



Increasing Profitability through Component Selection, Design Optimization, and Forecasting

19 Nov2013

Romanian Solar Summit

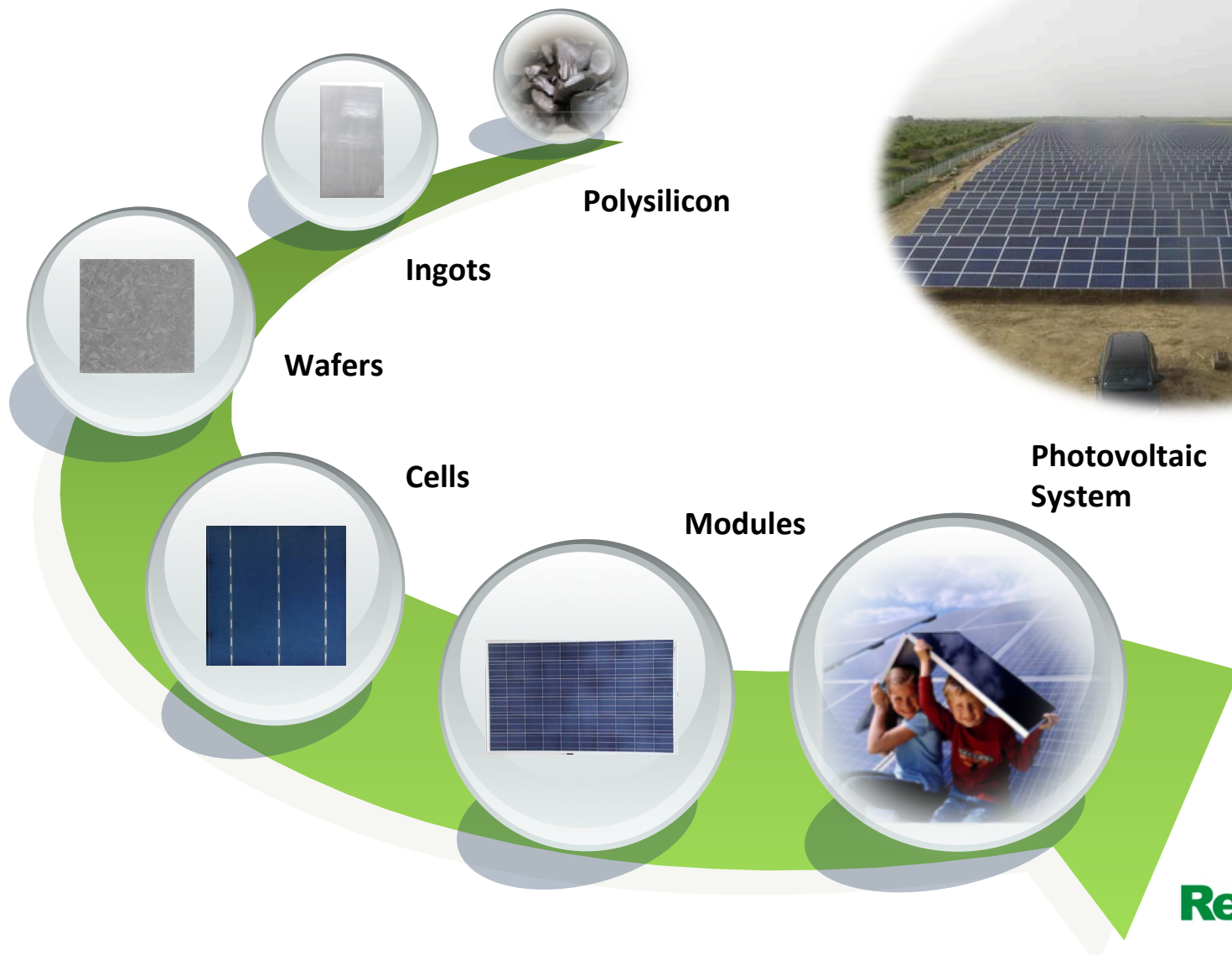


Who is ReneSola?

