

# HYBRID POWER FOR MINES

Reduce costs. Secure power price.  
Improve power quality and reliability.

[www.juwi.co.za](http://www.juwi.co.za)



Presented by:



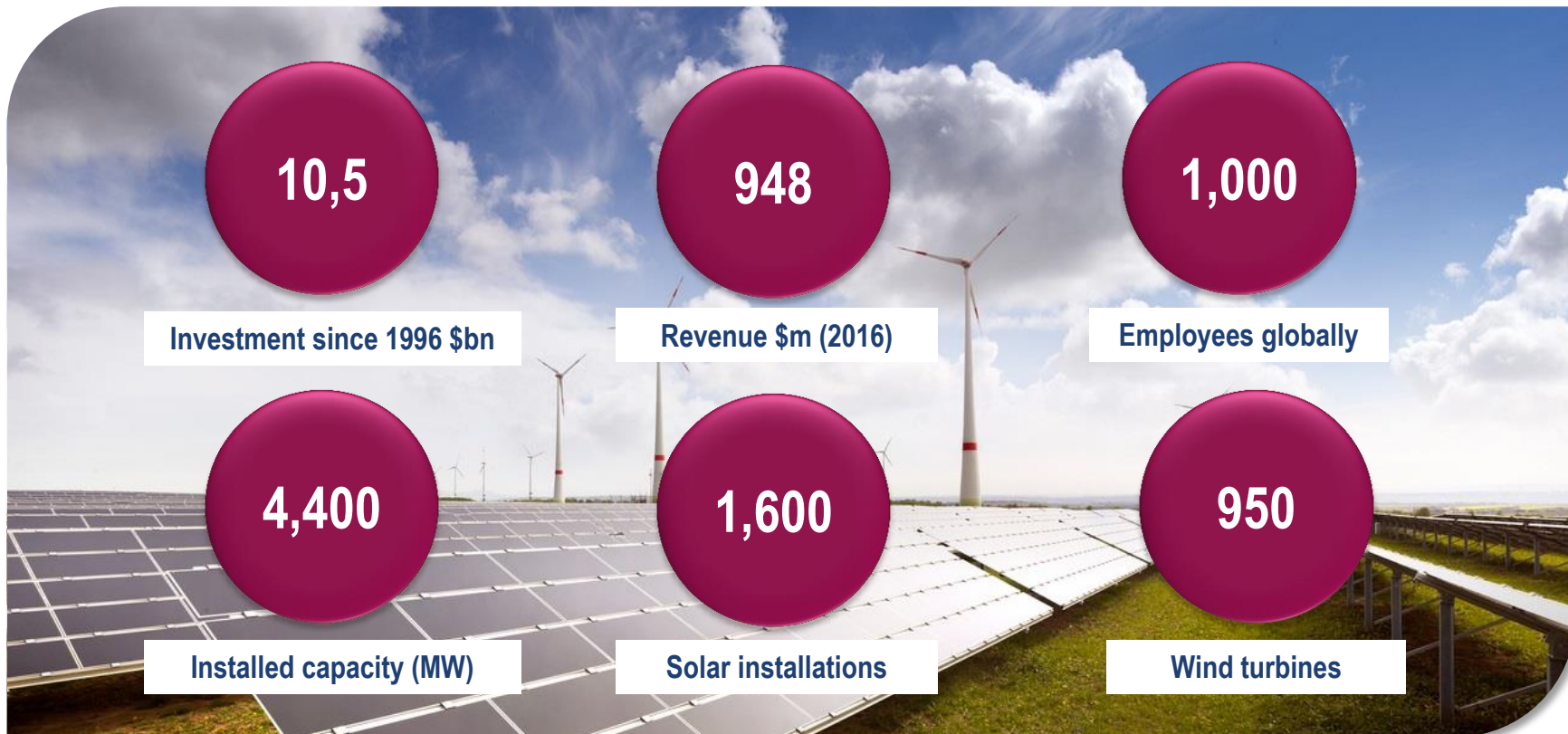
**Amiram Roth-Deblon**  
Head of Global Business  
Initiatives

