



Webinar Aplicaciones de Almacenamiento con baterías

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saft

a company of



Who is Saft today?

GROUP PROFILE



100+ years of history



Leadership position
on **75-80%** of revenue base

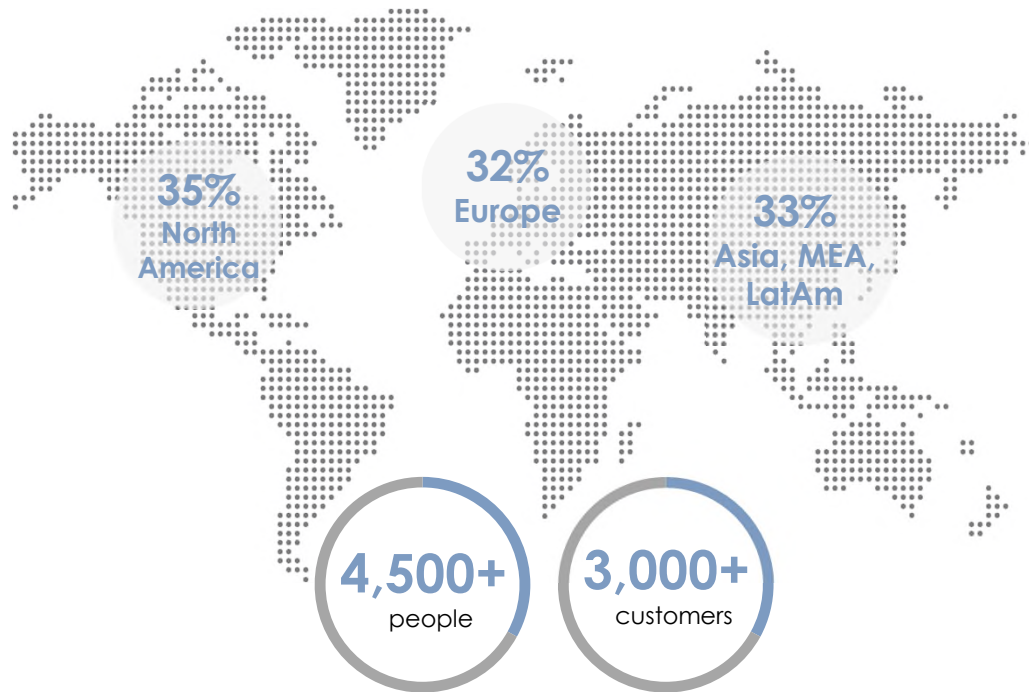


12.4% invested in **R&D** with **3** main technologies; primary lithium, lithium-ion & nickel-cadmium