2 PV plants in Romania



Photovoltaic System



Polysilicon

Ingots

Wafers

Cells

Modules

Why would someone speak about the obvious?

New Legislative Challenges
Fragile Electricity Grid
Uncontrolled Growth of Supply
Electricity Market Contraction

Lead to

Pressure on Profits

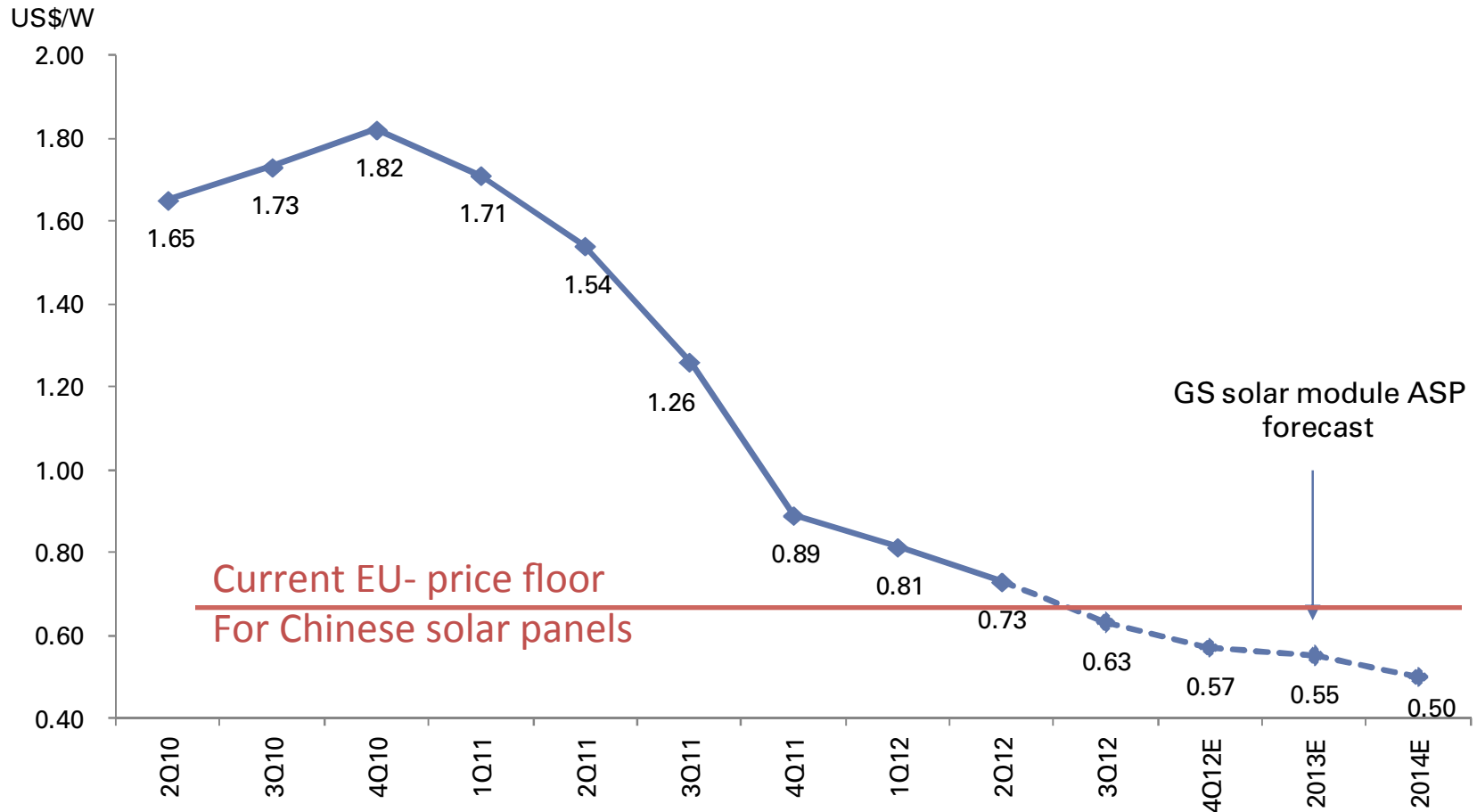
What can be done to rescue returns?

