Energy Storage
Global Conference
Explaining I Exchanging I Enabling
Paris | 19th to 21st November 2014




Energy storage: Market Analysis and Hurdles from the Client Point of View

Dr. K. Peter Röttgen
E.ON Innovation Center Energy Storage

Flexibility from …

Generation

Wind/Solar-to-Power

Gas-to-Power/Heat

Coal-to-Power/Heat

Grids

Power

Gas

Heat

Storage

Power-to-Power

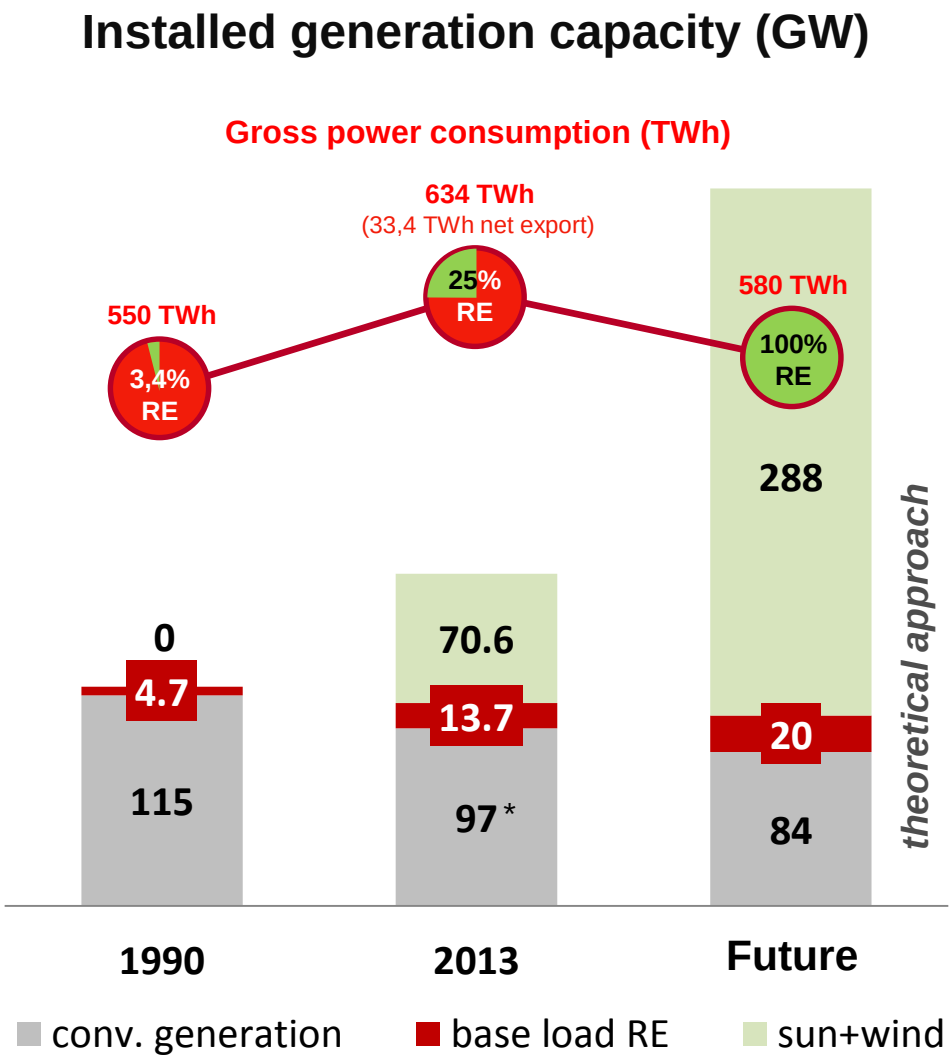
Power-to-Gas

Power-to-Heat

Consumption

Demand / decentralized generation
Residential | Mobility | SME | Industry

Example: Germany



*) data 2012

- **Wind and solar generation quadruples installed capacity**
- **1% curtailment requires additional 3 - 4 GW RE**

