BVES
Bundesverband
Energiespeicher
Systeme e.V.

JUNE 29, 2021

The role of energy storage in the energy transition

Urban Windelen
BVES e.V.

The German Energy Storage Systems Association

- The BVES is the industrial association of energy storage companies that is open to all technologies in the areas of electricity, heat and mobility.
  > More than 220 member companies

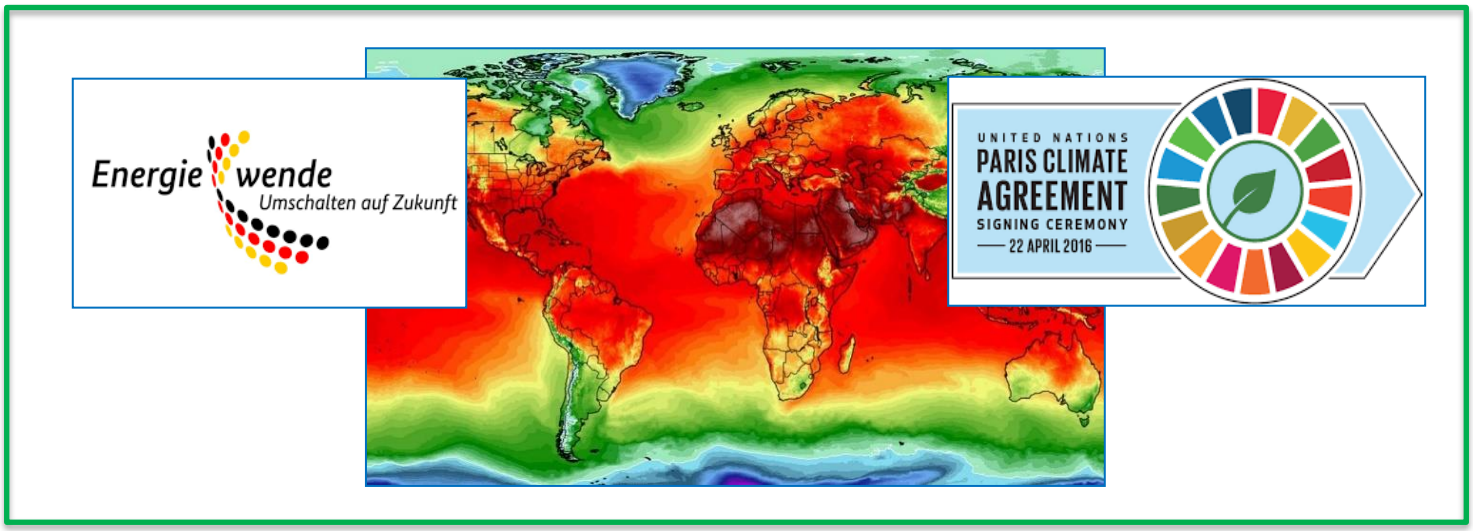
- We are a dialogue partner for politics, administration, science and publicity. With targeted lobbying at the interfaces of political decision making we are working for the improvement of the regulation and policy framework for energy storage (national and international).

- In addition, the BVES monitors research and development activities and informs members of new results and developments.