Agenda

- Equipment Choice:
 - Solar Module
 - Inverter
- Increasing Performance through System Design
- Optimization of Forecasting

Solar Module No Longer Driver for Price Declines


Solar module ASP trend, \$ per watt



Source: Goldman Sachs 2013 Equity Research: Americas: Clean Energy: Solar

Key Solar Module Requirements

1. Price
 - Solar Module is largest single component of total investment cost
2. High Conversion Efficiency
 - Reduced Balance of Systems
3. High low-light Performance
 - Irradiation in Romania is diffuse most of the time
4. Low Temperature Coefficient
 - Reduced losses during high temperature
5. Third Party Underwriter of Performance Warranty
 - Indemnification from warranty claims beyond manufacturer's existence



ReneSola solar modules are made outside of China and meet these requirements using the Virtus II[®] wafer technology

Inverter and Mounting Systems Prices down

Inverter prices 2013


1. Central Inverter prices down by 16% to 0.12 USD/W
2. 20-35 kW inverter prices down by 20% to 0.14 USD/W
3. Efficiencies and Inverter Software are no differentiator any more
4. Chinese manufactures increase competition

Mounting system prices

1. Moderate aluminum price drives price decline
2. Higher conversion efficiency reduces material usage
3. Prices dropped by 0.03 USD/W in 2013

Availability of the System: Central vs. String Inverters

	Central Inverter	String Inverter
Investment Cost	0.09 EUR/W	0.09 EUR/W
Number of Inverters	1	30
DC Capacity of Inverters	600 kWp	20 kWp
Failures in five years	5	15
Time to remedy a failure	5 days	1 day
Outage in five years	25 days	7.5 day

 String inverters can increase the availability of the system

Equipment Choice

1. Price
2. Performance
3. Longevity
4. Maintenance
5. Warranties

ReneSola

Virtus[®] II

Virtus[®] II Module

250W, 255W, 260W

Replus[™]
by ReneSola

Replus 10000TL3B-US 12000TL3B-US 18000TL3B-US 20000TL3B-US

ReneSola

Optimisation of Design: Increasing Yield

Avoid Shading

- Distance between module tables
- Nearby objects
- Onsite container / compact station locations
- Pylons for lighting, security cameras

Increase String Performance

- Landscape solar module orientation:
 - Daily marginal shading
 - Heat coefficient
- Module warranty terms

Auxiliary Design

- Security Systems
- Auxiliary Electricity
- Monitoring
- SCADA / Dispatch
- Electricity Meter Data

