Oportunidades emergentes Almacenamiento energético en Chile

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Silvia Zumarraga
Market Development Manager, Wärtsilä

Más de 1.5+ GW en operación, construcción o contratados

UK: balancing services, EV integration; 2020/21

Hungary: frequency response; 2018

Mali: mining microgrid; 2020

USA: CAISO wind integration, ancillary services, energy arbitrage; 2020

Islands: Caribbean grid reliability, Engine+; 2021

AMER Region

Canada:	13 MW
California:	90 MW
ERCOT:	+250 MW
PJM:	40 MW
Utility:	120 MW
Islands:	+100 MW
Mexico	10 MW

AFEU Region

UK:	100 MW
Ireland:	10 MW
Germany:	20 MW
Hungary:	6 MW
Mali:	17.3 MW
Islands:	+6 MW

Australasia Area

Success contracted or deployed:

342MW/320MWh

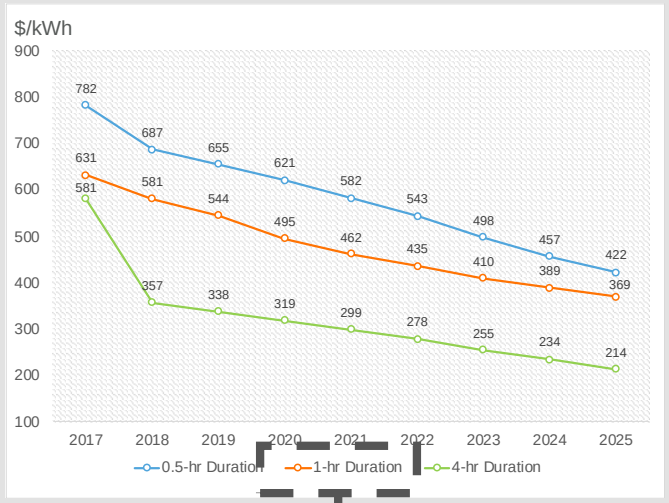
Australasia Region

Project Pipeline: **1.2GW/1.8GWh**