The German Energy Storage Systems Association

Excerpt of our Membership – Across all industries and energy sectors

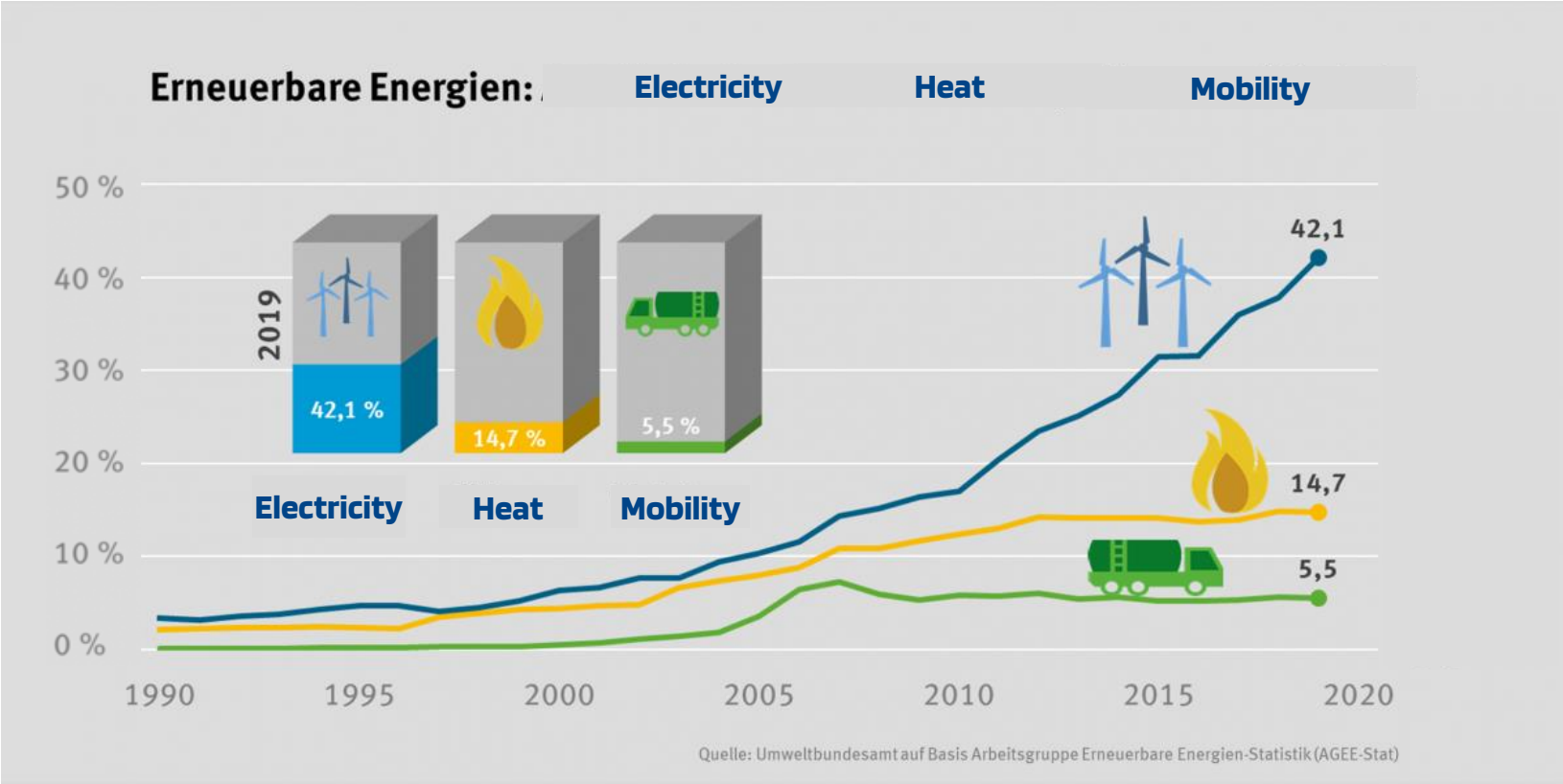
Energiewende, Paris Agreement, Sector Targets, Green Deal, Climate Neutrality, Carbon Free, ~~2050~~ 2045



