Experiencia y Nuevas Aplicaciones

Mercado Eléctrico Chileno

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2. Solar Inverters – Experiences in Chile
3. Grid Capabilities - STATCOMs
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5. Conclusions

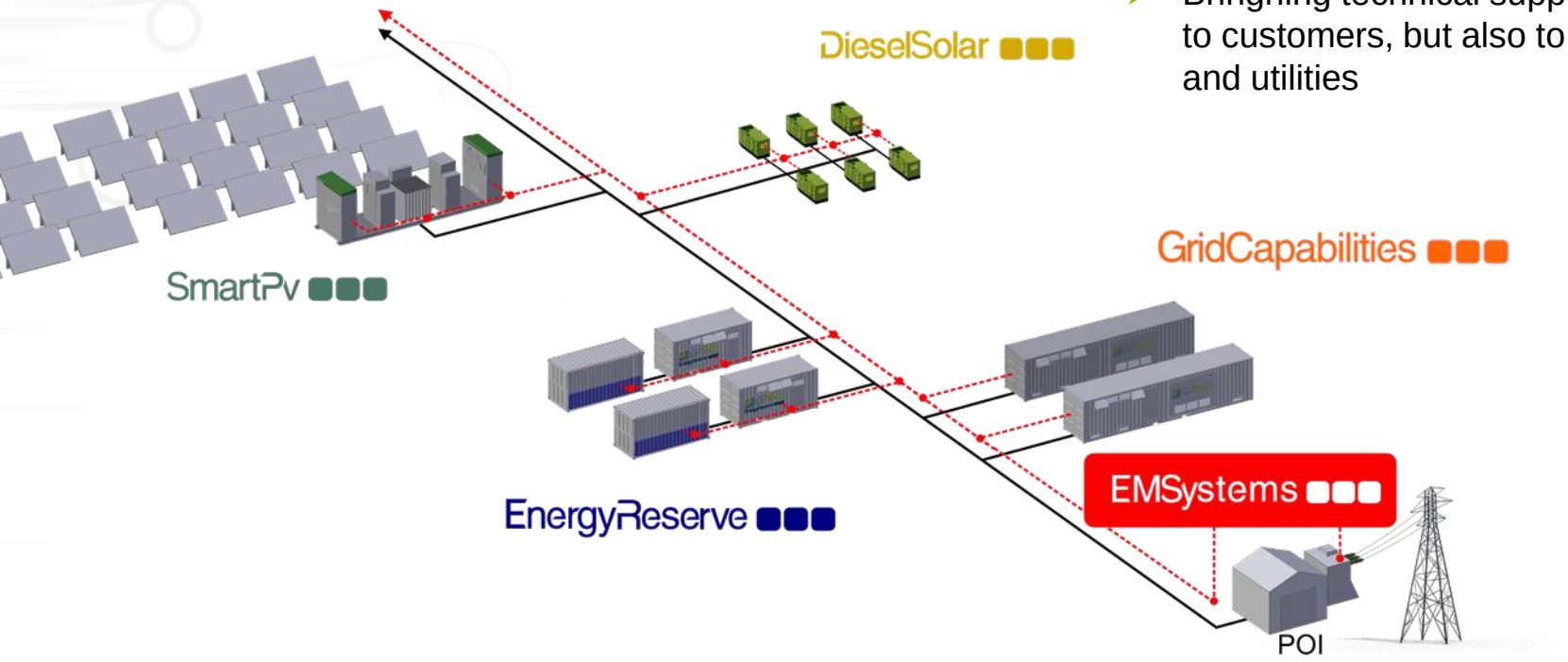
Integral Solutions

Experts in Large Scale Renewable Power Integration

GPTech develops solutions for power conversion and management required by renewable energies facilities, to obtain the best performance in utility-scale projects.

- **Innovative products** fully-developed by GPTech and adapted to different market requirements

- **System Integrators** with huge global market experience.
- Bringning technical support not only to customers, but also to SO, TSO and utilities

