Smart Grid on Existing Infrastructures of Mini Grids

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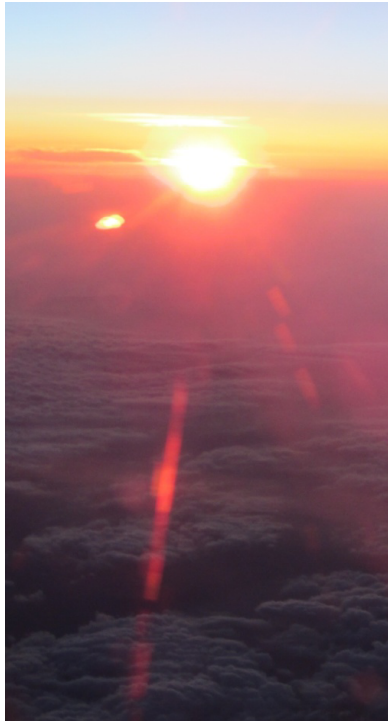


Agenda

1. Objective: Paradigm Change – Demand follows Supply
2. Business Models: Opportunities and Challenges for RE
3. Generation cheaper than Flexibility: Smart Grid – but when?
4. KISS (Keep It Simple and Stupid): „Easy" Smart Grid
5. Conclusion: Integrated view of RE, Storage, Smart Grid

Objective: Paradigm Change - Demand follows Supply

Issues to be addressed to achieve RE dominated grids:

- Enough **demand that can** follow
- **RE is cheaper** than the other forms of energy
- Savings (by shifting loads) **exceed Smart Grid transaction cost**
- **Combination of smart market and grid technology**
  (supplier and customer benefit, robust and cheap technology)

- Markets develop now, and suitable smart market/grid can **support their quick growth**

Opportunities and Challenges for RE

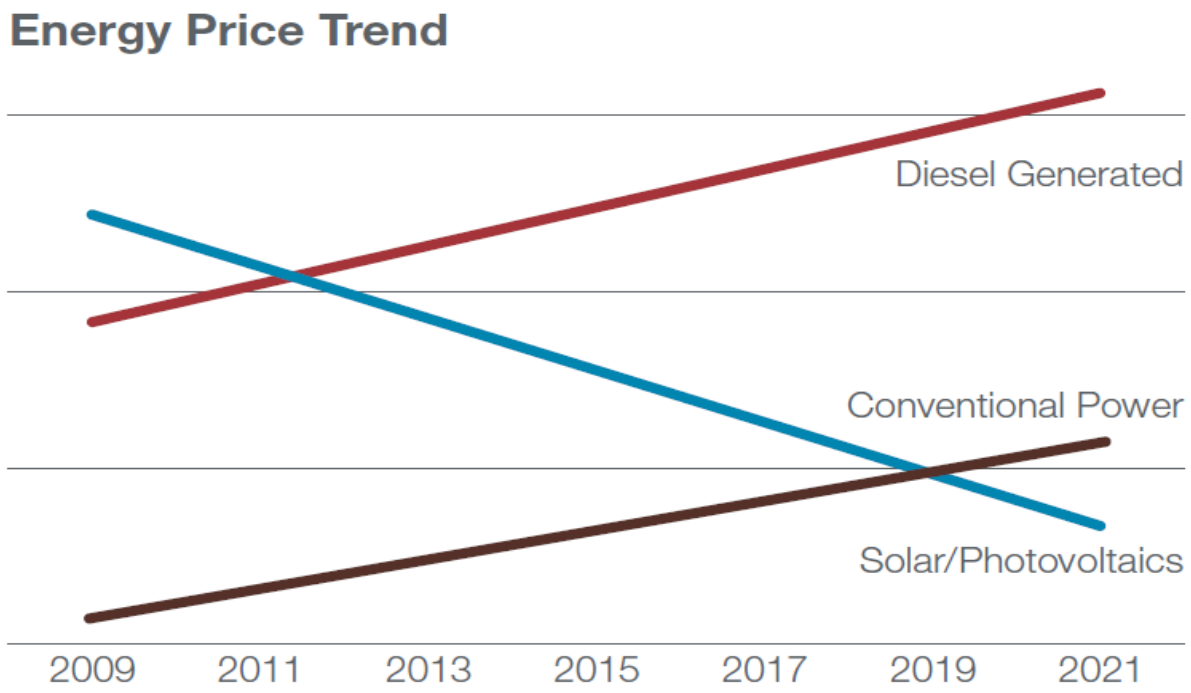
Our business background: PV substitutes fuel in PV-Diesel Hybrids