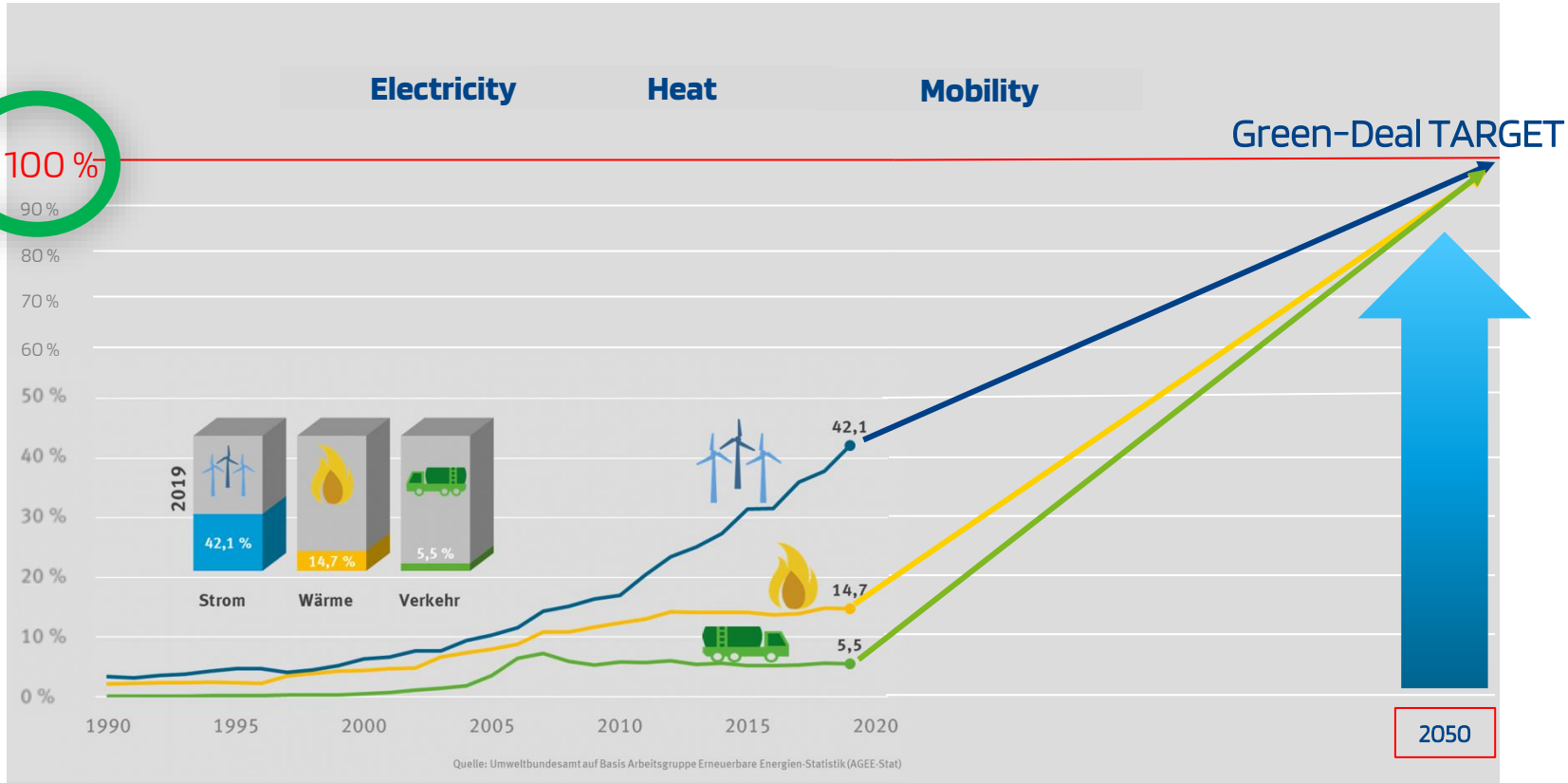
HOW do we achieve the goals?

- Energy storage technologies are ready and available on the market to make their contribution to a climate-friendly energy system
- There are various applications for storage in the sectors electricity, heat and mobility
- Research and development continuously advance the technologies

