Reshoring North American PV with Energy-Efficient, Low Carbon Footprint, High-Purity Granular Silicon

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Silicon Gases Global Sales

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Agenda

- About REC Silicon
- Our Technology
- Creating Solar Value
- Reshoring American Solar Industry
- Restart Status
- Technology and Value Chain Development Challenges
- Summary

ABOUT REC SILICON


A SILICON MATERIALS COMPANY
PROVIDING ENABLING MATERIALS
FOR THE GREEN ENERGY TRANSITION
RECSiLICON

Introduction

- Combining 40 years' experience and best-in-class proprietary technology
- Largest supplier of silane outside China, and largest silane module container fleet
- Low-cost, low-carbon high-purity granular producer
- Strong position with leading semi players
- Immediate silane capacity available for silicon anode material
- **Moses Lake**
  - Original Silane and FBR investment $1.7B
  - 24,000 MT silane gas capacity
  - Prime high-purity granular polysilicon capacity - 16,000 MT
    - Risk mitigating offtake contract
  - ~ 2,400MT silane for merchant sales/battery producers
  - Low energy – low cost and conflict-free
- **Butte**
  - 7,400 MT silane gas capacity
  - Silicon gases
  - Completed capacity expansion for DCS
  - Ongoing loading/container expansion for high-value silicon gases

Key facts

Two
Production sites

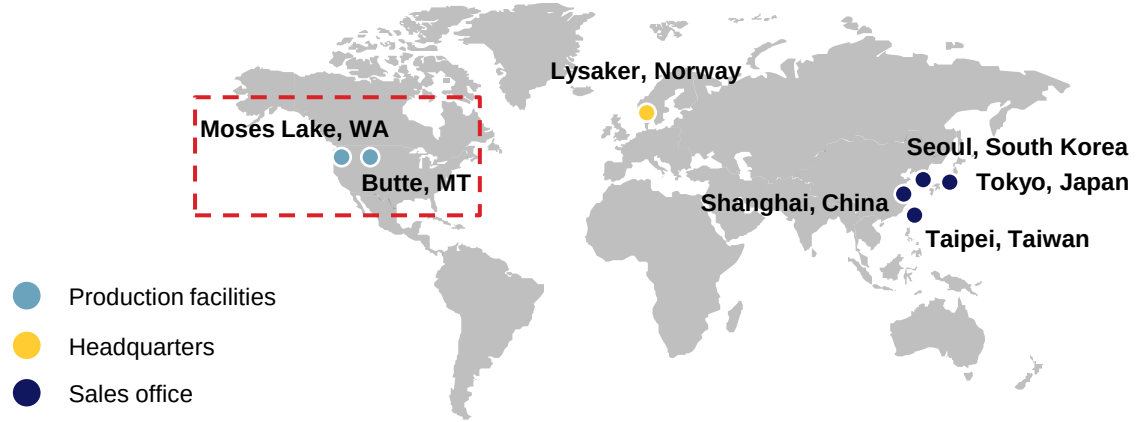
1984
First operations

~16,000[1,2] MT
High-purity granular polysilicon

~31,400 MT
Silane gas capacity

~500[4]
Employees

DCS, MCS, and Dislane



Notes: 1) Including Moses Lake at 100% of capacity, estimated Q4-24; 2) Figure shown for granular silicon, excluding fines and particulates; 3) On a global level ex. China; 4) By June 2024.

Our History

1983-1984

Union Carbide constructs facility in Moses Lake, WA

1990

Komatsu purchases company creating Advanced Silicon Materials Inc.

2002

REC Group enters into JV with Komatsu creating Solar Grade Silicon LLC

2005

REC Group purchases ASiMI creating REC Silicon

2013

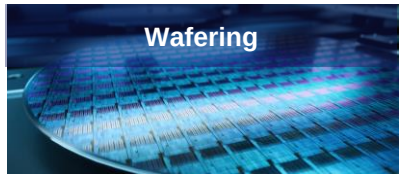
REC Group splits organization creating standalone company

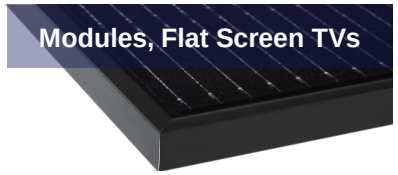
2021

Strategic Hanwha investment announced.

