additionally half-cut before the charge. No dopant was added.



# *PV Cell Manufacturing*

*08/2012*



# *Module Manufacturing in Spain*

*09/2012*



*Module Shipment to Astana*  
*09/2012*



# *Module Roof Astana Solar (1)*

*11/10/2012*



# *Module Roof Astana Solar (2)*

*25/10/2012*



# *Astana Solar Plant*

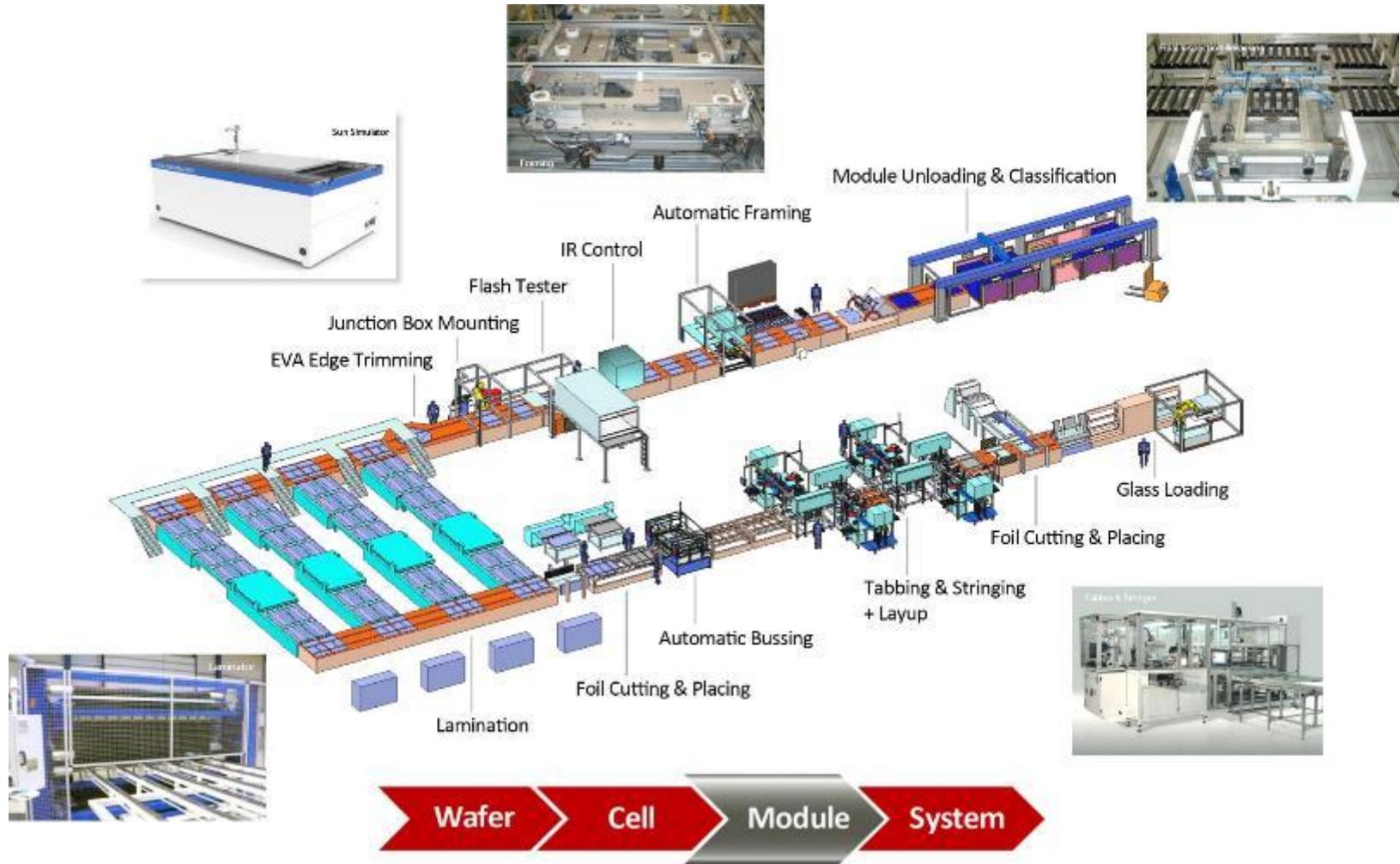
*25/12/2012*





# PV Module Production Line

## Astana Solar



*Factory Engineering*  
*Kazakhstan Solar Silicon (KSS)*



*PV Cell Production Line*  