Market characteristics:

- Mainly Diesel genset powered
- RE is cheaper (~ 0.3 $/kWh fuel cost in Diesel electricity)
- No distortion by subsidies (w/w fossils receive five times more subsidies than RE)
- High load shift potential (de-salination, cooling, E-mobility)

Opportunities and Challenges for RE

PV is beyond Grid Parity in diesel markets, other segments will follow soon

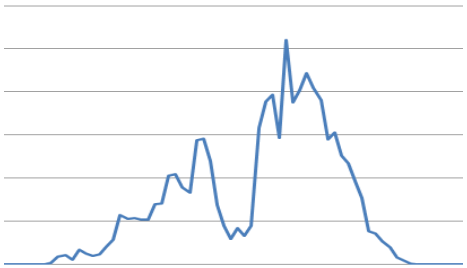


Opportunities and Challenges for RE

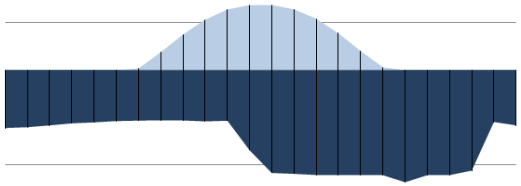
Balancing and stability are key from ~20% RE share

Challenge

Volatility of Renewables



Balancing Demand and Supply

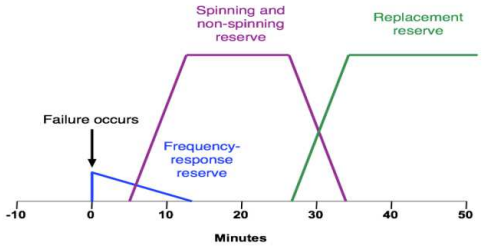


Business case 1

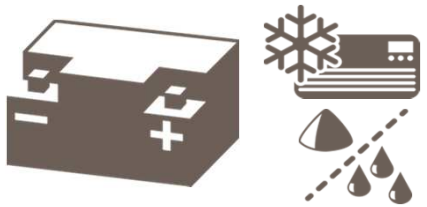
Business case 2

Solution

Spinning Reserve
(short term)



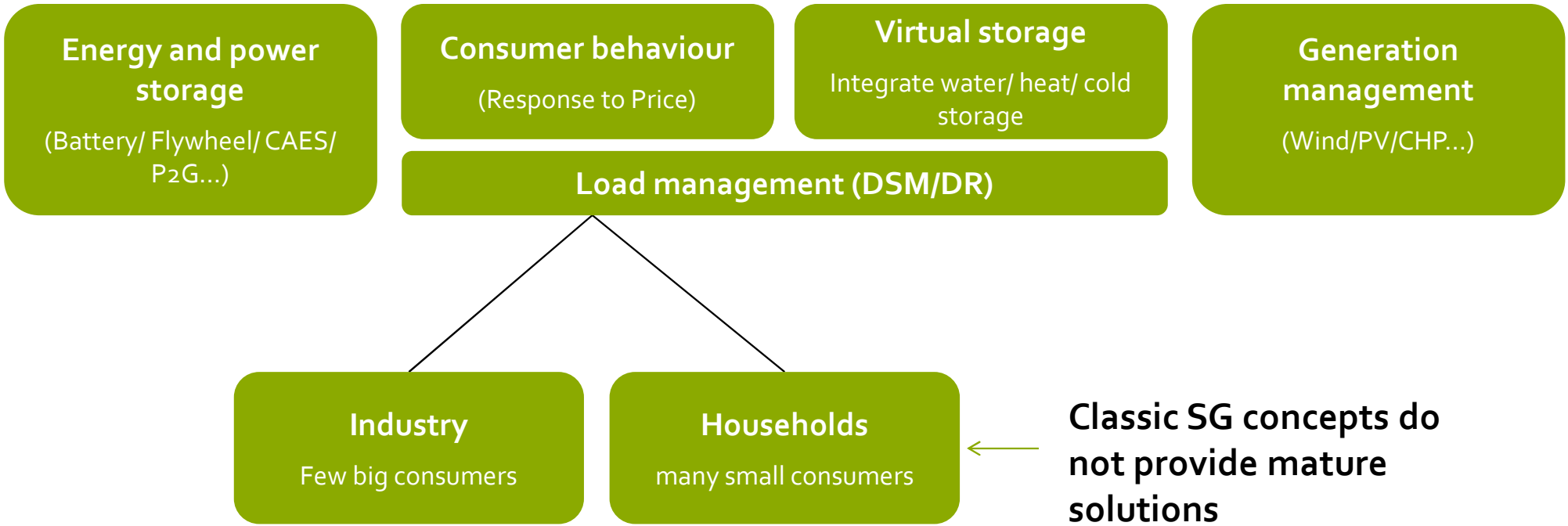
Storage & DSM[1]
(long term)