Forecast is Special Requirement in Romania

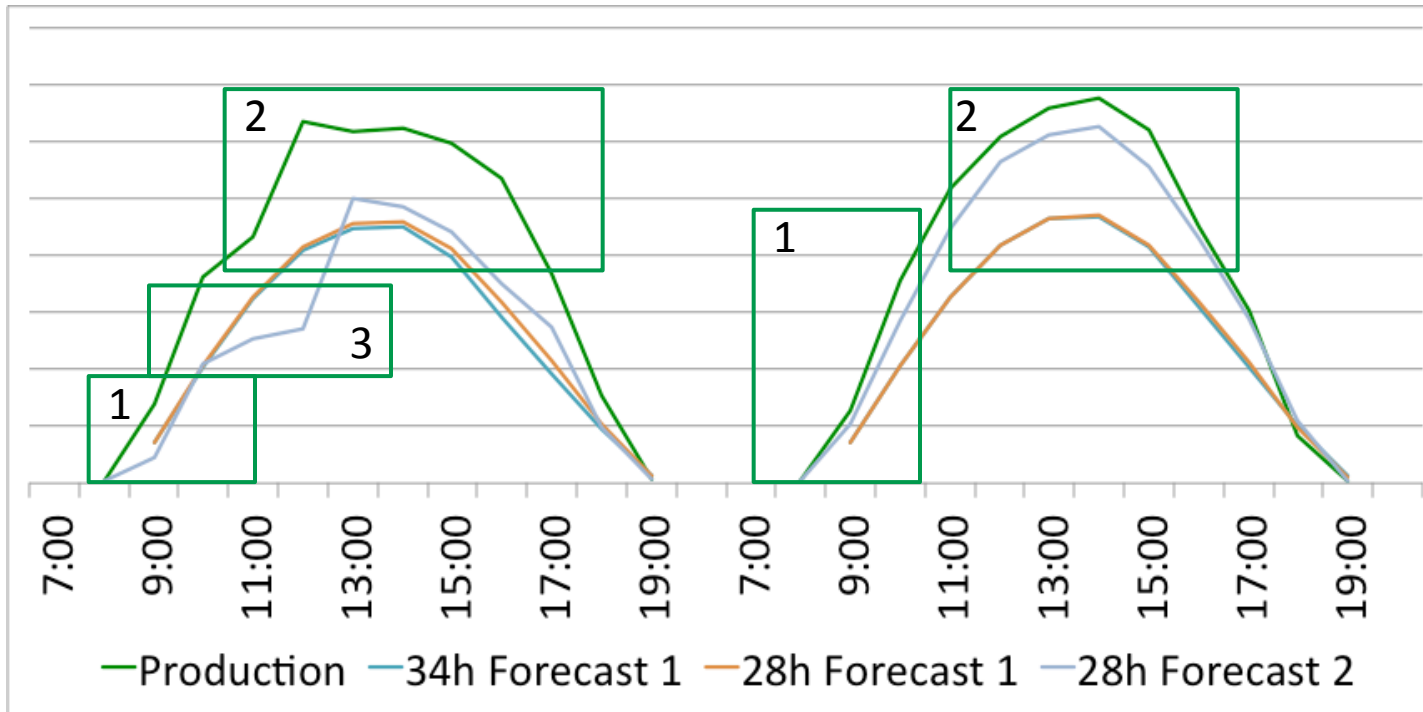
Forecasting Requirement

- Day-ahead forecasts required by traders.
- Dispatchable PV systems: Only forecasted electricity is awarded GC's
- No intraday market functioning yet

Impact on Profitability

- GCs are not awarded for electricity which was not forecasted
- Every dispatchable PV producer will optimise GC revenues
- Systematic over-Forecasting will lead to higher costs for balancing

Minimising Forecast Errors



1. Astronomy
2. Efficiency
3. Weather

- Imbalances accumulate
- Some forecasts cause -20% GC's and electricity sale

Increasing Profitability through...