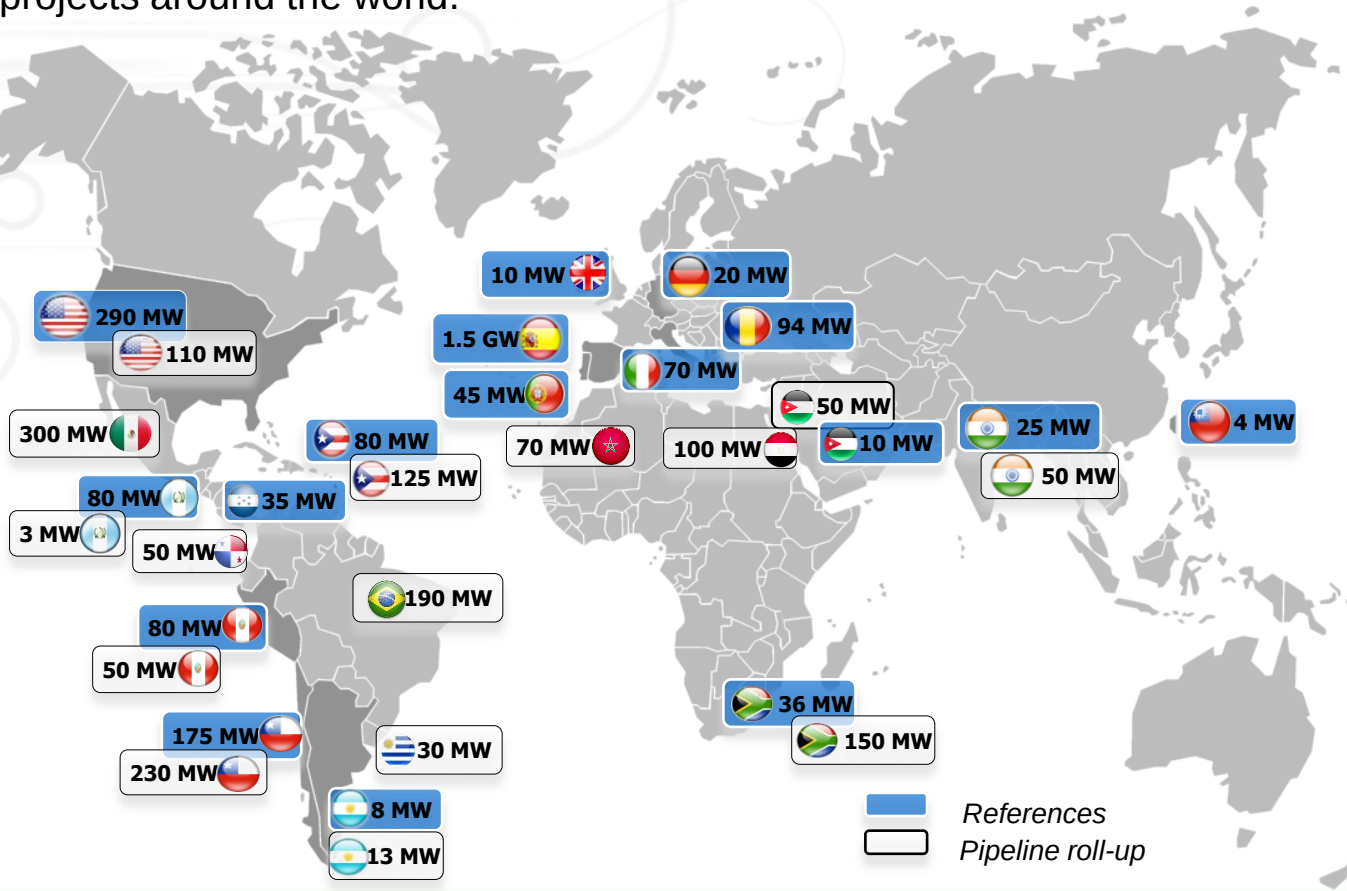


International Player in Renewable Power

Global Presence

GPTech has an active presence in key markets such as EU, USA, India, China and LATAM.

Its capacity to adapt its solutions to the new requirements and markets enables to a wide range of projects around the world.



- ✓ **2.500 MW** of capacity in PV and Wind renewable plants with GPTech solutions
- ✓ Current and planned projects covering all markets of interest.

V15-04

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GPTech Experiences in Chile

Solar Inverters Unit - installations operating/under construction

Desierto de Atacama, Chile (100 MW)

- ✓ 50 APIS 2200-i40

Calama 3, Chile (1.08 MW)

Pozo Almonte 1, Chile (9 MW)

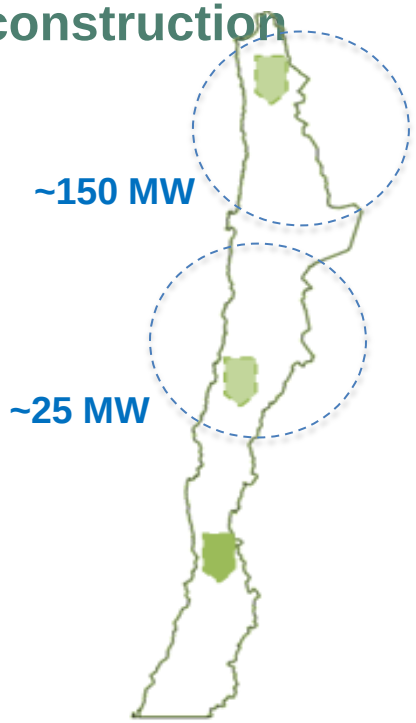
Calama 1, Chile (9 MW)

Diego Almagro 1, Chile (9 MW)

Minimum availability 99% by contract

3 x PV Plants

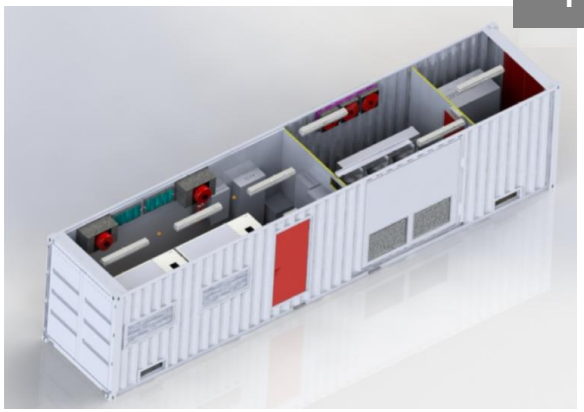
- ✓ 4 x APIS 2200-i20
- ✓ 1 x APIS 1000-i20