[1] DSM = Demand Side Management

Generation cheaper than Flexibility: Smart Grid – but when?

Storage is major cost element in system – toolkit to build solution



Classic SG concepts do not provide mature solutions

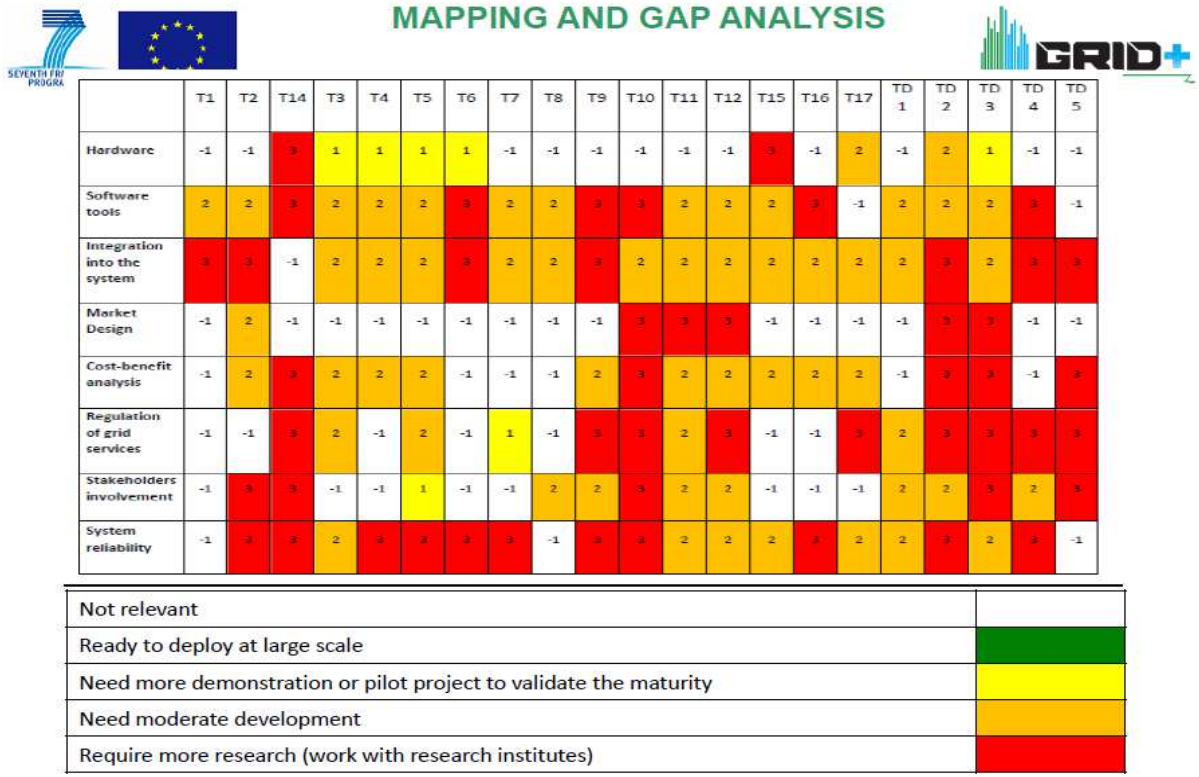
Generation cheaper than Flexibility: Smart Grid – but when?