Source: BMWi, Arbeitsgruppe Erneuerbare Energien-Statistik

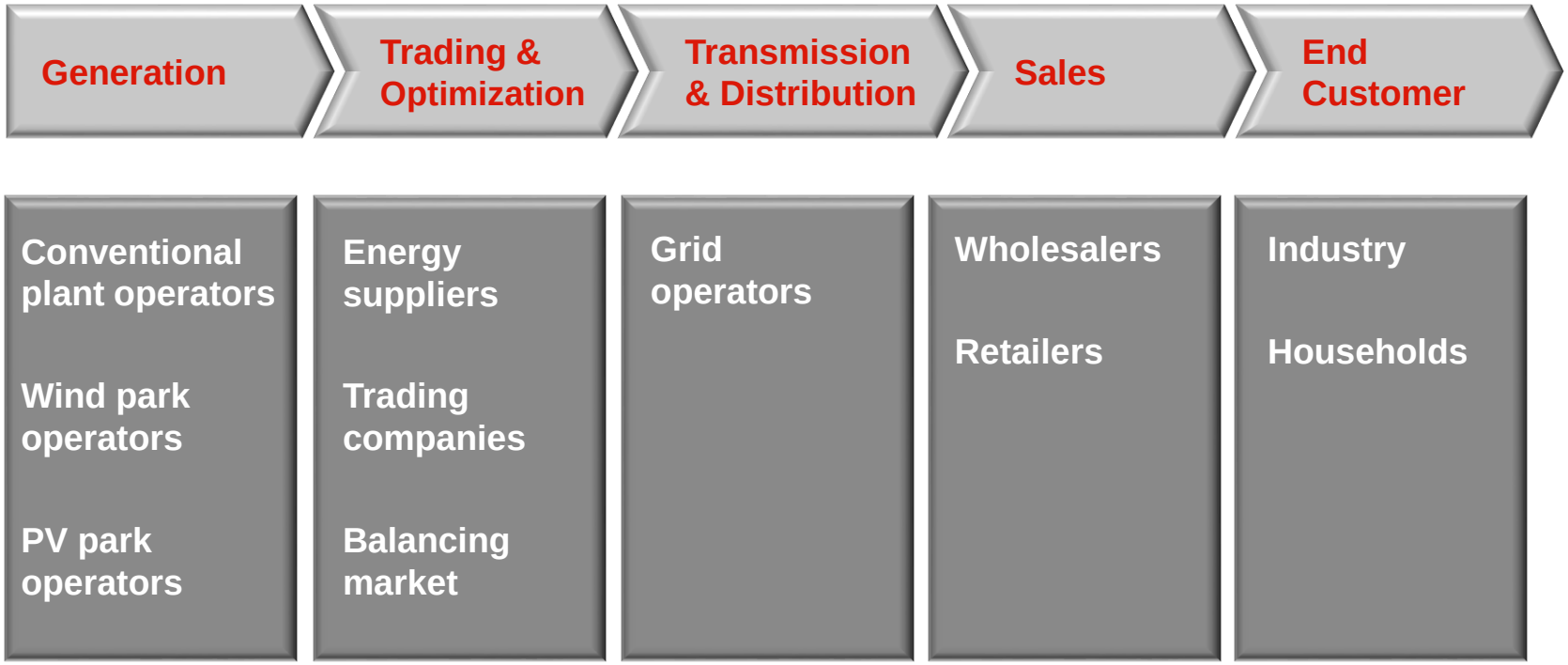
Assumptions scenario future:

- Power consumption is stagnant and corresponds the RE generated.
- **Full load hours of wind + sun = 1,600 h**
- Base load RE have a limited potential.

