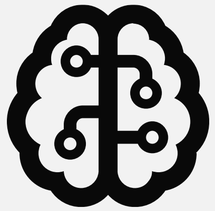
HARD SOFT WARE

JuMP/HiGHS in the Australian Electricity Market

OUR MAIN PRODUCTS

INFOLITE

Infolite a comprehensive solution that provides all the trading and operational requirements for profitably managing and running a renewable wind or solar farm in the Australian NEM.



AUTOMATED VRE TRADING

A recent development is enhancing our Infolite product with an automated bidding solution for solar and wind farms to provide optimized revenue trading at a much cheaper end-user cost than other automated solutions or 24 x 7 trading operations.

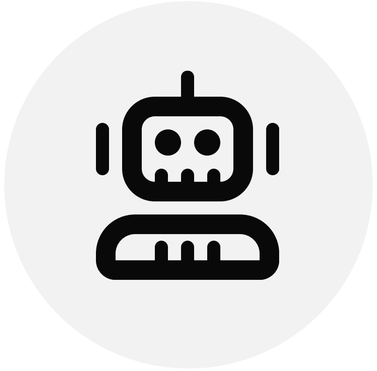
OPTIGEN

HARD software has recently launched Optigen, which is a cost-effective and reliable solution that seamlessly integrates with renewable energy generation and battery control systems to enhance revenue and manage risk.

COMPETITIVE ENERGY MARKET TRENDS

MULTI-MODAL SYSTEMS

Increasing numbers of renewable generators are looking to integrate BESS into their existing and planned sites. Proposed rule changes will make flexible optimization of these combined generation types necessary for generator profitability.



AUTOMATED TRADING

Automated trading of VRE generators is the most cost-effective solution for both single and multi-modal generation. Many existing alternatives have oversold the benefits or are too costly and many are now being replaced.