From a Status Review by European Electricity Grid Initiative (EEGI)

- Currently no project ready for deployment
- Research still required in many categories

Main Barriers:

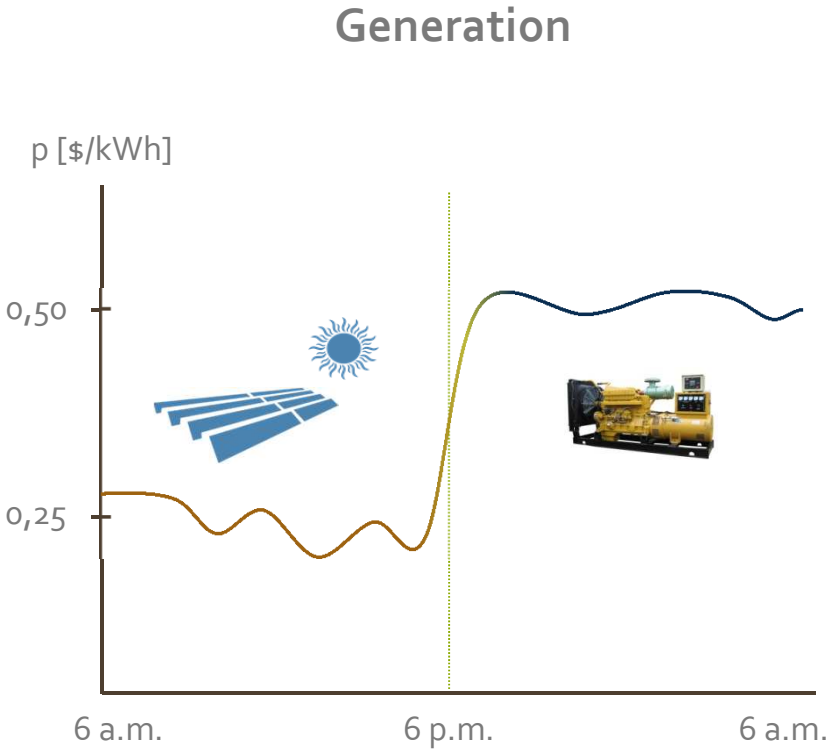
- Data privacy
- Integration of storage due to their high cost
- Integration of ICT (complexity)

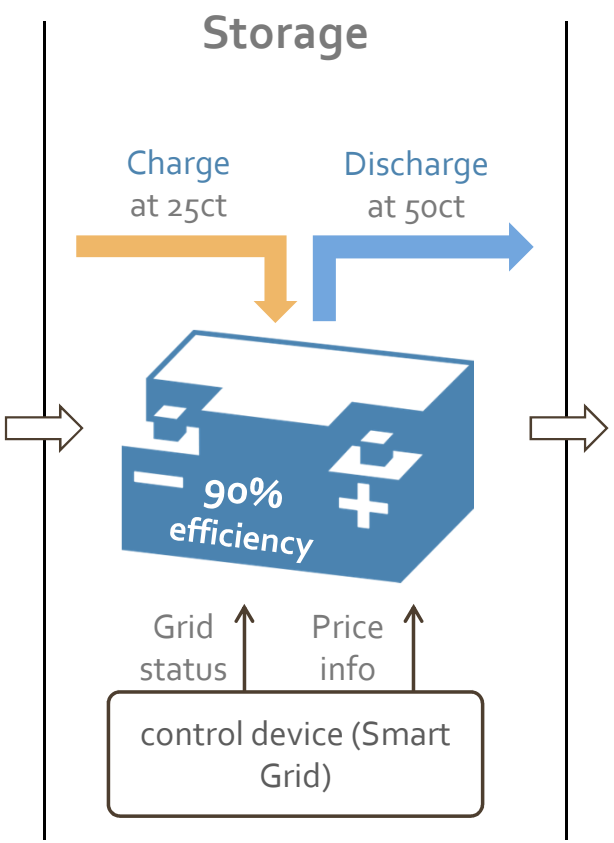


Source: Michele de Nigris, GRID+: COORDINATION ACTION IN SUPPORT TO THE EEGI: RECENT UPDATES

Generation cheaper than Flexibility: Smart Grid – but when?

