Elsa

ENERGY LOCAL STORAGE ADVANCED SYSTEM

Focus Group: Economy

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Economic aspects: business models and impacts

- Assessing existing AND future energy system
  - need for storage
  - possible applications
  - framework and influencing factors

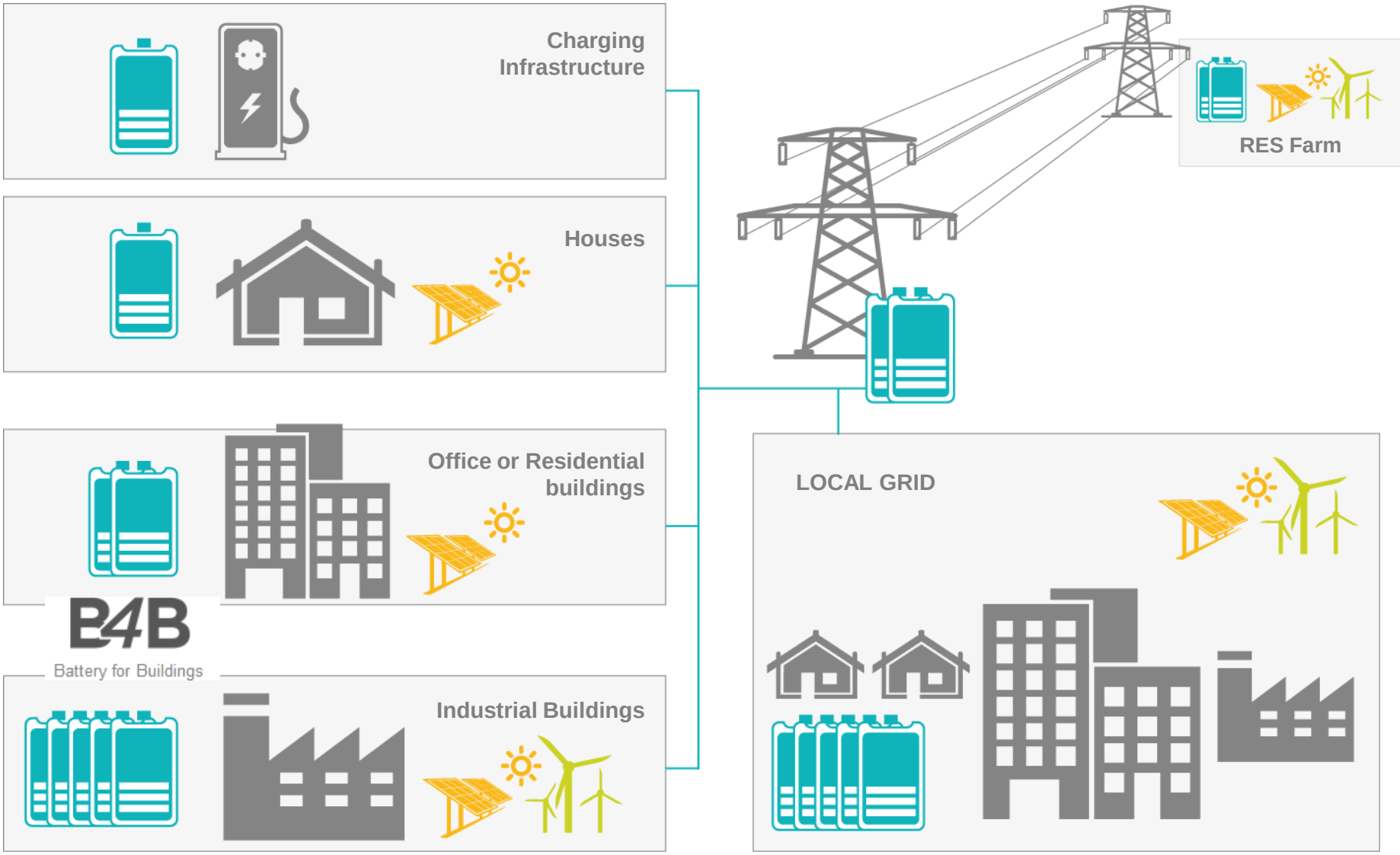
- Business models for storage owners/service providers and power operators
  - actual requirements
  - service descriptions
  - market volumes

ELSA Innovation Roadmap

- **Stage 1: BAU (Business-As-Usual):**
  - Boundary conditions: limited scale of second life batteries available

