CLEANHORIZON

Detect, analyze, monetize

Plenary IV:
Technological Innovation

Energy Storage -> future potential

May 12th 2016

Clean Horizon was started in 2009 and is the world's sole consultancy specifically dedicated to energy storage

Energy storage Market Analysis

Energy storage Business Development

Detect

Analyze

Monetize

Detect weak signals
- Emerging technologies
- Emerging start-ups

Provide expert analysis
- Energy storage market segment watch
- Energy storage regulatory analysis

Monetize energy storage
- Business model analysis
- Channel partners introductions
- Lead generation

Money, money, money… and the rest

Why INVEST in storage (B2B) ?

… Because storage SAVES money

- Optimize generation costs = fuel savings
- Optimize grid operations (thus entailing less need for generation to balance the grid, back to fuel savings, mostly)
- Optimize customer energy bill (thus back to fuel savings, mostly)

Or because it has another value

- Better power quality
- Resiliency in case of outage

Why SPEND on storage (B2C) ?

- Consumers buy “stuff”. Sometimes it is rational, sometimes it is not (why do people by Porsche?)
- We won’t talk too much about consumers here

So storage will happen if companies invest or if consumers spend.
We'll focus on investment.

Fuel savings: the diesel example (mostly developing world and islands)

1 MWh needs approx 300 to 500 Liters of diesel

So at 0.75 USD/liter (a not so bad proxy)

1 MWh produced by an engine costs 225 to 375 USD
(that's 22.5 to 37.5 cents/kWh for generation only)

Saving diesel is a pretty good business model !

PV is a good start
PV + Storage brings it home

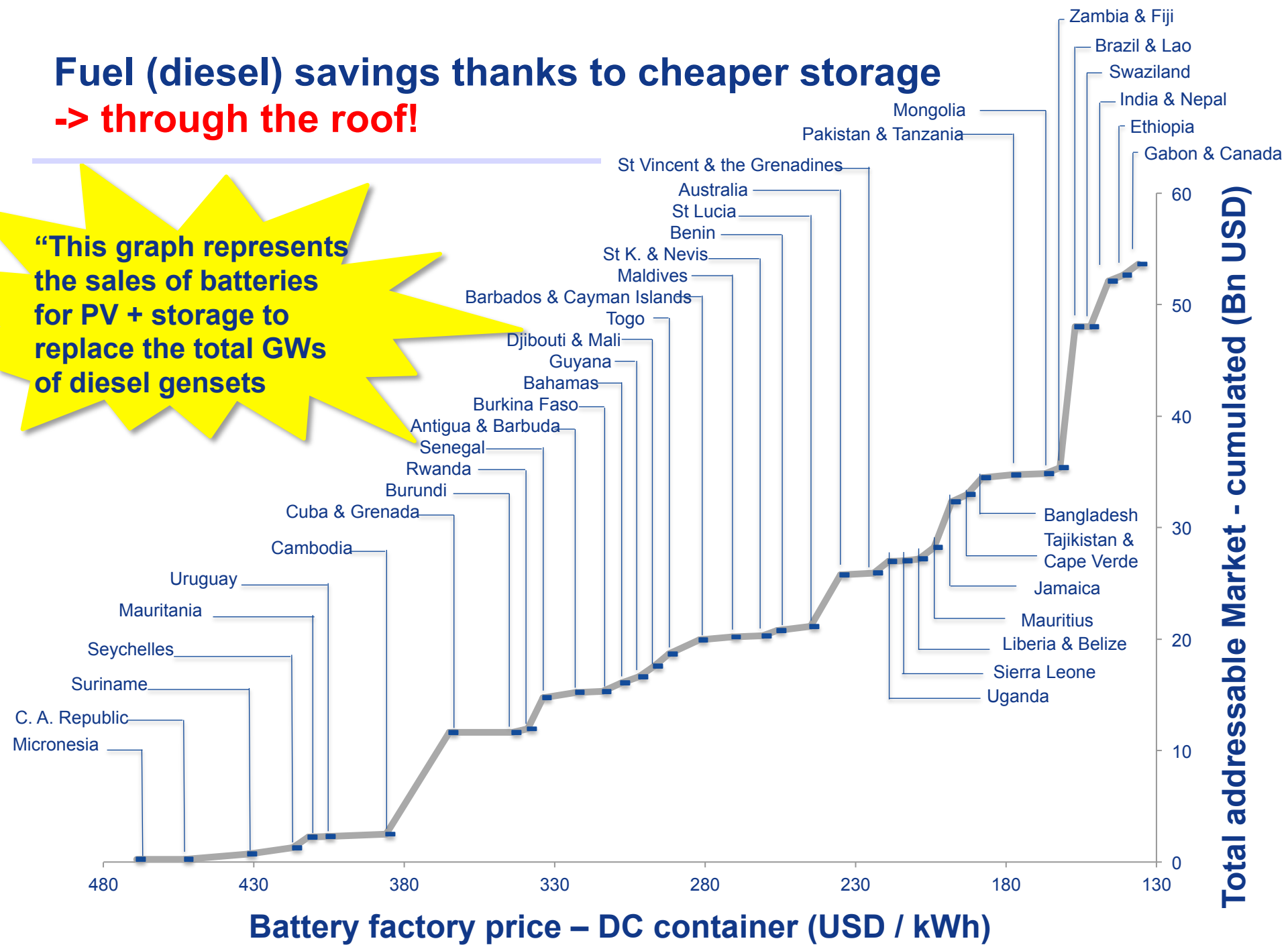
Fuel (diesel) savings thanks to cheaper storage (mostly developing world and islands)