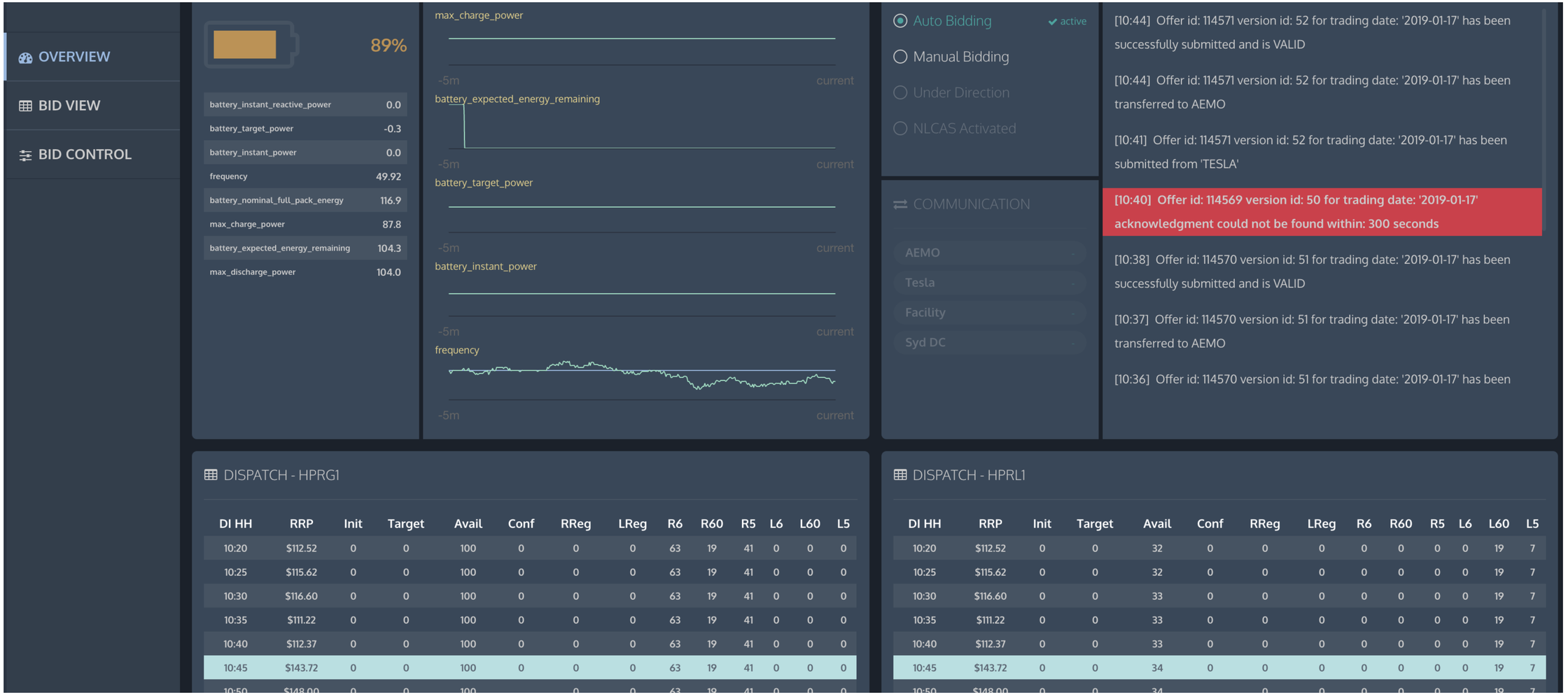
SYSTEMS SECURITY

Systems compliance and increasing security requirements for all the NEM trading and operational systems are becoming a priority for the security of the critical national infrastructure. It is expected that audits and penalties for non-compliance will become common.