A real storage business case (data: Maldives)



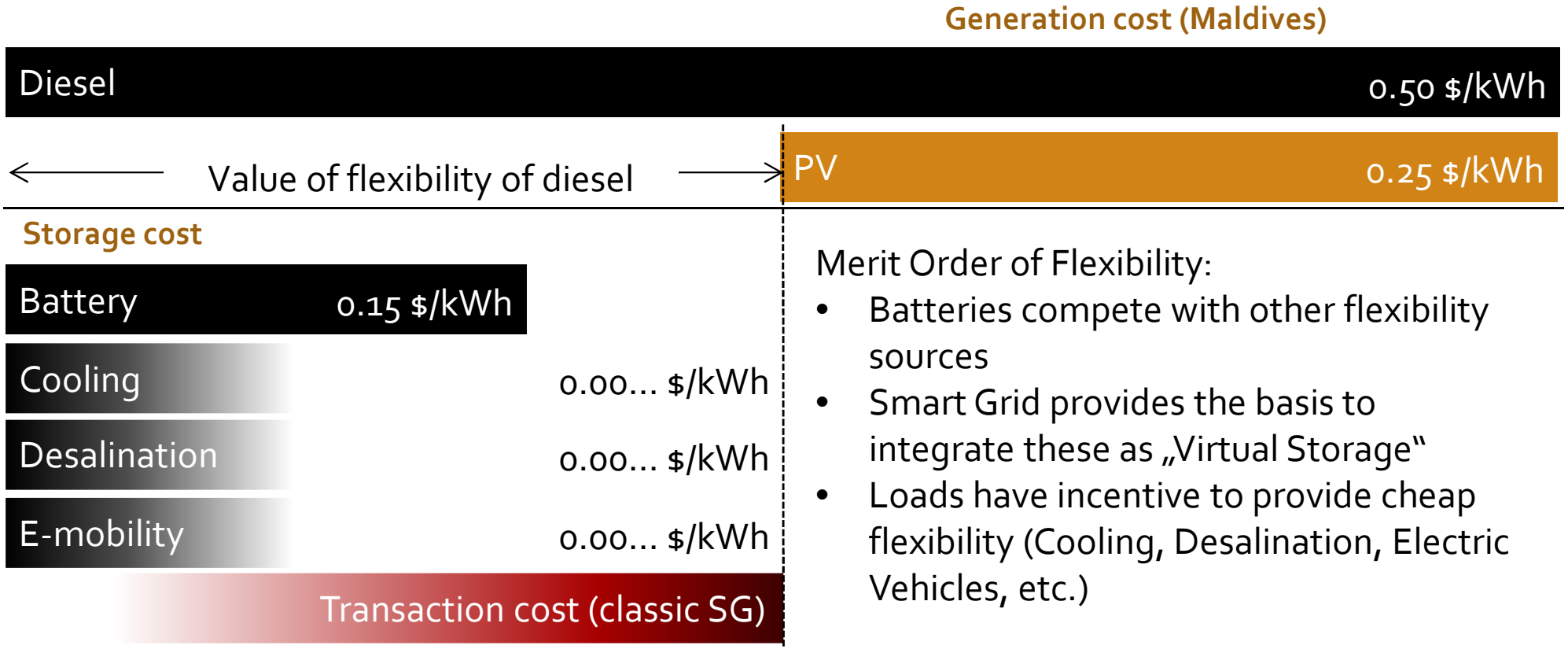


Margin

Value of storage	
0.9 kWh out:	45 ct
1.0 kWh in:	25 ct
Margin/kWh	**20 ct**
Battery cost (PLC)	
15ct/kWh	15 ct
Transaction cost ?	
(Zero Transaction Cost)	
Profit / kWh	**5 ct**

Generation cheaper than Flexibility: Smart Grid – but when?

Technical „Smart Grid" and a „Smart Market" allow optimal solutions



Merit Order of Flexibility:

- Batteries compete with other flexibility sources
- Smart Grid provides the basis to integrate these as „Virtual Storage"
- Loads have incentive to provide cheap flexibility (Cooling, Desalination, Electric Vehicles, etc.)