€796m revenue FY 2019

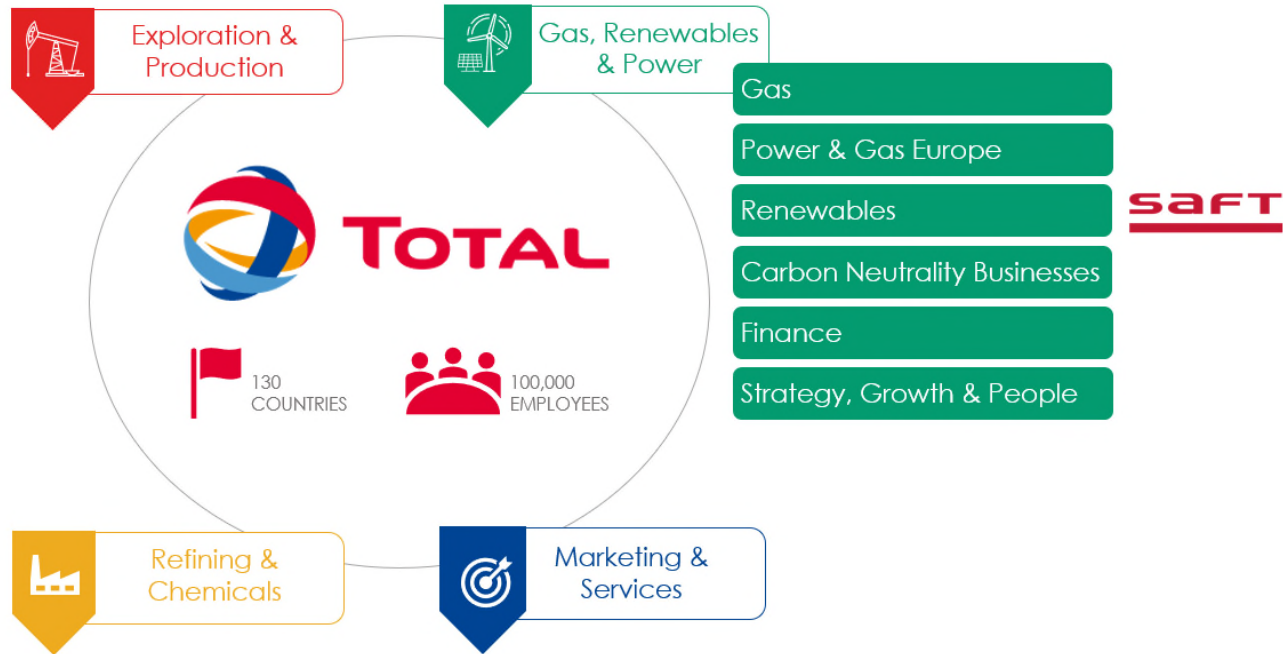
GLOBAL PRESENCE - SALES



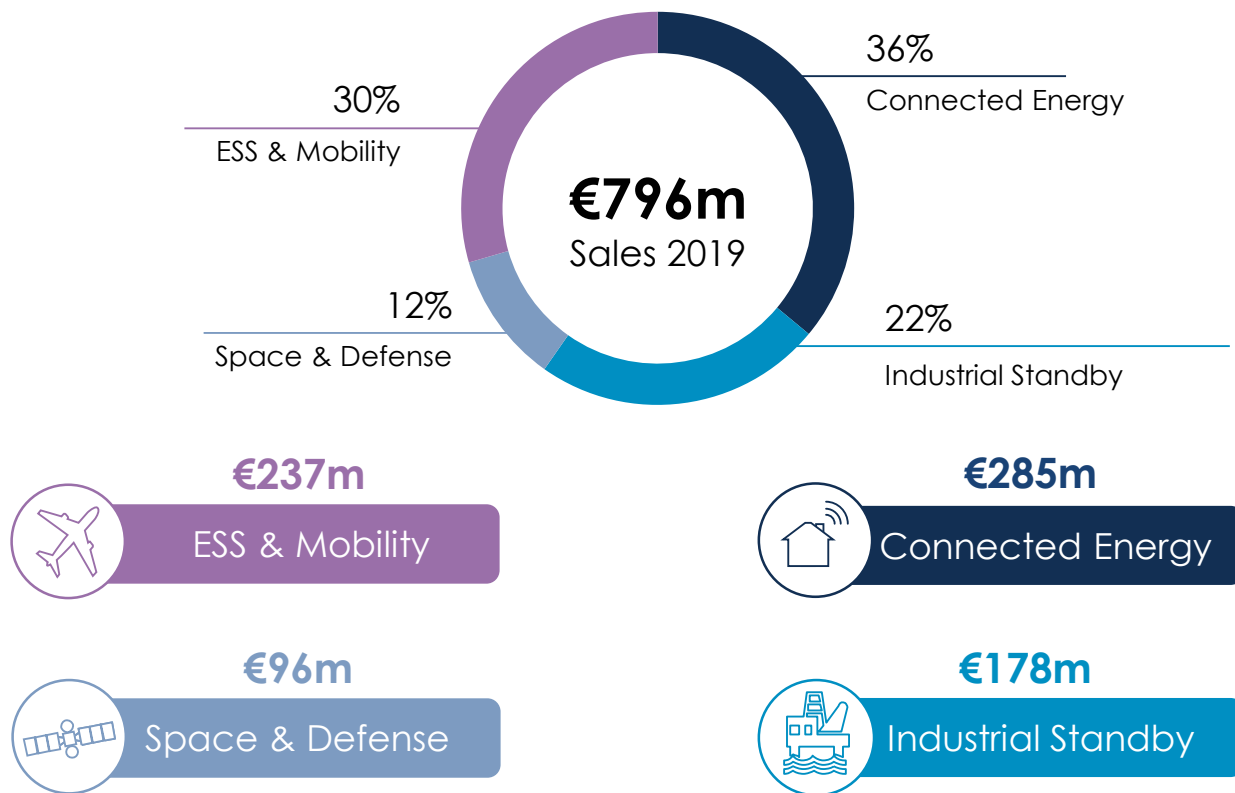
Global presence



Where we fit in Total



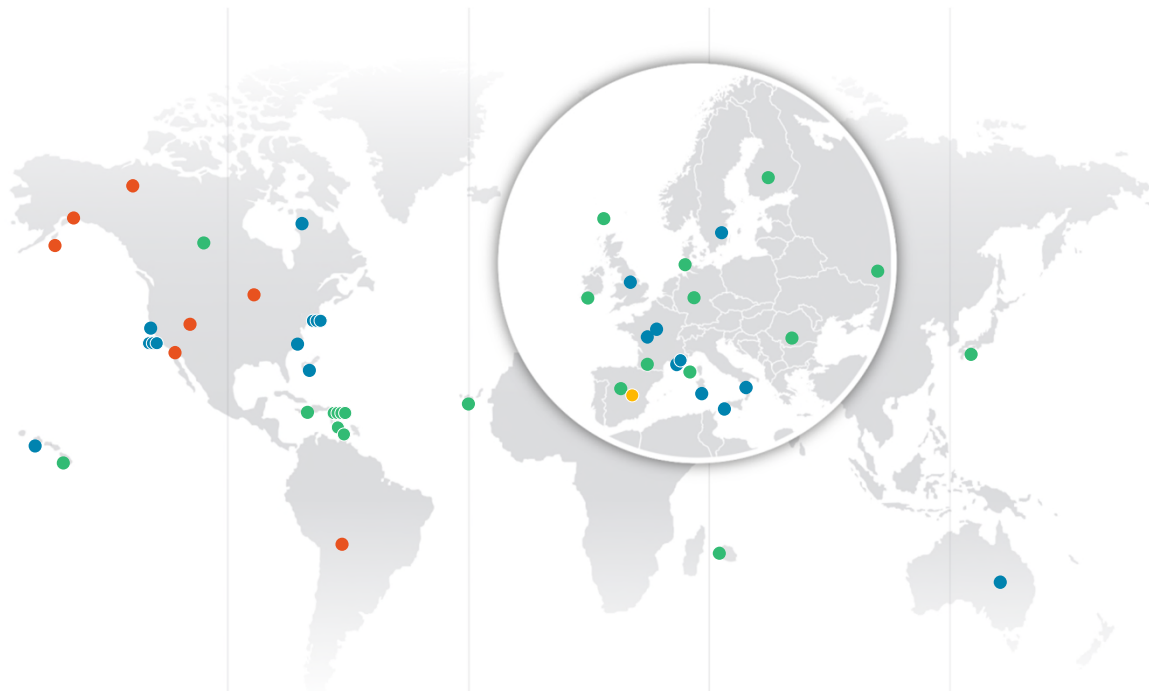
2019 sales by division





ENERGY STORAGE

Saft is the first mover in ESS with 10 years of experience



Some references



Renewables

Wind integration: Husahagi Wind Plant – Faroe Islands – 2 containers 2.1 MW/ 0.7 MWh