HORNSDALE TESLA/NEOEN POWER RESERVE

SOFTWARE DESIGN STARTED 1 AUG 2017
IN PRODUCTION ON 1 DEC 2017

TESLA HORNSDALE TRADING SOLUTION

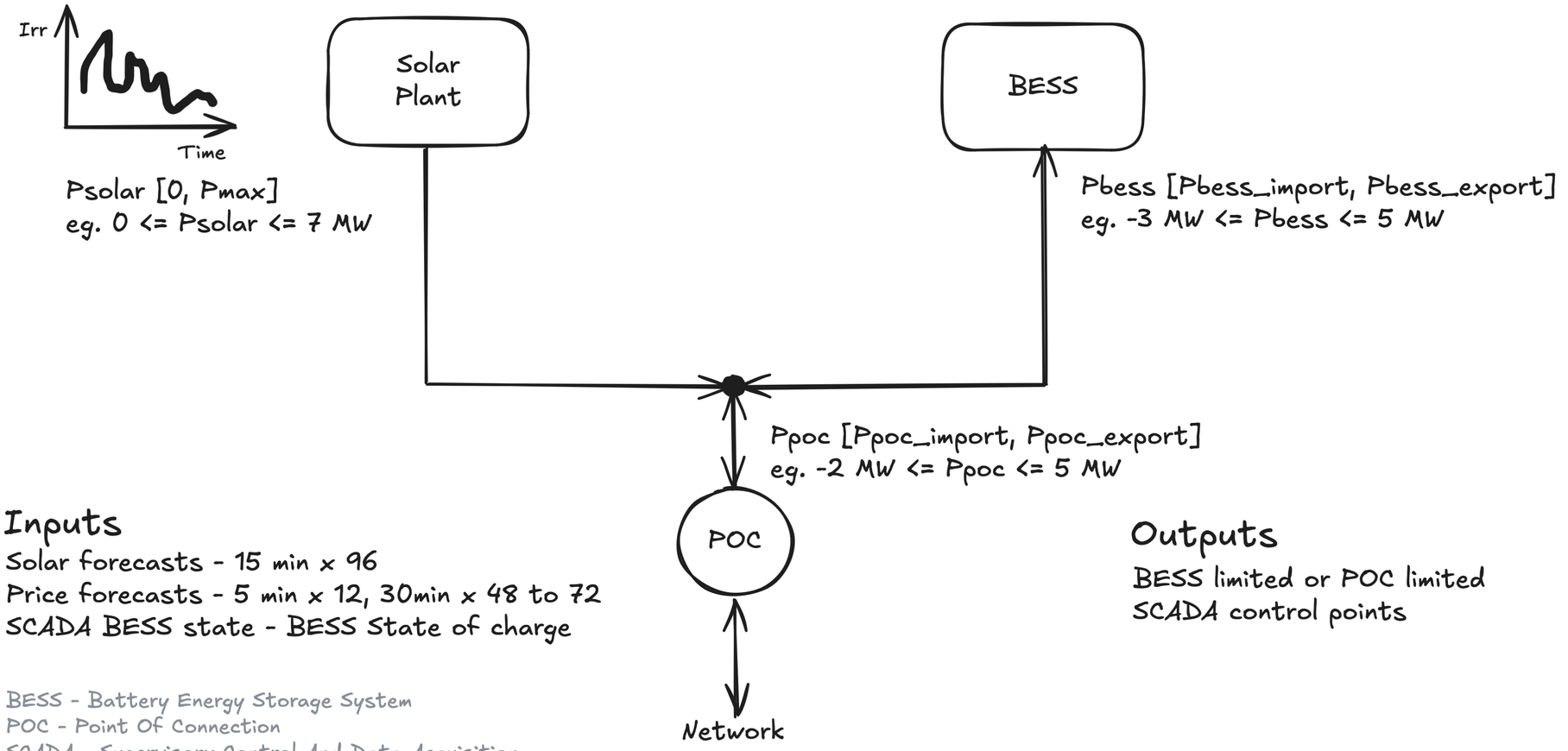


DI HH	RRP	Init	Target	Avail	Conf	RReg	LReg	R6	R60	R5	L6	L60	L5
10:20	$112.52	0	0	100	0	0	0	63	19	41	0	0	0
10:25	$115.62	0	0	100	0	0	0	63	19	41	0	0	0
10:30	$116.60	0	0	100	0	0	0	63	19	41	0	0	0
10:35	$111.22	0	0	100	0	0	0	63	19	41	0	0	0
10:40	$112.37	0	0	100	0	0	0	63	19	41	0	0	0
10:45	$143.72	0	0	100	0	0	0	63	19	41	0	0	0

DI HH	RRP	Init	Target	Avail	Conf	RReg	LReg	R6	R60	R5	L6	L60	L5
10:20	$112.52	0	0	32	0	0	0	0	0	0	0	19	7
10:25	$115.62	0	0	32	0	0	0	0	0	0	0	19	7
10:30	$116.60	0	0	33	0	0	0	0	0	0	0	19	7
10:35	$111.22	0	0	33	0	0	0	0	0	0	0	19	7
10:40	$112.37	0	0	33	0	0	0	0	0	0	0	19	7
10:45	$143.72	0	0	34	0	0	0	0	0	0	0	19	7

TYPICAL GENERATION PLANT SCHEMATIC

BESS with DC-coupled Solar



Inputs

Solar forecasts - 15 min x 96
Price forecasts - 5 min x 12, 30min x 48 to 72
SCADA BESS state - BESS State of charge