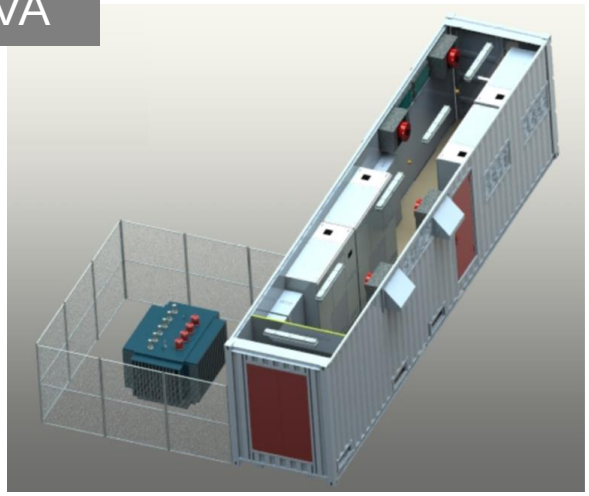


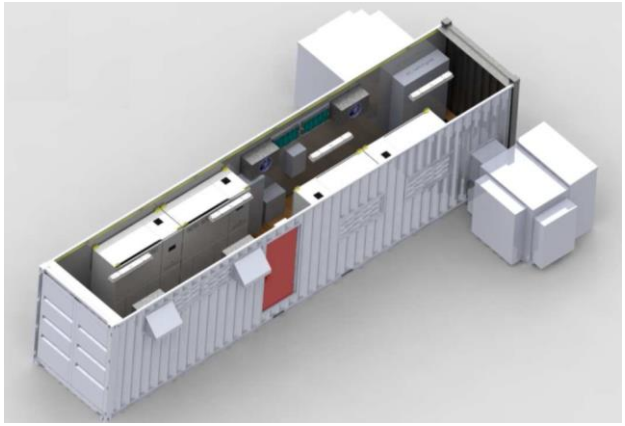
GPTech Experiences in Chile

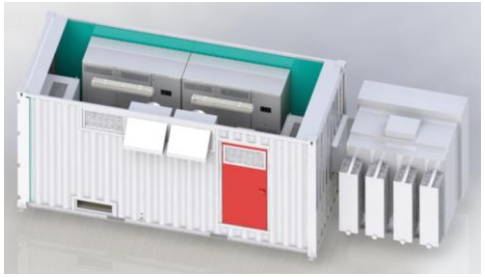
Power Electronics - APIS (Advanced Power Integraded Stations)

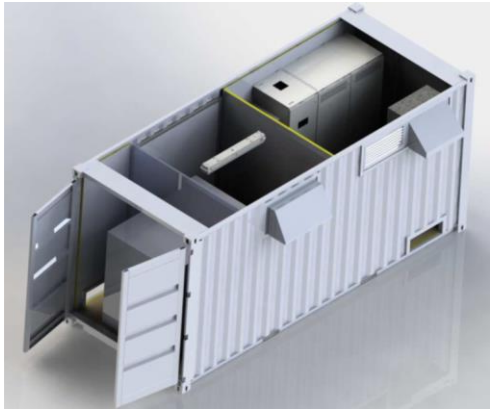
From 500KVA to 4600 kVA











GPTech Experiences in Chile

Power Electronics - APIS (Advanced Power Integraded Stations

From 500kVA to 4600 kVA

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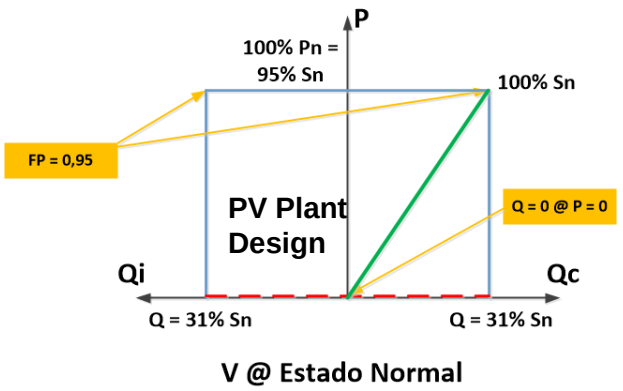
GPTech Grid Capabilities

POI – Demanding Standards



V @ Estado Normal

cos phi (PV Plant) ≤ 1

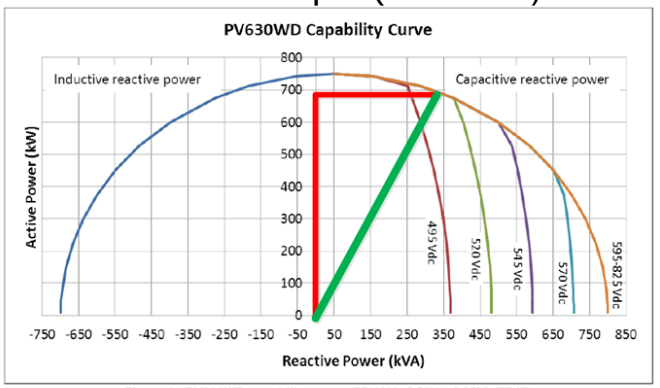


Figure 9. PV630WD capability curve, 750kVA @50Hz @25°C (77 °F)

PV Inverter Capability

P < Sn

- # of PV Inverters
- ~5%-13% Sn (kVA)
  PV inverters + Transfomer size

cos phi (PV Plant) = 1

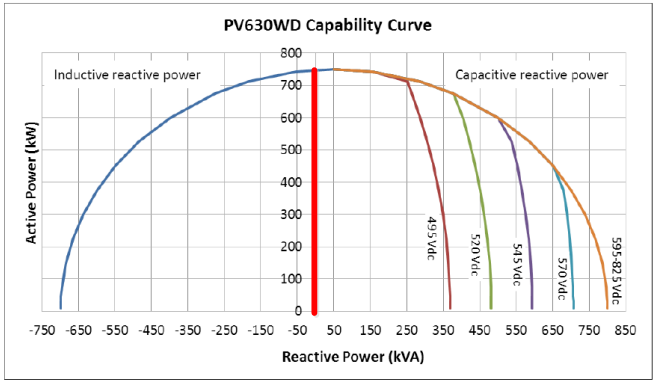


Figure 9. PV630WD capability curve, 750kVA @50Hz @25°C (77 °F)

PV Inverter Capability

P = Sn
# of PV Inverters does not increase

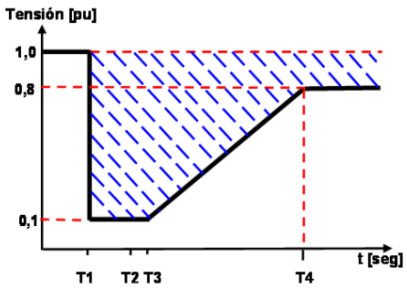
- **STATCOMs**
- Static Var Compensators (L, C)