Grid

Congestion management: Ringo project – RTE in France – 12 containers 15,6 MW/ 30,8 MWh



MicroGrid

Frequency regulation: Idexis project – TuuliWatti – Finland – 3 containers 3,9 MW/ 7,7 MWh



Commercial & Industrial

Spinning / diesel optimization: KEA project - Alaska, US – 1.2 MW/ 0.9 MWh

Genset bridging, PV smoothing, wind smoothing: Agnew project – EDL – Australia – 6 containers 12,8 MW/ 6,4 MWh

Saft has provided energy solutions for diverse portfolio of clients across the globe.

Saft ESS at a glance



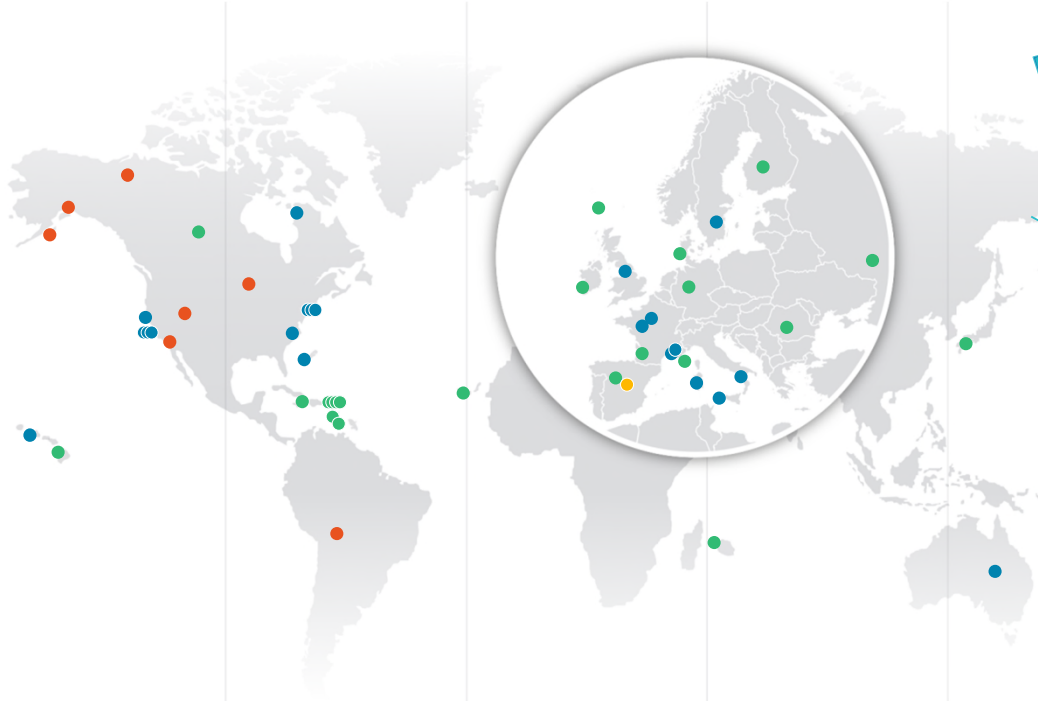
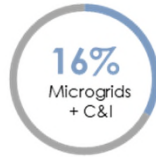
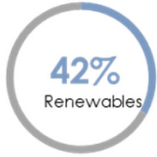
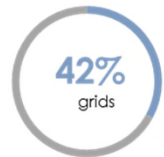
260+ energy storage systems worldwide



19+ countries on **5** continents



42% of Saft installations are supporting distribution or transmission grids



Renewables



Grid



MicroGrid



Commercial
& Industrial

saft

Intensium
Max

Li-ion

ESS MAIN APPLICATIONS

ESS provide flexibility along the electricity value chain



RENEWABLE GENERATION



GRID



MICROGRID



COMMERCIAL AND INDUSTRIAL



Typical size

1 to 100's MW

10's MW

0,1 to 5 MW

Commercial 0.1 to 1 MW
Industrial 1 to 10 MW

Typical applications

- Renewable Integration: ramping, smoothing, shaping
- Arbitrage / Shifting

- Frequency regulation
- T&D grid support
- Peaking

- Spinning reserve
- Diesel optimization
- PV / Wind harvesting
- Resiliency

- PV self-consumption
- Peak demand reduction
- Energy Efficiency
- Backup
- Resiliency

Major ESS Functions

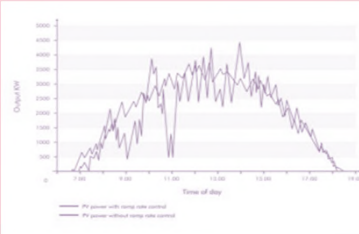
Power (5 – 10%) versus Energy (90-95%)