- **Stage 2: Contribute to redesign of market and regulatory mechanisms: local balancing market to provide system services to DSO**

Candidate Stakeholders for Using ELSA Systems

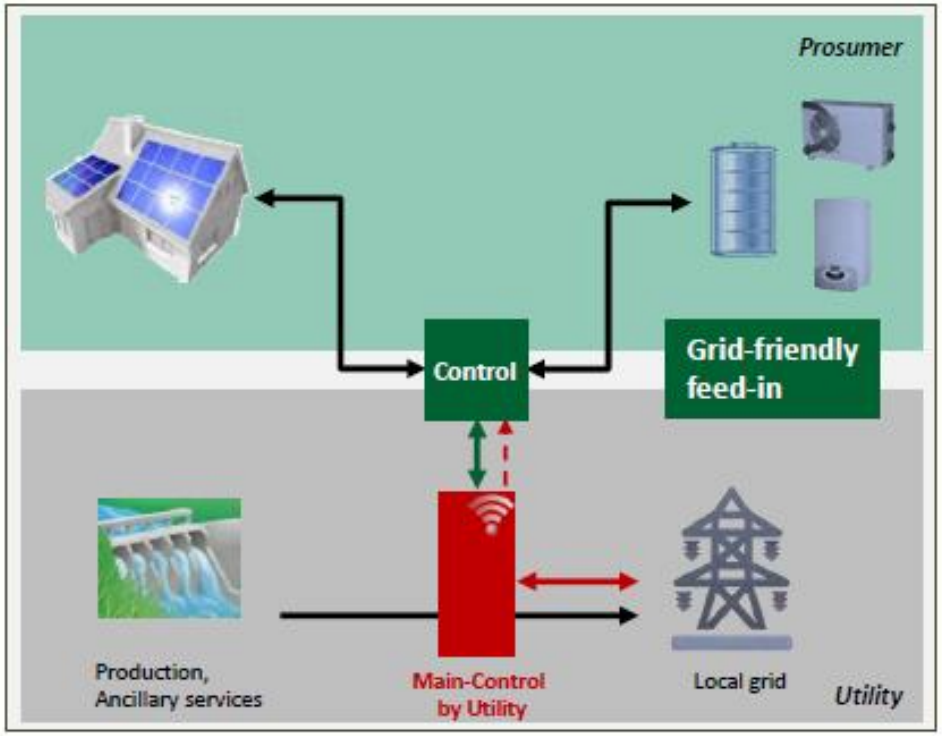


Enabler for novel storage grid-scale services

Integration of grid independent prosumers with decentralised storage in the energy management value chain

Prosumer:
Maximising own production incl. storage under the premise of grid stability

EVU:
Grid stability
Security of supply



Towards cooperative & cross-sector business models

- Cooperative business models where **non-grid stakeholders** are willing to trade off their **own societal or business objectives** against system-level objectives, such as greener energy systems

- Cooperative business models for **decentralized energy storage** may leverage **hybridization** and **merging** of formerly disjoint energy supply and mobility value chains with EVs increased penetration

Barriers for viable business models

- **High up front costs for storage versus multiple volatile revenue streams**
- Stand alone storage business will face higher costs and lower ability to capture value than incumbents (generators, network companies and customers)
- **Appropriate market design and regulation** will determine the ability to monetise storage services
- Granularity of bids too large, preventing a large number of storage resources to participate in flexibility markets