**WELCOME**  
The webinar will start momentarily

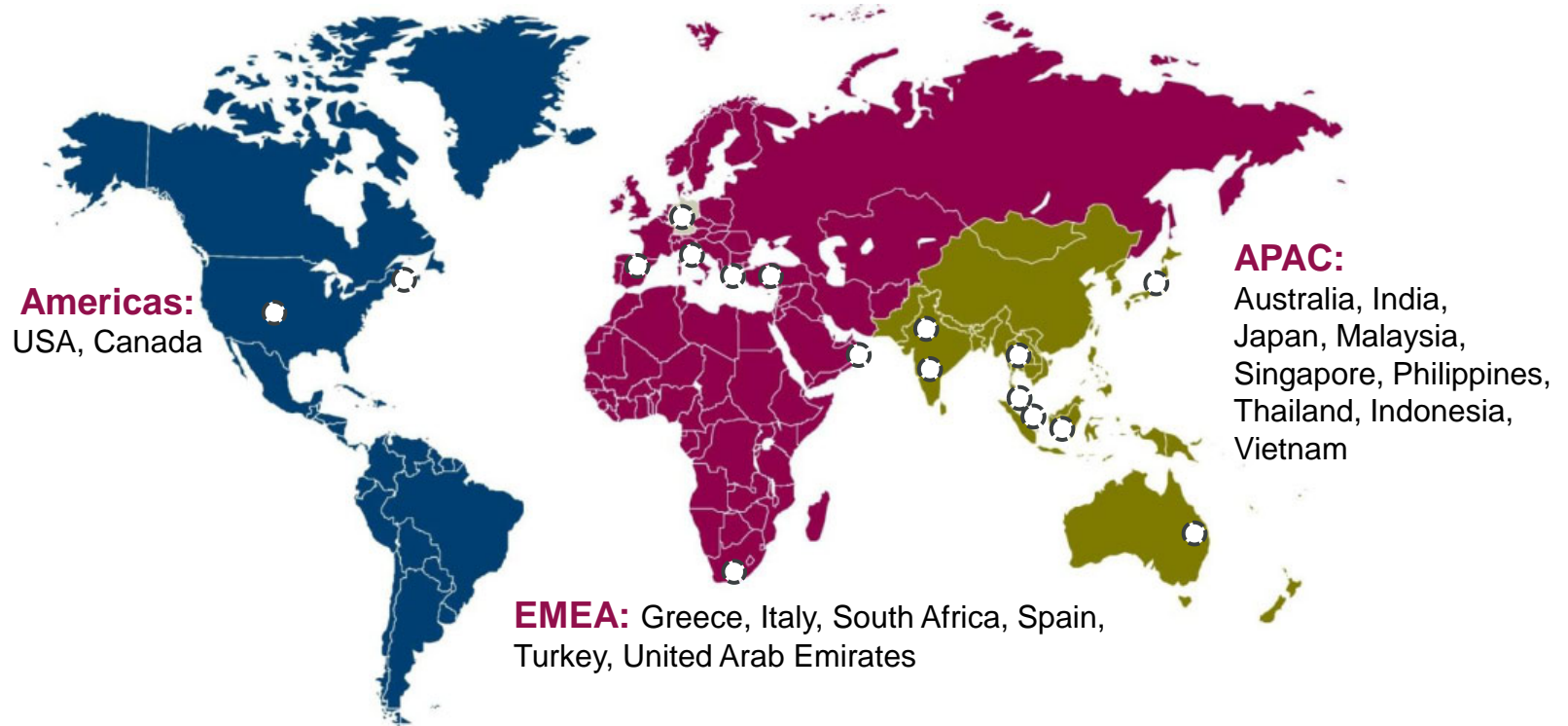
15 February 2018



# juwi Facts & Figures



# juwi Locations Globally



# Poll 1



**Are you considering hybrid solutions for your operations?**

- Yes, Off-grid
- Yes, On-grid / behind the meter
- No



# Hybrid Power for Mines



# Hybrid Power - How much Solar or Wind?

## Low Penetration

Solar/Wind

<7  
%

Fuel Savings

<7  
%

RE of power

<  
15%

# Hybrid Power - How much Solar or Wind?

Low Penetration		Medium Penetration	
Solar/Wind	<7 %	Solar/Wind	8 to 20 %
Fuel Savings	<7 %	Fuel Savings	8 to 20 %
RE of power	< 15%	RE of power	Up to 85%



# Hybrid Power - How much Solar or Wind?

Low Penetration		Medium Penetration		High Penetration	
Solar/Wind	<div><div>&lt;7 %</div><div></div></div>	Solar/Wind	<div><div>8 to 20 %</div><div></div></div>	Solar/Wind	<div><div>&gt;20% to 100%</div><div></div></div>
Fuel Savings	<div><div>&lt;7 %</div><div></div></div>	Fuel Savings	<div><div>8 to 20 %</div><div></div></div>	Fuel Savings	<div><div>&gt;20% to 100%</div><div></div></div>
RE of power	<div><div>&lt; 15%</div><div></div></div>	RE of power	<div><div>Up to 85%</div><div></div></div>	RE of power	<div><div>&gt;80% to &gt;100%</div><div></div></div>



# Hybrid Power - How much Solar or Wind?

## Low Penetration

- Simple to integrate
- No hybrid controller
- No energy storage needed
- Low fuel and cost savings
- Not the lowest LCOE
- Gensets / grid strongly required

# Hybrid Power - How much Solar or Wind?

Low Penetration	Medium Penetration
<ul style="list-style-type: none"><li>▪ Simple to integrate</li><li>▪ No hybrid controller</li><li>▪ No energy storage needed</li><li>▪ Low fuel and cost savings</li><li>▪ Not the lowest LCOE</li><li>▪ Gensets / grid strongly required</li></ul>	<ul style="list-style-type: none"><li>▪ Advanced integration</li><li>▪ Hybrid controller required</li><li>▪ With or without energy storage</li><li>▪ Medium fuel and cost savings</li><li>▪ Optimised LCOE</li><li>▪ Gensets / grid required partially</li></ul>

# Hybrid Power - How much Solar or Wind?

Low Penetration	Medium Penetration	High Penetration
<ul style="list-style-type: none"><li>▪ Simple to integrate</li><li>▪ No hybrid controller</li><li>▪ No energy storage needed</li><li>▪ Low fuel and cost savings</li><li>▪ Not the lowest LCOE</li><li>▪ Gensets / grid strongly required</li></ul>	<ul style="list-style-type: none"><li>▪ Advanced integration</li><li>▪ Hybrid controller required</li><li>▪ With or without energy storage</li><li>▪ Medium fuel and cost savings</li><li>▪ Optimised LCOE</li><li>▪ Gensets / grid required partially</li></ul>	<ul style="list-style-type: none"><li>▪ Very advanced integration</li><li>▪ High-end hybrid controller</li><li>▪ Only with energy storage</li><li>▪ Maximum fuel savings</li><li>▪ Optimised LCOE</li><li>▪ Full Genset off-mode</li></ul>

## Poll 2



### Have you realised hybrid projects?

- Yes, Off-grid
- Yes, On-grid
- Yes, with battery
- Yes, without battery
- No

# DeGrussa Solar Project





# Where we began (2013)

## Questions / unknowns

- Will the system affect the existing power station?
- What about power system stability and outages?
- What will be the level of solar curtailment?
- Soiling losses?
- System operation in harsh remote environment?
- Will the mine life be extended?
- What is the best commercial structure?