Generation

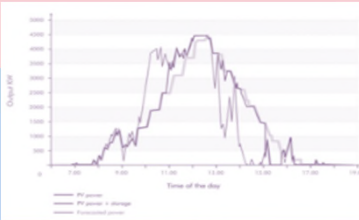
Fossile

Solar/wind

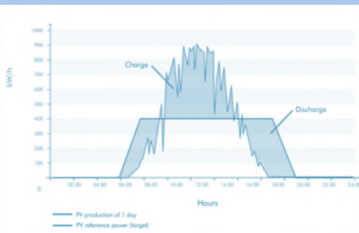
Ramp control
Limit speed of
ramping up &
down



Smoothing
Keep
production
in forecast
window



Shifting
Stable power
Output &
Controlled
ramp up/down



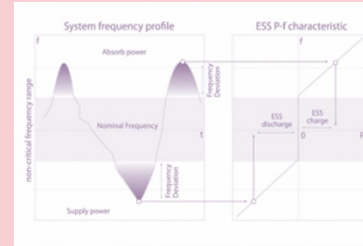
Grid

Transmission

Distribution

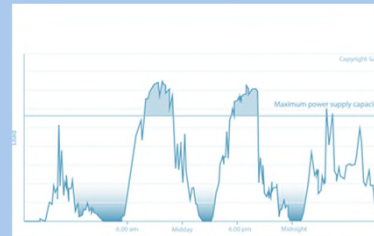
Frequency Regulation

Injection / absorption of active power to stabilize the grid



Peak Shaving

- of consumption peaks
- of generation peaks



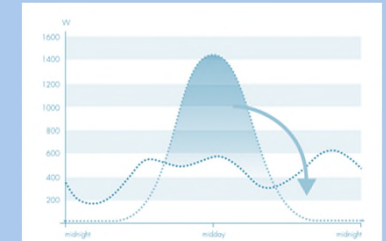
Behind the meter/off-grid

Industrial and
commercial

Residential

Energy Management

- Self consumption
- Arbitrage
- Load management



I Renewable Integration

Overcome technical limits of integrating variable renewable generation

High power variability

- Ramp control

Limited predictability

- Smoothing & Firming
- Shaping

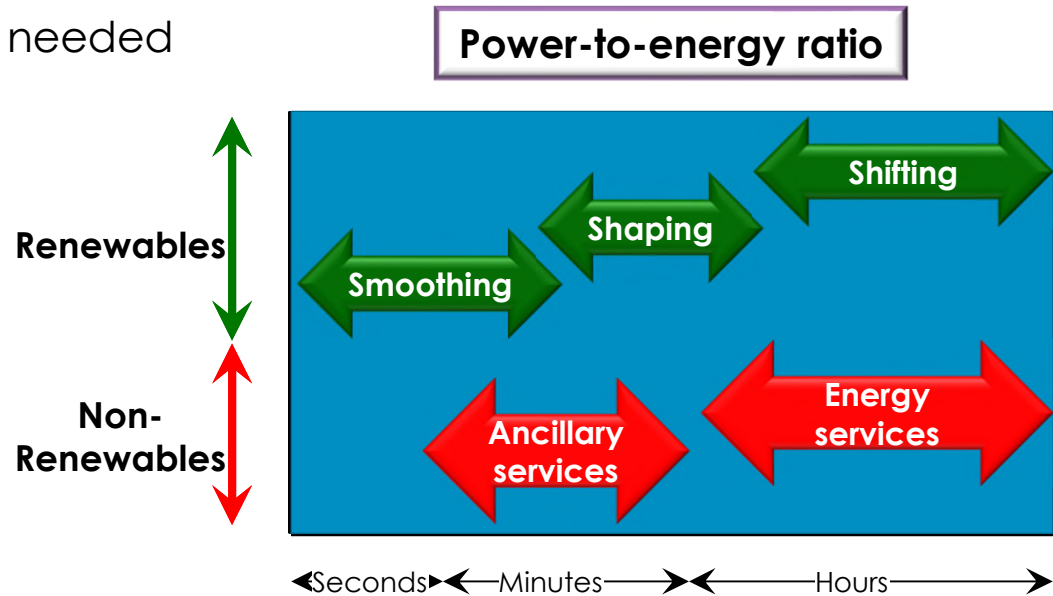
Lack of inertia

- Frequency support
- Spinning reserves



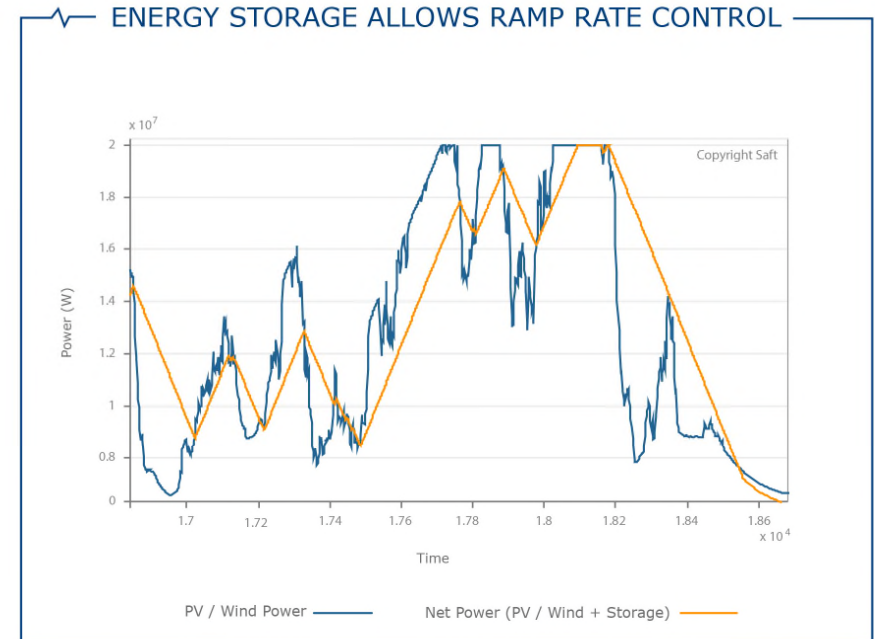
Renewables integration – 3 solution levels