GPTech Grid Capabilities

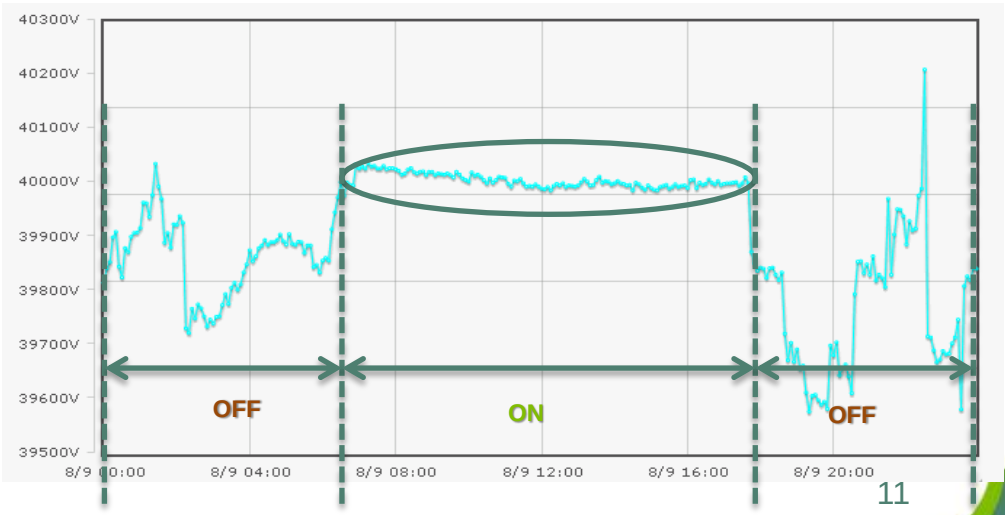
Reactive Power (Q) Compensation / STATCOMs

16 MVA – RM, Chile

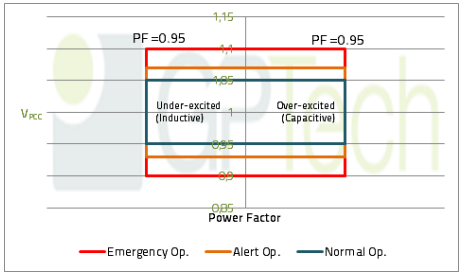
- ✓ 4 AVCS 4000-i40



Low-voltage Ride Through



Power Factor complience



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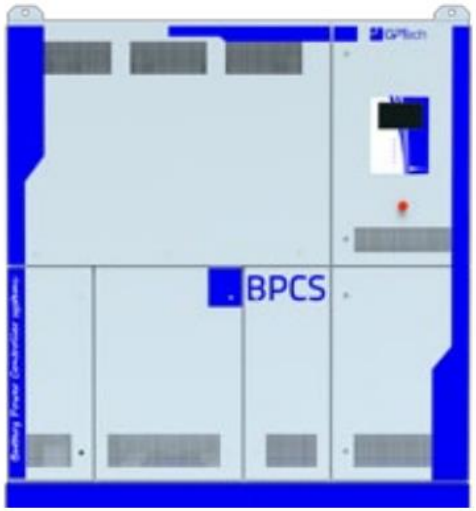
GPTech EnergyReserve®

Power Electronics - BPCS (Battery Power Conditioning Systems)

From 500KW to 1100 kW



BPCS	SERIE [500,630,750,900]	WD	ENCLOSURE [O,I]	-	DC SWITCH [1]	GROUNDING [N,P,F]	COMM [1,2,3]

Figure 2. Code making up the trade name

- Serie: **500**, **630**, **750** or **900**
- Enclosure: **O** (outdoor)
  I (indoor)
- DC switch: **1** (contactor for the DC switch)
- Grounding: **N** (negative pole connected to ground)
  P (positive pole connected to ground)
  F (floating connection)
- Comm.: **1** (NTU - Modbus-RTU)
  2 (NTU - Modbus-TCP)
  3 (CACP - PPC Control compatible)

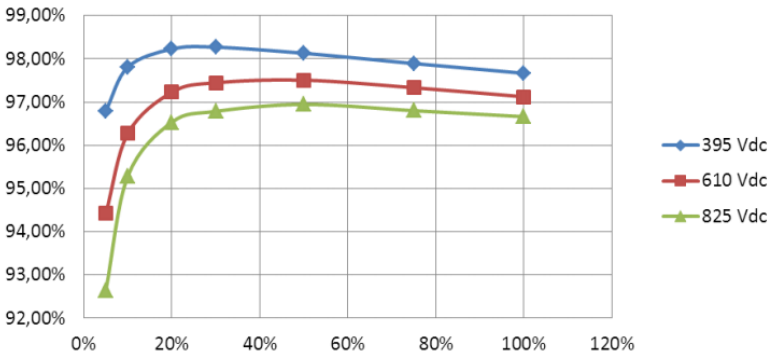
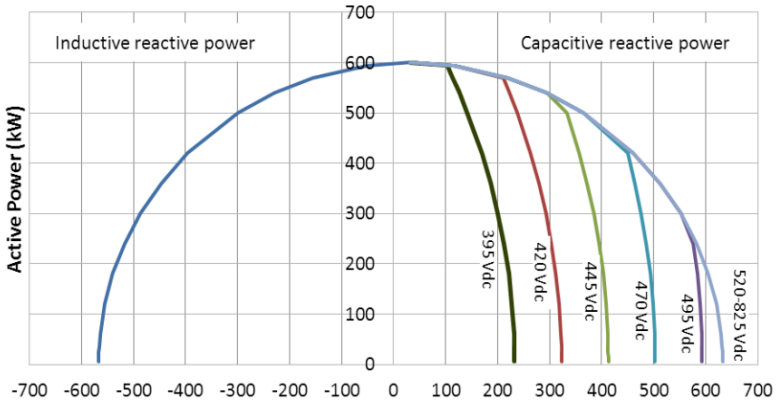


Figure 6. BPCS500WD efficiency curve 600 kW @PF=1.0 @25ºC (77 ºF)



Utility-Scale Real Cases

Large-Scale Storage System in Puerto Rico: Utilities grid integration

- **Managing power plants according to the MTRs of Puerto Rico – 10MWn PV Plant**
- An advanced hybrid solution with storage and integrating different power sources is required to comply with all the local requirements.
- The main objective is to avoid the potential quality degradation in the power injected to the grid in relation to voltage regulation and unbalancing, harmonic distortion, Flicker effect, Voltage and Frequency sags/interruptions and transients.

