



Energy storage innovation 储能技术创新

Technology & Innovation, EGS

技术与创新，EGS

Essen, 26.11.2015

艾森，2015年11月26日

e-on

Flexibility from 灵活应对 ...

Generation 发电

Grids 电网

Storage 储存



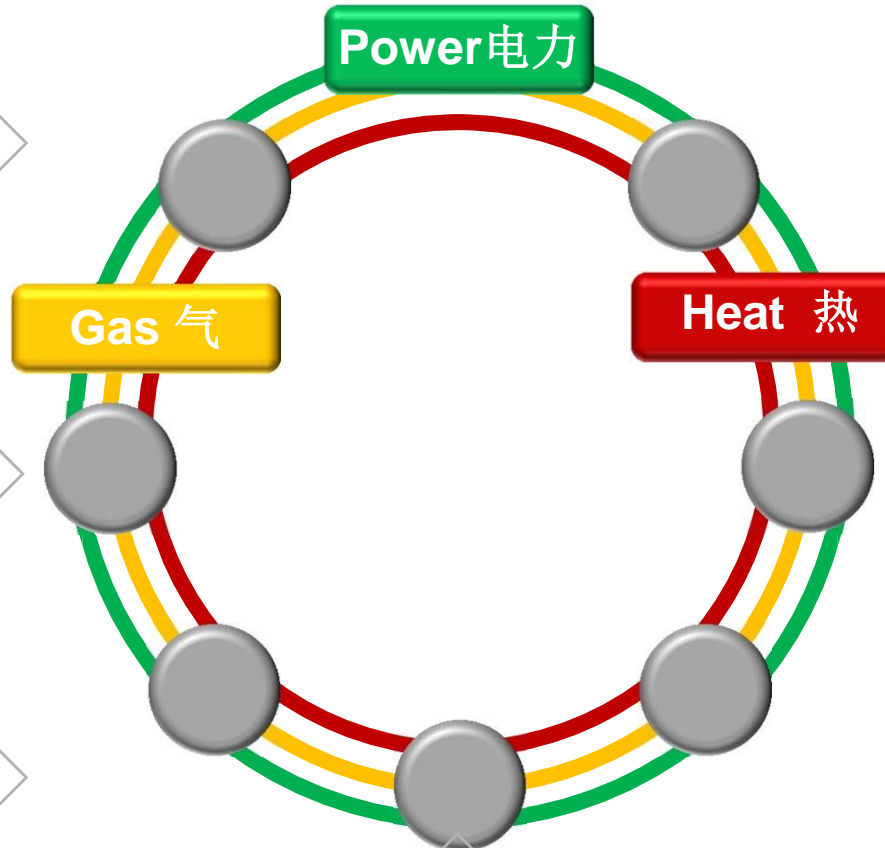
Wind/Solar-to-Power
风/太阳能-电



Gas-to-Power/Heat
气-电/热



Coal-to-Power/Heat
煤-电/热



Power-to-Power
电-电



Power-to-Gas
电-气



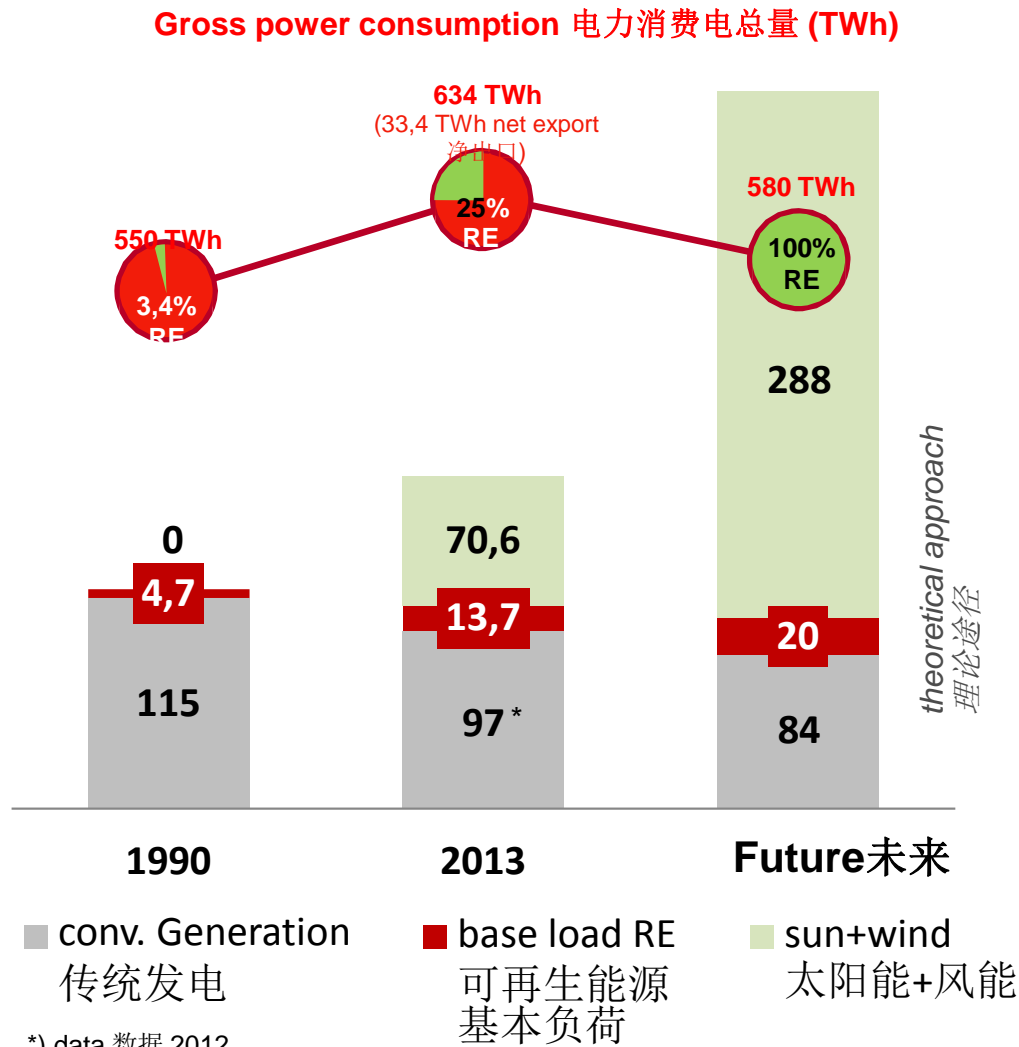
Power-to-Heat
电-热

Demand / decentralized generation
需求/分散式发电
Residential | Mobility | SME | Industry
住宅 | 交通 | 中小企业 | 工业



Development of the generation in Germany to 400 GW 德国发电量至400 GW发展情况

Installed generation capacity 装机发电量 (GW)



- **Wind and solar generation quadruples installed capacity**
风能和太阳能发电将装机容量提高至原有水平的四倍
- **1% curtailment requires additional 3 - 4 GW RE**
1%的缩减需要3-4 GW的额外可再生能源

Source: BMWi, Arbeitsgruppe Erneuerbare Energien-Statistik
资料来源: BMWi, 可再生能源工作组-统计数据

Assumptions scenario future :未来情境假设:

- Power consumption is stagnant and corresponds the RE generated.
电力消费停滞, 与可再生能源产量对应。
- **Full load hours of wind + sun = 1,600 h**
风能+太阳能全负荷小时数=1,600h
- Base load RE have a limited potential.
可再生能源基本负荷潜力有限。