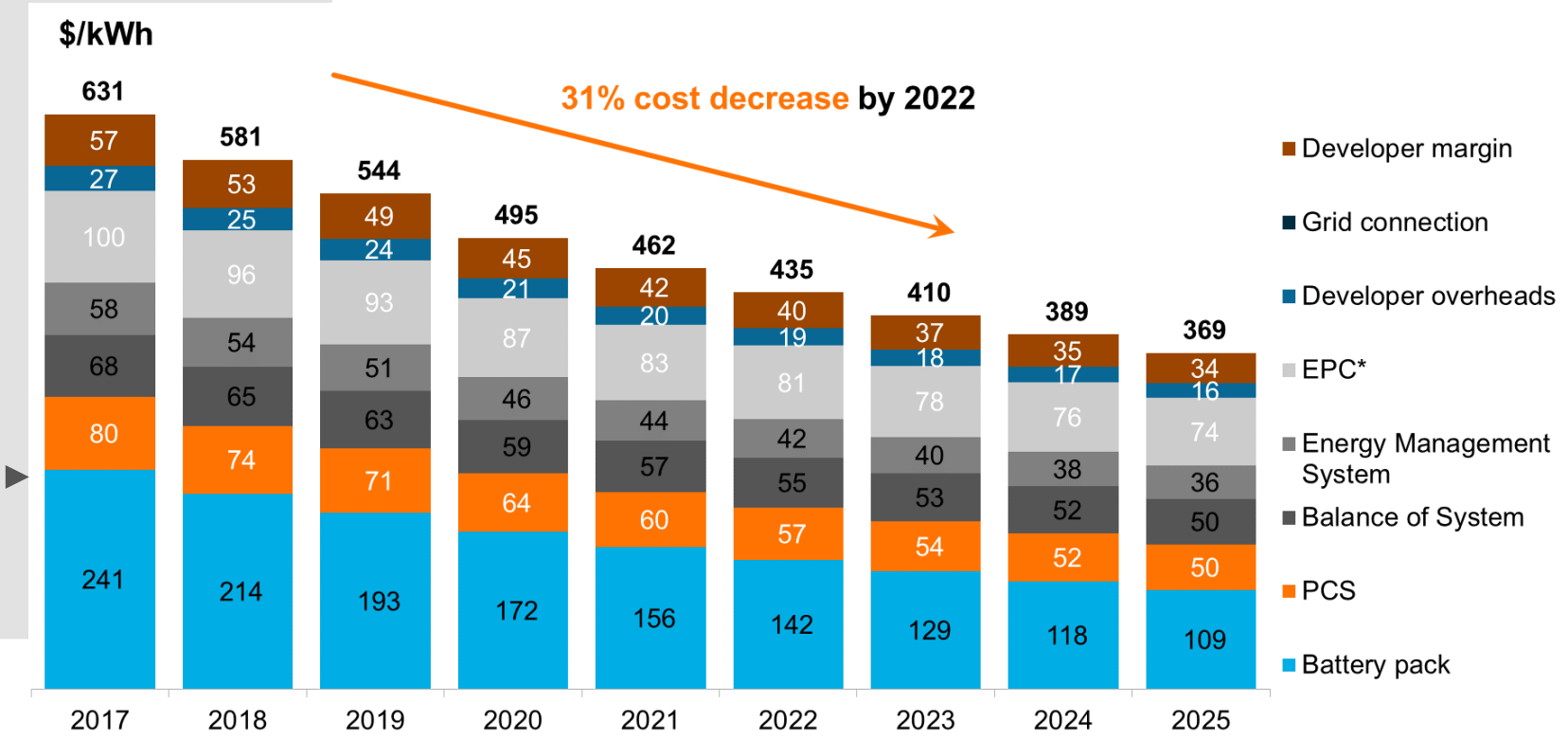
Singapore: grid reliability, renewable integration; 2020

Southeast Asia: grid stability and peaking; 2020/21

DESGLOSE DEL PRECIO EN SISTEMAS DE BATERÍAS



Desglose de Costos | 1-hr Duration (10MW/10MWh)



Source: Bloomberg New Energy Finance (Utility Scale Energy Storage Systems)

MODELACIÓN PLEXOS DEL SISTEMA CHILENO HACIA 100% RENOVABLES

INPUTS

Fleet data:
- Power plants from CEN's model
- Dispatch constraints
  - Min stable level (%)
  - Part load efficiencies (%)
  - Min up/down times for coal (h)
  - Start Cost ($)
- Renewable/hydro profiles

System data:
- Transmission: 3 nodes
- Demand + Growth rate
- Reserves: 2 zones

Capacity addition candidates:
- Next slide

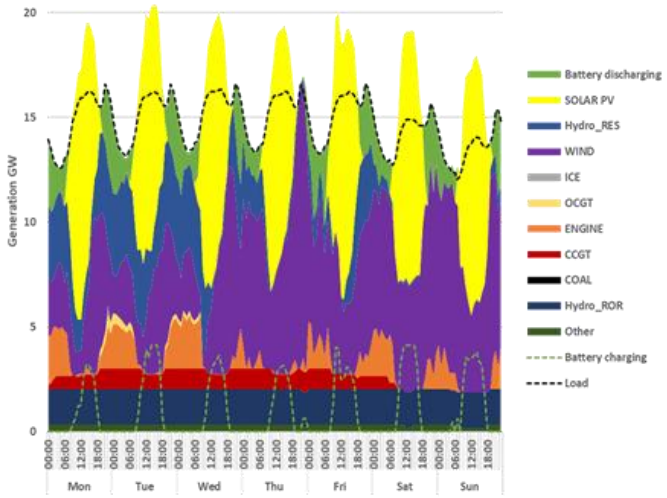
CCGT life-time extension
- At age of 30 years
- 300 USD/kW