- Make it compatible
- Make it predictable
- Make it dispatchable when needed



Ramp Rate Control

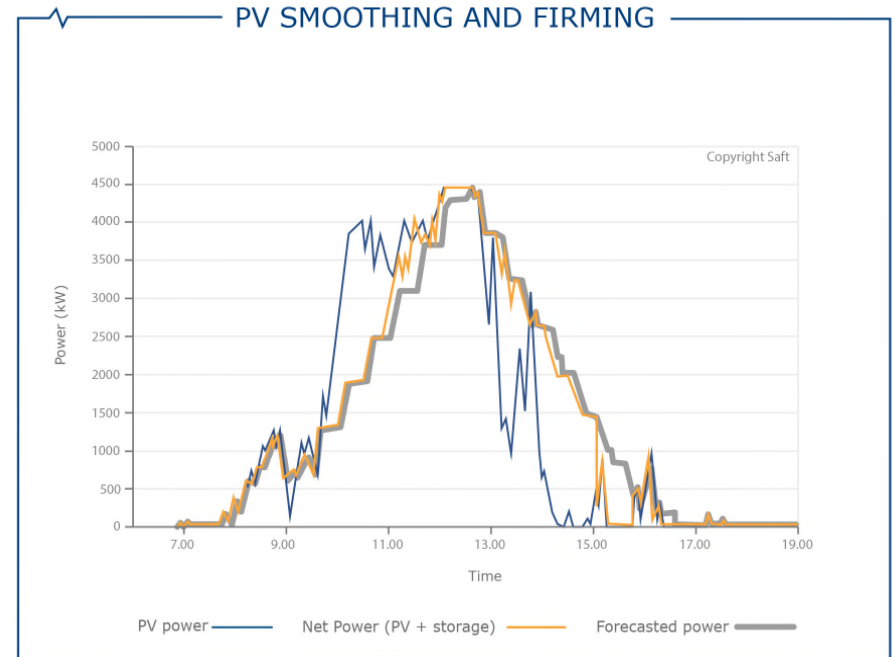
- Limits up- and downramping of renewable power generation to acceptable limits for the grid
- Specified as:
max power variation per minute
(MW/min)
- Typical:
max 10% of nominal plant output per min



Smoothing & Firming

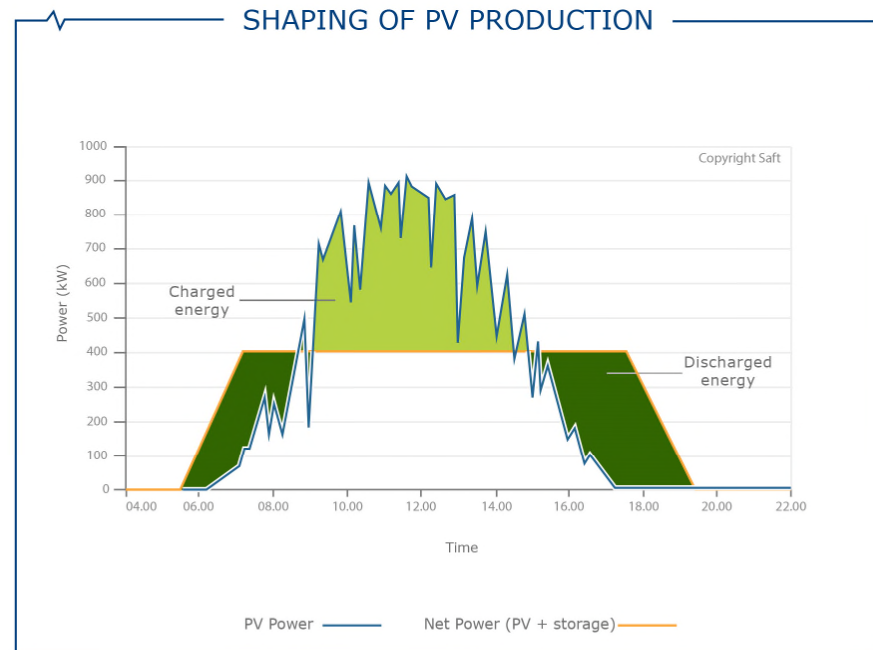
- Keep production within given forecast window
- Compensate short term power sags
- Typical :
keep power output within +/- 10% of
30min forecast window

➔ Renewable generation becomes
“firm” within a limited time window



Shaping

- Stable power output over several hours
 - Fixed power level = fraction of total system power
- Controlled ramping up / down
- Requires shifting of energy blocks