RE: Renewable Energy 可再生能源



Energy storage technologies 储能技术

Proven Technology - Potential for improvement - New Technology
成熟技术 - 提升潜力 - 新技术

Power-to-Power
电-电

Pumped Storage
抽水储能



Battery
电池



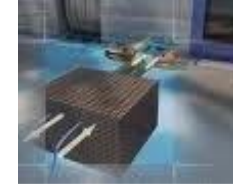
(A) CAES
压缩空气储能



Fly Wheel
飞轮



Capacitor
电容器

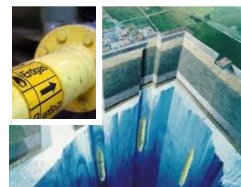


Power-to-Gas
电-气

Power-to-Gas
电-气



Gas storage
储气



Power-to-Heat
电-热

Heat storage
蓄热



Power-to-Heat
电-热



There is much more than "storage"! 不仅仅是“储能”！



**Power
to Power**
电-电

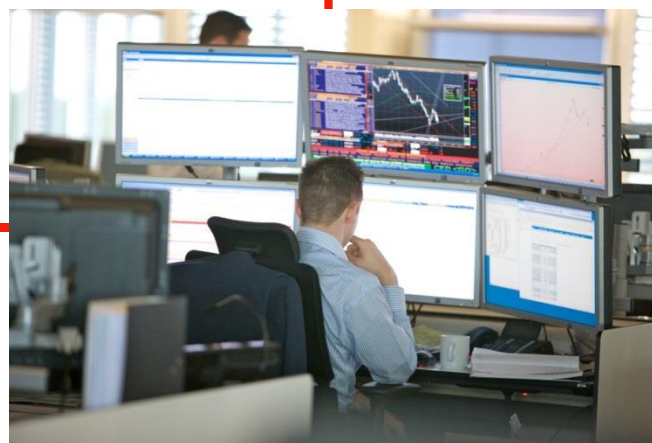


**Power
to Fuels**
电-燃料



**Power to
Chemistry**
电-化工

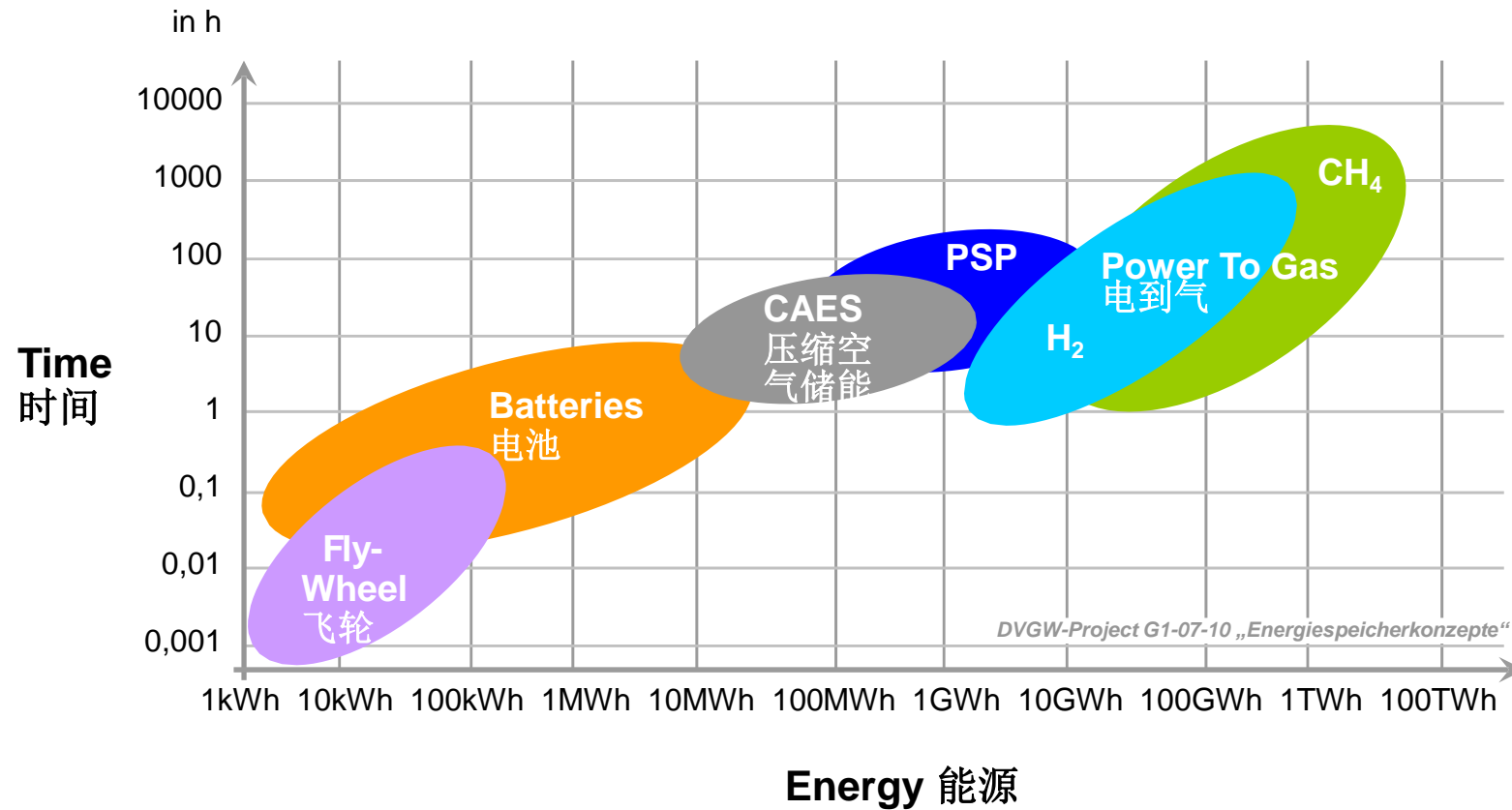
**Existing
portfolio!**
现有组合！



**Dispatching, trading and
portfolio optimization**
调度、交易、组合优化

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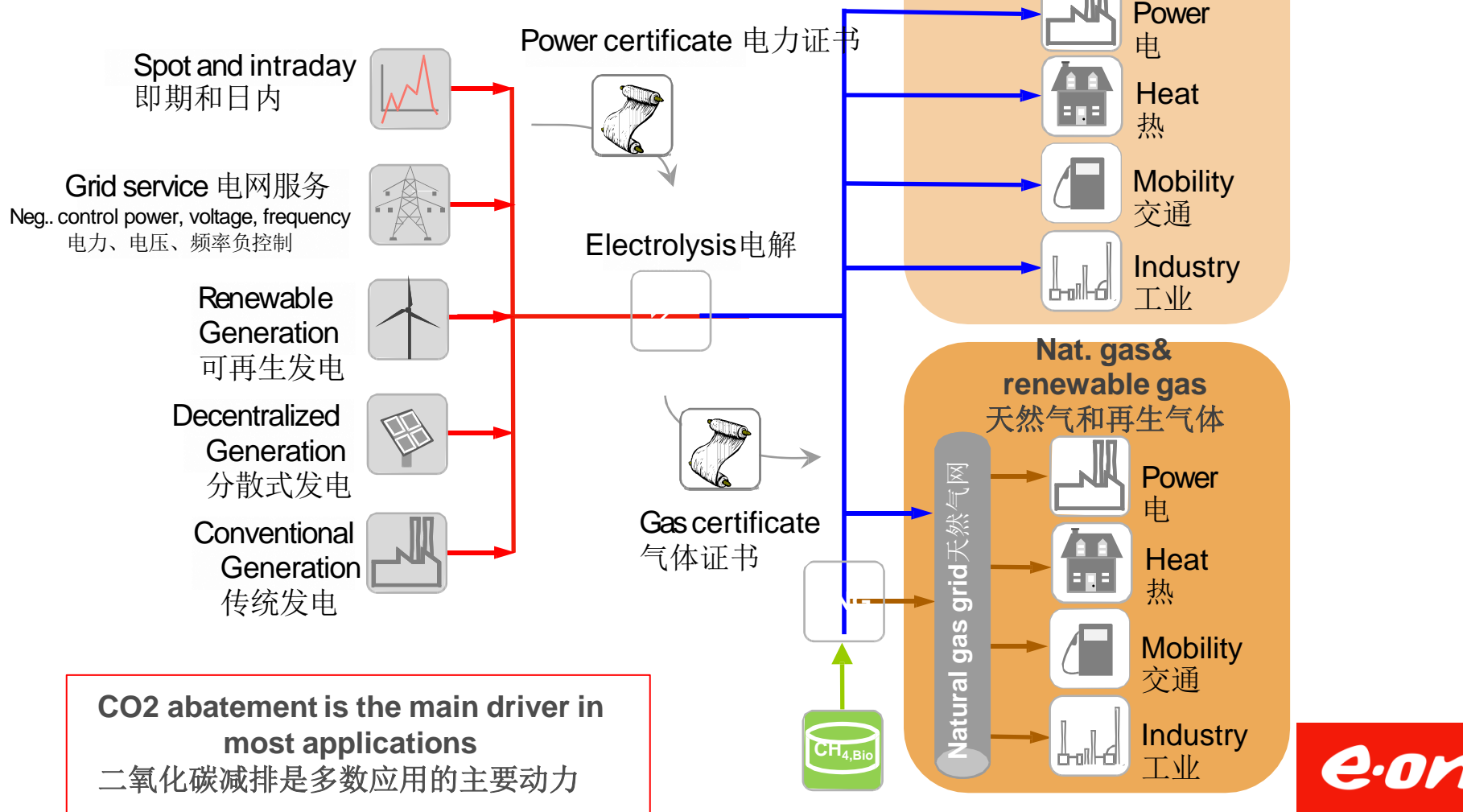
Different capabilities & applications 不同产能与应用