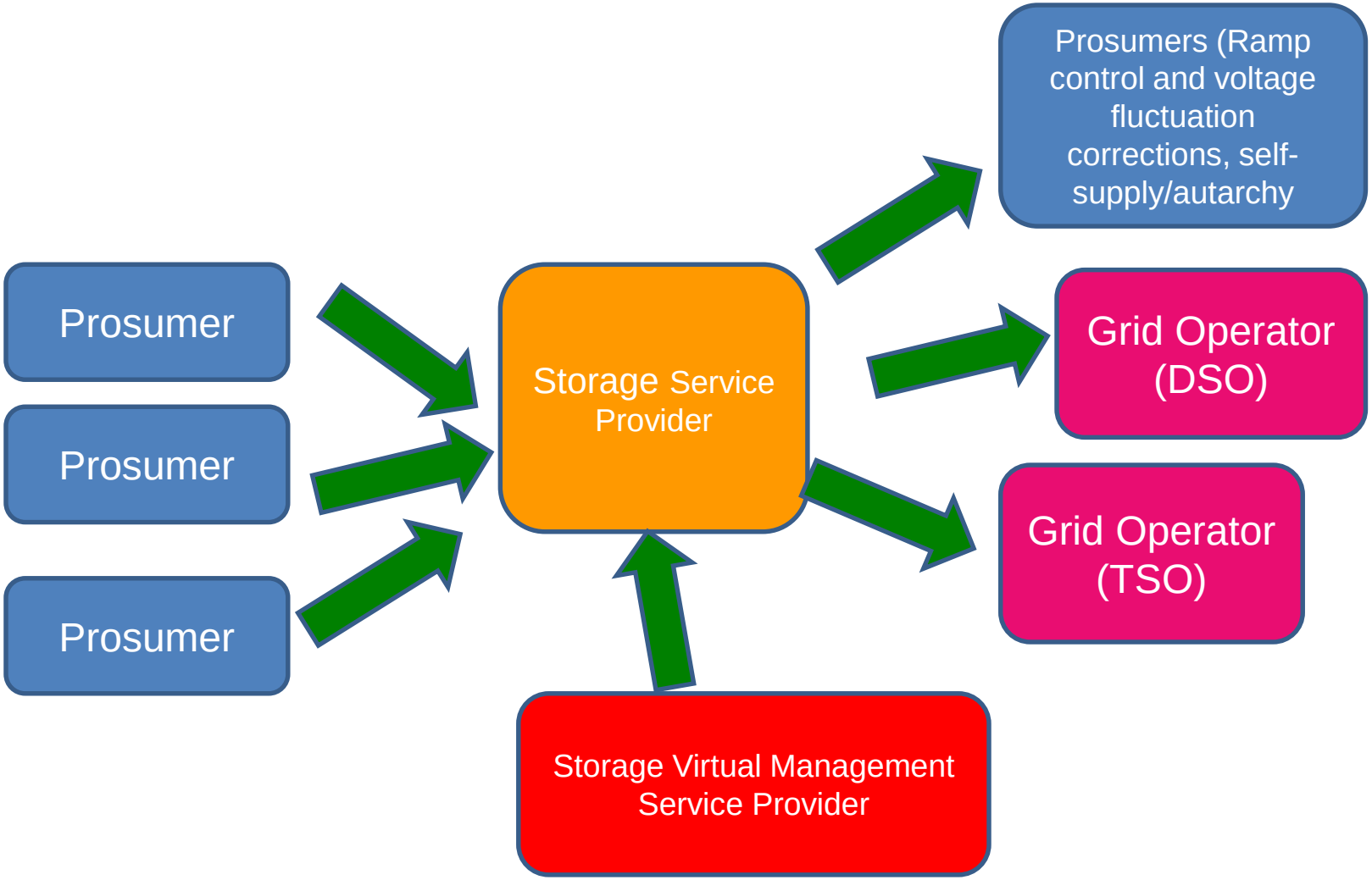
Market and regulatory issues

- Historically, the **system operator has directly procured** response and reserve capacity from existing generators as by products, rather than used organised markets that would allow storage to compete
- **Storage products** need to be defined in order to allow them to be monetised. In general, small facilities are often excluded from directly trading in electricity markets.
- **Multiple regulatory barriers need to be overcome**
  - **Definition of storage** – is it generation or retail or something else?
  - **Regulated incumbent network companies** may be able to include storage in their asset, reducing the scope for non-regulated storage.
  - •Unbundling rules may mean that if network companies own storage they cannot dispatch it and must work through a third party