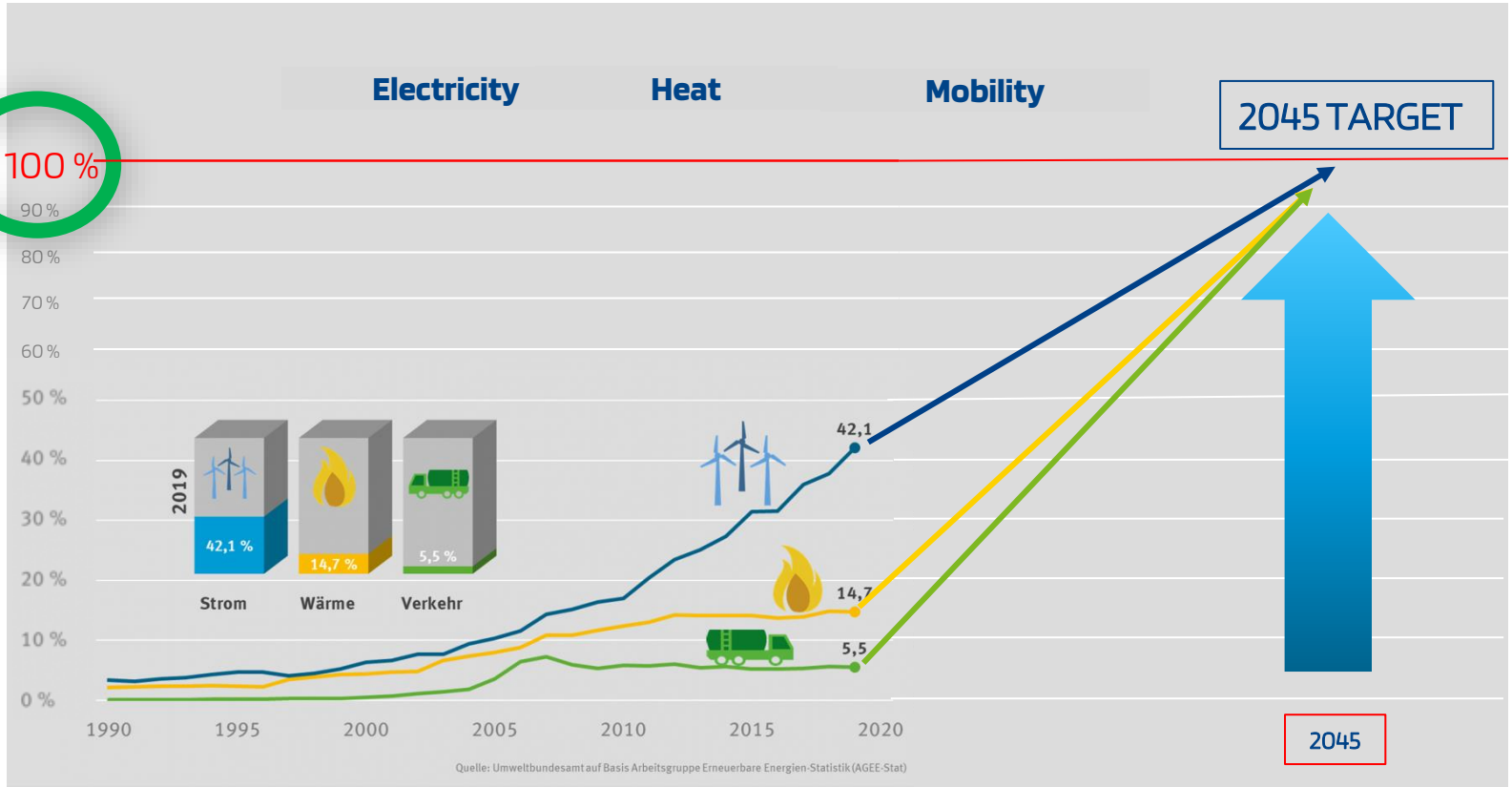
On the way to 100% renewables.