EMS POWER PLANT CONTROLLER

GRID CAPABILITIES STATCOMS

ENERGY STORAGE **BATTERY POWER SYSTEM**

GPTech Hybrid Storage Solution in Salinas, Puerto Rico

Utility-Scale Real Cases

Large-Scale Storage System in Puerto Rico: MTRs

Voltage Regulation System (VRS)

The PV facility shall contribute to the grid's voltage regulation, following the settings and reference of the utility's operator with a continuously variable and acting close loop.

Frequency Ride-Through

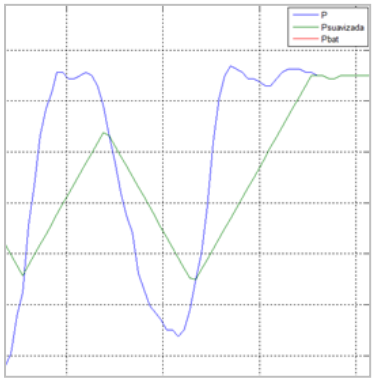
The frequency protection will be set under PREPA requirements.

Voltage Ride-Through

The generators shall be online despite of the presence of 'voltage sags' (LVRT) and Overvoltage (OVRT) in the grid.

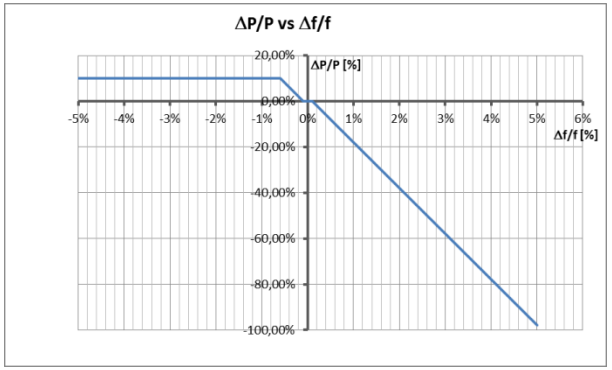
Power Ramp Rate control

- The PV facility shall be able to **control the rate of change of power output** during some circumstances.
- The maximum change allowable is 10% of the rated power per minute. PV plant has to reduce power under utility demands (curtailment).



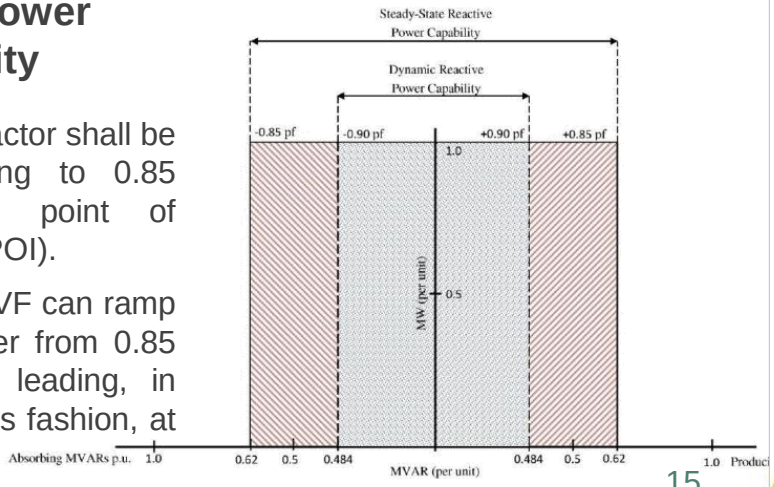
Frequency response/regulation

PV facility should response like a classical governor due to primary frequency regulation.



Reactive Power Capability

- The total power factor shall be from 0.85 lagging to 0.85 leading at the point of interconnection (POI).
- The aim is that PVF can ramp the reactive power from 0.85 lagging to 0.85, leading, in smooth continuous fashion, at the POI.