# Mine Site

## Location and power supply

<b>Off taker</b>	Sandfire Resource NL
<b>Resource</b>	Copper and Gold
<b>Location</b>	Western Australia (900 km northeast of Perth)
<b>Existing power supply</b>	Diesel 23 MW (originally 19 MW)
<b>Average load</b>	~ 13.5 MW
<b>Average consumption</b>	~ 100 GWh/a



# Project details (Completed 2016)

## Design and system integration by juwi

- juwi hybrid SCADA
- New level of monitoring and control of all generation assets
- Micro grid controller of ABB

## Solar PV

- 10.6 MWp single-axis tracker
- Area: 20 hectares (~40 football pitches)

## Battery

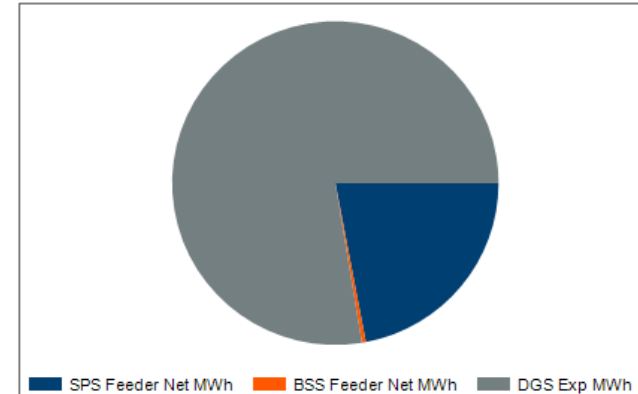
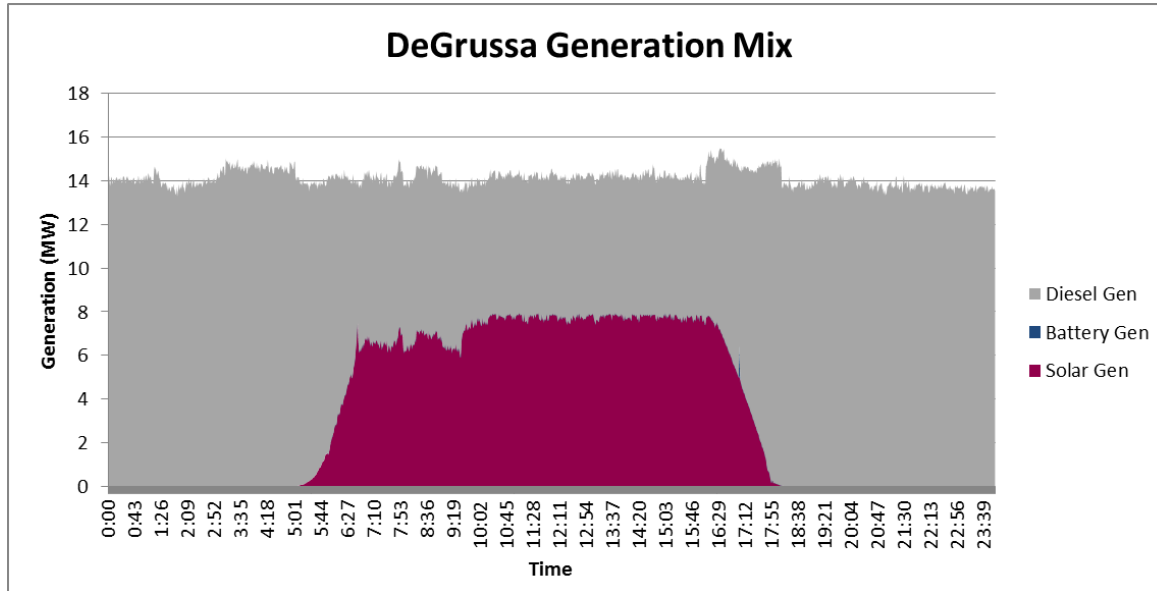
- Battery: 6 MW / 1.8 MWh (4 MW nominal)
- Type: Lithium Ion



# Where we are now

## Key parameters

- ~ 60% instantaneous power from solar (and increasing)
- ~ 2 GWh monthly generation from solar
- Diesel savings: ~ 450,000 litre diesel per month



# What the stakeholders say about the project



**Peter Gordon**  
**Electrical Superintendent,**  
**Sandfire Resources**

*"Now after more than 1 year of operation I can confirm that the hybrid system is running smoothly, delivers substantial diesel savings and the power quality and reliability are as good or better than before."*



**Karl Simich**  
**CEO, Sandfire Resources**

*"...several of our peers are interested in adopting this technology at their mine sites."*