RE: Renewable Energy

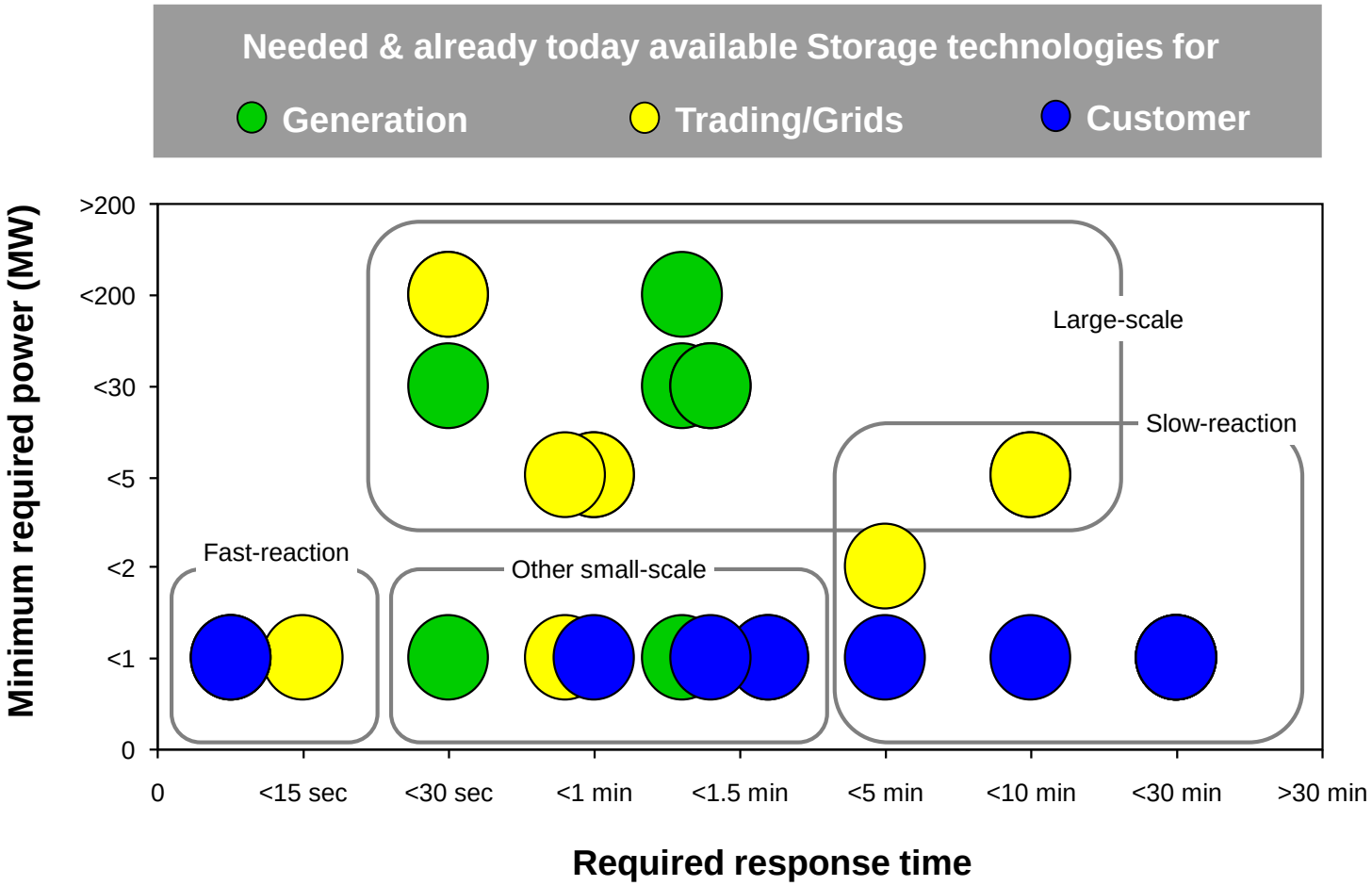
Energy storage render various services

Applications



Moreover important fields of application in mobility, chemical industry, steel, etc.