KISS: „Easy“ Smart Grid

Early markets need Smart Grid that will work soon

„Easy“ Smart Grid: Single (Realtime-) Price within Mini Grid:

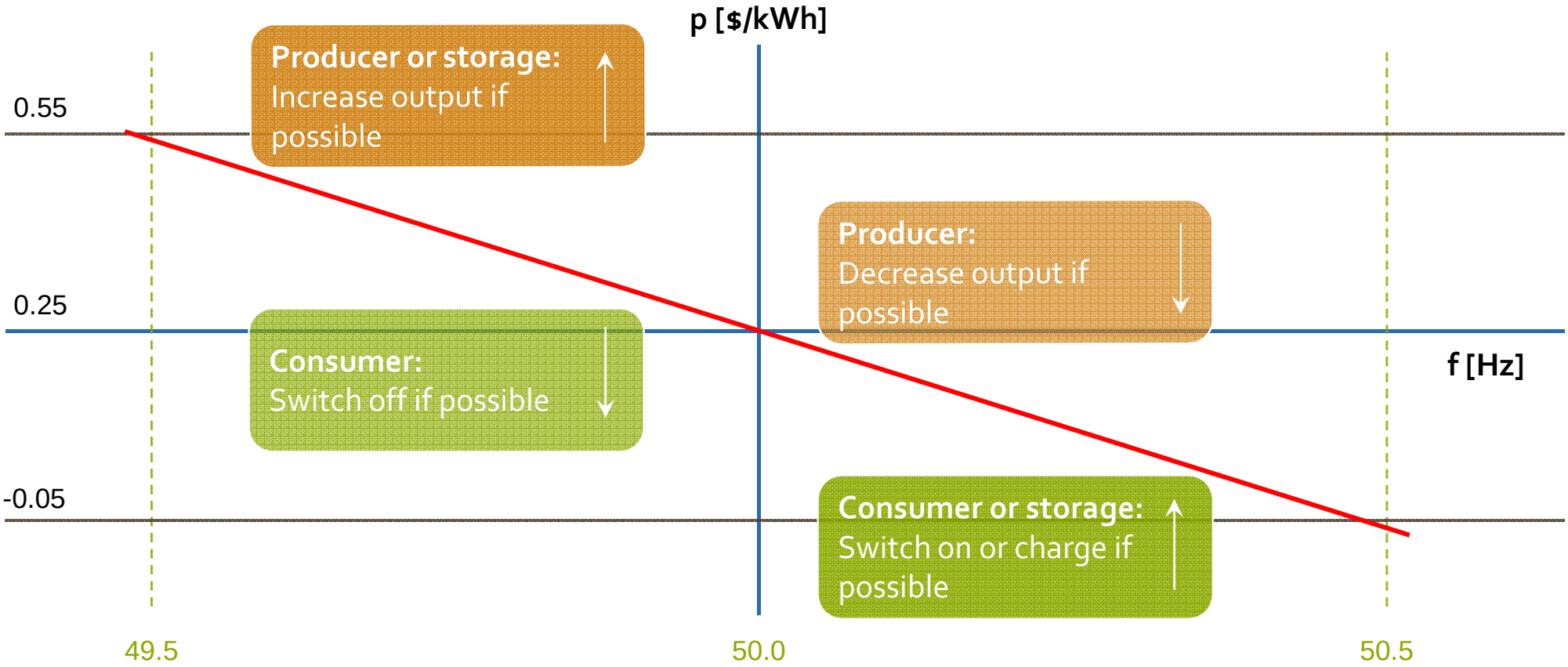
- If generation < load: Increase price until balance reached
- If load > generation: Reduce price until balance reached
- Flexible generators: Shift to high price times
- Flexible consumers: Shift to low price times
- Storage: Charge at low price, discharge at high price

How to identify the balance and communicate the price?