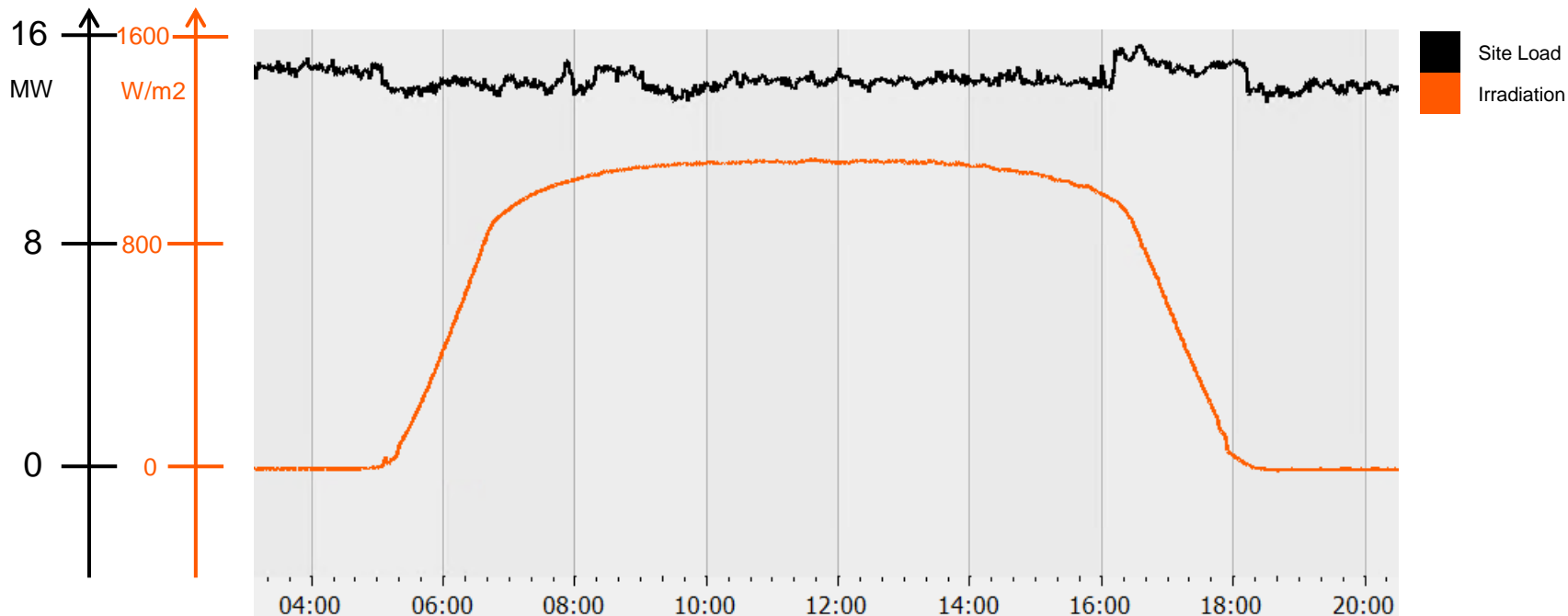


**Ivor Frischknecht**  
**CEO, Australian Renewable**  
**Energy Agency**

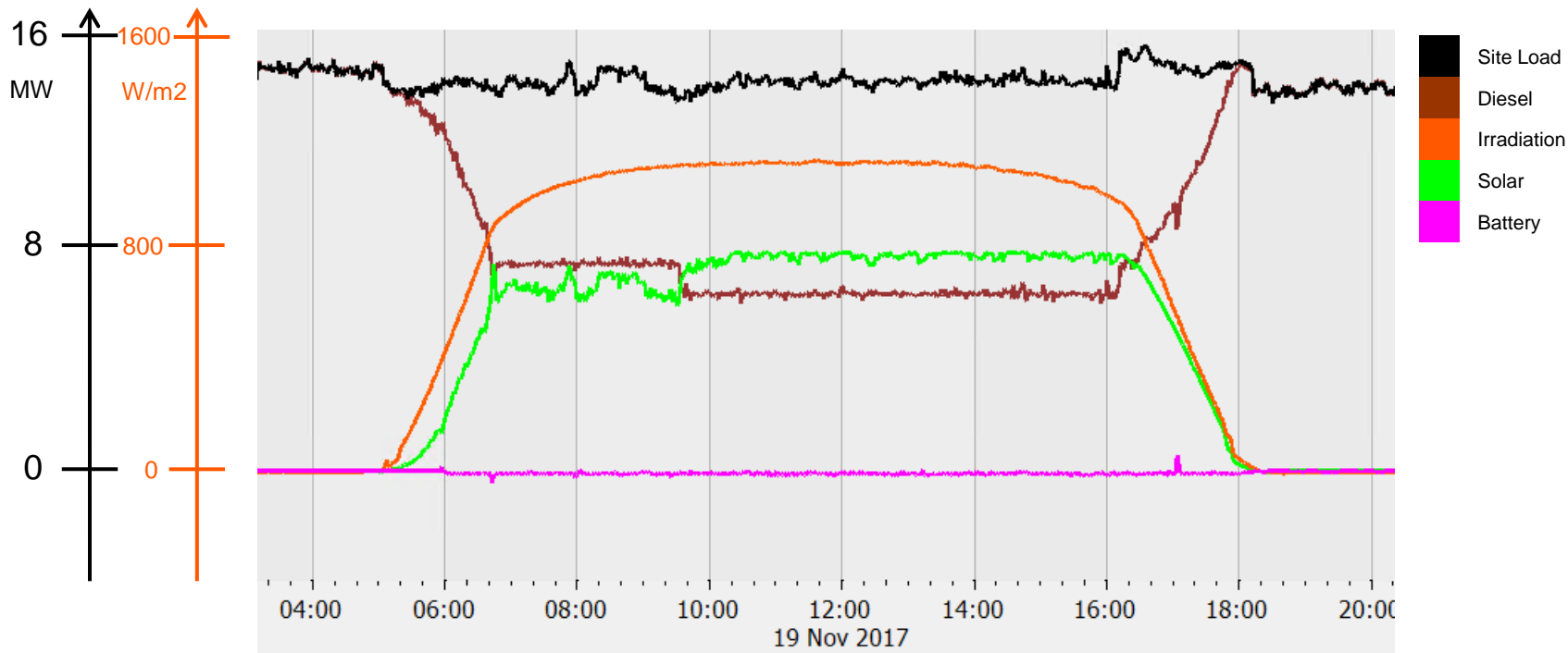
*"The project was constructed in 10 months and delivered on budget, despite being located in remote Australia."*