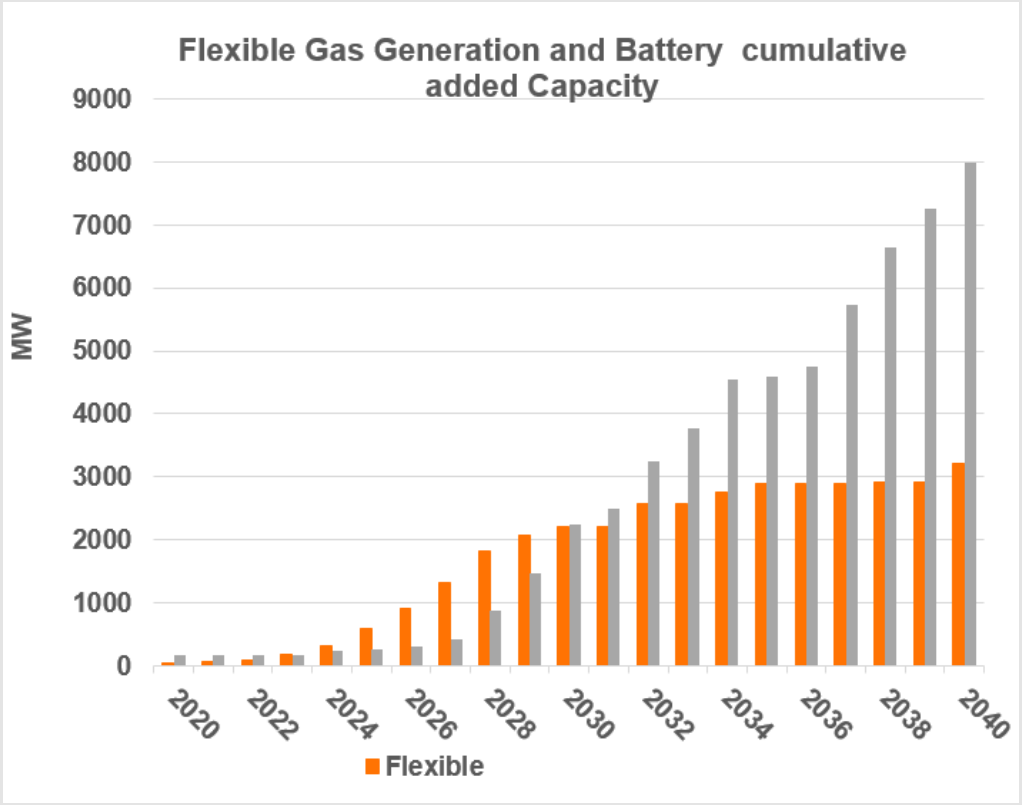
MODEL

With input data and scenario definitions power system mathematical problems are formulated in PLEXOS platform

System optimizer by PLEXOS

PLEXOS solver optimises i.e. finds the lowest cost solutions for defined scenarios. In optimisation process all defined real life constraints are considered. Hourly dispatch and capacity additions.





Plexos agrega **baterías** para reserva y generación flexible a gas para balance desde 2020 y luego **baterías** para energy shifting

Tecnología Básica que debes contemplar para maximizar tus retornos y aumentar tu competitividad

RISK MANAGEMENT

Disponibilidad

Debes proveer servicio

Garantias

Integrador es la respuesta

Gestion de riezgo

Quien esta mejor posicionado?