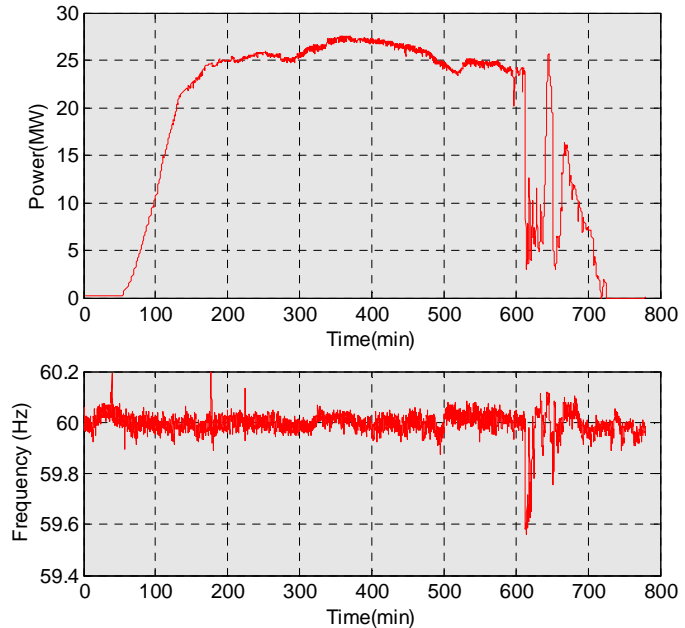


Puerto Rico example – Salinas 10MW



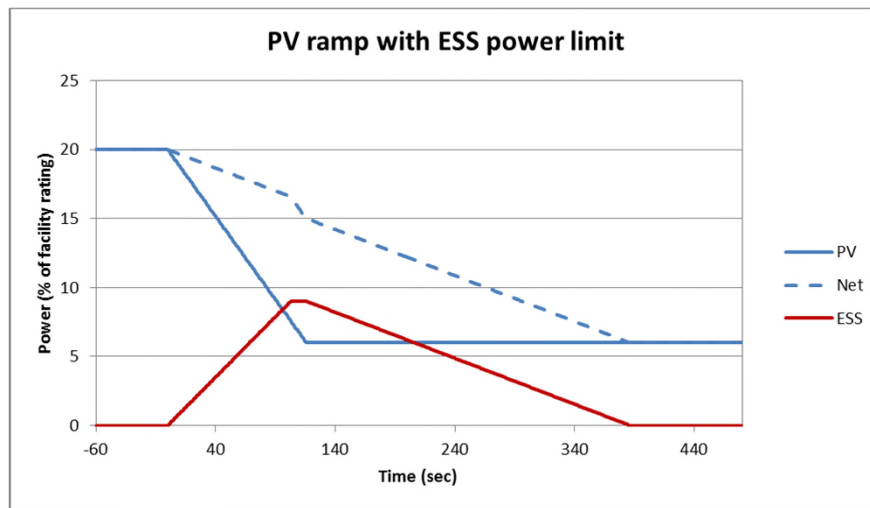
Compatibility with island networks

- Variability of renewable generation can affect grid frequency
- One solution is to implement grid interconnection requirements
 - E.g. PREPA Minimum Technical Requirements (MTRs)
 - Ramp-rate control – 10% per minute
 - Frequency response – 10% of facility power; 5% droop



PREPA MTR philosophy

- Minimum ESS output
 - Peak power at 45% of facility rating
 - Sufficient to control most (but not all) ramps
- When one facility falls short...
 - Frequency response of other facilities kicks in
 - Portfolio effect



II Electricity Grid Support



Energy intensive projects

Power intensive projects

Main Applications and ancillary services

- Grid congestion management and reduction of wind curtailment
- Frequency Containment Reserve
- Frequency Restoration Reserve
- Tertiary Reserve
- Supporting voltage regulation

- Integration of grid resources in the Defence Plan, to integrate RES generation and increase the security of the System
- Frequency Containment Reserve
- Frequency Restoration Reserve
- Synthetic inertia
- Supporting voltage regulation

Storage technical requirements

- Energy to Power Ratio ≥ 7 MWh/MW;
- AC round-trip efficiency $\geq 75\%$;
- Response time < 1 sec

- Energy to Power Ratio ≥ 1
- AC Round-trip Efficiency $\geq 85\%$
- Ultra-rapid frequency regulation: ~ 200 msec

Source: Terna

The Clean Energy Package: a new framework for energy storage in the electricity system

CEP Electricity Directive and Regulation

- Energy storage definition
- Specific role of network operators
- Participation of energy storage in the market and provision of **flexibility services at a level playing field with other energy resources**



Non-discriminatory and effective provision of storage services:

- ☐ Balancing (TSOs)
- ☐ Non-frequency ancillary services (DSOs/TSOs)
- ☐ Flexibility services for system operators (DSOs/TSOs)

Market rules for the participation of energy storage in the market alongside generation and demand response:

- ☐ Redispatching rules should account for storage
- ☐ Network tariffs should not discriminate against storage
- ☐ Participation in capacity mechanisms

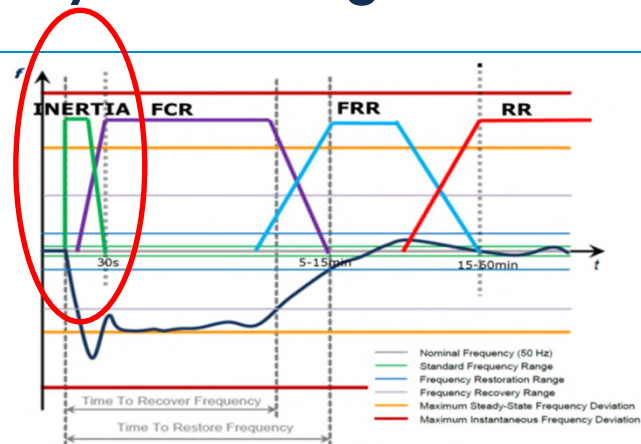
- ➔ **Energy storage services should be a market-based activity and developed under competitive terms**
- ➔ **Efficient use of storage facilities and fair access to storage services for all market participants.**