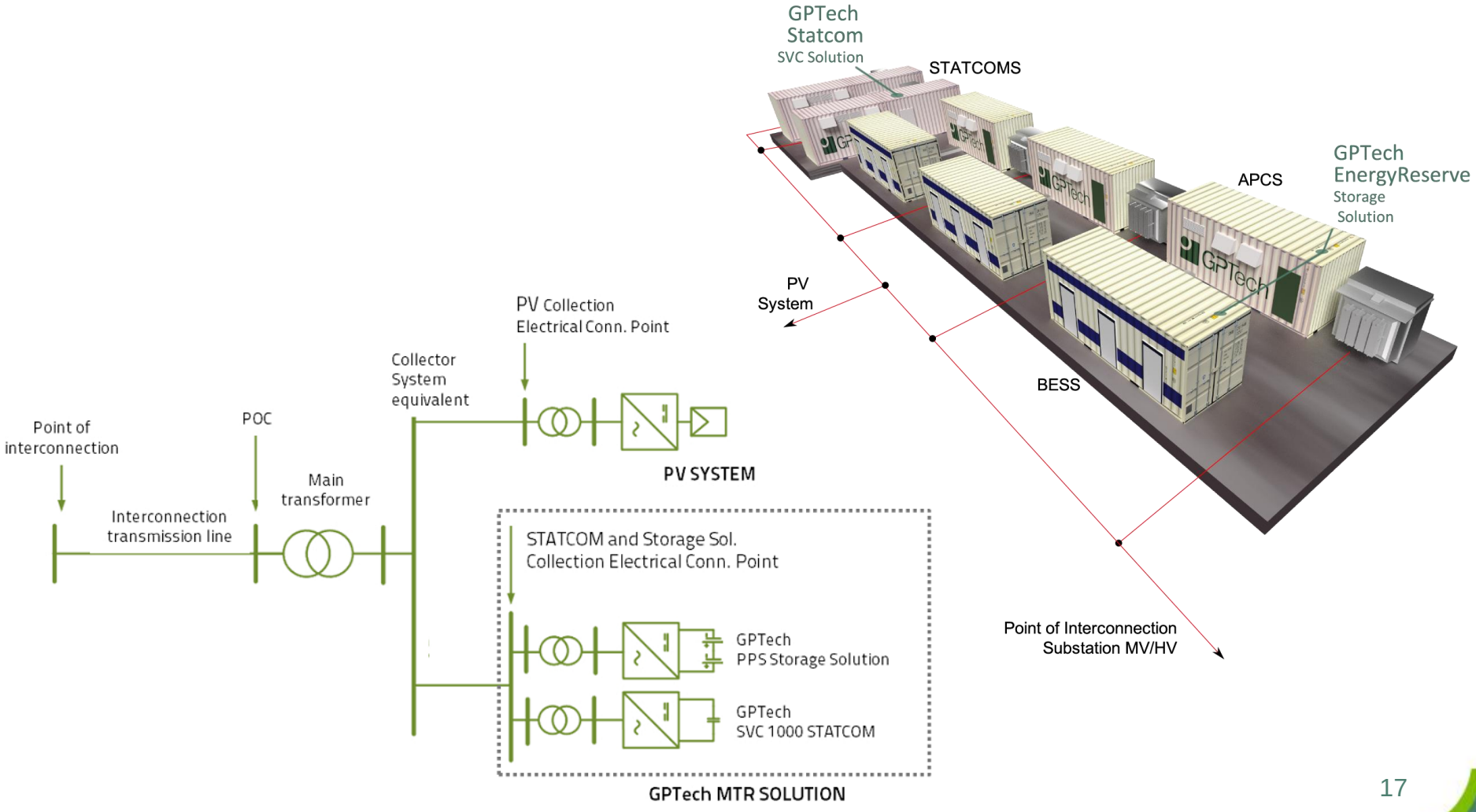
Utility-Scale Real Cases

Large-Scale Storage System in Puerto Rico: Final Integration

System	Description	Tech. Data	Qty.
Batteries	Containerised ready-to-install Li-ion technology Intensium Max	▪ Voltage range: 600-800Vdc ▪ Peak Power: 1,8 MW ▪ Energy@BOL: 420kWh (40% DoD)	3 containers of 1,1MW Continuous (1.8 MW peak, 1')
BPCS	GPTech DC/AC BPCS, based on PVWD proofed technology	▪ Nominal Power: 5.1MVA.	3 Containers x 1700
FACTS	GPTech DC/AC FACTS, based on SCV1000WD	▪ Nominal Power: 7MVA.	1 container x 4MVA 1 Container x 3MVA

Utility-Scale Real Cases

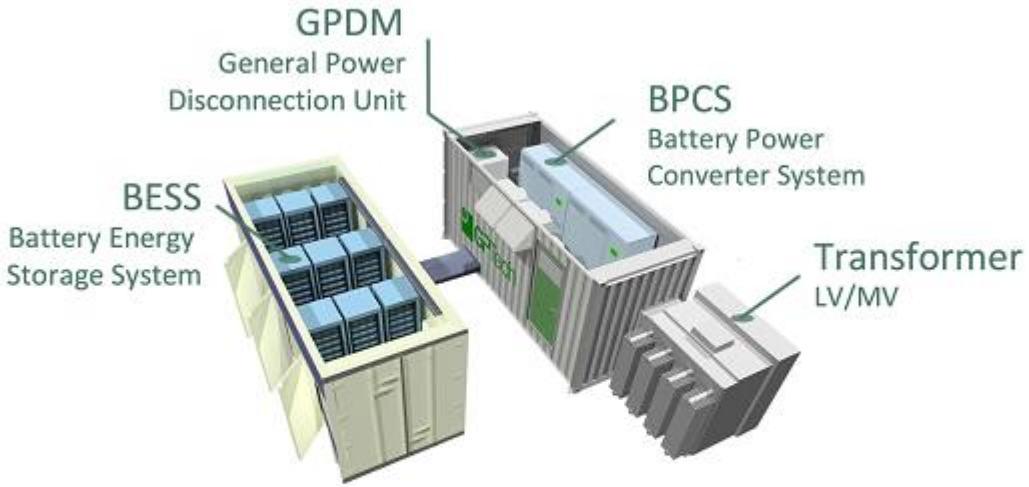
Large-Scale Storage System in Puerto Rico: Utilities grid integration



Utility-Scale Real Cases

Large-Scale Storage System in Puerto Rico: Utilities grid integration

GPTech EnergyReserve: BESS system with modular GPTech Battery Power Conditioning System.