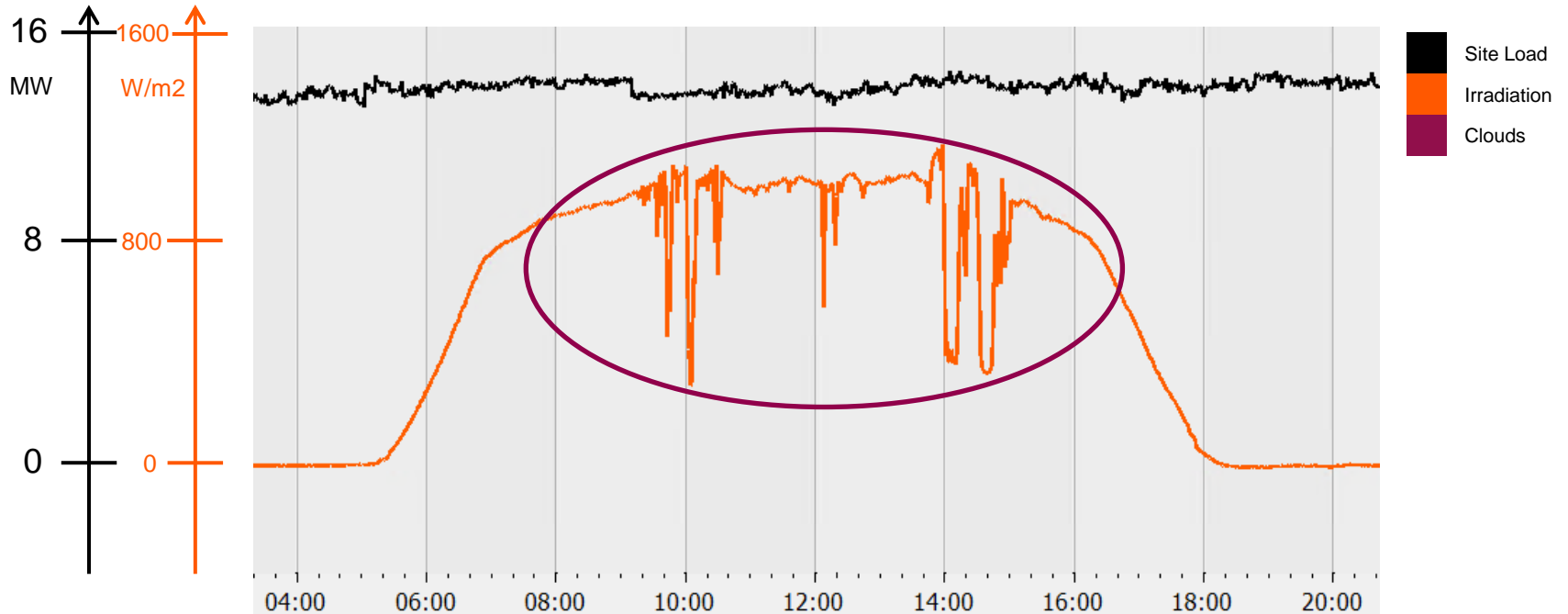
# Typical operation – Nov. 2017



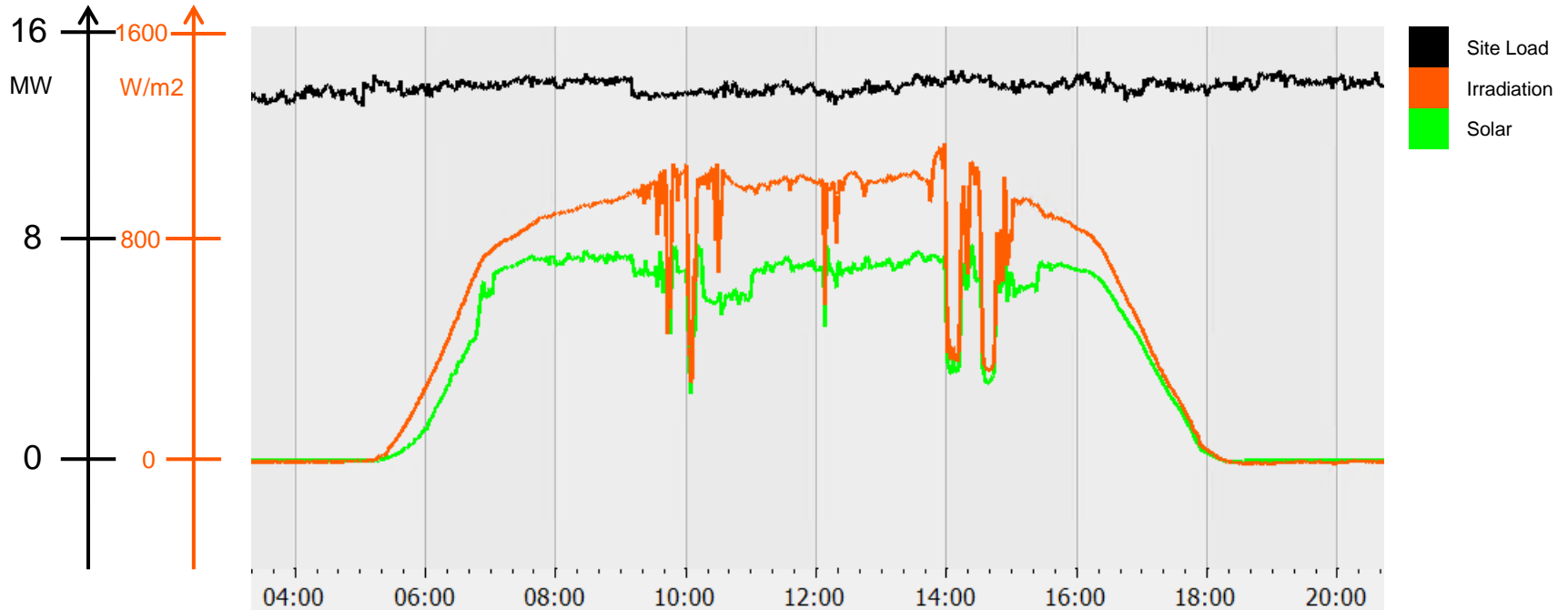