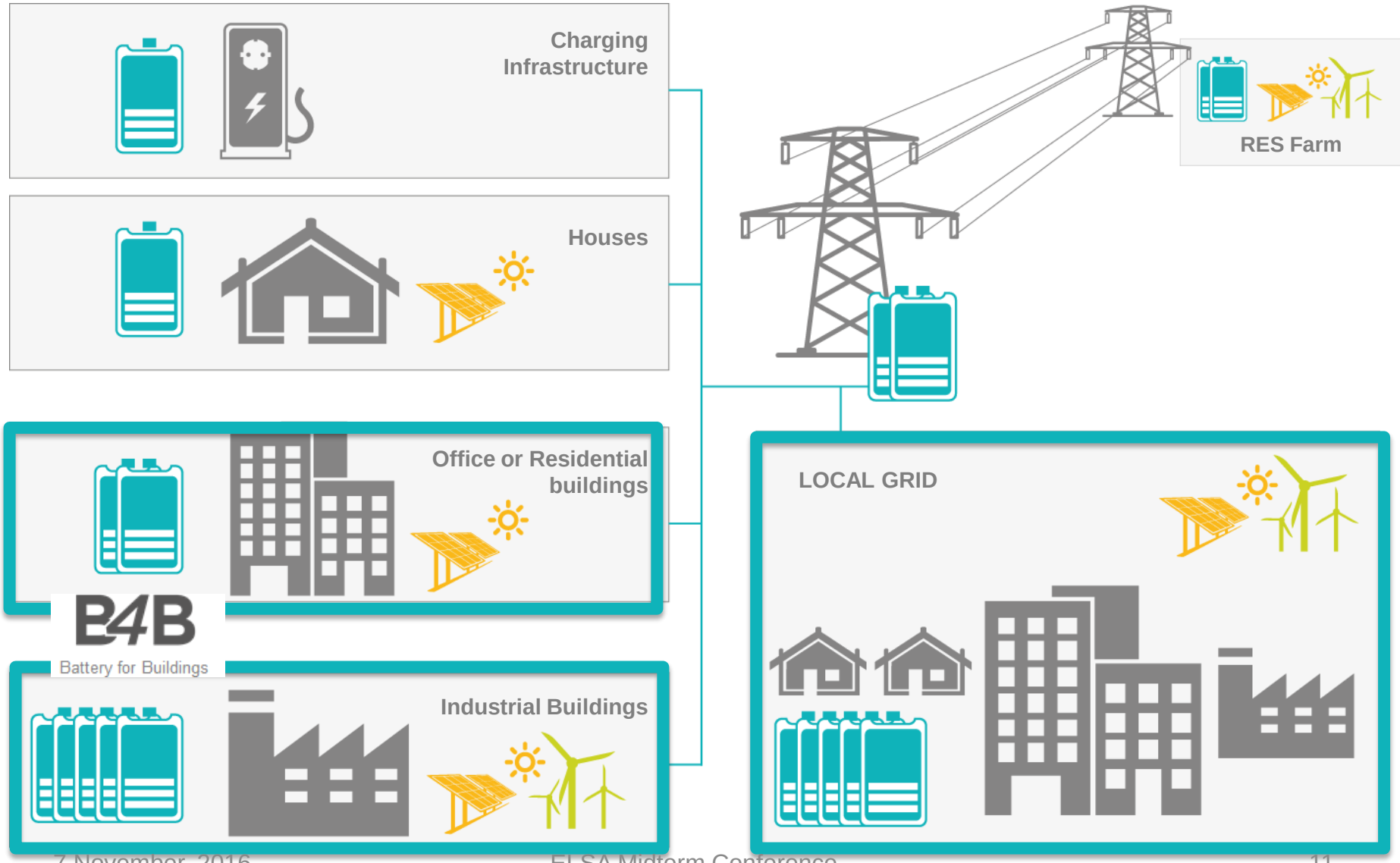
ELSA Business model & value proposition

- "**Storage as a Service**" business model and "servitization" service delivery model, which shifts costs from CAPEX towards OPEX
- Redesign of market mechanisms, value chain and business models towards "storage servitization", through the introduction of a new stakeholder, the **"Energy Storage Service Provider"**
- **Multi-functional storage business model**, in which some of the services will be combined either horizontally way (same storage service mix at any time) or vertically (storage service mix changing in different time intervals)