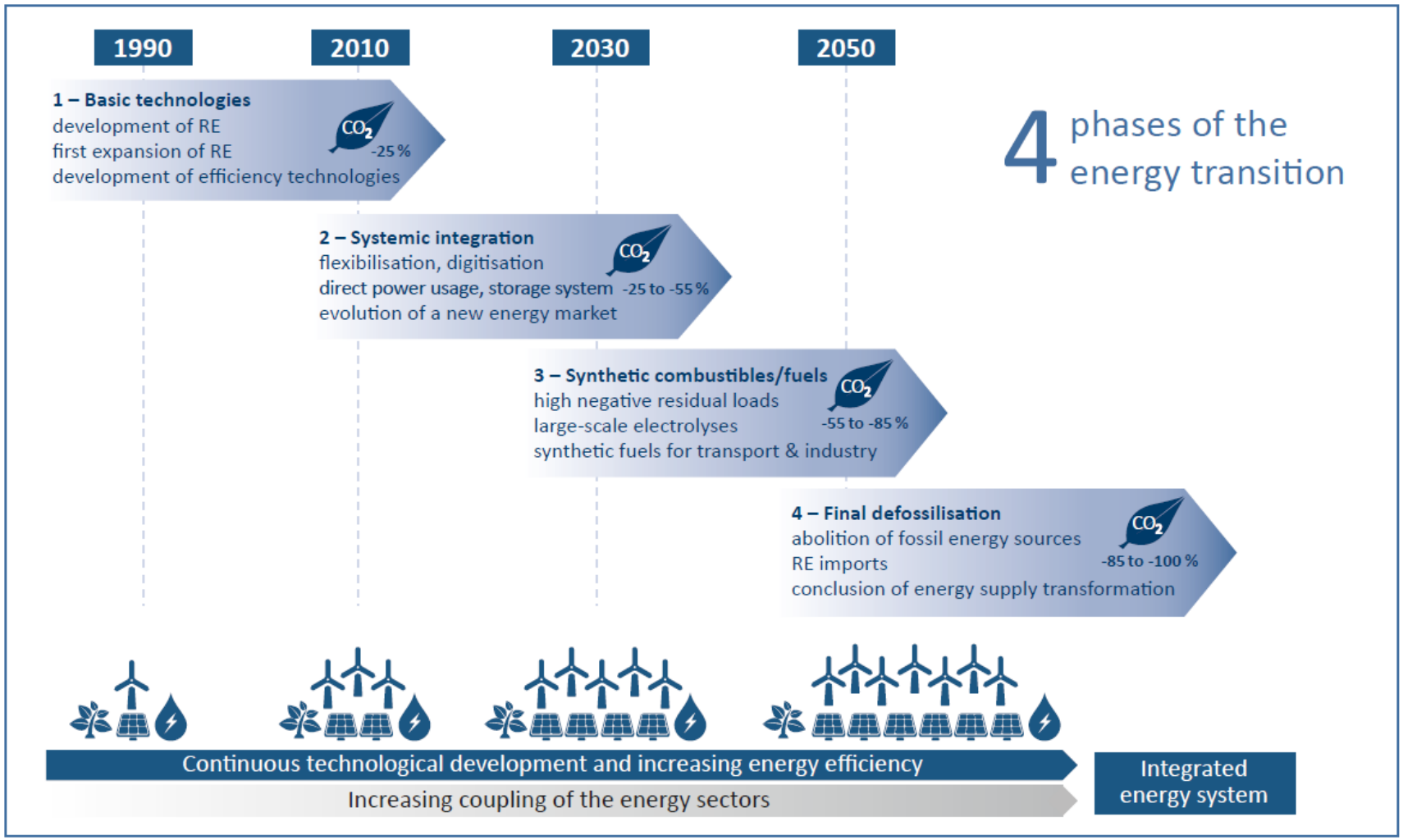
On the way to 100% renewables.



On the way to 100% renewables.