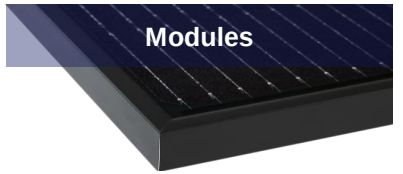
A Global Leader in Production of High-Quality Silicon Materials

Butte





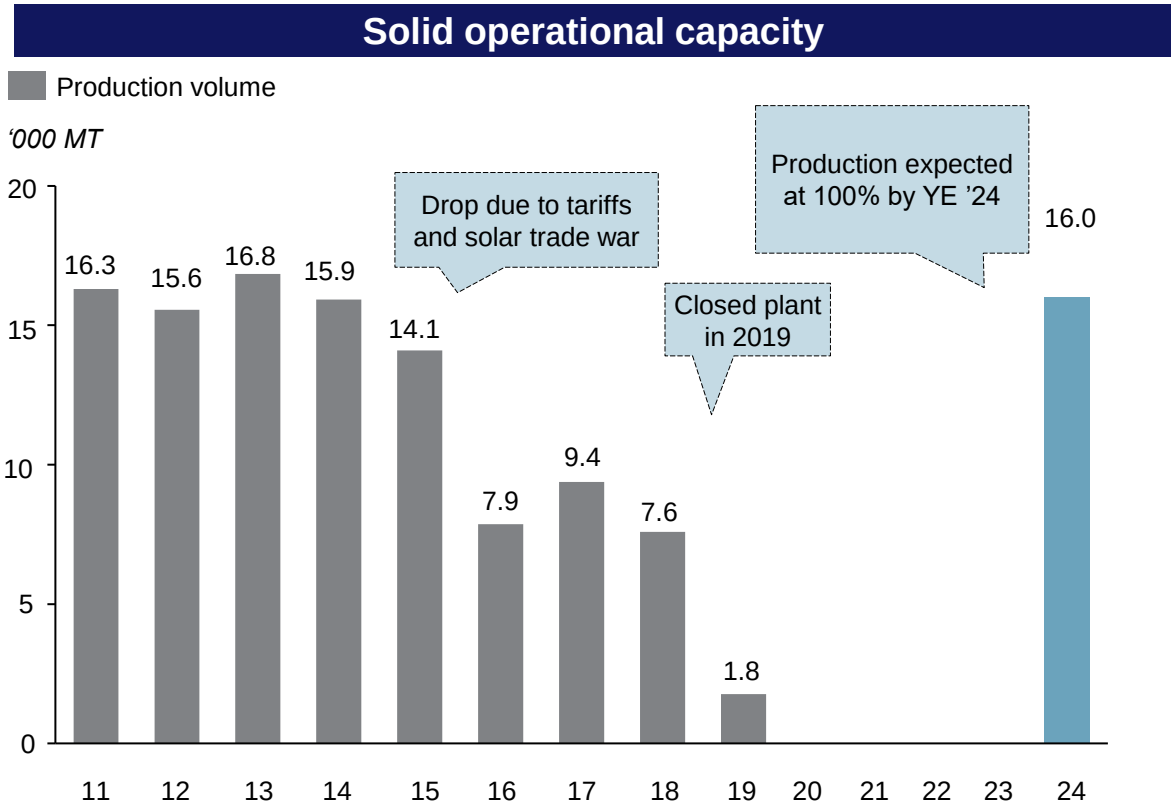
Moses Lake



REC Silicon is uniquely positioned to capitalize on the green transition and the resulting need for solar power and further electrification.