# Typical operation - Nov. 2017



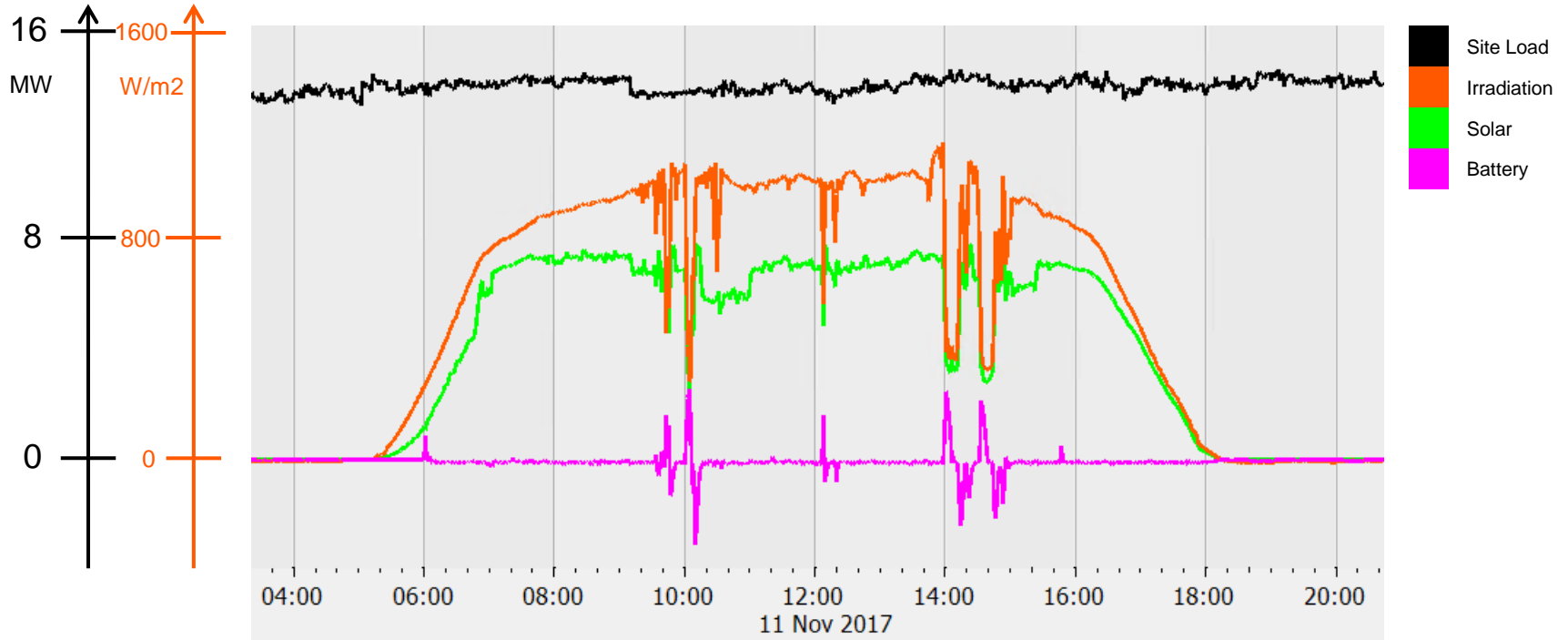
# Clouds overhead – Power System is stable