... Component Selection

- Solar Module
- Inverter Type

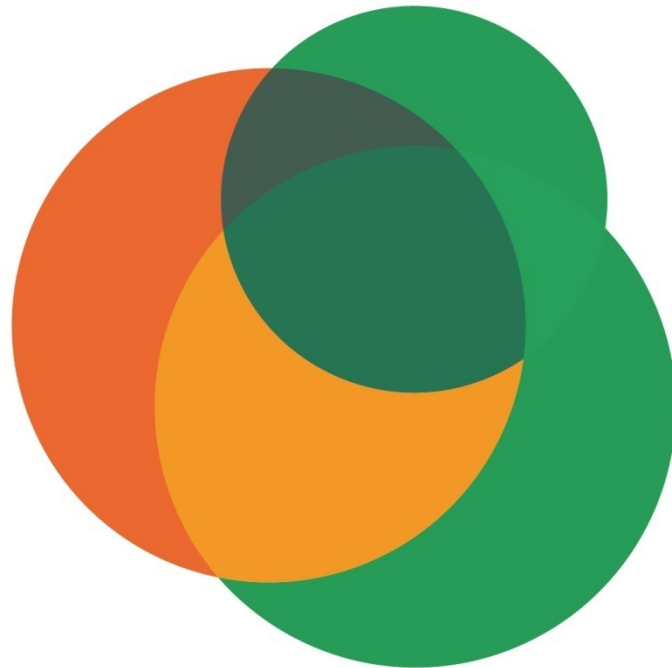
... Design Optimization

- Avoiding Shading
- String Performance
- Auxilaries

... Forecasting

- Being Precise

THANK YOU
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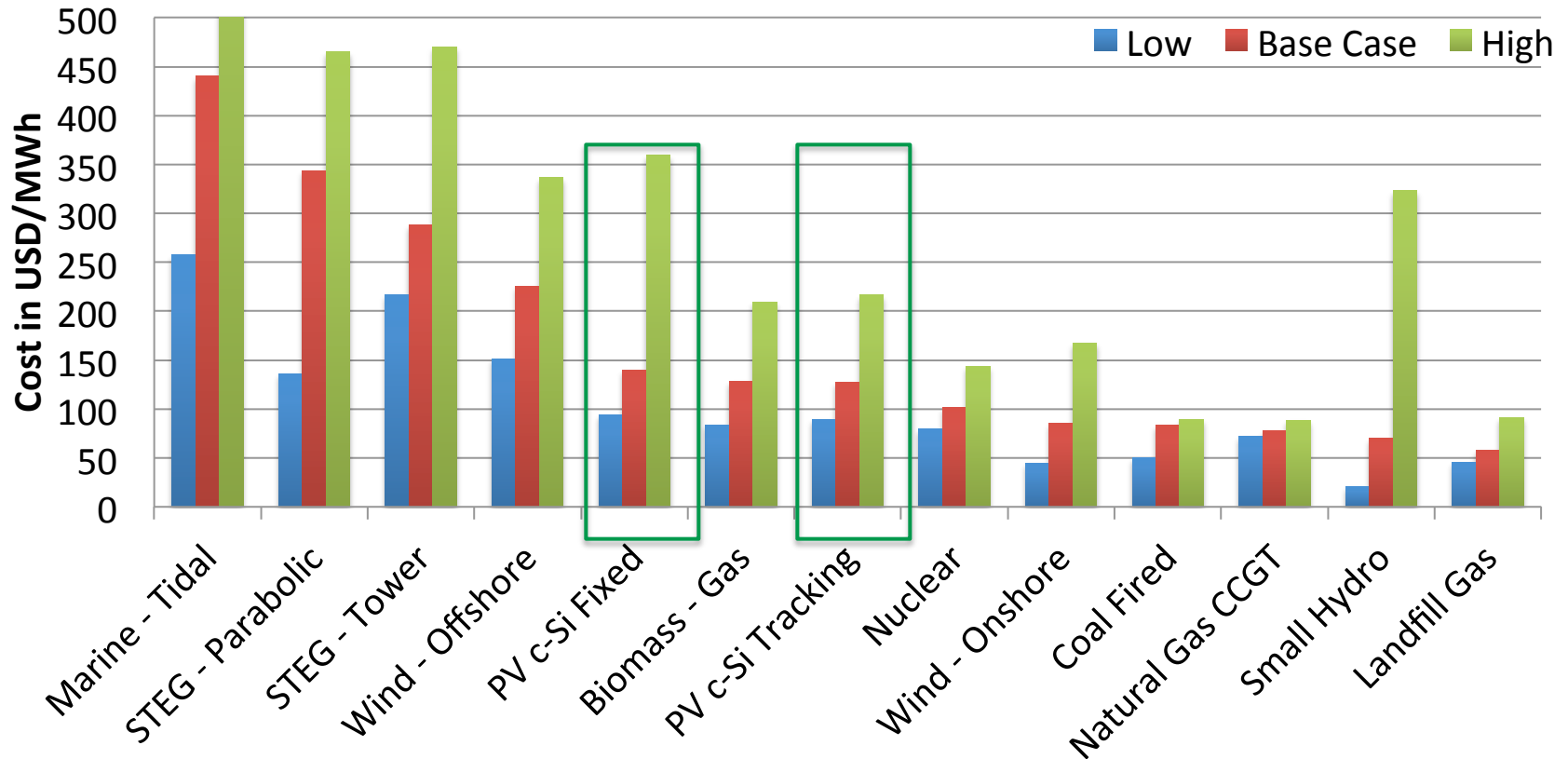