Moses Lake Restarted Polysilicon Production in November 2023

- Moses Lake to produce monograde polysilicon for US wafer industry
- Expected to reach full production annual capacity of 16,000 MT high-purity polysilicon during Q4’24
- FBR is a well-known technology through REC’s long track record
- REC Silicon has strong track record of cash cost reduction and operational improvements
- Technology and upgrade process of the FBR-B is understood to REC Silicon, as similar facility upgrades were performed at the Yulin plant in 2019
- The process has proven to consistently produce high purity granular polysilicon, and, additionally, has been verified by pilot processes and long-standing industrial applications



OUR TECHNOLOGY

Our Technology

REC Silicon FBR Development History

1970's — JPL / UCC FBR Study & Pilots

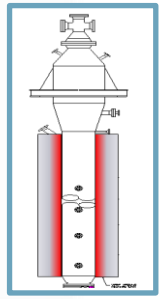
1990's — ASiMI/Komatsu FBR Pilots

2002-2023 — FBR-A

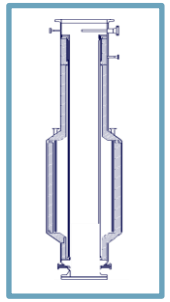
- **2004** › FBR-A Pilot startup
- **2009** › Startup › 2:1 Scale up
- **2023** › Upgrade › High Purity with Liner

2008-2023 — FBR-B

- **2010** › FBR-B Pilot startup
- **2018** › Yulin JV Startup › 1.9 Scale up from FBR-A