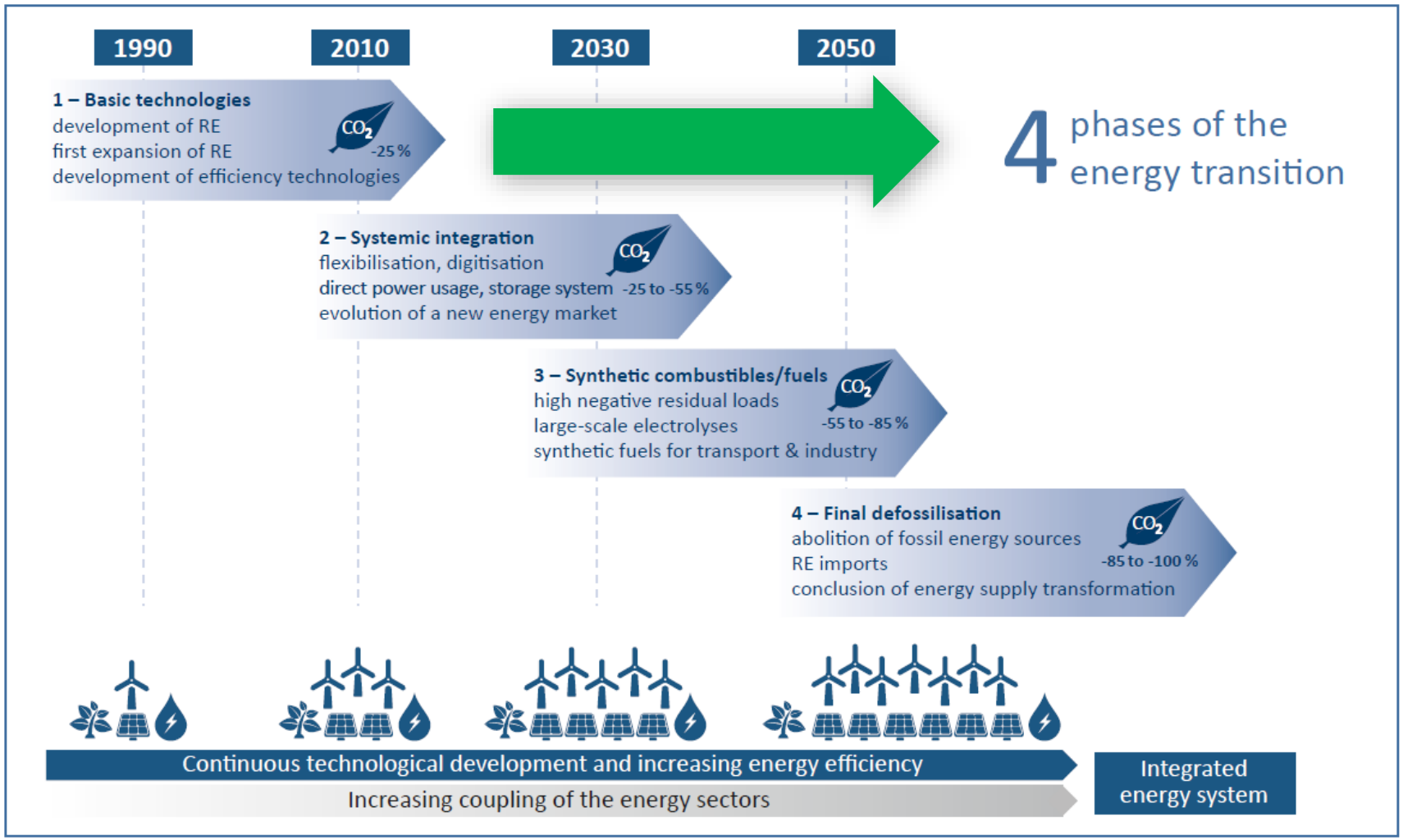


Energiewende: STEP BY STEP



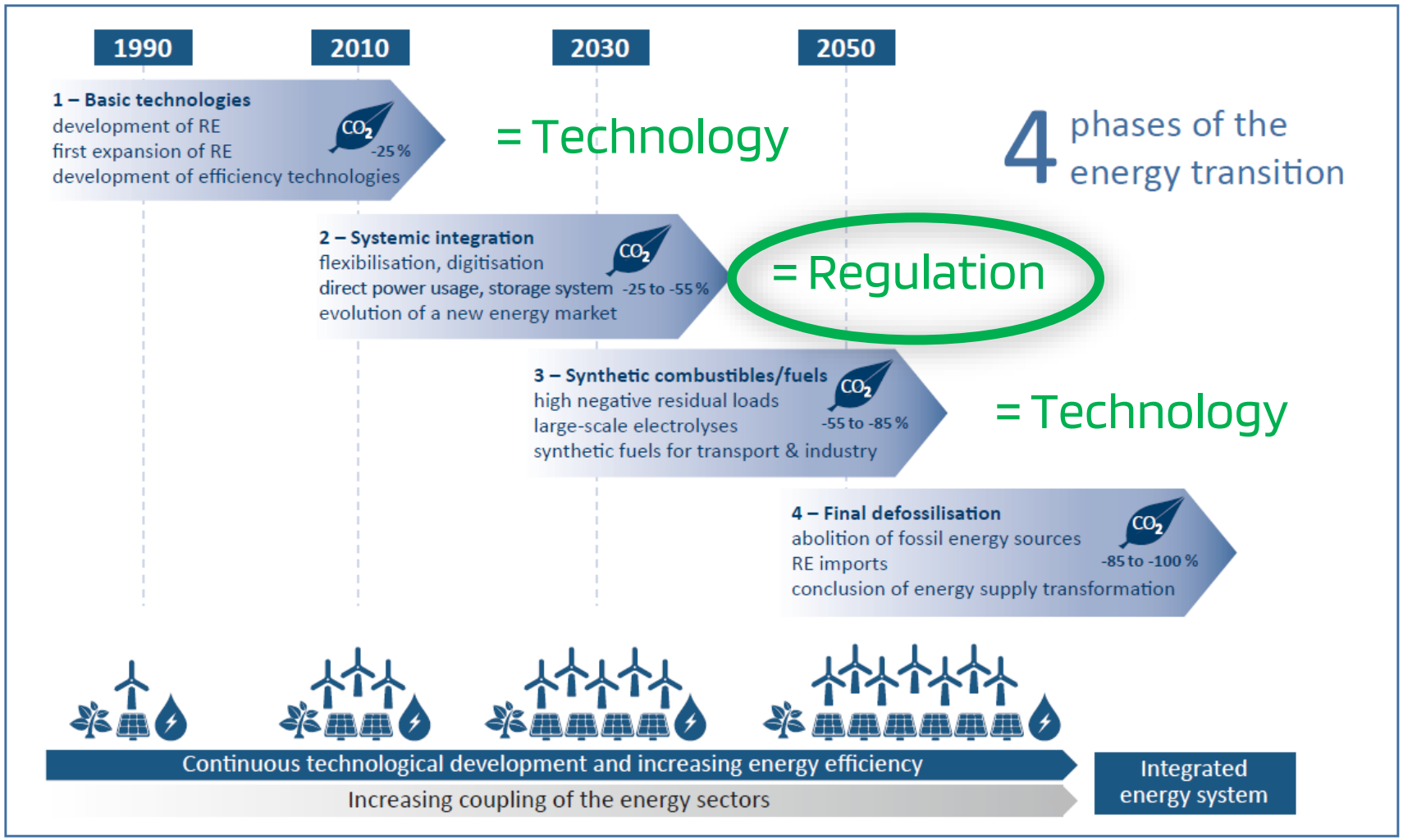
Source: acatech/Leopoldina/Akademienunion: Sektorkopplung – Optionen für die nächste Phase der Energiewende (Schriftenreihe zur wissenschaftsbasierten Politikberatung), 2017