Software

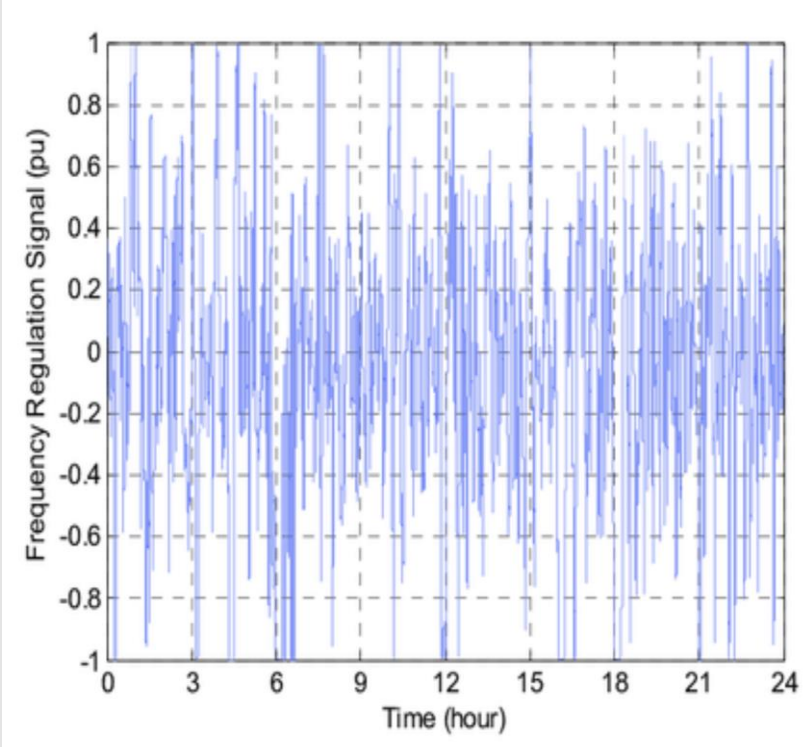
No es un tema de estructurar LDs (penalidades) sino de tener un sistema confiable

Software y hardware son inseparables

GTM Storage Focus: Managing Risk For Mega-Storage Projects

What is necessary to manage risk?

Data to be Logged	Unit of Measure	Precision	Periodicity
Bank SOC (for each Bank)	%	1	1s
Bank Daily Average Cycling SOC	%	1	daily
Bank Daily DOD	%	1	daily
Bank Daily Average Resting SOC	%	1	daily
Lifetime Average Cycling SOC	%	1	daily
Lifetime Average DOD	%	1	daily
Lifetime Average Resting SOC	%	1	daily
Rack SOC	%	1	1 s
Rack Voltage	V	0.1	1 s
Rack minimum cell voltage	V	0.001	1 s
Rack maximum cell voltage	V	0.001	1 s
Rack current	A	0.1	1 s
Rack minimum cell temperature	ºC	0.1	1 s
Rack maximum cell temperature	ºC	0.1	1 s
Ambient temperature at nearest measurement point to affected Product*	ºC	0.1	1 min
Ambient temperature at second nearest measurement point to affected Product*	ºC	0.1	1 min
Alarm and fault status(for each rack)	status		1s
Contactor status (for each rack)	status		1s
Lifetime minimum cell voltage (for each rack)	V	0.001	Case dependent
Lifetime maximum cell voltage (for each rack)	V	0.001	Case dependent
Lifetime minimum rack voltage (for each rack)	V	0.1	Case dependent
Lifetime maximum rack voltage (for each rack)	V	0.1	Case dependent
Lifetime maximum rack current (for each rack)	A	0.1	Case dependent
Lifetime Throughput of each Bank	GWh	0.1	Case dependent
Lifetime Throughput of cumulative Product	GWh	0.1	Case dependent
Lifetime Throughput of rack	MWh	0.1	Case dependent
Ambient temperature at nearest measurement point to affected Product*	ºC	0.1	Case dependent
Ambient temperature at second nearest measurement point to affected Product*	ºC	0.1	Case dependent
Ambient Temperature readings in battery containers	ºC	0.1	Case dependent