Cheaper PV and cheaper storage can make this happen*

* Assuming you can finance ;-)

Fuel (diesel) savings thanks to cheaper storage
-> through the roof!

"This graph represents the sales of batteries for PV + storage to replace the total GWs of diesel gensets

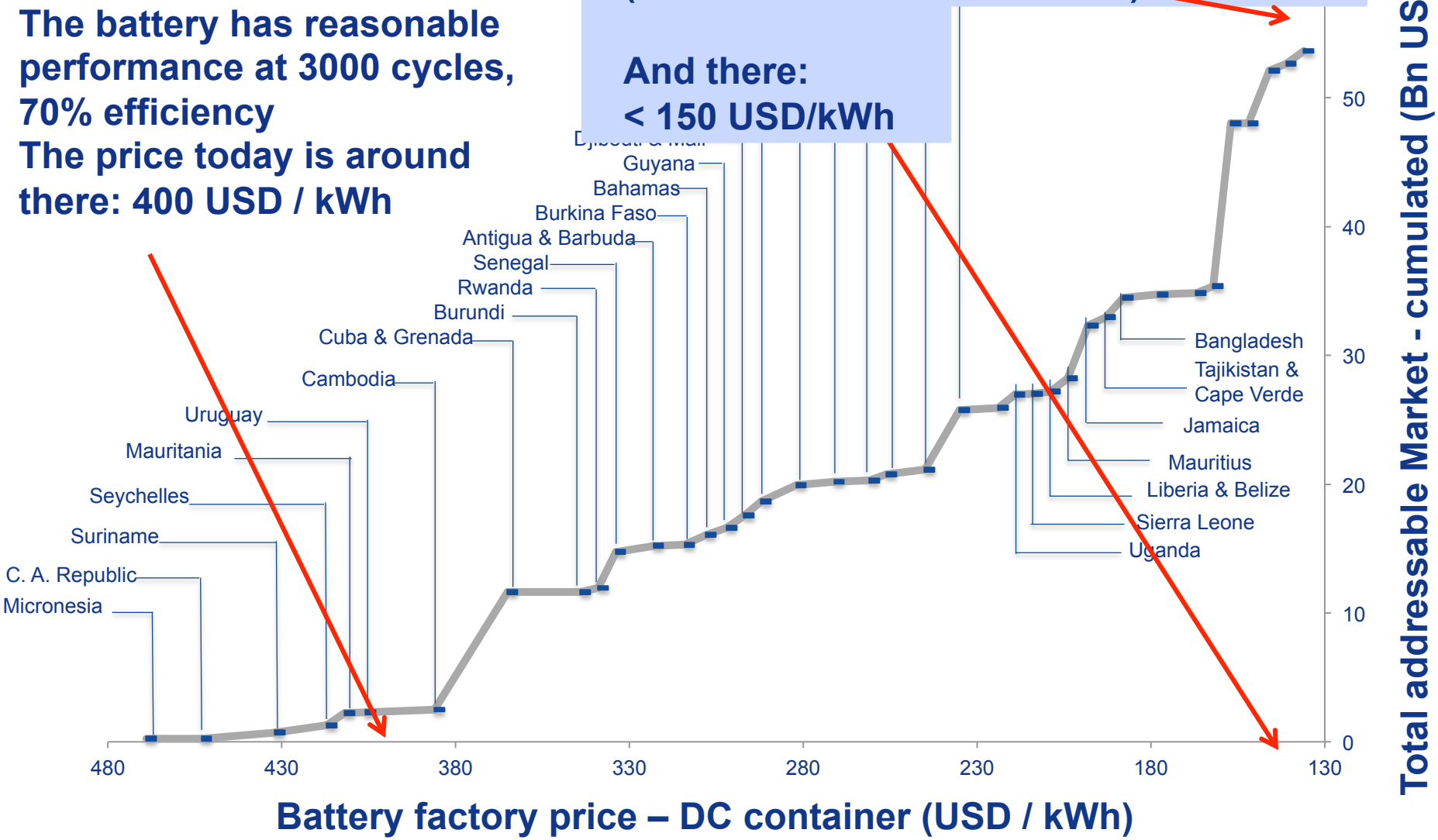