Ancillary Services: storage can satisfy increasing and new needs

A variety of Existing and New Ancillary Services for ESS

- Synchronous Inertial Response (SIR)
- Enhanced Frequency Response (EFR)
- Fast Frequency Response (FFR)
- Frequency Containment Reserve (FCR)
- Automatic Frequency Restoration Reserve (aFRR)
- Manual Frequency Restoration Reserve (mFRR)
- Replacement Reserve (RR)
- Black start
- Frequency stability of weak grids
- Voltage support
- Dynamic Reactive Response (DRR)

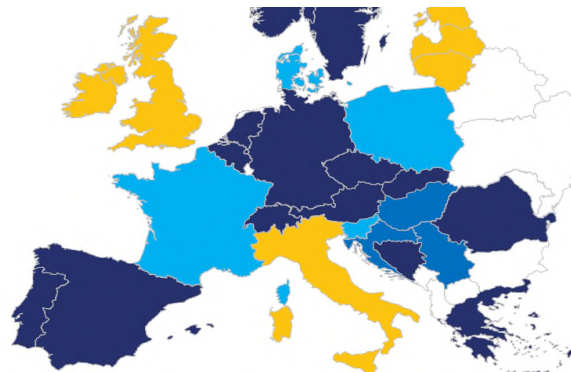


Source: Entsoe

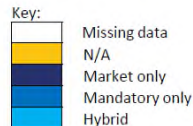
A market for energy storage ?

- Procurement schemes widely differ in Europe
 - For different services
 - Technical conditions and rules
- Common marketplace for FCR in Europe by 13 TSO's in IGCC(*)
 - Accessible for Storage
- FFR and RR accessible to storage in few countries only
- Increasing importance for fast responding FR and inertia

(*) International Grid Control Cooperation www.regelleistung.net



Procurement of aFRR capacity in Europe



Source: Entsoe



Grid Investment Deferral : Who can own storage ?

TSO, DSO are required to consider energy storage in network planning as an alternative to grid expansion.

(Electricity Directive, Articles 32 and 51)

DSOs and TSOs should not own or operate storage facilities

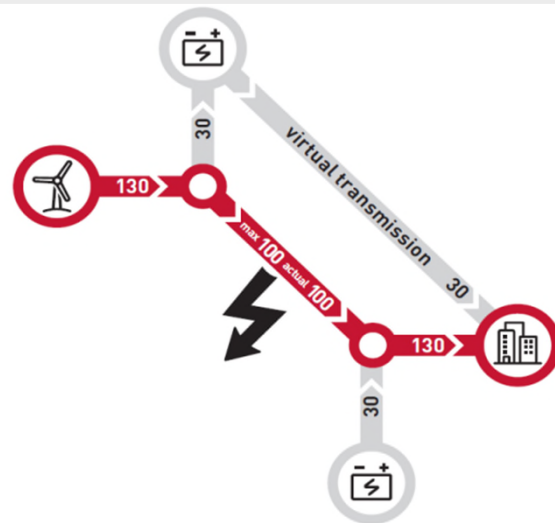
(Electricity Directive, Articles 36 and 54)

Derogations by Member States are possible for ensuring reliable and secure operation of the system:

- If other parties could not invest and deliver storage services
- For fully integrated network components

Solutions

- 1 TSO ownership on Experimental Basis : example RINGO
... not viable on long-term
- 2 Market based procurement of flexibility services
... risk to “secure, reliable and efficient electricity system” ?
- 3 Mixed models ?



RINGO

Virtual power lines to solve grid bottlenecks

3 ESS of 10MW – 2h
3-year trial starting 2020





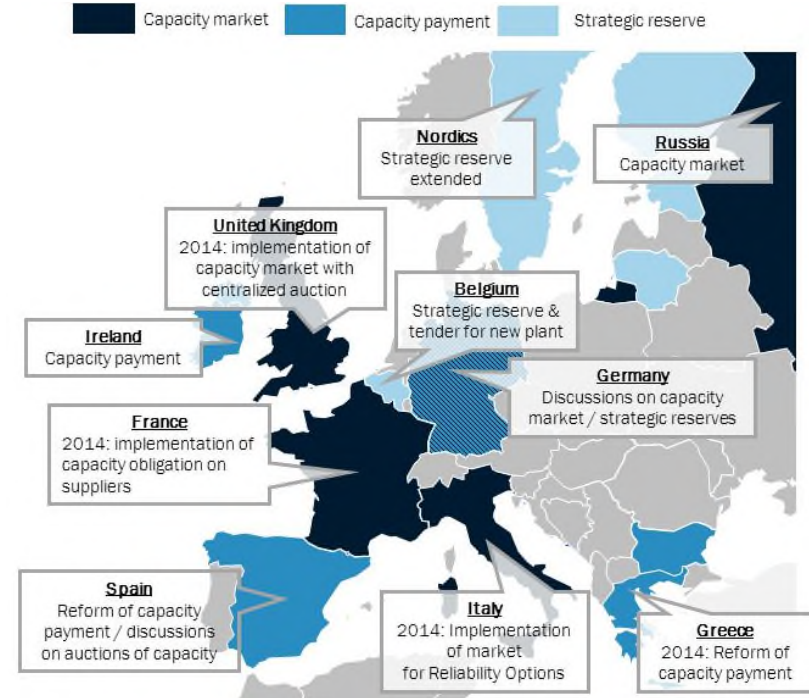
Capacity Markets: Energy Storage competing with CCGT's