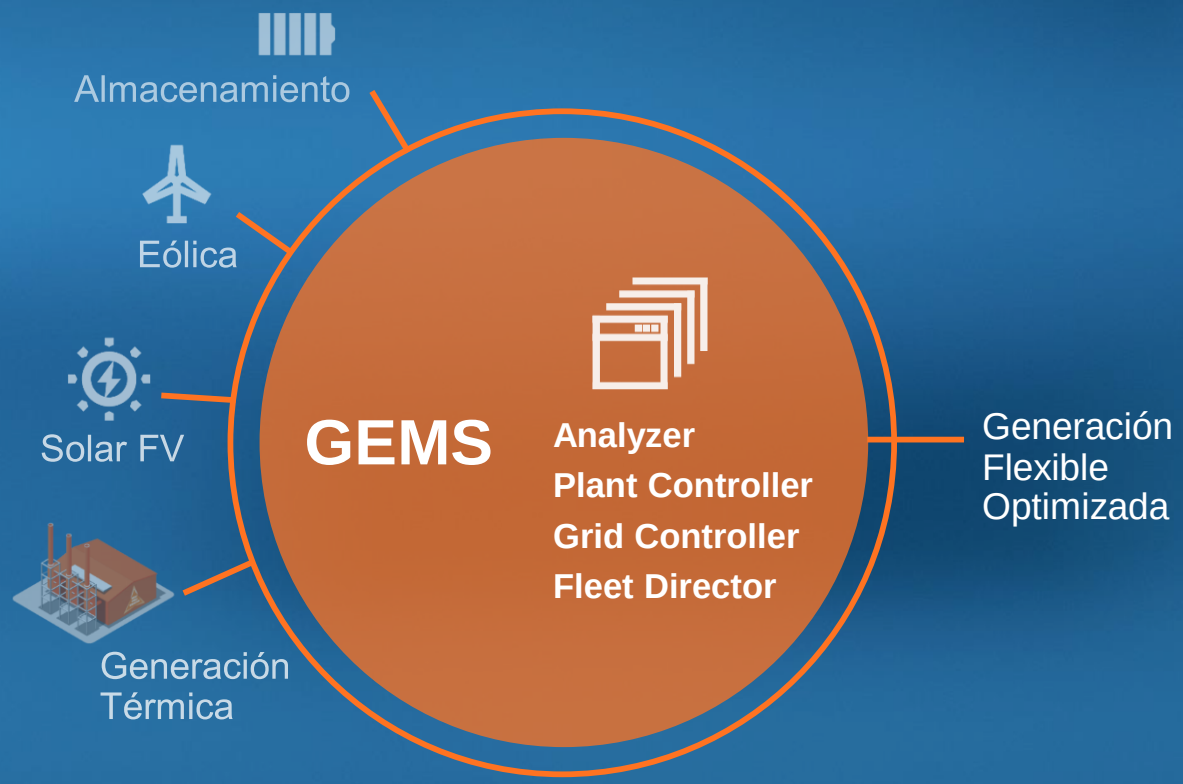
Flexible Parametres

- Charge C-rate
- Discharge C-rate
- Depth of discharge
- Temperature
- Discharge throughput
- Resting SOC (rSOC)
- Center SOC (cSOC)