FBR – A

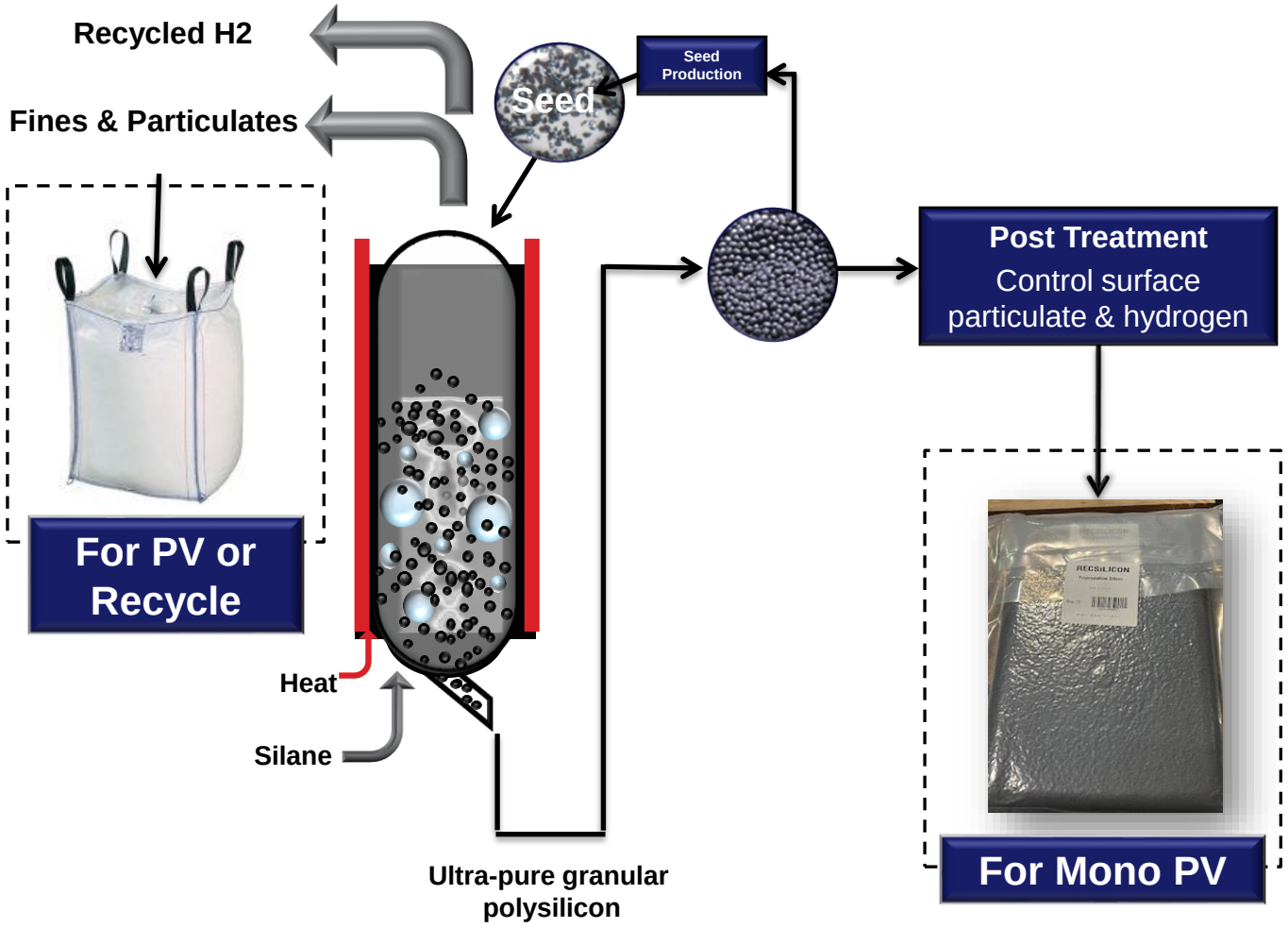


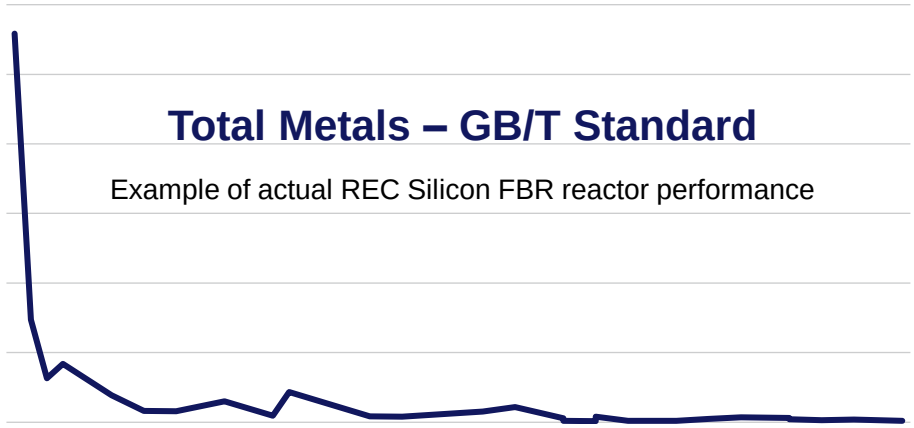
FBR – B

2016-2023 — Surface Particulate & Hydrogen Control

- **2016** › Demo Scale Surface Particulate Control
- **2018** › Yulin JV Startup › 1st Design Particulate Control
- **2023** › Moses Lake Upgrade › 2nd Design Particulate & H2 Control

Fluidized Bed Reactor (FBR) Process





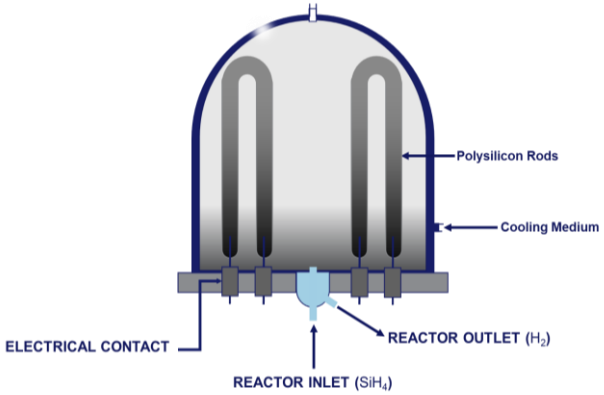
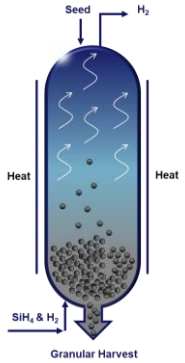
Purity (>99.9999%)	Yulin 69003	GCL ZN 901A	GB/T Premium Grade
Acceptor (Boron) ppba	0.2	0.4	≤0.18
Donor (Phosphorus) ppba	0.3	0.8	≤0.30
Carbon ppma	0.4	1.0	≤0.20
Total Metals ppbw	**<5**	**<4**	**≤13**