Outputs

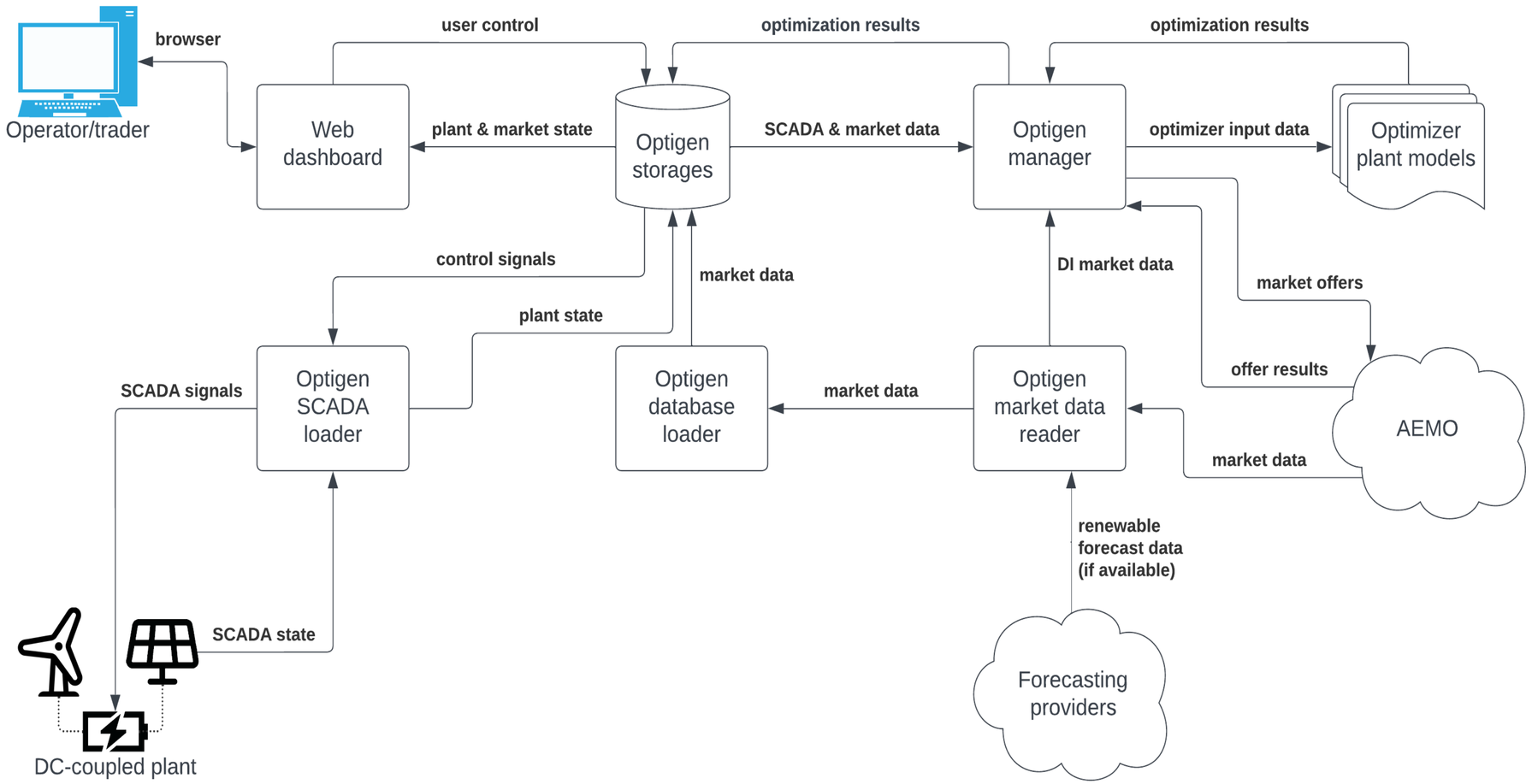
BESS limited or POC limited
SCADA control points

BESS - Battery Energy Storage System
POC - Point Of Connection
SCADA - Supervisory Control And Data Acquisition

OPTIGEN OPTIMISED TRADING SOLUTION

Optigen scalable hosted solution logical diagram

February 2024



OPTIGEN CONTROL SYSTEM INTERFACE

OPTIGEN TECHNOLOGY

JULIA/JUMP

The optimisation multi-threaded module is written entirely in Julia using JuMP to interface to HiGHS.

MULTI-TENANTED

A principal feature of the design is to be able to run multiple site models on a single instance to allow for scaling the solution.

DISCRETE MODULES

Each other component of the Optigen framework is entirely independent and uses a unified Python multi-threaded architecture.

OPEN SOURCE

All programming & modelling languages, application infrastructure & operating systems are open source.