Energy pathways for Power to Gas 从电到气的能源路径

Destination market 目的地市场

Source markets for energy 能源来源地市场



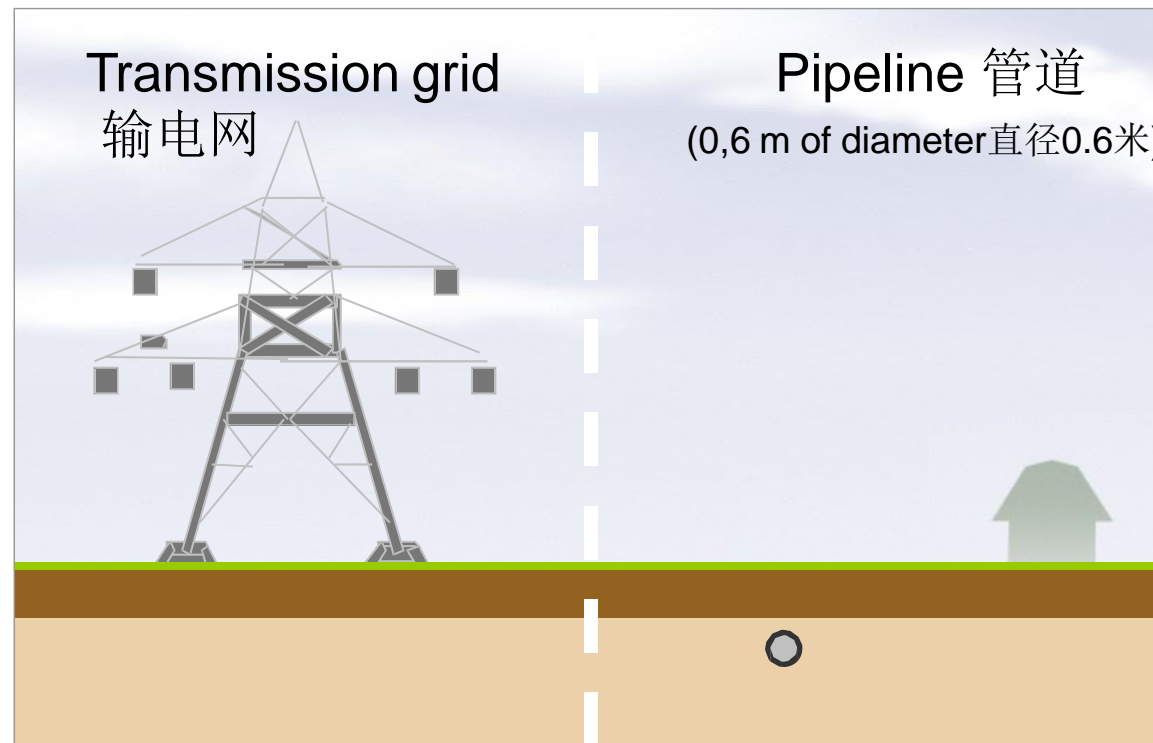