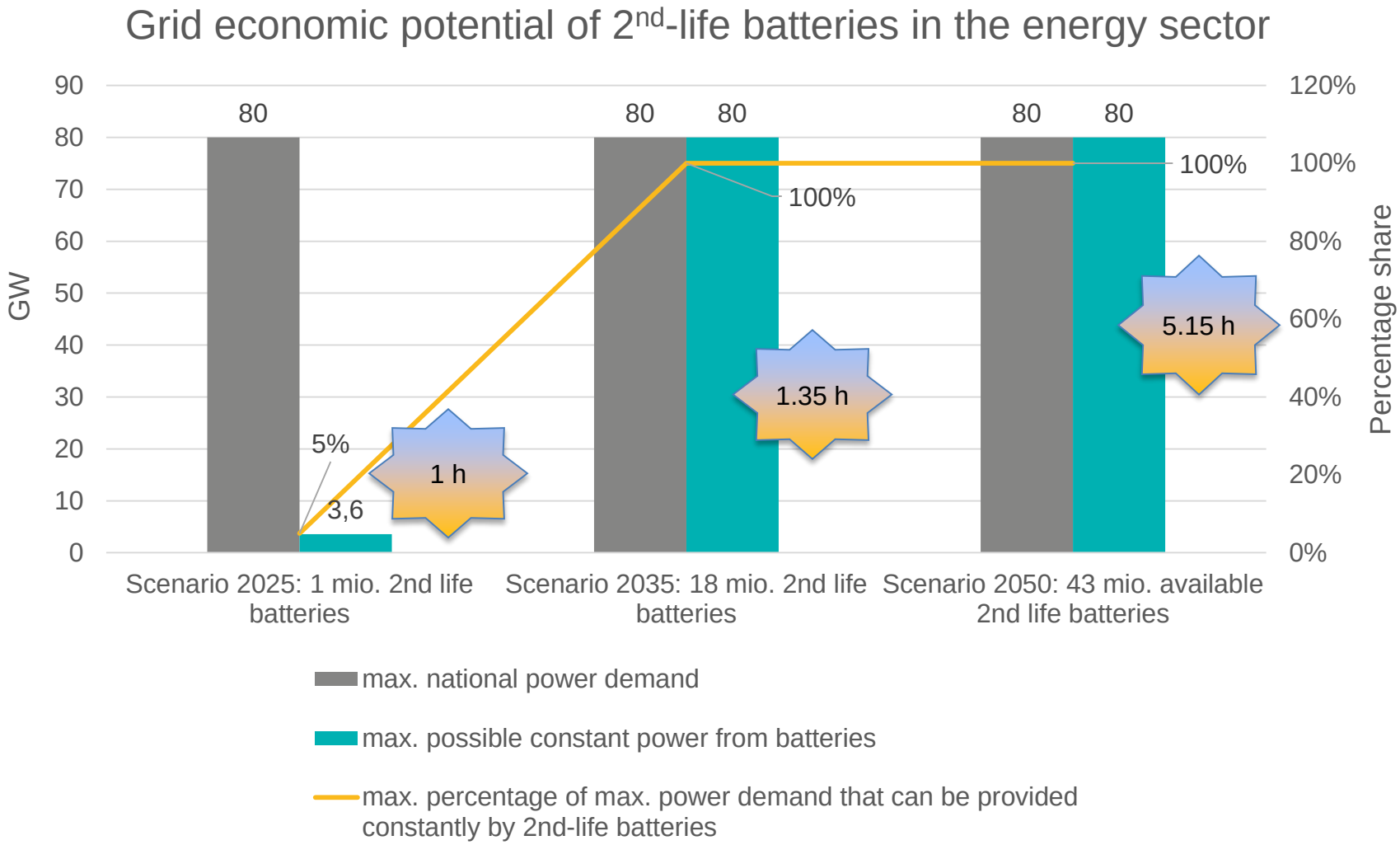
ELSA Novel Value Chain



ELSA target sectors



Assessing the overall potential: EVs and energy transition in Germany



Conclusions

Scenario 2025

- Theoretically, 300,000 2nd-life batteries can provide most of the operating reserve (primary, secondary, minute reserve) actually needed.

Scenario 2035

- 9 million 2nd-life batteries can guarantee about 100% of the max. national power demand for 1.35 hours constantly.

Scenario 2050

- 43 million 2nd-life batteries can cover 100% of the max. national power demand for 5.15 hours constantly.
- 2nd-life batteries from fully electrified national vehicle fleet can match short-term storage need (at least up to one hour) for 100% PV-wind supplied economy (extreme case of highest flexibility need).