Fuel (diesel) savings thanks to cheaper storage -> through the roof!

The number there reads: >50 GBn USD (Above 250 GWh of batteries)

And there: < 150 USD/kWh

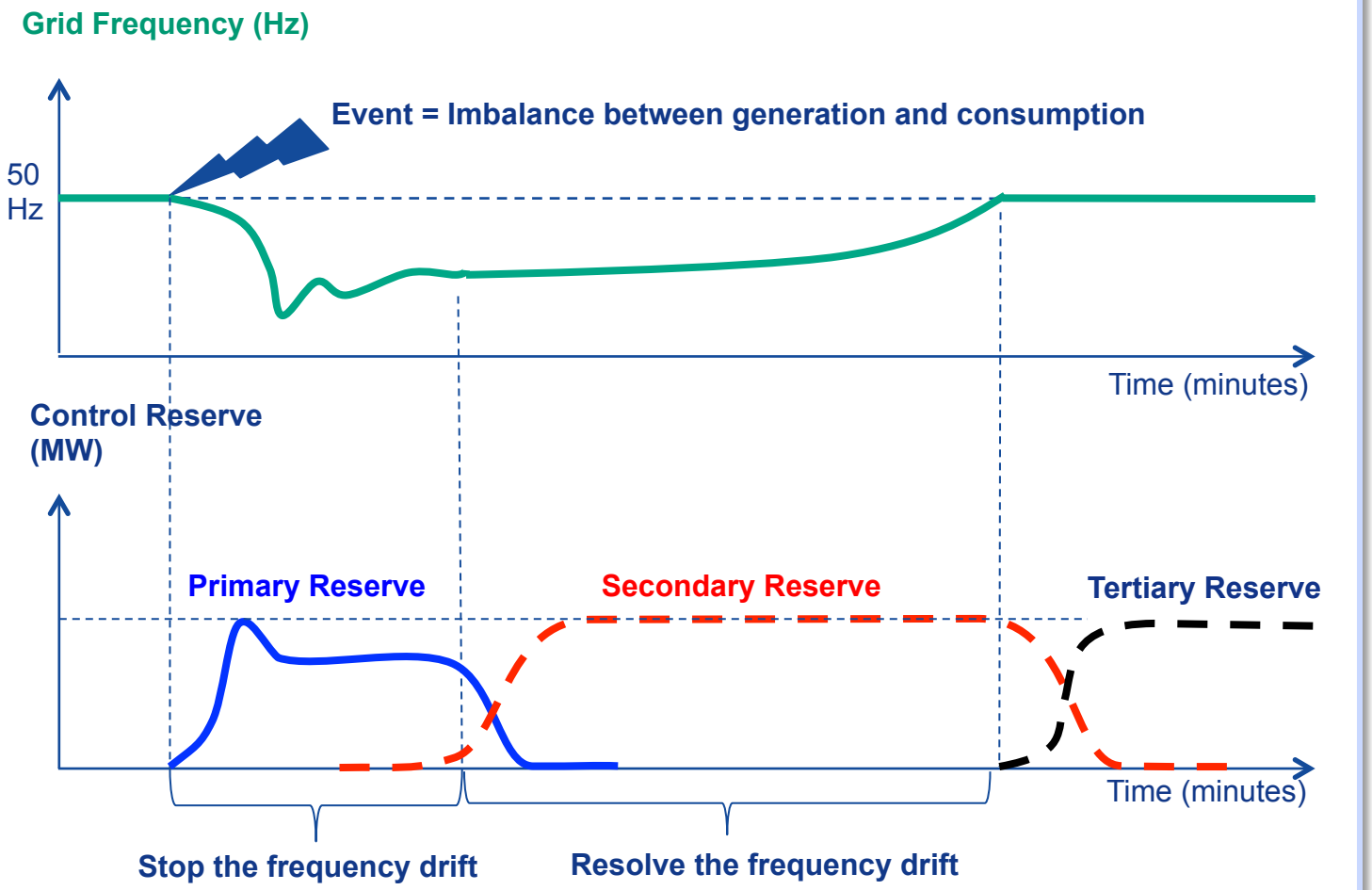
The battery has reasonable performance at 3000 cycles, 70% efficiency
The price today is around there: 400 USD / kWh