# Solar output follows irradiation

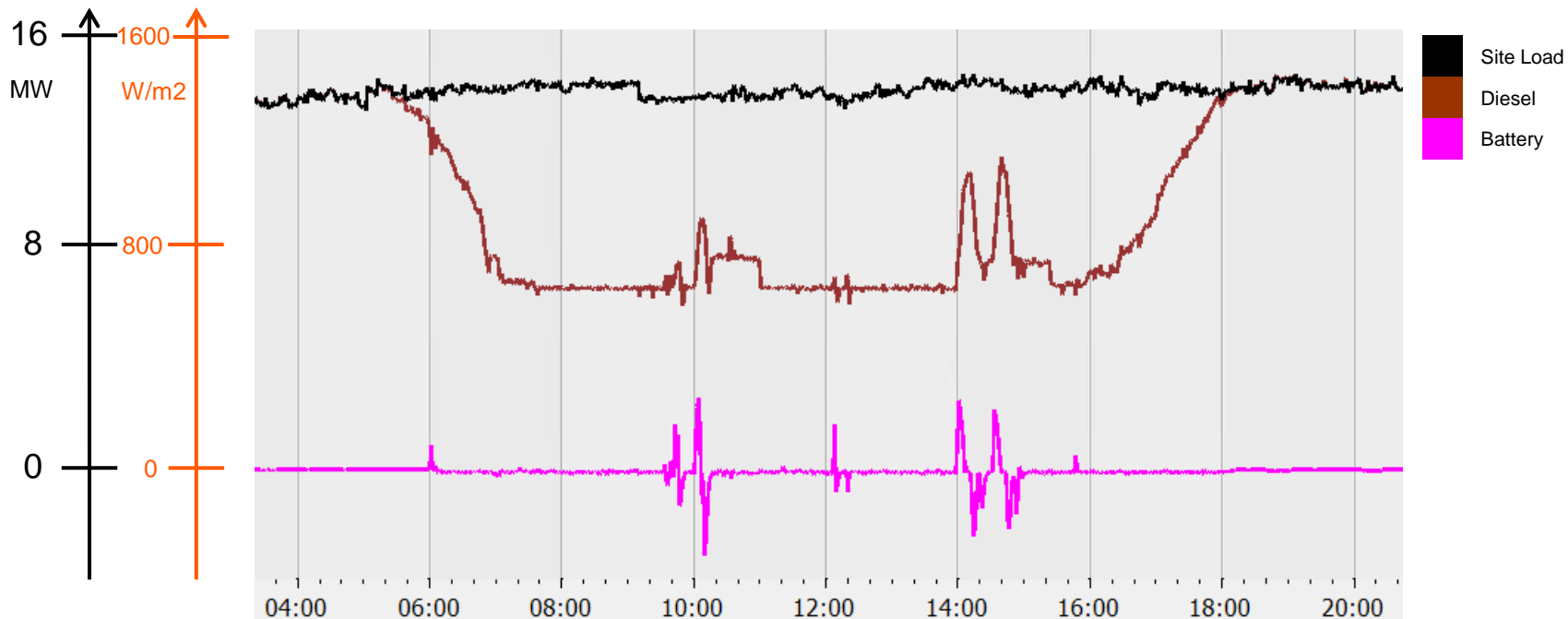


# Solar smoothing – fast response of batteries





# Gensets provide additional spinning reserve



## Poll 3

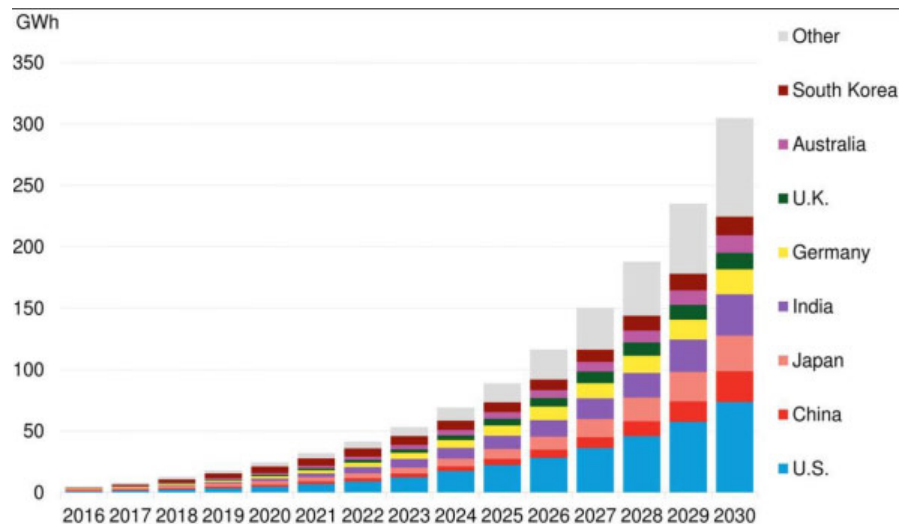
### What are you looking for?

- Energy Supply
- Hybrid power supply
- Energy Off-takers
- Hybrid technology
- EPCs
- Project Developers
- Projects
- Investors
- other

## juwi

- 
- BNEF lithium-ion battery price survey, 2010-16 (\$/kWh)**
- | Year | Price (\$/kWh) | % Change (YoY) |
|------|----------------|----------------|
| 2010 | 1000           | -              |
| 2011 | 800            | -20%           |
| 2012 | 642            | -20%           |
| 2013 | 599            | -7%            |
| 2014 | 540            | -10%           |
| 2015 | 350            | -35%           |
| 2016 | 273            | -22%           |

Source: Bloomberg New Energy Finance



# Challenges

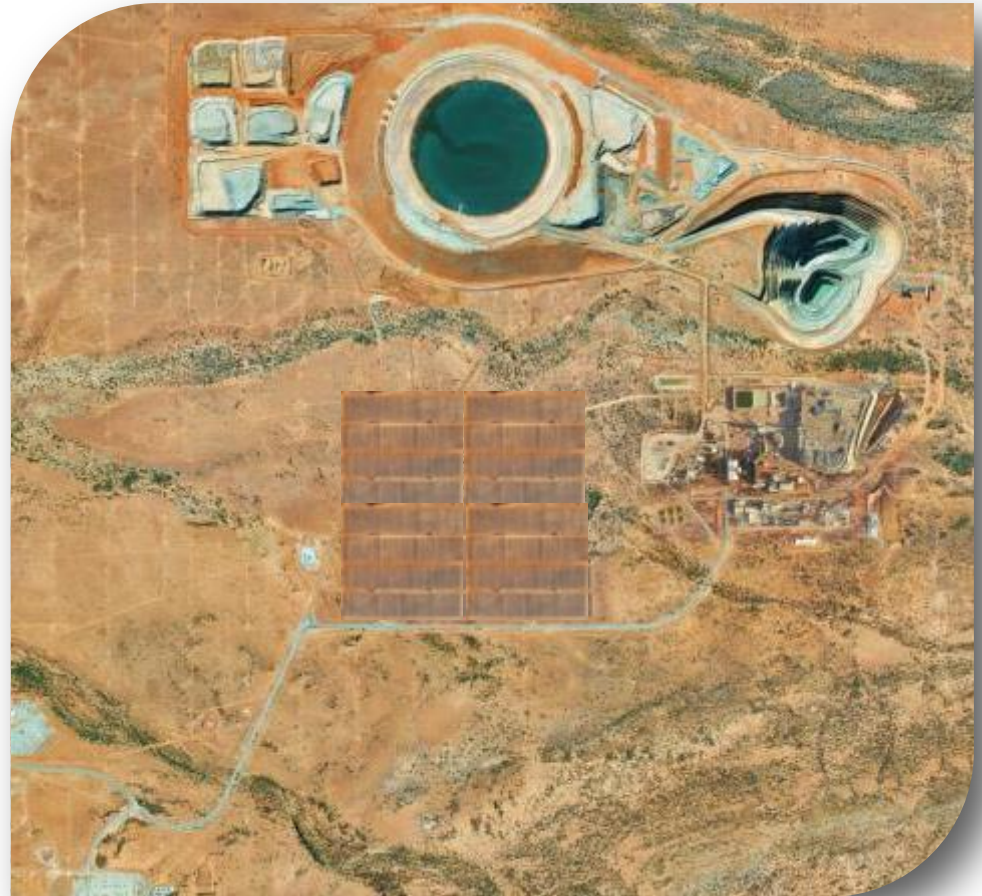
- Shifting from thermal power to mix of energy sources
  - PPA tenor & mine life
  - Mining industry requirements vs energy industry standards
  - Control system integration and SCADA
- 
- Firming power
  - Grid connection and power export
  - Energy wheeling
  - CO2 & energy policy