Use cases: We need to Stack Services

Services for Building & District

+

Services for The Grid

Decreasing costs and increasing self-consumption

Optimizing local grid operation

Maintaining stability of electricity system

Immediate applications

1. PV with batteries for self-supply in single family homes
2. PV with batteries for self-supply in large buildings
3. Provision of primary operating reserve
4. A combination of the above (self-supply+grid services)

1. PV with batteries for self-supply in private homes

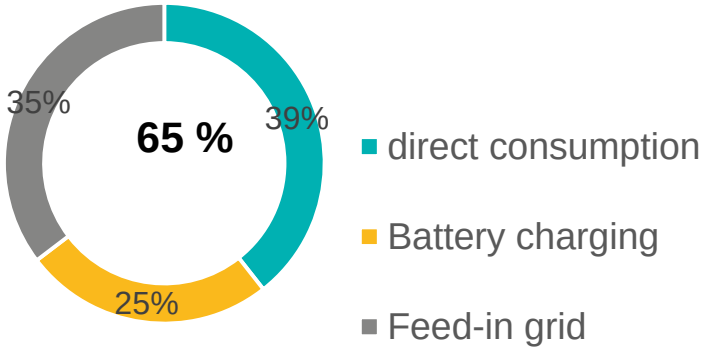
Require 6.6 kWh battery on the average
→ requires dismantling of car batteries
→ no market for 2nd life batteries

See e.g.: Fischhaber, Sebastian, et al. 2016, Ancillary Research of German Electromobility Programme

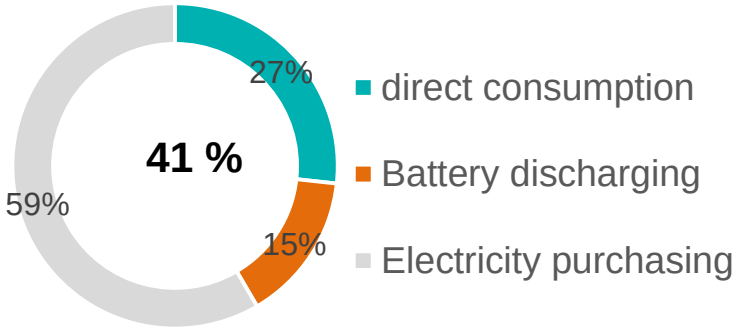
2. PV-storage for 10 families residential building (DE)

Annual electricity consumption:	45,000 kWh
Photovoltaic system:	30 kWp
Storage capacity:	24 kWh
Costs for PV-storage system:	800 €/kWh
Costs for PV-system:	1,700 €/kWp