Energiewende: STEP BY STEP



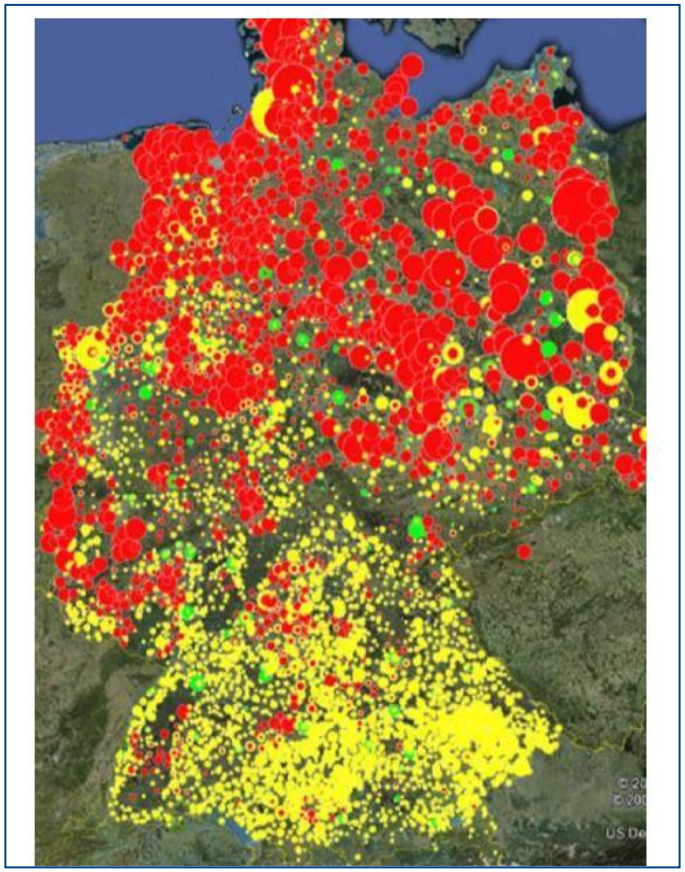
Source: acatech/Leopoldina/Akademienunion: Sektorkopplung – Optionen für die nächste Phase der Energiewende (Schriftenreihe zur wissenschaftsbasierten Politikberatung), 2017