El Software está en el centro de la integración

GEMS Solutions Suite

La plataforma líder de gestión de sistemas de energía eléctrica

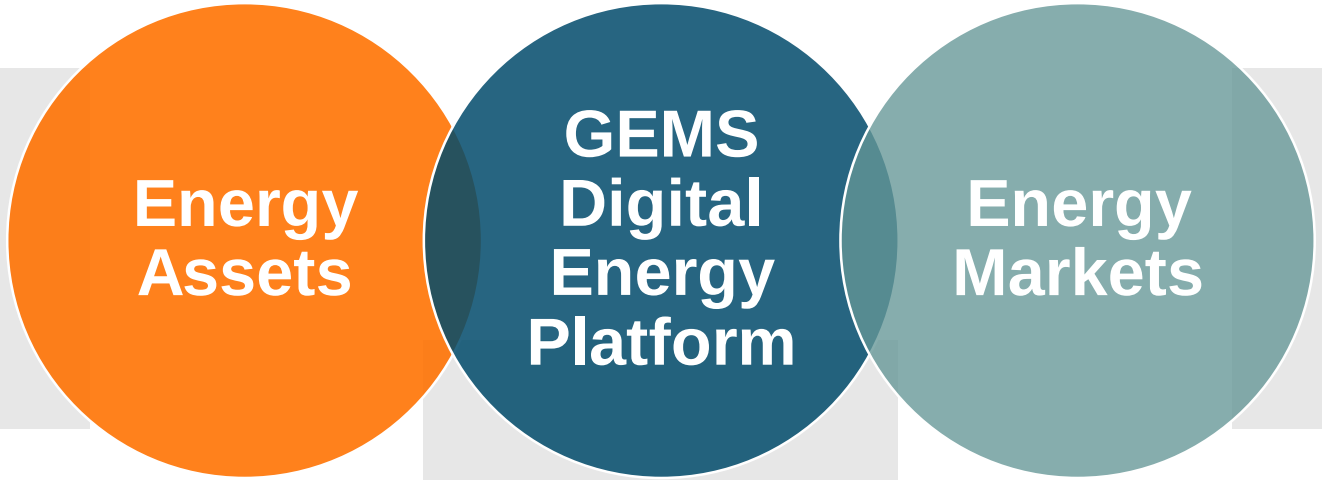


- OPERADOR DE CENTRALES DE GENERACIÓN Y RECURSOS ENERGÉTICOS
- OPTIMIZACIÓN DE TODOS LOS ACTIVOS DE GENERACIÓN
- SEGURO, FLEXIBLE, ESCALABLE
- EMPLEADO EN +90 PROYECTOS EN EL MUNDO

ES&O Market Positioning

Connecting energy assets to energy markets

Theme: ES&O is central to renewable energy transition by providing **Flexibility Solutions** and **GEMS Digital Energy Platform** which connect energy assets to **energy markets** in technically and economically optimised manner



Solar/Wind

Wärtsilä Flexibility Solutions

- Storage
- Engine Power Plants

Renewable + ESS Hybrids

Virtual Power Plant

Microgrids/Island Grid+

IntelliBidder

Capacity

Ancillary Services

Renewables Firming/RRC

Network Deferral

Wholesale trading

Modelos de negocios
Ejemplos

Balance de Red para soporte de Vehículos Eléctricos

Cowley, Oxford

Kemsley, Kent

Servicios para respuesta de frecuencia, comercialización [market trading] y potencia reactiva

GEMS software optimiza varios activos bajo un solo portfolio—almacenamiento, infraestructura de VE y fluctuaciones de la red

Coming online mid-2021

Dos sistemas de 50 MW / 50 MWh

Este active de almacenamiento esta conectado a la transmisión y con alto volumen provee la capacidad esencial para la carga de **VE en forma rápida**