Flexibility demand needs different storage technologies



Energy storage technologies

Proven Technology - Potential for improvement - New Technology

Power-to-Power

Pumped Storage

Battery

(A) CAES

Fly Wheel

Capacitor

Power-to-Gas

Power-to-Gas

Gas storage

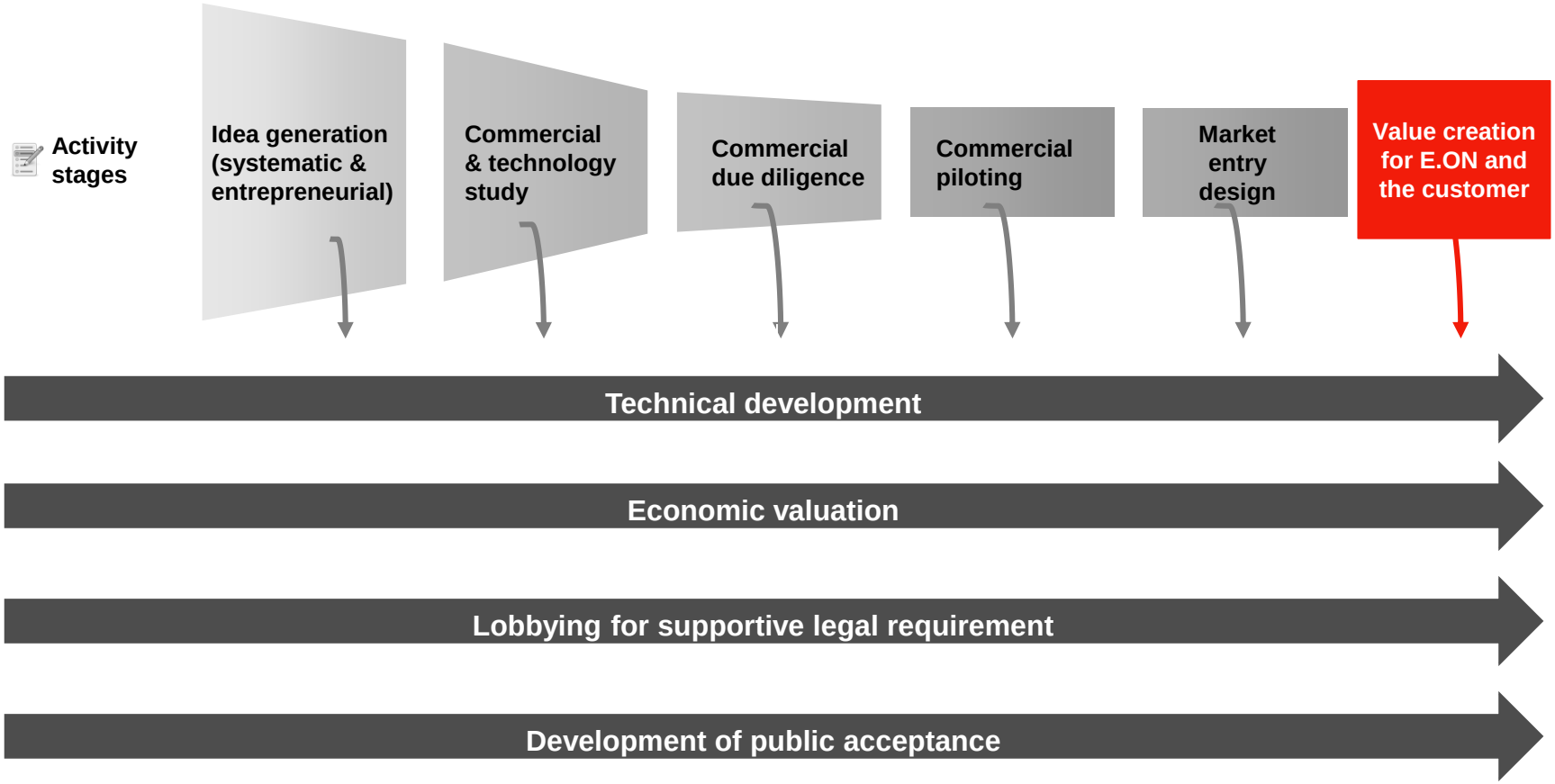
Power-to-Heat