Evolving Markets

- Trend towards market based capacity mechanisms
- France, Italy, UK share common structural approach
- Significant differences remain in the design of the different capacity markets

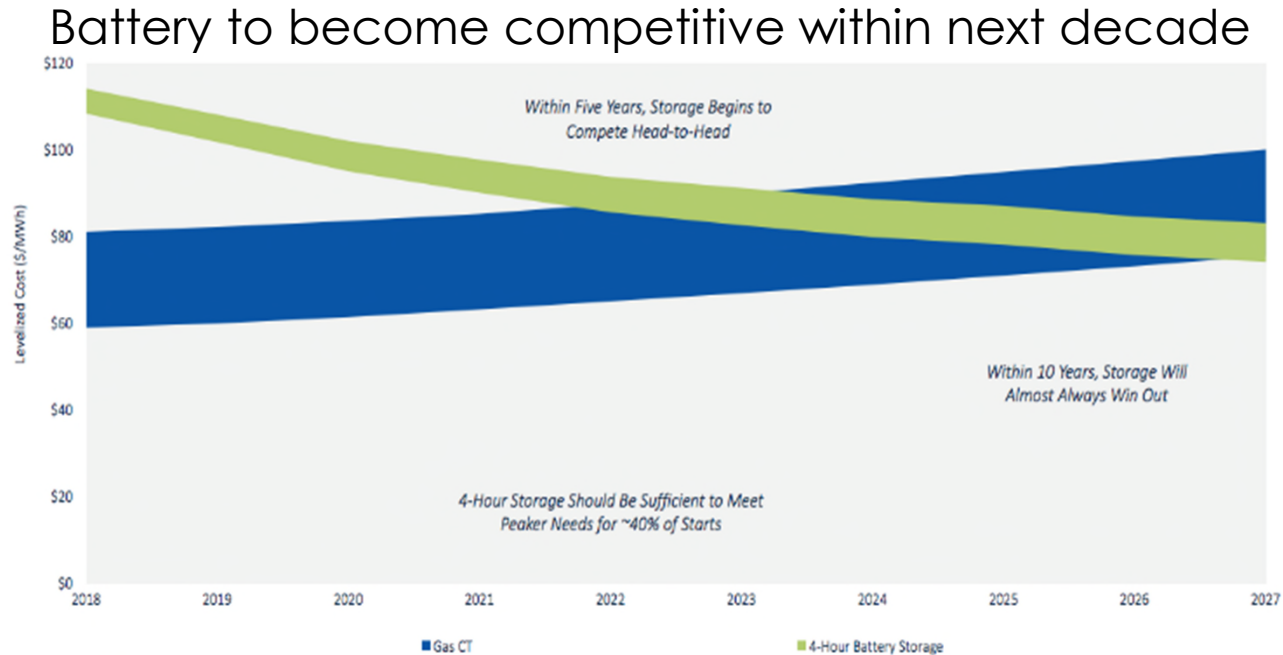
A new Eldorado for Energy Storage ?

- New capacities are needed and planned in Europe
- LCOE of 4h battery storage can compete with CCGT by mid-2020ies (WoodMack, 2018)
- Market Inertia may slow down substitution process



Source: FTI CL

Energy storage for peak generation



Source : GTM / Wood Mc Kenzie, April 2018

Sound Business Cases for Energy Storage

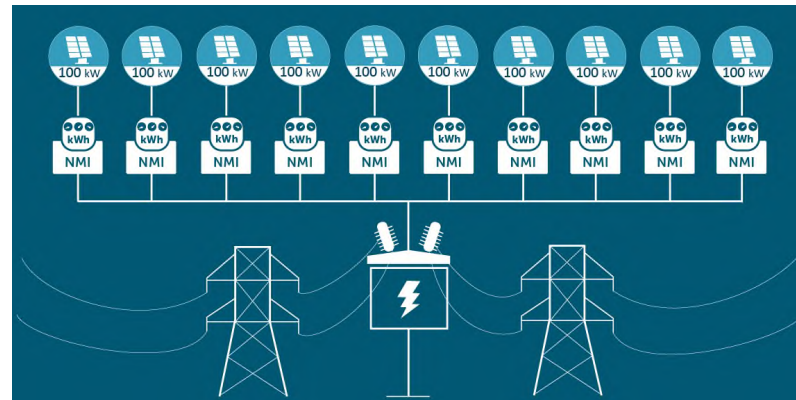
Opportunities to provide market-based services will increase

... but prices and revenues are subject to fluctuations

- Stacking revenues by providing multiple services
- Adjust operation model to market conditions
- Flexible Performance Guarantees
- Augmentation

Supporting the Storage Case

- **Enable non-discriminatory access to market-based services**
- **Enable long-term contracts**
- **Enable mixed ownership models between regulated and non-regulated entities**



Storage coupled to PV generation

- Common point of grid connection
- Renewables Firming
- Grid services enabled

Thank you !



**We energize the world.
On land, at sea, in the air
and in space.**



Stay tuned!