Comparing the energy content 能量含量比较



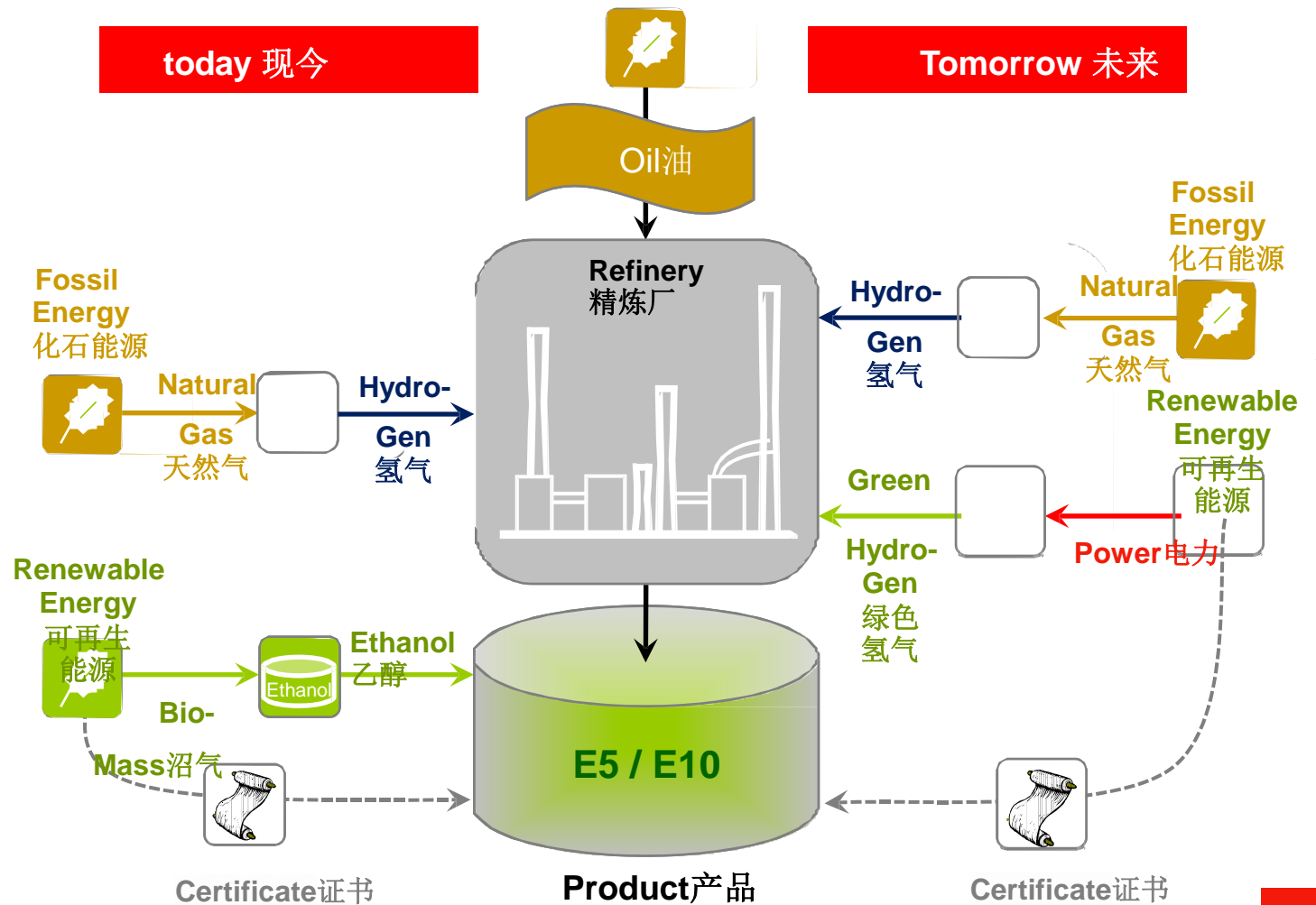
Comparison of 1 GW (1000 MW) transport capacity 1 GW (1000 MW) 输电能力比较