CREATING SOLAR VALUE

Low Cost, Low Carbon Footprint FBR

FBR vs Siemens Polysilicon Production

Polysilicon production methods

	Siemens method (Butte plant)	FBR method (Moses Lake plant)
Product output	› High-purity product ideal for Float Zone (FZ) and Czochralski (CZ) polysilicon applications 	› High-purity granular polysilicon for the solar industry 
Raw materials (input)	› Silane gas › Hydrogen	› Silane gas › Hydrogen
Polysilicon process	› The process takes place in a large Siemens reactor, where silicon seed rods are heated, and the elemental silicon is deposited. The rods grow progressively larger in diameter as the process continues over time. 	› Silane along with fluidization gases are introduced into a heated and fluidized bed of polysilicon particles where silicon is deposited onto the silicon particles that grow larger in diameter. These silicon particles are continuously withdrawn with seed particles continuously introduced into the reactor. 
	Discontinuous process with significant post processing	**Continuous process with low energy consumption**

Comparison of methods

FBR technology, due to its energy savings, has the lowest cost and one of the lowest carbon footprints in the industry

› Economy of scale, larger equipment

› Higher production rate with less downtime, cleaning and maintenance activities

› Stable quality and output with continuous quality monitoring rather than batch end

› Improved flexibility and efficiency

› Energy consumption is reduced comparative Siemens-silicon

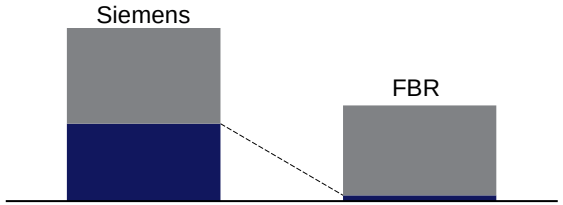
› Small form factor will be a larger part of mix

› Elegant solution to chips

Energy consumption per technology

Polysilicon CVD[1]

Feed gas, utilities, recovery, waste treatment



Note: 1) Includes gas recirculation for FBR, heat recovery for Siemens

RESHORING AMERICAN SOLAR INDUSTRY

PV Silicon Markets

- Solar demand forecast for 2024 over 500 GW
  - Total installations in China forecasted at 250 GW for 2024
  - Module inventory build will reduce demand in US for 2024
  - US companies file new AD/CVD case
- Prices 2024
  - China prices now below cash cost for most producers
  - Outside China polysilicon prices gap increasing
  - Continue pricing pressure throughout supply chain
- Polysilicon expansion
  - China is ~200% of the global market capacity for PV Grade Polysilicon
  - FBR is currently 18% of China capacity
  - China slowing down expansion plans but still increasing capacity

Silicon-Based Industries Facing Disruptive Changes

- China dominance
- High-emission energy
- Political risks
- ESG issues

- Investments moving from Asia to the US
- Support from US legislative initiatives

- The CHIPS & Science Act 2022
- Inflation Reduction Act 2022
- Uygur Forced Labor Prevention Act 2021
- Infrastructure Investment & Jobs Act 2021

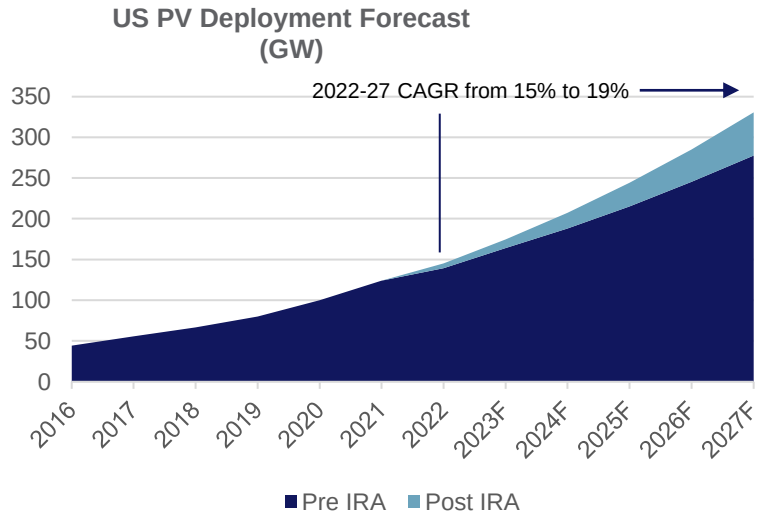
- Strong political and regulatory push
- Low-emission energy
- Supply chain geographical diversification
- End-user proximity
- Tech war