OK, this was for offgrid – weak grid regions.
What about strong grid regions such as Europe?

Working principle of the provision of primary reserve

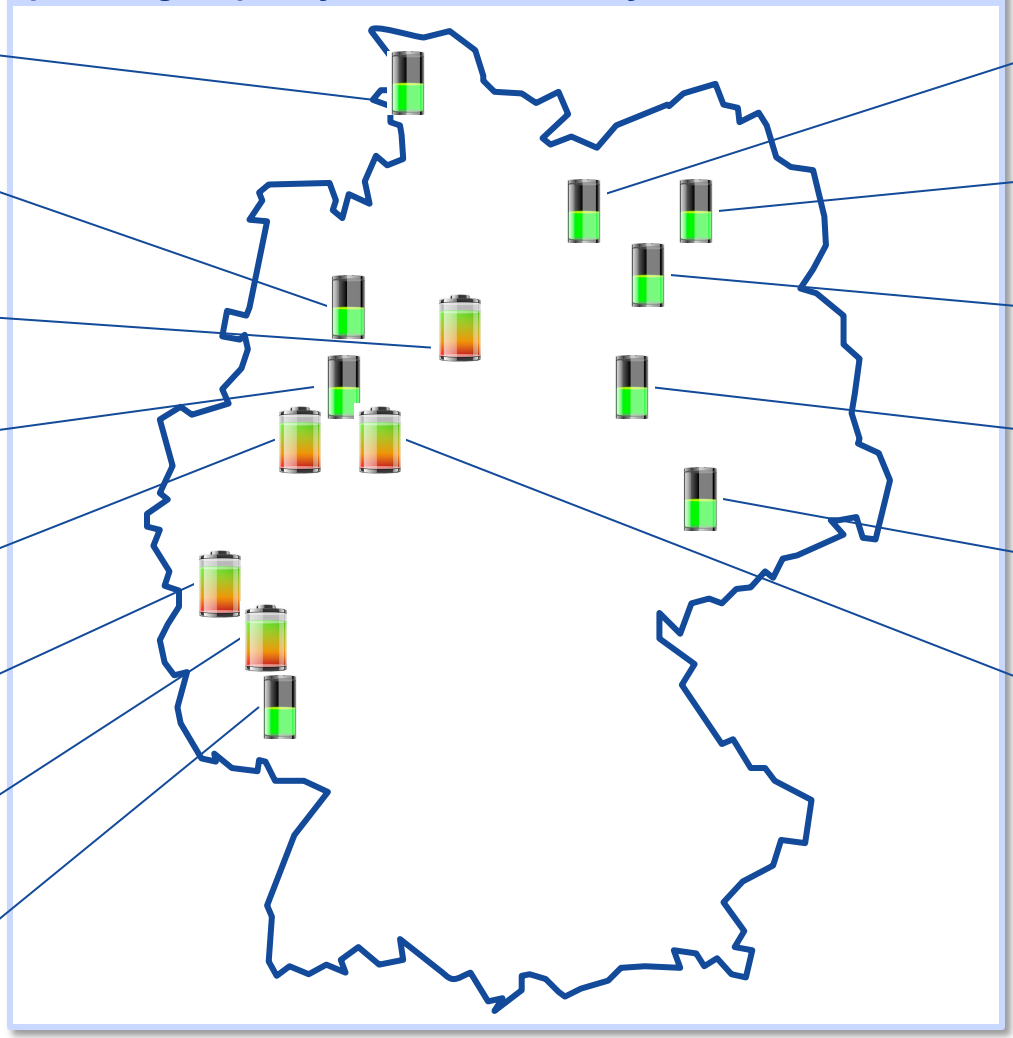
Reserves ensure balance between generation and consumption