corresponding to the power of an large scale power plant or
peak power of 200 wind turbine

相较于大型发电厂或峰值功率为200的风力涡轮机



Example: Power to gas for refineries 例子：精炼厂从电到气



Storage effect = Integration of Renewables
储存效应=可再生能源融合

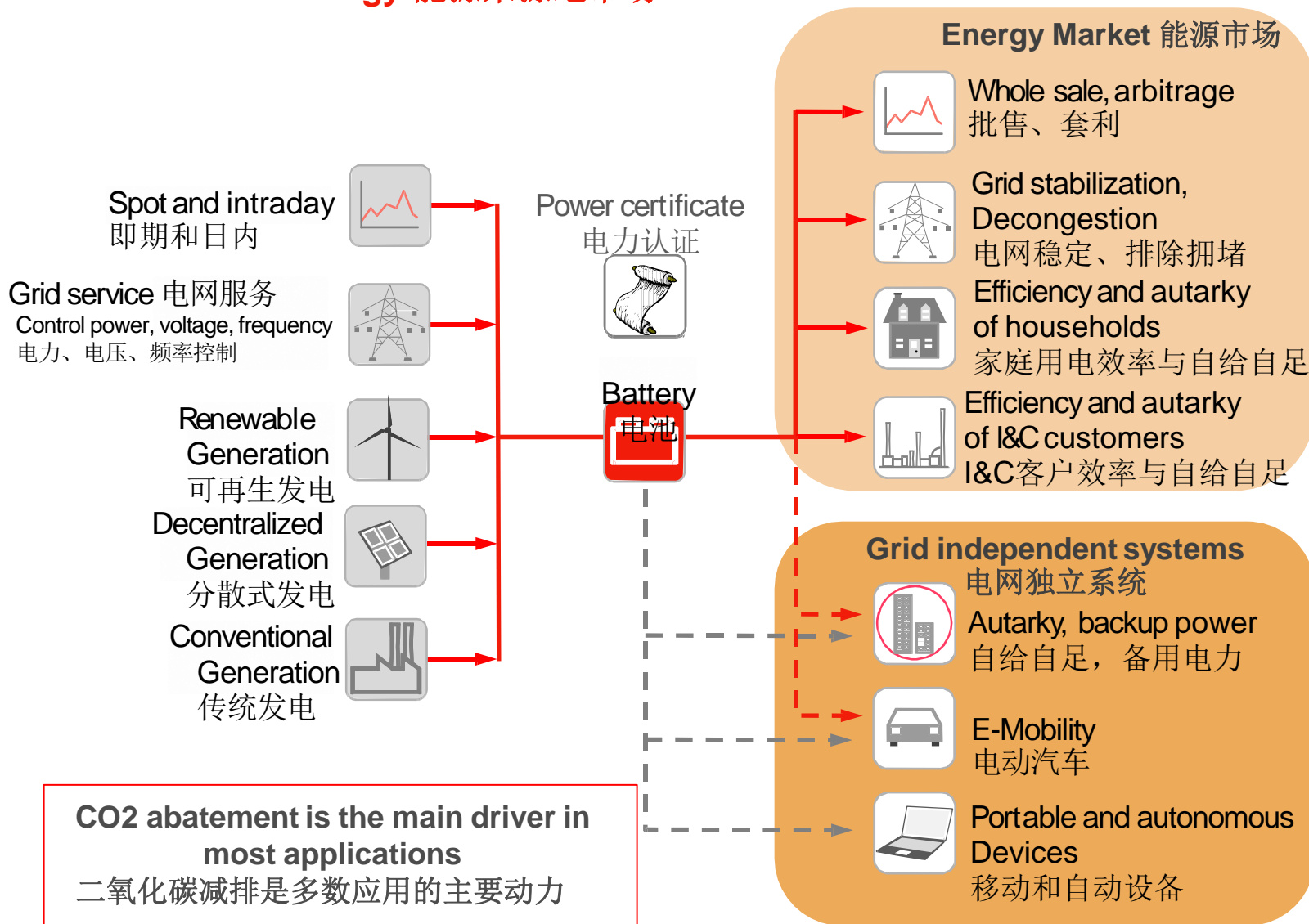
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Energy pathways of Power to Power (battery storage)