National Security – Energy, Defense, Communication

PV Market

Strong impact from IRA already

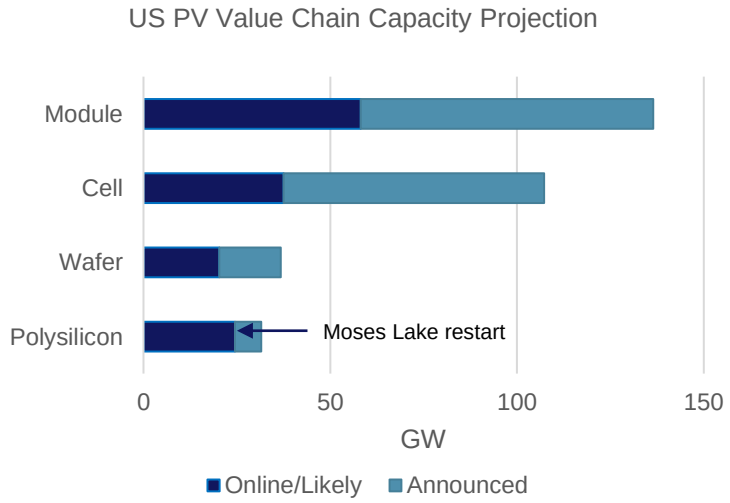
- 35% increase in expected installations in 2022-27 from the introduction of the IRA
- USD 100 bn of investments already announced from companies in the US, Asia and Europe
- Full impact throughout the US value chain



Source: SEIA, Wood Mackenzie

Value chain growing

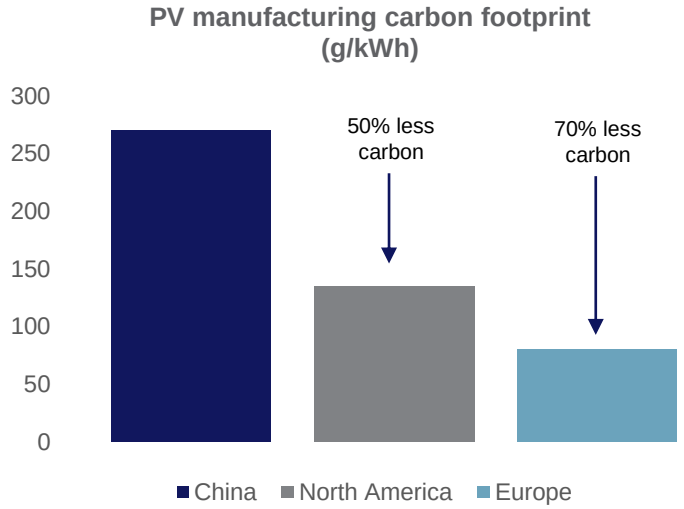
- Limited existing value chain for PV in the US
- Significant expansion is required, and announced for major value chain components
- REC Silicon has the only announced expansion of the solar grade polysilicon capacity (Moses Lake)



Source: REC Silicon research, public announcements and market analysts' reports

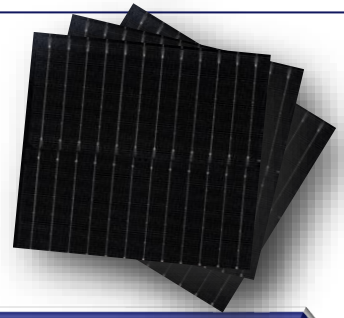
The quest for low cost and low carbon

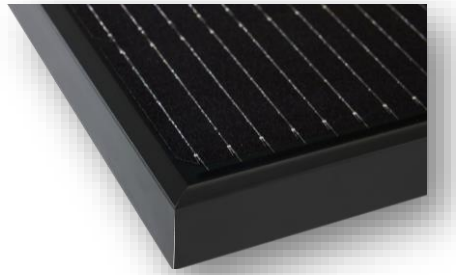
- Strong demand from end users and module producers for low carbon PV supply chain
- Moses Lake has ~ 70% lower carbon intensity than traditional polysilicon which is ~40% of total PV carbon footprint
- With IRA incentives, Moses Lake is also competitive with Chinese producers on a cost per kg basis