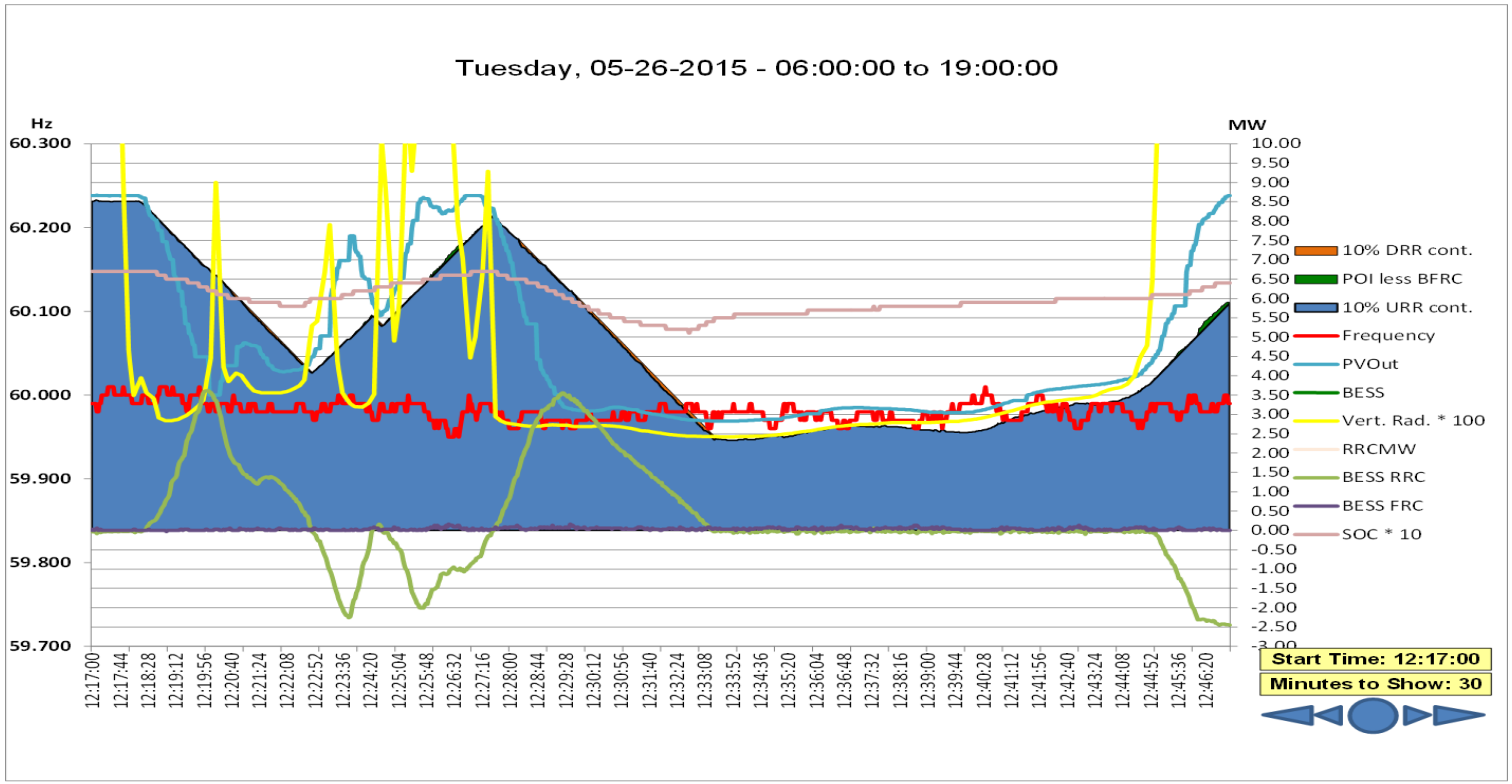


GPTech STATCOM: Integrated Solution using modular electronic converters for VAR support.

GPTech EMSystem PPC: Power Plant Controller for centralised management of the Power Regulation.