*Kazakhstan Solar Silicon (KSS)*



# PV Cell Production Line

## Kazakhstan Solar Silicon (KSS)



*KSS PV Cell Production Line*  
*Texturing*



*KSS PV Cell Production Line*  
*Diffusion*



*KSS PV Cell Production Line*  
**PECVD**



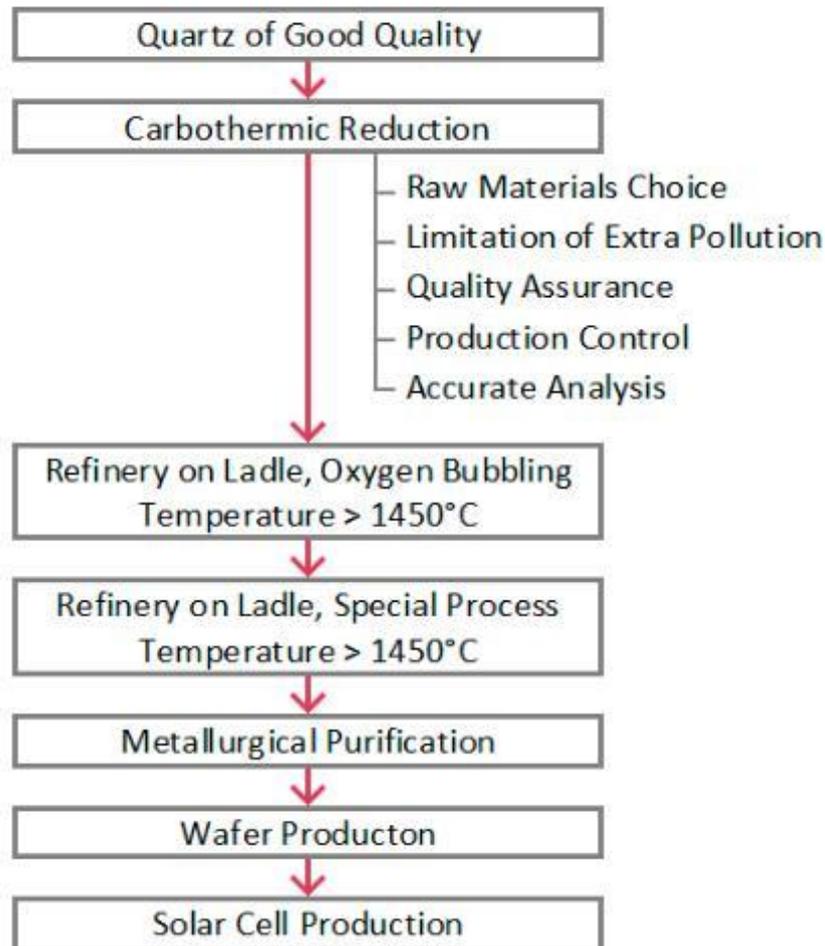
*PV Cell Production Line  
Sorter*





# Production of Solar Grade Silicon

## METALLURGICAL ROUTE

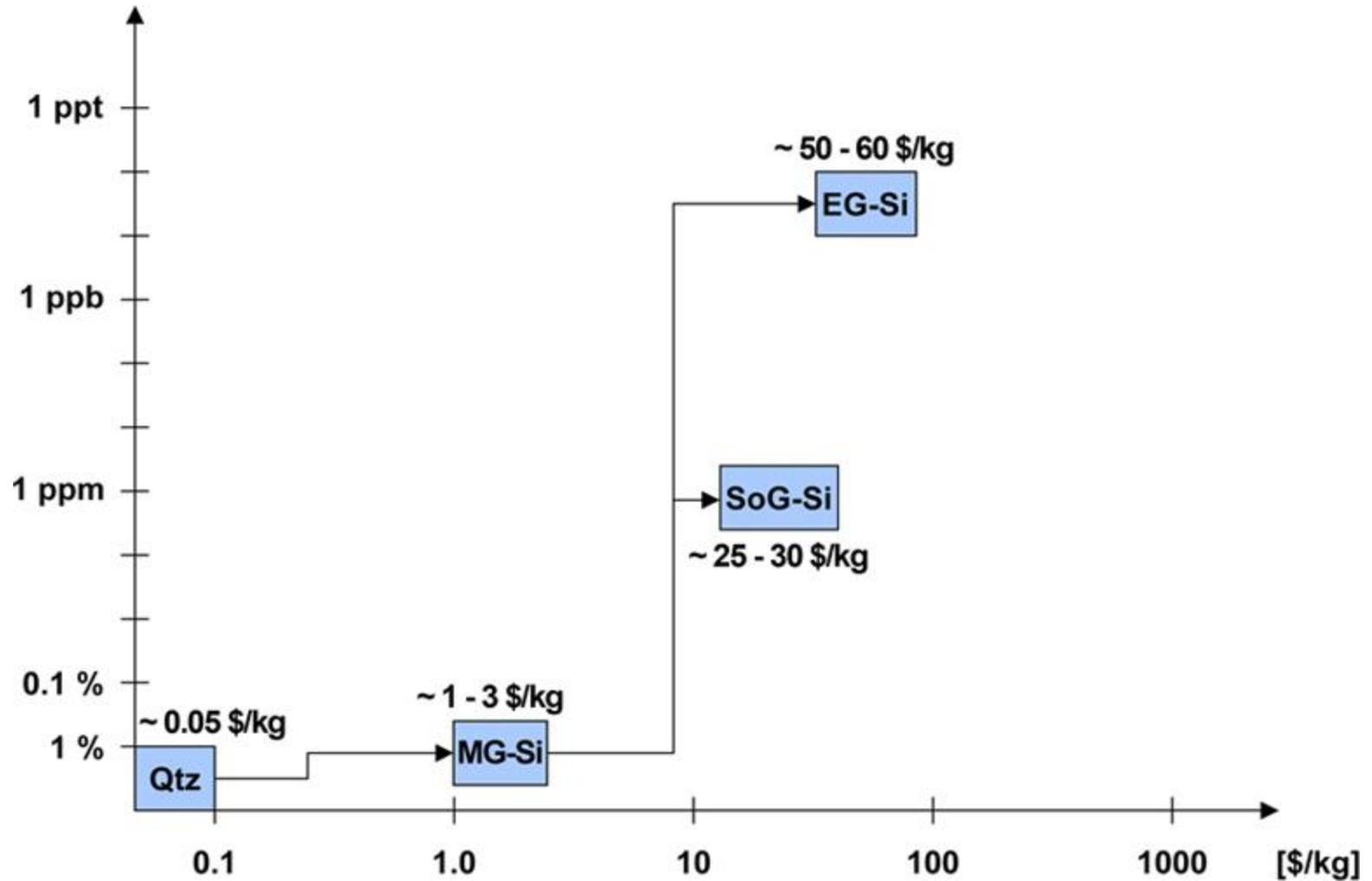


# Solar Grade & Electronic Grade Analysis

Element	Metallurgical-grade silicon (ppm)	Solar-grade silicon (ppm)	Polycrystalline solar-grade silicon	Electronic-grade silicon (ppm)
Si*	99	99.999 9	99.999 99	99.999 999 999
Fe	2 000–3 000	<0.3		<0.01
Al	1500–4 000	<0.1		<0.0008
Ca	500–600	<0.1		<0.003
B	20	<0.3		<0.0002
P	20–50	<0.1		<0.0008
C	600	<3		<0.5
O	3000	<10		
Ti	160–200	<0.01		<0.003
Cr	50–200	<0.1		

\* Si content in mass %

# Purity and Price of Materials





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## End of Presentation

Thank you for your attention