Source: The Ultra Low Carbon Solar Alliance

USA Solar Value Chain is Back





Silane Gas → FBR Silicon → Crystallization/Wafers → Cells → Modules

RECSiLICON

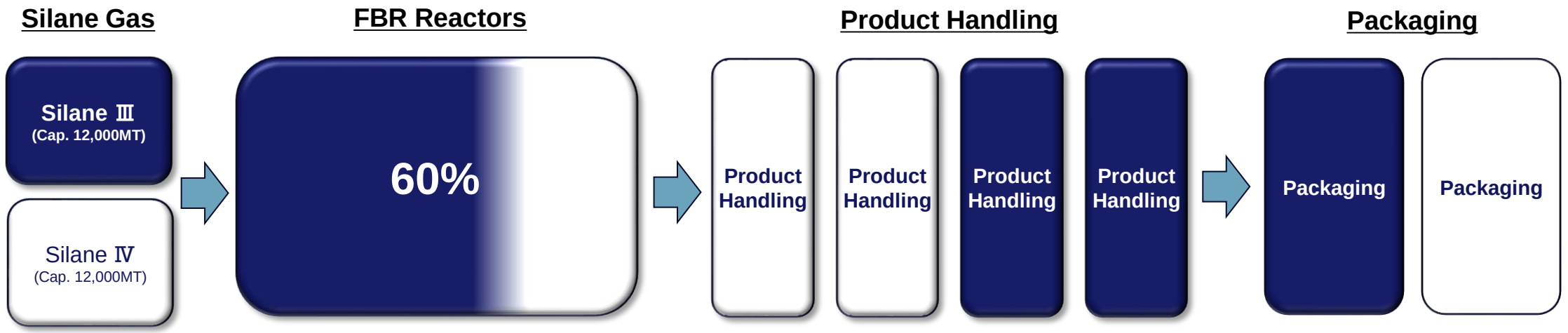
Washington State

qcells

Georgia

RESTART STATUS

Moses Lake Operating Ramp Status



- Estimated project completion cost increased by up to 10% due to contract labor, delay and efficiency
- Starting to wind down construction activities
- Full capability online by the end of the year

TECHNOLOGY AND VALUE CHAIN DEVELOPMENT CHALLENGES

Initiatives to address main topics

Secure and develop competence

- Workforce development
  - Entry-level positions are very specialized, requiring 2.5 years to fully qualify in silane and FBR
  - Increased use of automation
    - Fewer employees, higher pay for skillset
    - Gap between legacy experience and advancements in machine learning/AI
- Skilled trades
  - Welders
  - Electricians
  - Instrument Techs
- Localized education and training
  - Establishing trade and education at local levels
    - High School
    - Community College

Industry and market position

- Regain leadership position in PV
  - America and EU are behind in PV technology
  - China dominates the market and technology
  - Value chain gaps
  - Reshoring technology and R&D
- Quality
  - P-Type to N-Type roadmap
    - Going from PPB to PPT
  - Multiple recharges
    - Small form factor equals more surface area

SUMMARY

Summary

- Favorable legislation reshoring PV back to US
- High-purity polysilicon:
  - Small form factor expected to be a larger part of mix
  - FBR reduces carbon footprint in downstream value chain
- REC Silicon supports reshoring with restart of Moses Lake facility
  - Partnership with Qcells to bring value chain back to US

Upcoming event

REC Silicon will release its **Q2 2024** results on **Thursday, August 8, 2024**, at 7:00 a.m. CEST.

The same day at 8:00 a.m. CEST, the company will host a videocast to present the results.

The live webcast from the presentation can be accessed at www.recsilicon.com or with the following link:

https://channel.royalcast.com/landingpage/hegnarmedia/20240808_2/

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Thank You

Wayne Osborne, MEM
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