Batteries are well suited to provide primary reserve due to their fast response

Batteries are therefore flourishing on the German landscape: More than 150MW of storage will be operational by the end of the year

Map of the current and future large scale storage projects providing frequency reserve in Germany



Braderup
2MW/2MWh

Statkraft
3MW/4.5MWh

Daimler AG
15MW/15MWh

Daimler/Mobility House
13MW/13MWh

Bosch second life
2MW/2MWh

M5BAT
5MW/5MWh

STEAG[1] – Saarland
45MW/70MWh

Lessy
1MW/840kWh

Schwerin
5MW/5MWh

Younicos - Berlin
1MW/6MWh

Alt Daber
1.6MW/2MWh

Feldheim
10MW/10MWh

DREWAG
2MW/2.7MWh

STEAG[1] – Westphalia
45MW/70MWh

Legend:
Operational
In construction

Note:1. STEAG's projects are actually constituted of 6 different installations, 15MW each

Yes but, primary reserve is… about 1% of capacity installed!

So, in a strong grid region, the rationale remains limited and is more linked to optimizing the system operation

And even at 150 $/kWh, we would need PV to be 50% of its present cost to achieve a LCOE ov PV + storage of around 5-7 c€/kWh... which does not compare so well with efficient thermal.
=> So its is quite unlikely we will see massive deployment at the generation level in strong grid regions

Unless new regulations come and create a new value for storage…

Renewables can be DISTRIBUTED

(Small local plants can be distributed across a country)

Renewables are AUTONOMOUS

(No need from external resources)

And with storage, renewables can be FIRM

(Economic, firm power for a few hours)

Rewenables and storage complement existing, integrated, grids by making them RESILIENT to external threats

But today resiliency has no value. And tomorrow?
-> A scenario study for 2050 made by DHL in 2012*

A scenario study for 2050 made by DHL in 2012*, 5 scenarios. **Scenario 5: "Global Resilience – Local adaptation"**

Resiliency to catastophic weather events, terrorism, cybersecurity threats

Only distributed renewables coupled with (some) storage can provide real resilience to the electricity sector

If this resilient world materializes and regulators place a market value on (or an obligation of) resilience, then storage will be adopted massively in « strong-grid » regions

"Logistics 2050, http://www.dhl.com/en/about_us/logistics_insights/studies_research/logistics_2050.html#.VzOz4GbZGes

A conclusion: Looking forward

Offgrid and developing nations	▪ As storage prices go down, developing nations, islands and any locations relying on engines will end up adopting renewable + storage
Strong-grid regions	▪ For more mature markets, storage will most likely provide optimization of system operations in the short to medium term ▪ In the long run, storage will be a game changer if new functions such as resiliency become valuable – today, it is not really the case ▪ … And one last thing: consumers may kick in as well, either for economic or grid defection reasons... Or just because they like it.

Feel free to contact us for more information!

Join 4000 other storage professionals and subscribe to our TOP 5 newsletter at: www.cleanhorizon.com

Michael Salomon Ph.D.
Clean Horizon CEO
michael.salomon@cleanhorizon.com
+33 1 78 76 57 03 (direct)
+33 6 72 61 27 34 (cell)