从电到电的能源路径（电池储存）

Source markets for energy 能源来源地市场

Destination markets 目的地市场



Pilot assets 示范资产

SmartRegion Pellworm 佩尔沃姆SmartRegion



in operation
运营中

- 200 kW / 1600 kWh
Redox flow Battery
氧化还原液流电池
- 560 kW / 560 kWh
Lithium Ion Battery
锂离子电池
- Smart Grid 智能电网

WindGas Falkenhagen 法肯哈根WindGas



in operation
运营中

- 2 MW_{el} | 360 m³/h H₂
Alkali-Elektrolyse
碱电解
- H₂ injection into the gas grid
H₂注入供气网

M5BAT Aachen 亚琛M5BAT



under construction
建设中

- 5 MW_{el} / 4 MWh
Led acid and different lithium ion batteries
铅酸和不同锂离子电池
- Integration & tests
real time trading
整合和测试实时交易

WindGas Hamburg 汉堡WindGas



in operation 15.10.
运营中10.15

- 1 MW_{el} | 265 m³/h H₂
PEM-Elektrolyse
PEM电解
- H₂ injection into the gas grid
H₂注入供气网

Summary 总结



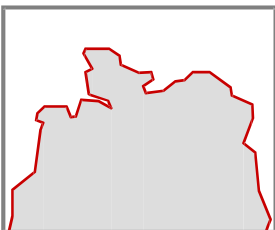
For integration of a steadily increasing share of renewable energy, grid extension and demand side management and flexible generation and storage are needed. 可再生能源比重稳定上升，其整合需要实行电网扩张和需求侧管理以及灵活发电和储存。



Different storage technologies render different services. Energy storage technologies can couple the power, heat and gas market. 不同的储能技术提供不同服务。储能技术可将电热气市场连接起来。



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. 可再生能源整合需要储能解决方案，但只有提供其他灵活选择的公平竞争环境形成后才会实现。



Energy storage demonstrations show that a good basis for public acceptance is given. 能源储存示范项目显示公众接受已具备良好基础。



Innovation Energy Storage 储能技术创新

E.ON Innovation Center Energy Storage

能源储备创新中心