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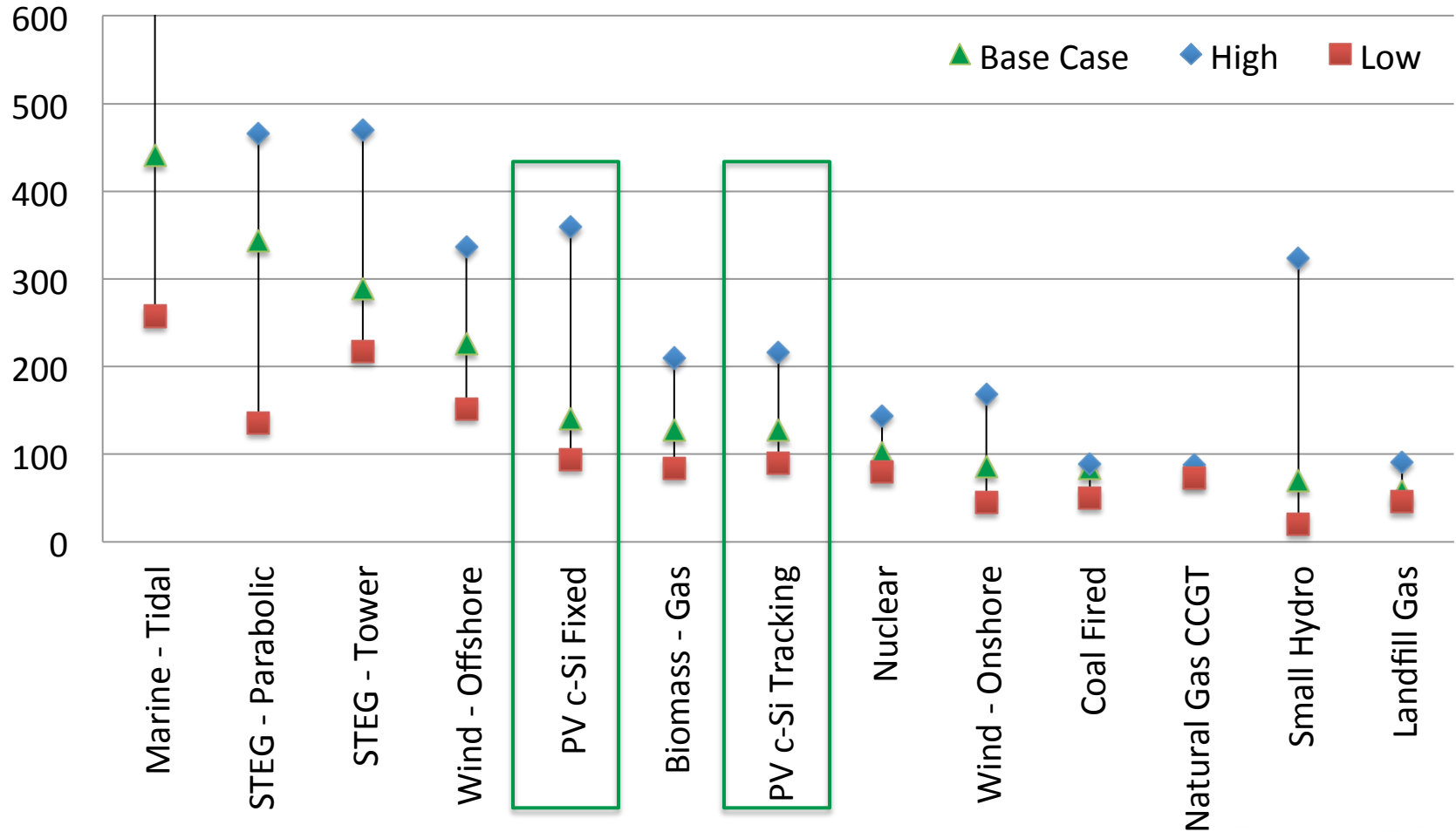
Solar PV is an affordable energy source

Levelised Cost of Electricity



Solar PV is a competitive energy source

Levelised Cost of Electricity in USD/MWh



Source: Bloomberg Renewable Energy Finance; Results - target IRR 10% =, Swap rate 3.8%, Tax rate 35%