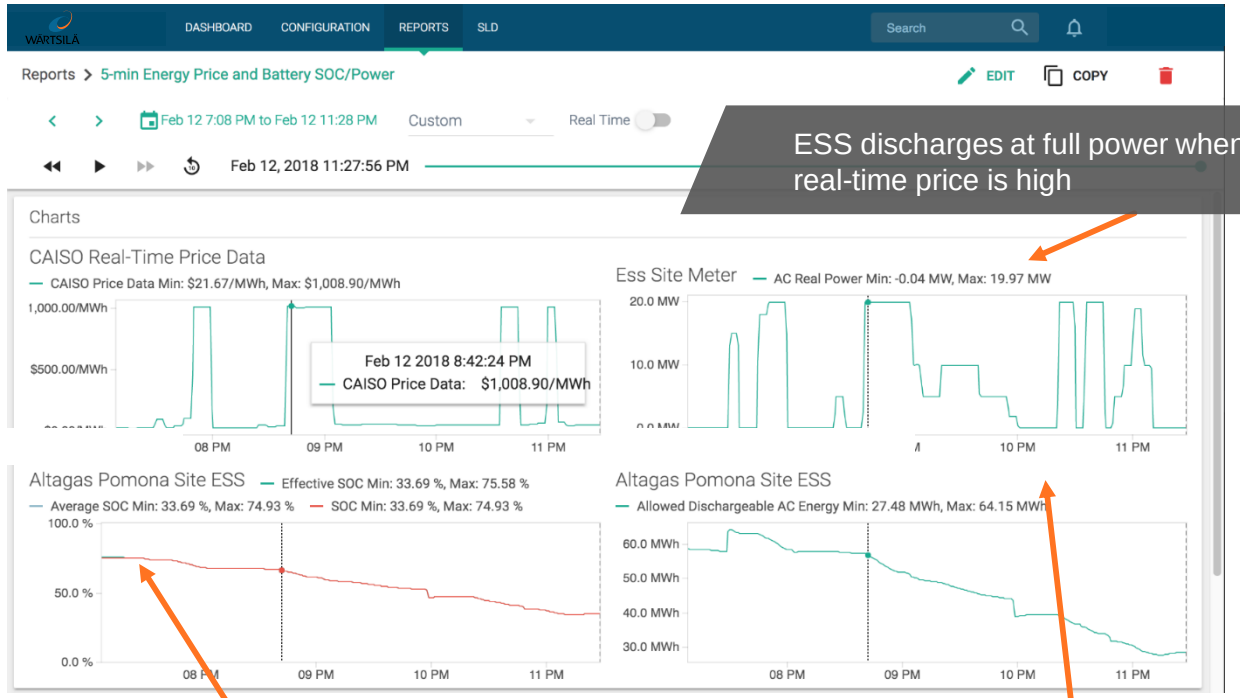
Contribuye con estabilidad y flexibilidad a la Red Nacional de UK mejorando la ruta de mercado para una solución mas limpia y reduciendo las huellas de carbono

Multiple Revenue Streams
Realized through the same system

- CAISO real time price can be as much as **$1000/MWh (20MW x $1000/MWh = $20000/hour revenue stream)**
- CAISO Ancillary Services Reg up and down can provide consistent revenue stream
- CAISO RA market provides long-term contracted revenue stream and is dispatched infrequently

Operational Logic:

- Bid-in 5mins CAISO **Ancillary Services** Reg up and down markets
- **Arbitrage** in California ISO real time market when prices warrant
- Be ready to be dispatched for **RA** market when called on



ESS discharges at full power when real-time price is high

ESS state-of-charge is positioned well to take advantage of arbitrage opportunities using forecasting based on historical market and weather data

ESS provides Reg up when real-time price is low

PJM: Economic impact for 10MWz system

Client Partner	Deployment	Solution	Key takeaway
PJM	62 MW/53 MWh ESS	Reg D and Reg A	Transformational agility

Revenue for RegD assets in PJM is calculated as:

Regulation Capacity Price + (Regulation Performance Price * Mileage Ratio).

The output of this formula has averaged $15/MW-hour in 2017. Unit-specific performance, availability and capacity are then multiplied by this value to determine revenue.

	Other ESS	Wartsila
Average PJM RegD Hourly Price	$15/MW-hour	
PJM Performance Score	90%	94%
Availability	90%	100%
Capacity (% of nameplate)	50%	66.6%
Market Revenue for a 10 MW energy storage system	$532,170/year	$822,617/year

Incremental Value:
$290,447/year
+54% revenue

$15/MW-hr * 8760 hrs./year * 10 MW * 90% perf score * 90% availability * 50% capacity	$15/MW-hr * 8760 hrs./year * 10 MW * 94% perf score * 100% availability * 66.6% capacity

Revenue Calculation

Q&A

storage.wartsila.com


WÄRTSILÄ

Energy Storage Solutions + Applications