Quote of self-consumption



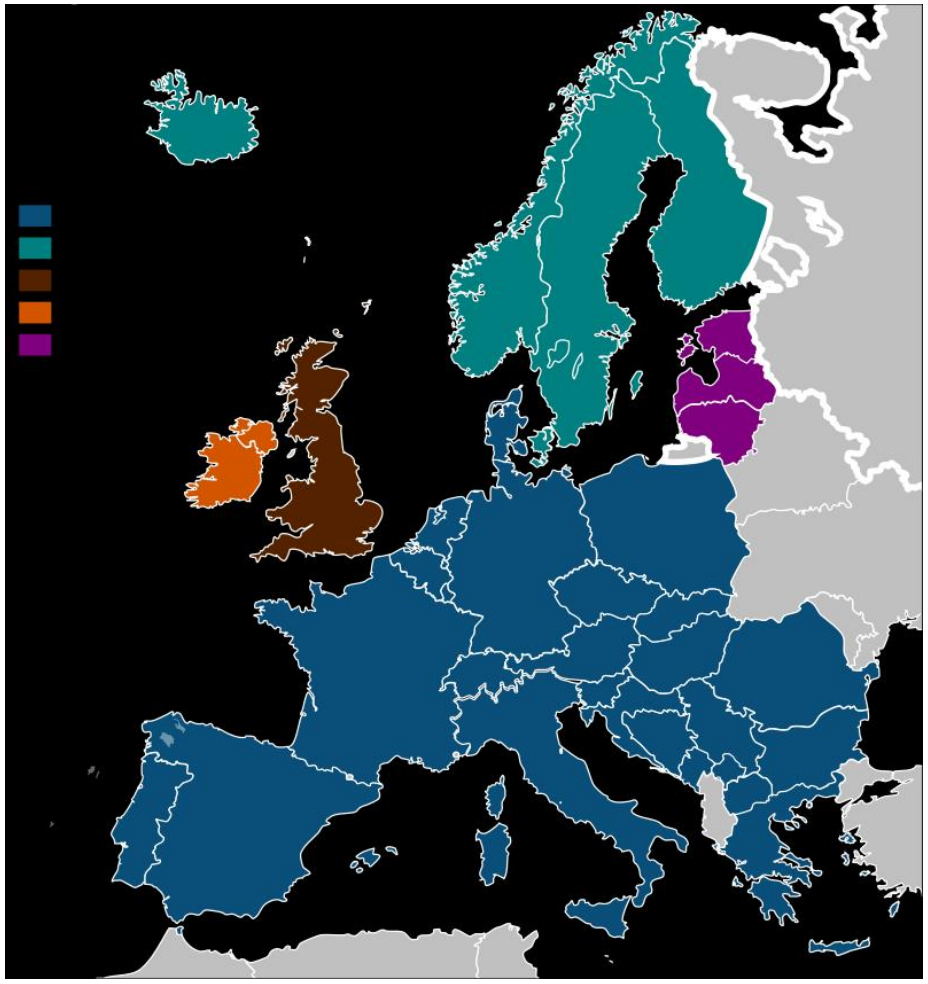
Quote of autarky



Calculation over 10 years

Investment:	-70,200 €
Electricity from grid:	-79,650 €
Electricity self supply:	+55,350 €
National subsidies:	+60,000 €
EEG-apportionment:	+16,964 €
Revenue after 10 years:	-12,314 €

3. Primary operation reserve provision



- About 20 MW primary reserve power (PR) are activated per mHz deviation from 50 Hz in the UCTE grid network (countries coloured in blue) by TSO
- PR is activated when deviation exceeds 10 mHz
- Needs to be available fully after 30 sec
- If necessary, PR needs to last normally up to 5 min before secondary reserve takes over, up to 15 min if necessary
- **± 3,000 MW primary reserve have to be kept available in the UCTE grid**
- Mainly provided by central power plants which need to keep 2% of their nominal power available for PR

Wikipedia: **ElectricityUCTE.svg**

https://de.wikipedia.org/wiki/Regelleistung_(Stromnetz)

Conclusion

- 250,000 ELSA 2nd life batteries are sufficient to provide the entire primary operation reserve presently hold available in the UCTE grid network
- This number of batteries can serve up to primary reserve requests with the same direction (positive or negative) in succession for the maximum duration of 15 min before re-establishing the optimum readiness-SOC of 50 %

Providers of primary reserve from batteries

- STEAG: 6 lithium battery projects for primary reserve with about 15 MWh / MW each, e.g. with 2nd life batteries from Daimler
- Sonnen GmbH:
  primary reserve to be provided from 2,000 small PV battery systems installed in single family houses in Germany;
  first battery systems contribute already to primary reserve in Switzerland

  http://www.pv-magazine.de/nachrichten/details/beitrag/sonnen-bietet-flatrate-mit-erlsen-aus-primrregelleistung-an_100024328/

Example: Dynamic Frequency in UK

- Tendered by National Grid (TSO in UK)
- Minimum power of 10MW if contracted directly with NG
- Minimum power of 1 kW if contracted with an aggregator
- Required response time: <2s
- Optimal capacity ratio: 2C (100kW/50kWh)
- Locally installed relay triggering the service provision
- 2 years contract typically
- **Up to 200 000 euros/MW/year availability payment**
  (Cornwall energy, Limejump)

Is there a Market for ELSA Systems?

Market segments		Residential buildings	Office, Comm. & Industrial buildings	Grid	
				Substations	Solar or wind turbines farms
Storage size (bat. 2nd life)		**0.5 bat.** (Home) **2 – 12 bat.** (Bldg)	**2 – 18 bat.**	**18 bat.**	**>> 48 bat.**
European market (2020 est.)		~30-40%	~20-30%	~10-20%	~20%
Germany	**50%**	★★★	★★	★★	★★★
Italy	**25%**	★★	★★★	★★	★★★
UK	**9%**	★	★★★	★★	★★
France	**4%**	★	★★★	★★	★★

Questions

- ELSA targets at large buildings. What type of facilities are feasible and how can they be addressed?
- Today, ELSA could participate in Primary Reserve, which is actually managed by TSOs. What are restrictions and hurdles that need to be considered?
- Who would be potential partners to be successful in the two identified market domains?
- Which potential do you see for cost-effective services tailored for DSO? What are the barriers preventing DSO-level services to be fully deployed?

Contact:

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