Heat storage

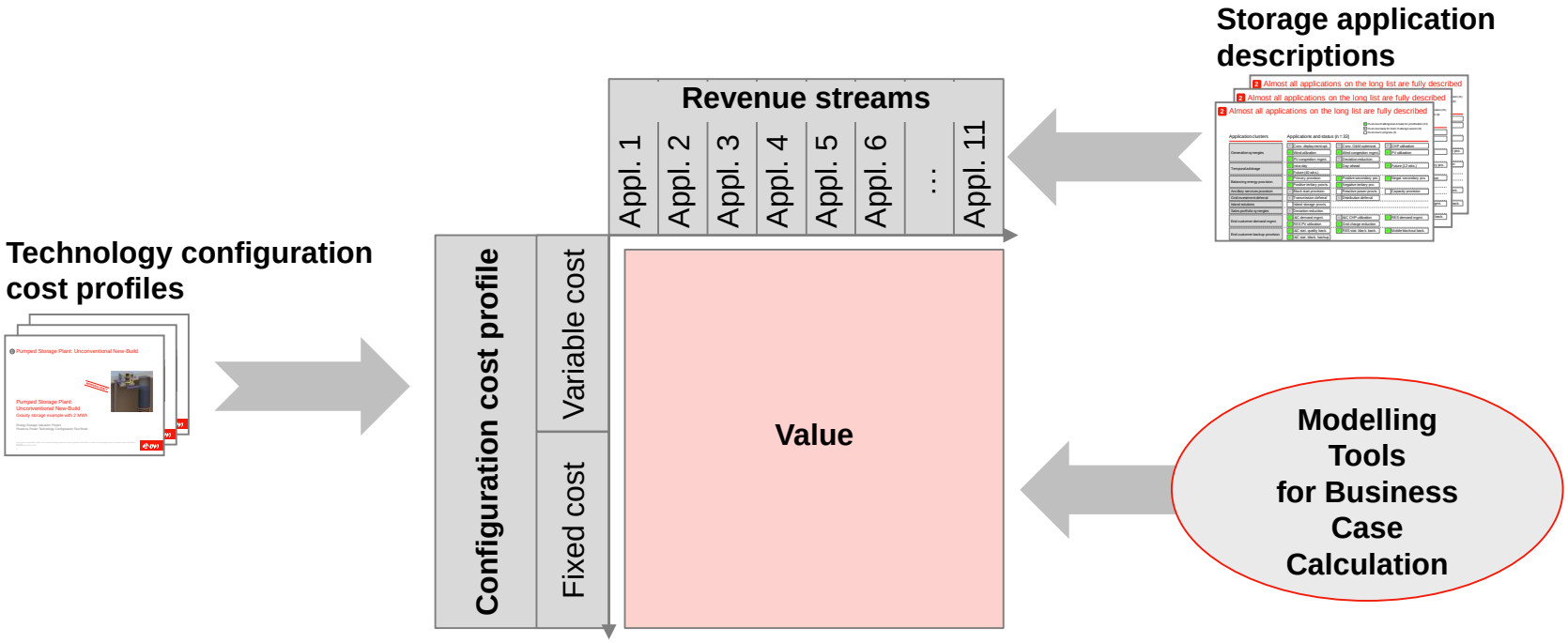
Power-to-Heat

E.ON Energy storage development methodology

From Idea to Business



Technical and commercial studies



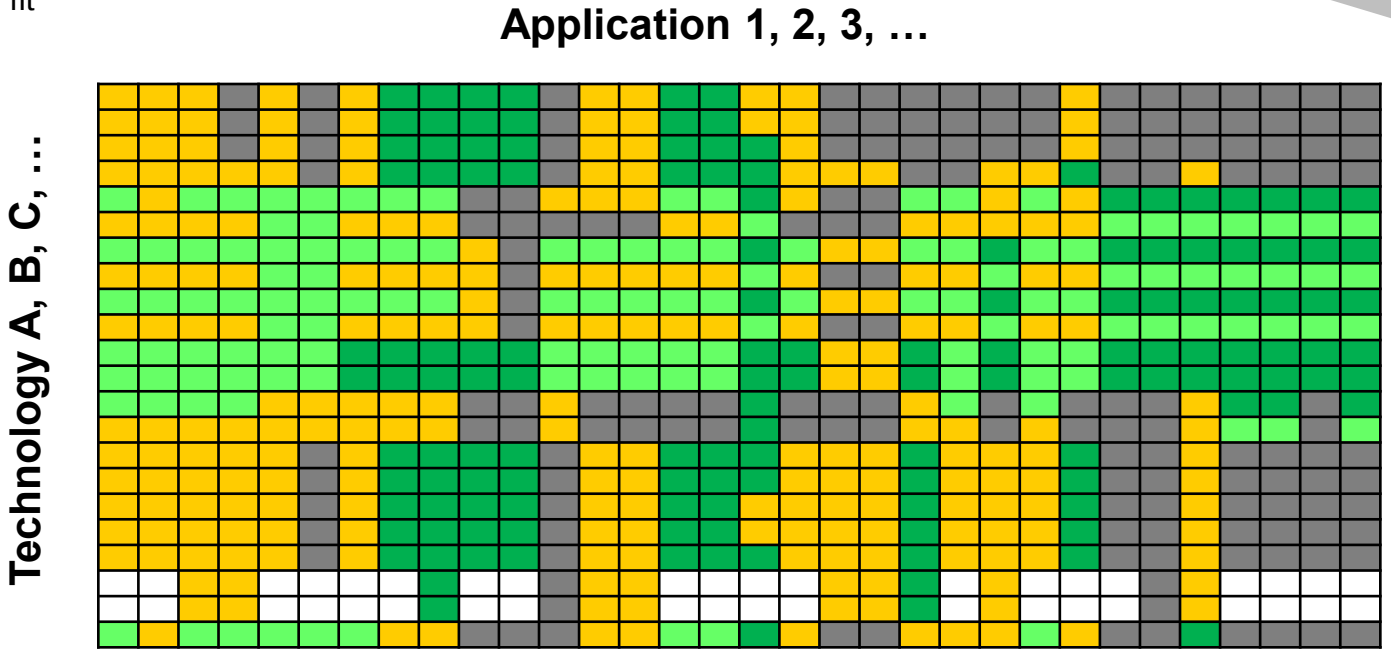
Revenue streams for storage assets come from various applications while costs are defined by the technology