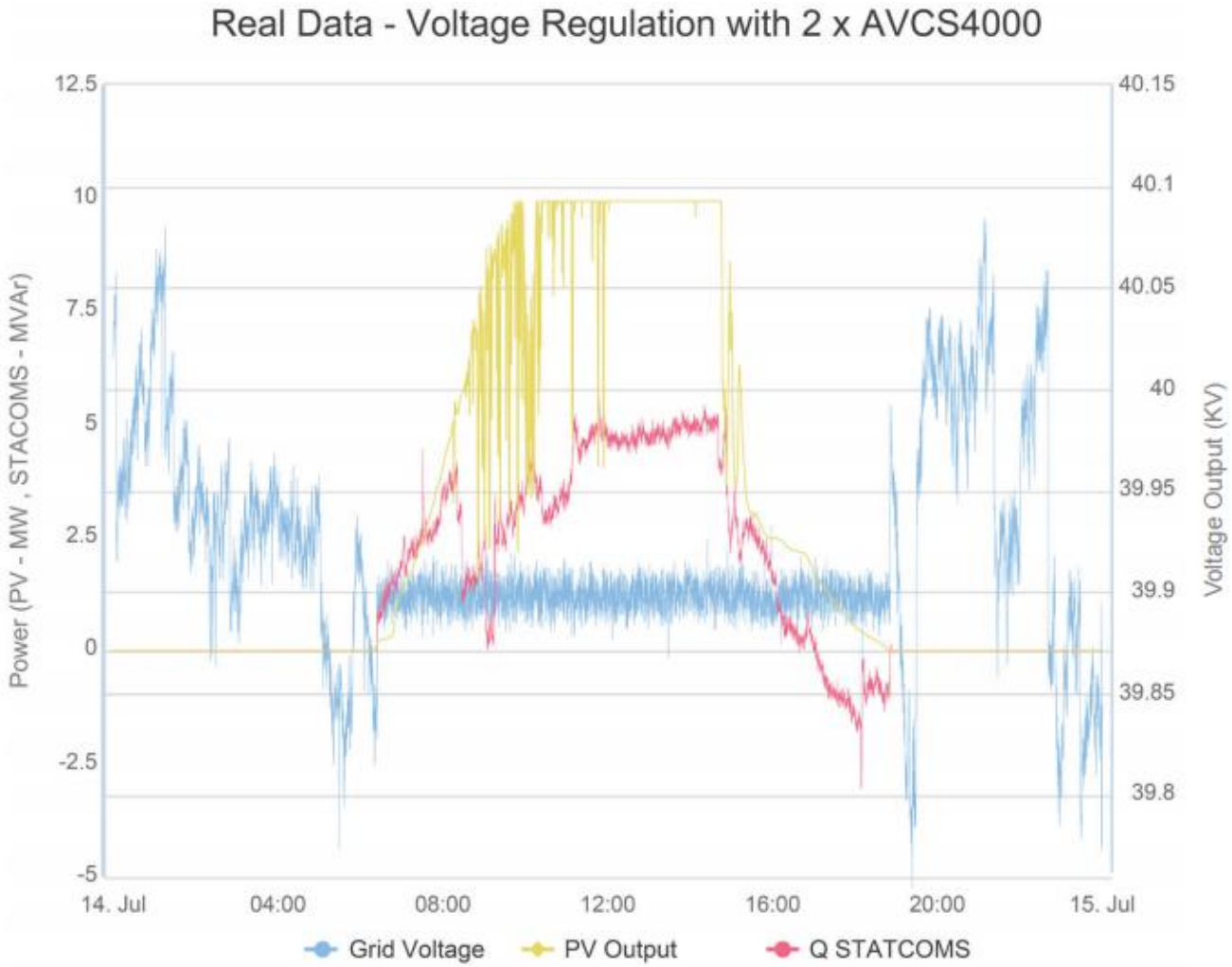
Utility-Scale Real Cases

Large-Scale Storage System in Puerto Rico: Succesful conformance to MTRs



Utility-Scale Real Cases

Large-Scale Storage System in Puerto Rico: Succesful conformance to M



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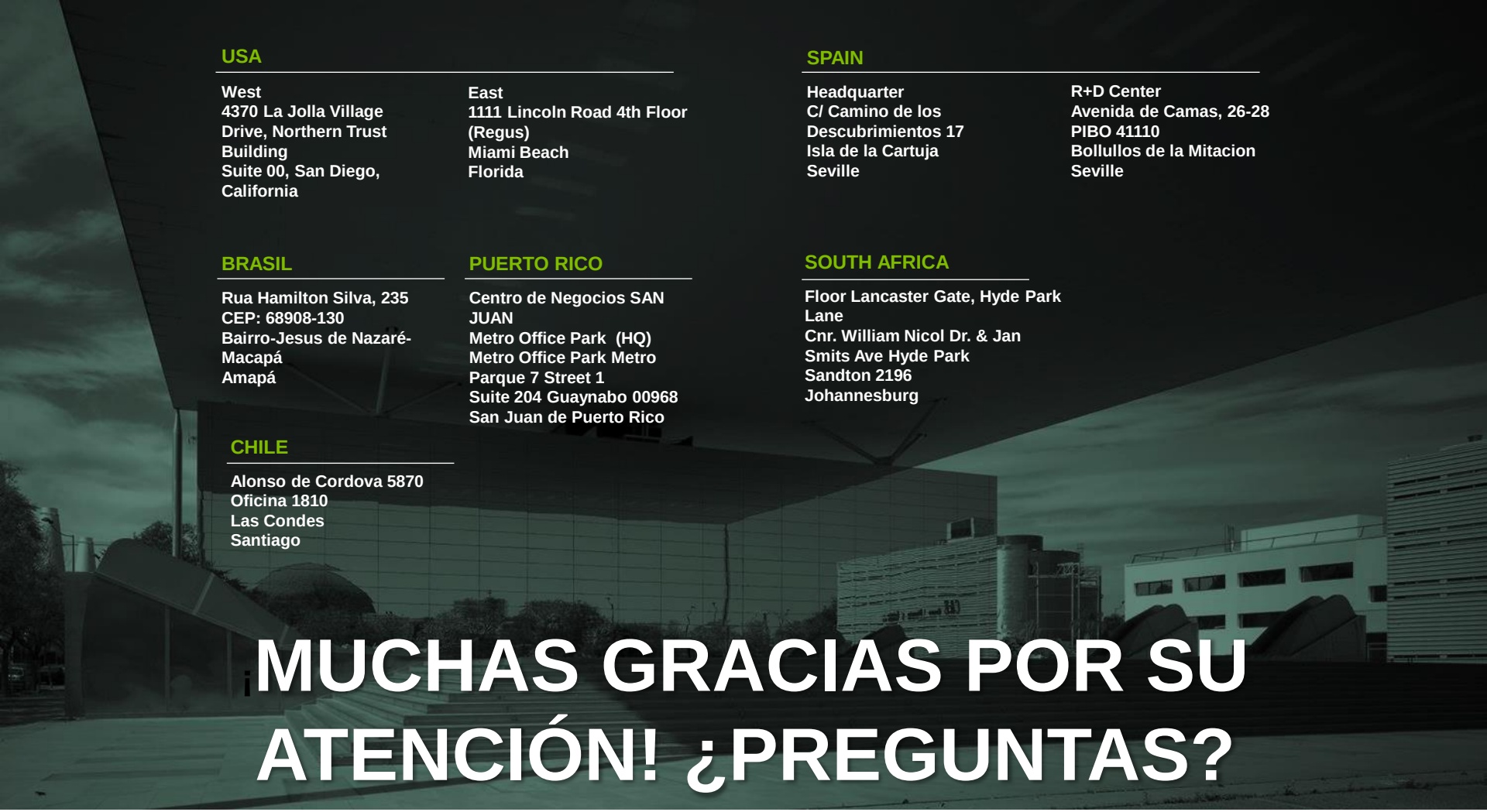
Experiencia y Nuevas Aplicaciones

Conclusiones para Chile

- Integración de Plantas PV:
  - Buen potencial en PMGDs
  - Necesidad de O&M-Servicio de Garantías confiable.
- Sistemas de Compensación:
  - Necesidad de adaptación a NTSyCS: alta exigencia
  - Oportunidad para unidad de Servicios Complementarios
- Sistemas de Almacenamiento:
  - Desplazamiento de Energía
  - Reserva en Giro / Control Primario de Frecuencia
  - ¿Normativa futura de mayor exigencia?
- Power Plant Controller:
  - Necesidad de adaptación a NTSyCS: alta exigencia en velocidad y precisión
  - ¿Normativa futura de mayor exigencia en SD?



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