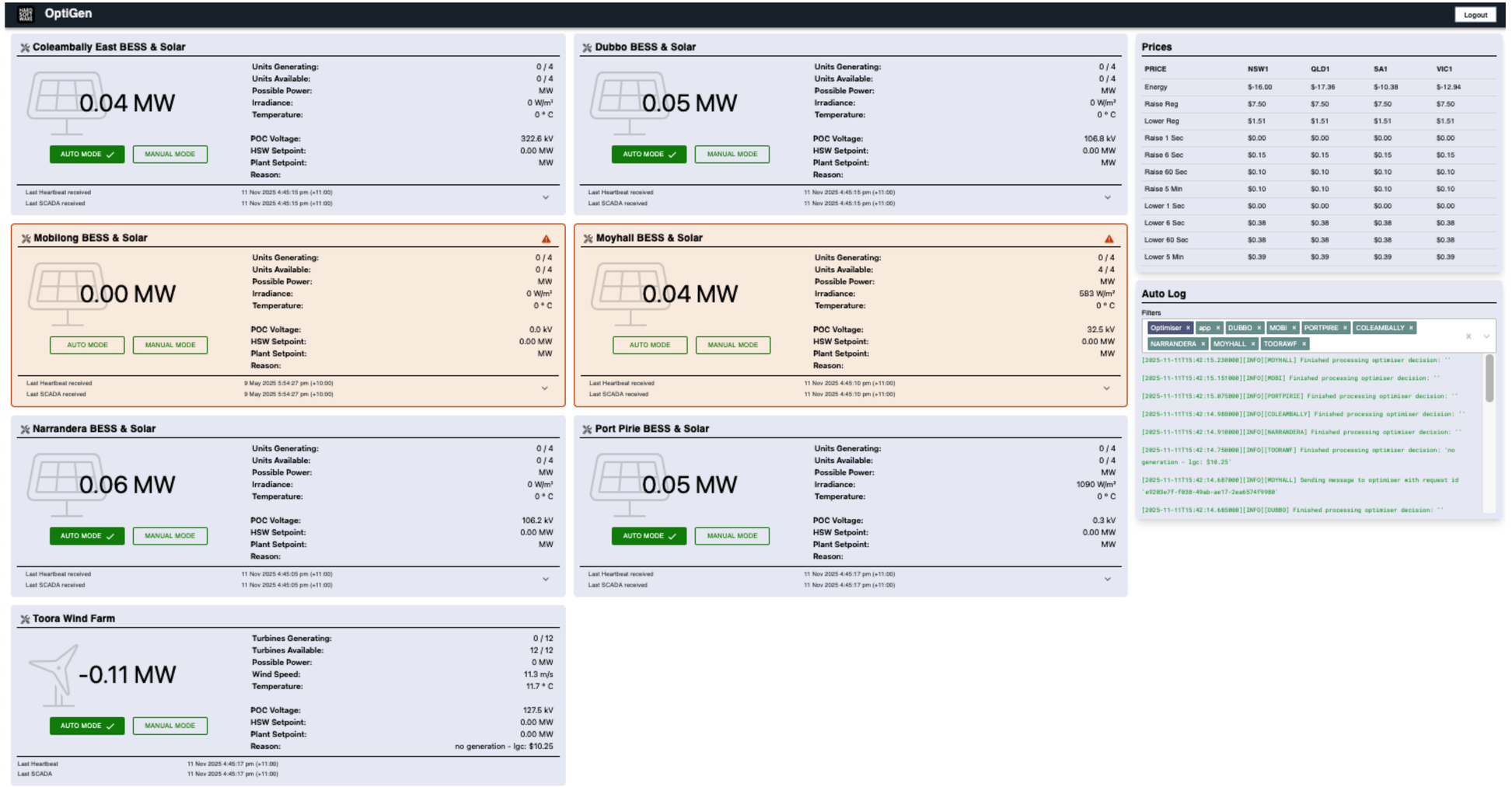
MESSAGING

All inter-process communication is implemented using a unified messaging framework and message format.

DEPLOYMENT

A small, economical industry standard RTU device is used to provide the interface directly to the plant SCADA.