Technology configurations

Application matching

- Good fit
- Good fit when scaled
- Some fit when either adjusting KPIs or requirements or scaling extensively
- Poor fit

illustrative



E.ON Pilot projects in a distributed energy system

in operation

SmartRegion Pellworm

- 200 kW / 1600 kWh **Redox-flow und** 560 kW / 560 kWh **Lithium-Ionen Battery**
- Smart grid

in operation

WindGas Falkenhagen

- 2 MW_{el} / 360 m^3/h H_2 **Alkali-Elektrolysis**
- H_2-Injection in Gas transportation pipeline

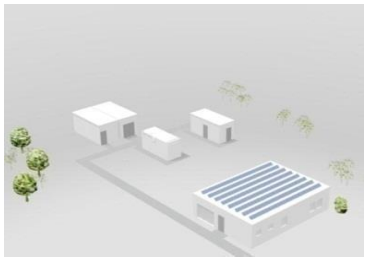
under construction

M5BAT Aachen

- 5 MW_{el} / 4 MWh **Blei, Lithium-Ionen, Hochtemperatur Batterie (Na-Ni-Cl)**
- Integration & test in real trading

under construction

WindGas Hamburg



- 1 MW_{el} / 265 m^3/h H_2 **PEM-electrolysis**
- H_2-Injection in Gas distribution pipeline

And Power-to-Heat pilots in preparation …

Example: Power to Gas pilot "WindGas Falkenhagen"

Important european discussion: All use cases of **Green Hydrogen** should be accepted as **Advanced Biofuels** in the mobility sector (FQD, RED)!

Example: Project "SmartRegion Pellworm"

Proposal for the legal requirement

- **Storages represent a fourth element in the energy system**
  = they are neither generation, nor network, nor consumers.

- **The regulatory framework for storages should be technology open**
  = Power-to-Power, Power-to-Gas, Power-to-Heat
  = part of the competitive market

- **Storages should be relieved from grid tariffs, charges and/or taxes**
  = no burdens for innovation prior economic efficiency

- **Direct marketing of renewables**
  = customer interest

- **Energy storage definition needed**
  = basis for legal implementation

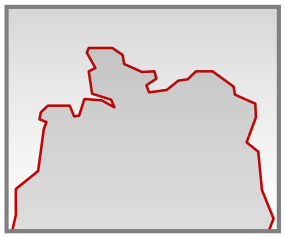
- **European market design**
  = would build the storage market
  = european support in single approaches is essential

Summary

For integration of a steadily increasing share of renewable energy, grid extension and demand side management and flexible generation and storage are needed.

Different storage technologies render different services. Energy storage technologies can couple the power, heat and gas market.

Storage solutions are required for the integration of renewable energy, but will only come if a regulatory level playing field with other flexibility options is developed.



Energy storage demonstrations show that a good basis for public acceptance is given.

Energy Storage
Global Conference
Explaining I Exchanging I Enabling
Paris | 19th to 21st November 2014




Energy storage: Market Analysis and Hurdles from the Client Point of View

Dr. K. Peter Röttgen
E.ON Innovation Center Energy Storage