# What is possible today?

## Cover 100% of Daytime Usage

- Solar PV: 27 MWp
- Battery: 20 MWh
- Diesel Savings: 11.5mn litres p.a.
- CO2 Savings: 31,000 tonnes p.a.
- Payback: ~ 5 to 6 years



# What is possible today?

## Daytime + Night time + Mobile Plant

- Solar PV: 120 MW
- Battery: 300 MWh
- Diesel Savings: 45mn litres p.a.
- CO2 Savings: 122,000 tonnes p.a.
- Payback: 9 to 13 years

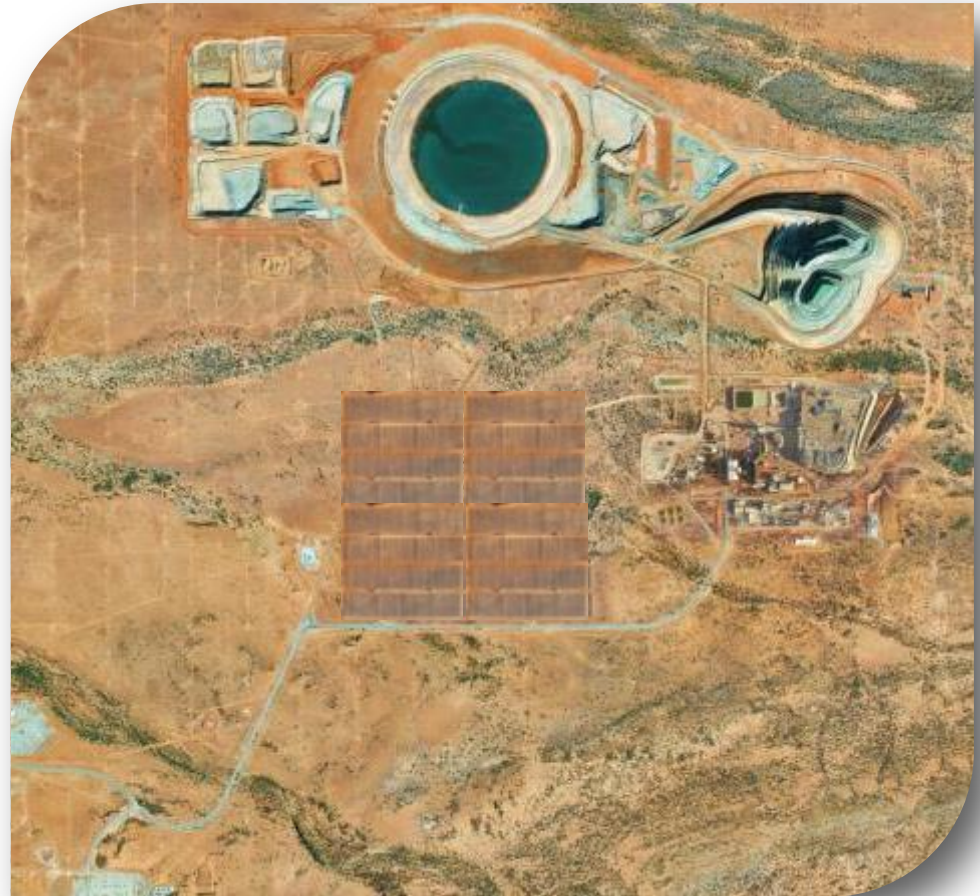




# The Future - In 5 years & 2030

## Cover Daytime demand

- 2023: Payback ~ 4 years
- 2030: Payback < 3 years



# The Future - In 5 years & 2030

## Daytime + Night time + Mobile Plant

- 2023: Payback ~ 6 years
- 2030: Payback ~ 4.5 years





# Should you wait?

## Power supply duration has higher impact than annual cost reductions

- 1 year longer power supply can decrease power price by up to 25%
- Annual technology cost reductions are forecast at 3 – 8% year on year until 2040
- For projects that need power and have a limited mine life →

A maroon speech bubble with a white border and a drop shadow, pointing towards the right. It contains white text.

**Investing today in  
Solar and Wind  
delivers the  
LOWEST  
power cost**

# Questions?



## Thank you for joining our Webinar!

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