OPTIGEN OPTIMISED TRADING SOLUTION



OPTIGEN CONTROL LOGIC

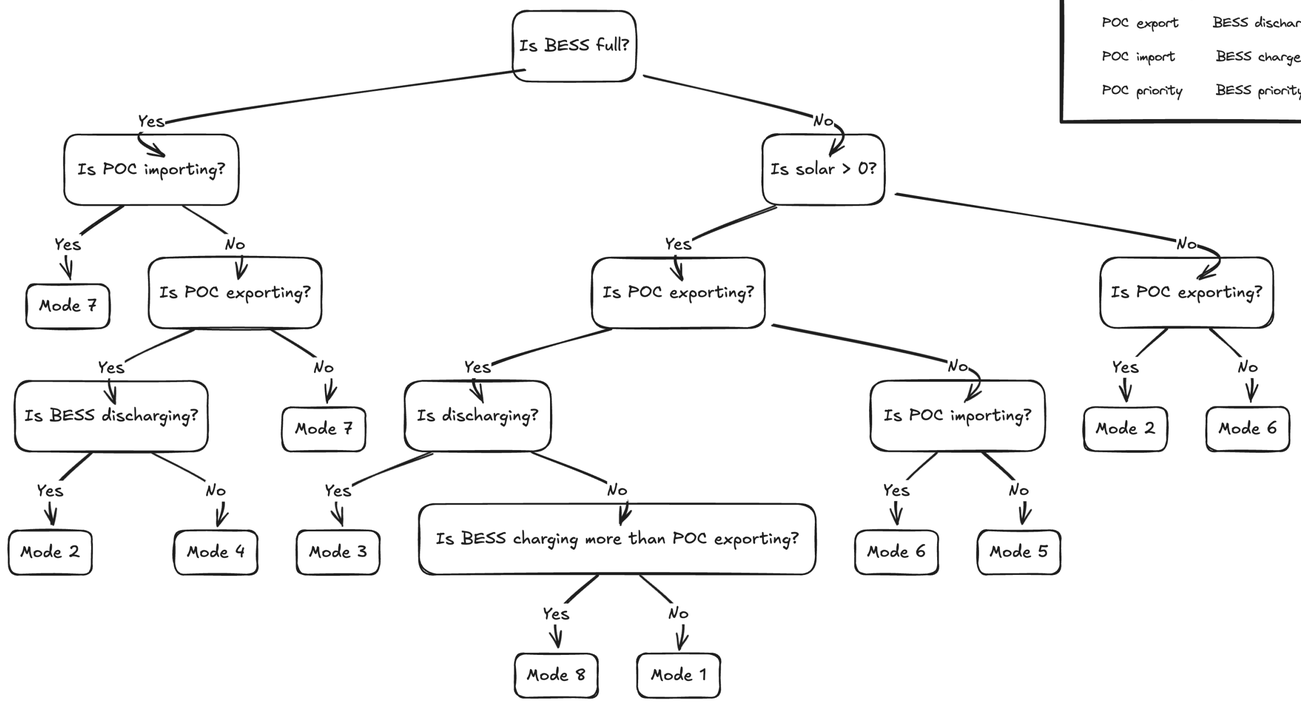
BESS DC-coupled solar optimisation scenarios