- „Big Data“ (classic Smart Grid) solutions or
- „Easy“ Smart Grid (using existing grid operation principles)

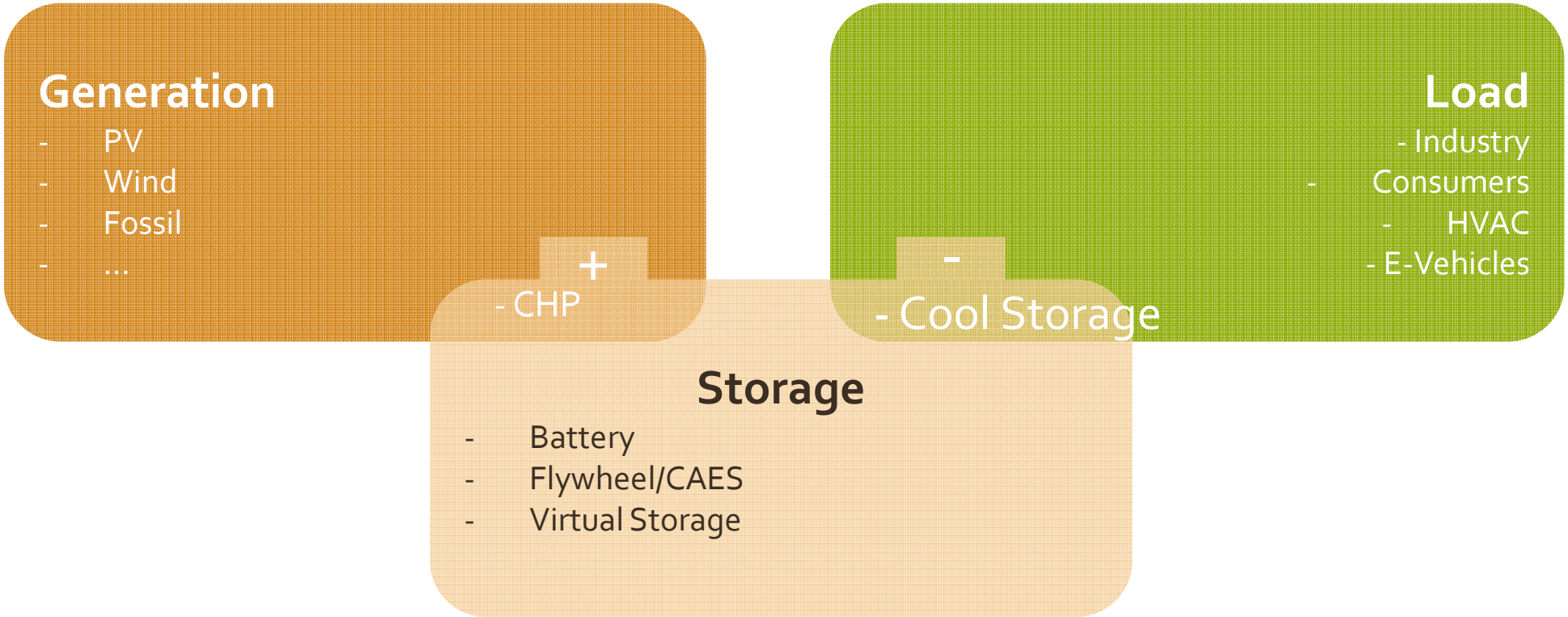
KISS: „Easy“ Smart Grid

Existing grid operating principle – extended by price info



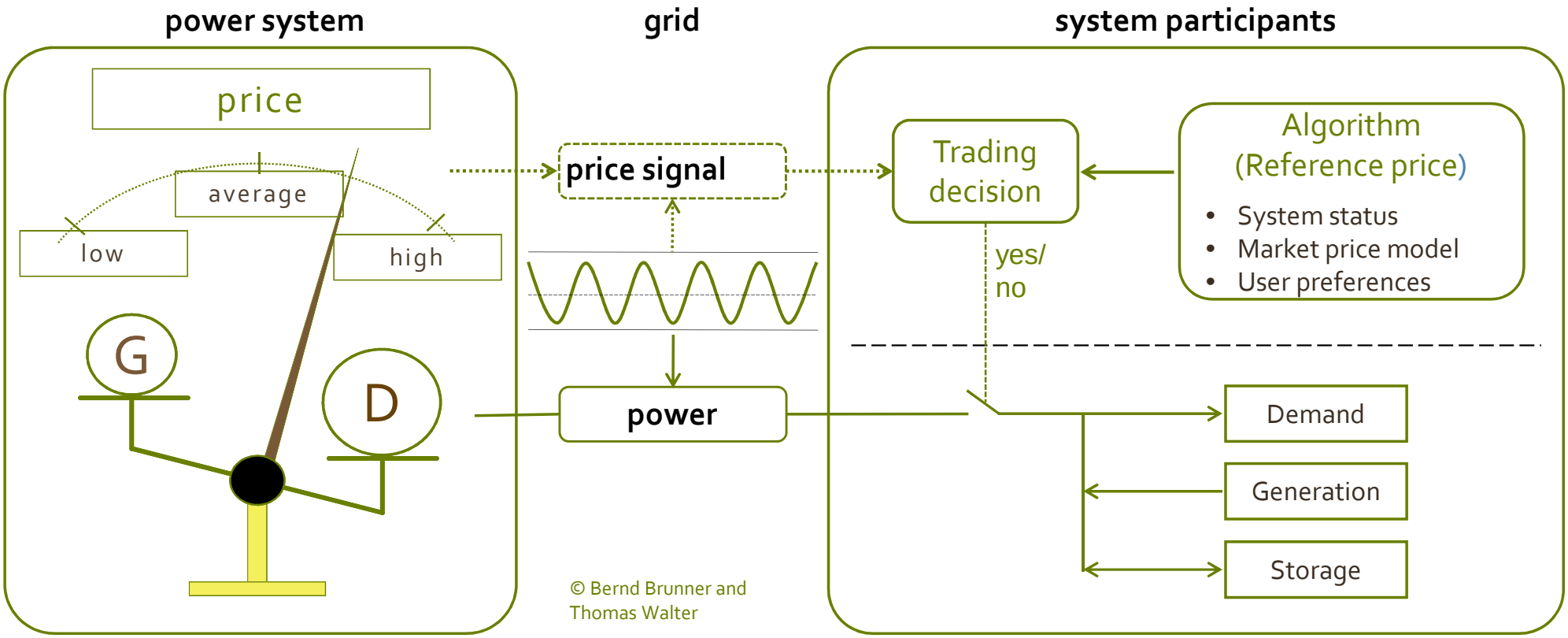
KISS: „Easy“ Smart Grid

Integrated market for energy ($/kWh), grid cost is covered by fee ($/kW)



KISS: „Easy“ Smart Grid

Smart Grid: A Real Time Trading Platform with Near Zero Transaction Cost



Summary of benefit

System benefits

- Different flexibility sources integration
- Simple market rule for generation, demand and storage
- Real time and transparent price (no latency, better system stability)
- Near zero transaction cost
- Relevance of technology for larger electricity grids?

Grid/system operators, regulators, politics

- Faster migration to RE
- Grid operator enhanced as exchange operator
- Investment reduced in ICT and storage
- Less risk through reduction of complexity
- Future proof

Benefits for end users and equipment suppliers