29 January 2025 - Dr. Harley Mackenzie
HARD software

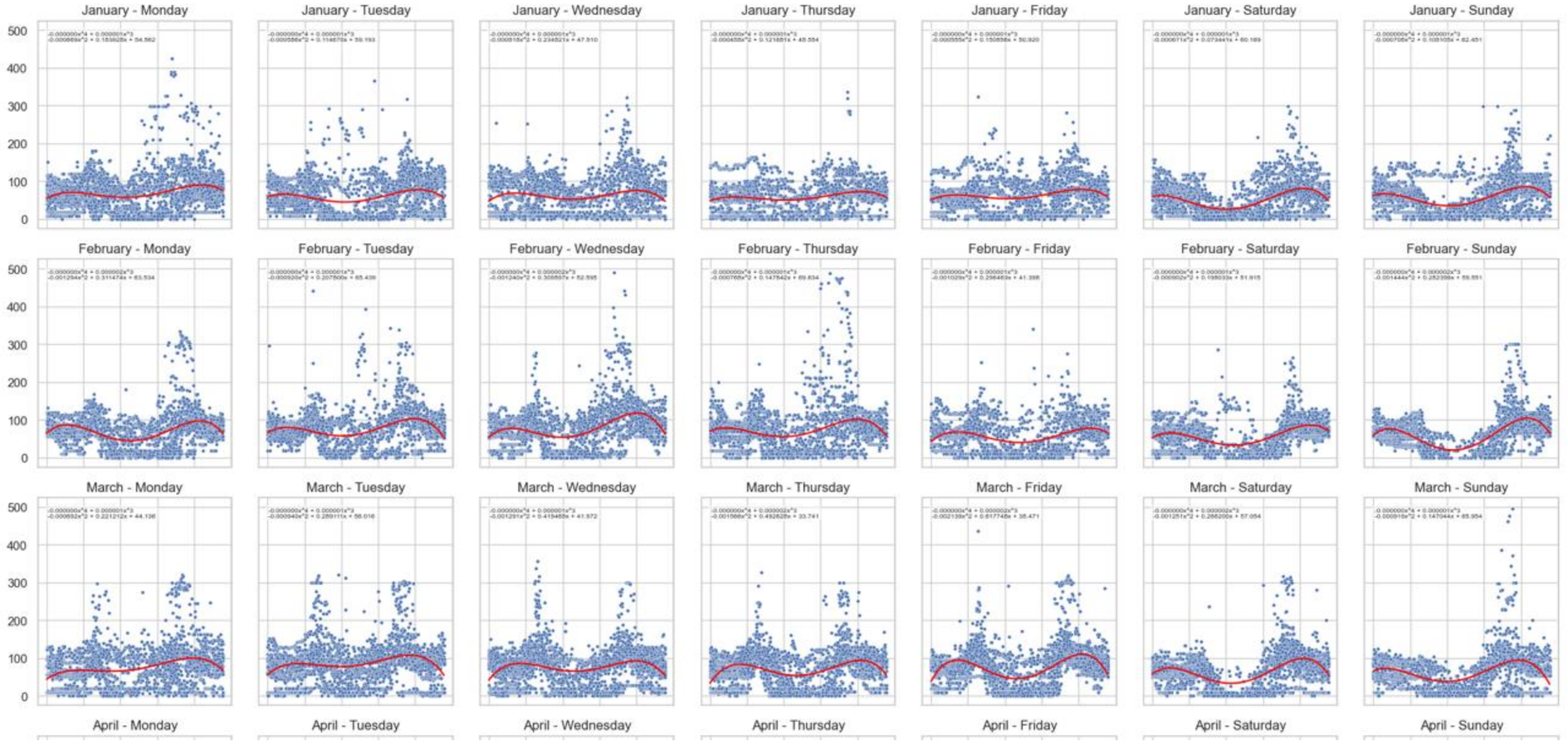
Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6	Mode 7	Mode 8
max POC exp excess BESS	max POC exp & no BESS imp	max POC exp & BESS exp/imp	No BESS POC export	solar to import BESS	max imp BESS & POC import	No BESS or solar	max imp BESS & POC export
T F F T T F	T T F F T F	T T F T T F	T F F F T F	F F F T F T	F F T T F T	F F F F T F	T F F T F T

SCADA signals legend

POC export	BESS discharge
POC import	BESS charge
POC priority	BESS priority



STORAGE VALUATION APPROACH



OPTIGEN MONITORING DASHBOARD

MQTT Broker: 192.168.32.21:1883 | Client ID: mqtt_dashboard_5818

Market Data Dispatch Interval: 2025-11-11 14:00

Prices: 2025-11-11 13:55:43 5 MIN forecasts: 2025-11-11 13:57:37

NSW1: -$16.77 [-$20.35, -$20.77, -$21.01, -$21.72, -$21.69, -$20.98, -$20.00, -$21.06, -$21.45, -$20.95, -$20.00, -$20.00]
QLD1: -$10.82 [-$14.53, -$14.53, -$14.53, -$10.82, -$10.85, -$14.53, -$13.89, -$14.53, -$15.01, -$14.53, -$14.53, -$14.53]
SA1 : -$16.77 [-$19.14, -$19.88, -$17.81, -$17.81, -$17.81, -$18.85, -$17.90, -$18.94, -$19.88, -$20.83, -$19.98, -$18.24]
TAS1: $23.18 [$23.13, $23.13, $23.13, $23.13, $23.13, $21.93, $23.13, $22.04, $21.38, $20.98,

TOORAWF Dispatch Interval: 2025-11-11 14:00 Region: VIC1

SCADA readings:	11/11/2025 13:57:37		
request:	2025-11-11 13:57:33	response:	2025-11-11 13:57:35
generation:	-0.118 MW	wind speed:	12.30 m/s
no available:	12	no generating:	0
solution status:	OPTIMAL	modes:	[1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1]
HSW setpoint:	0.000 MW	plant setpoint:	21.000 MW

MOBI Dispatch Interval: 2025-11-11 14:00 Region: SA1

SCADA readings:	N/A	forecast:	2025-11-11 13:43:03
request:	2025-11-11 13:57:34	response:	2025-11-11 13:57:35
POC active power:	N/A	solar generation:	N/A
irradiance:	N/A	temperature:	N/A
no available:	N/A	no generating:	N/A
BESS storage:	N/A	BESS output:	N/A
solution status:	OPTIMAL	modes:	MODE_6 [0, 0, 1, 1, 0, 1]
HSW setpoint:	N/A	POC setpoint:	N/A

PORTPIRIE Dispatch Interval: 2025-11-11 14:00 Region: SA1

SCADA readings:	11/11/2025 13:57:32	forecast:	2025-11-11 13:43:05
request:	2025-11-11 13:57:34	response:	2025-11-11 13:57:35
POC active power:	0.048 MW	solar generation:	0.045 MW
irradiance:	1112.00 W/m*m	temperature:	1.9 Deg C
no available:	0	no generating:	0
BESS storage:	0.000 MWh	BESS output:	0.000 MW
solution status:	OPTIMAL	modes:	MODE_2 [1, 1, 0, 0, 1, 0]
HSW setpoint:	N/A	POC setpoint:	0.050 MW

NARRANDERA Dispatch Interval: 2025-11-11 14:00 Region: NSW1

SCADA readings:	11/11/2025 13:57:20	forecast:	2025-11-11 13:43:04
request:	2025-11-11 13:57:34	response:	2025-11-11 13:57:35
POC active power:	0.066 MW	solar generation:	0.046 MW
irradiance:	0.00 W/m*m	temperature:	0.0 Deg C
no available:	0	no generating:	N/A
BESS storage:	0.000 MWh	BESS output:	-0.003 MW
solution status:	OPTIMAL	modes:	MODE_2 [1, 1, 0, 0, 1, 0]
HSW setpoint:	N/A	POC setpoint:	4.700 MW

MOYHALL Dispatch Interval: 2025-11-11 14:00 Region: SA1

SCADA readings:	11/11/2025 13:57:40	forecast:	2025-11-11 13:43:04
request:	2025-11-11 13:57:35	response:	2025-11-11 13:57:35
POC active power:	0.046 MW	solar generation:	0.065 MW
irradiance:	962.00 W/m*m	temperature:	14.8 Deg C
no available:	4	no generating:	N/A
BESS storage:	0.000 MWh	BESS output:	0.000 MW
solution status:	OPTIMAL	modes:	MODE_7 [0, 0, 0, 0, 1, 0]
HSW setpoint:	N/A	POC setpoint:	0.004 MW

Status: Connected & Listening | Total Messages: 2303 | Active Sections: 8/8

q Quit r Refresh

JuMP LESSONS FROM OPTIGEN

ENERGY/MARKET OPTIMISATION & JuMP

Energy/market optimisation is a “killer app” for JuMP: many users of JuMP are interested in power-systems modelling, scheduling & market bidding.

DATA QUALITY IS EVERYTHING

Market data needs to “productionised” eg. actual versus forecast data needs to be consistent, and control system interfaces must be reliable and consistent.

CONTINUOUS MONITORING REQUIRED

Data quality and timing need to always be monitored. Issues can arise when delivery of data is inconsistent and variable (prices 20s to 90s into DI, forecasts 90s to 210s).

SOLUTION TIME IS NOT ALWAYS CRITICAL

Model for BESS and solar solution typically runs in under 1s, allowing for multi-tenanted solutions. Mapping optimisation results to controls is not as straightforward.

JuMP MODELLING IS QUICK AND EASY

AMPL is easier to learn only due to the available educational resources and example implementations. JuMP is a serious contender in the Open Source and energy / market modelling community, and the availability & quality of resources are improving all the time.

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