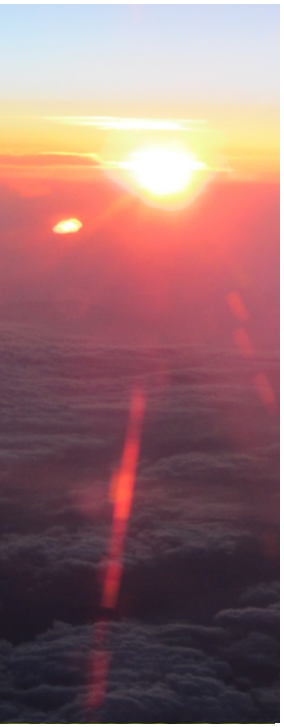
- Lower cost of energy
- Lower grid fees
- Additional income from „selling flexibility"
- Functionality can be implemented „for free" by suppliers
- Investors in flexibility (storage, algorithms) can expect attractive business cases
- Key partners add features attractive for customers (and grid)

Integrated view of RE, Storage, Smart Grid

The time to act is now

- A substantial market with a „triple win" for suppliers, operators and customers
- „Easy" Smart Grid synchronizes interaction of all players involved
- Collaborative concept implementation will benefit market development of intelligent mini grids- possily with spinoff into „traditional" grids
- Saved cost enables a sound business model and profit opportunities – with substantial reduction of GHG emissions on top

- Your inputs and contributions are most welcome



Thank you for your interest!

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This slides have been adapted to a new corporate design.