Energiewende: STEP BY STEP

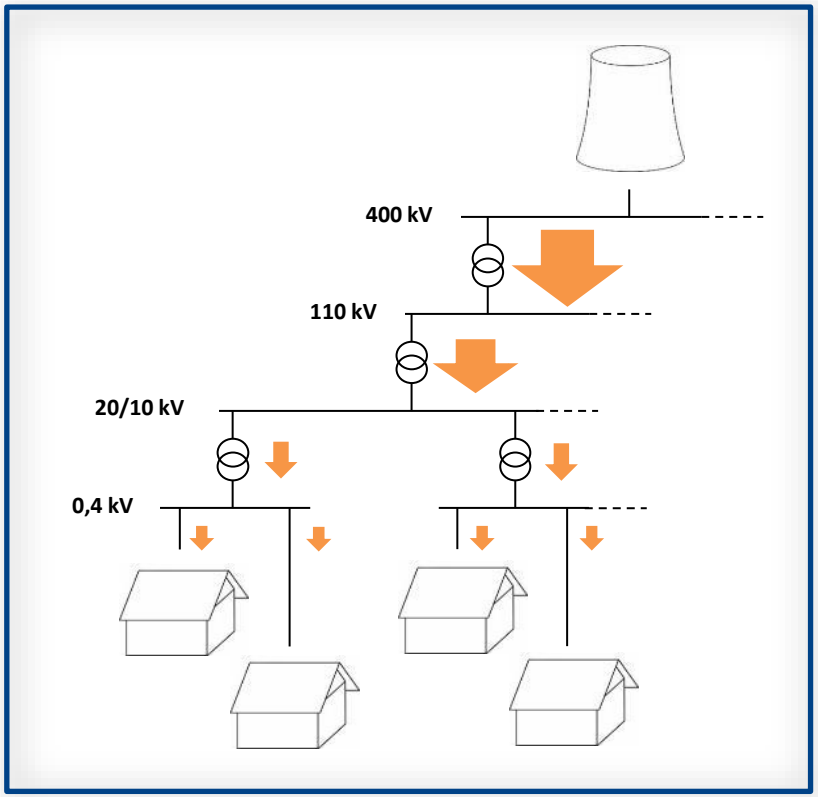


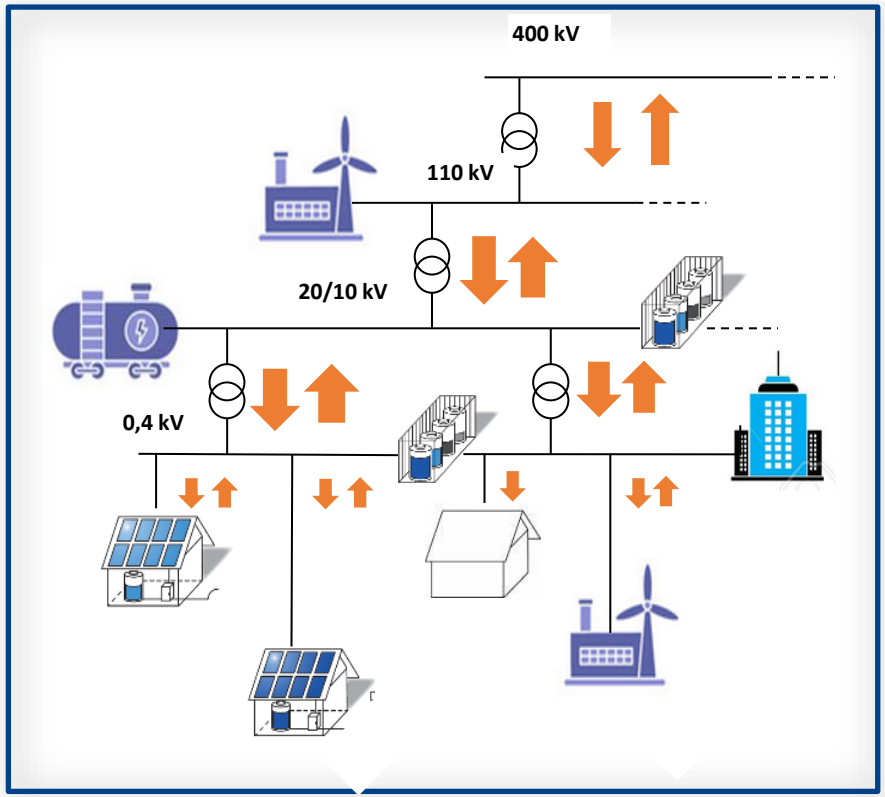
Source: acatech/Leopoldina/Akademienunion: Sektorkopplung – Optionen für die nächste Phase der Energiewende (Schriftenreihe zur wissenschaftsbasierten Politikberatung), 2017

Energy Transition: Result No. 01 = Decentralization



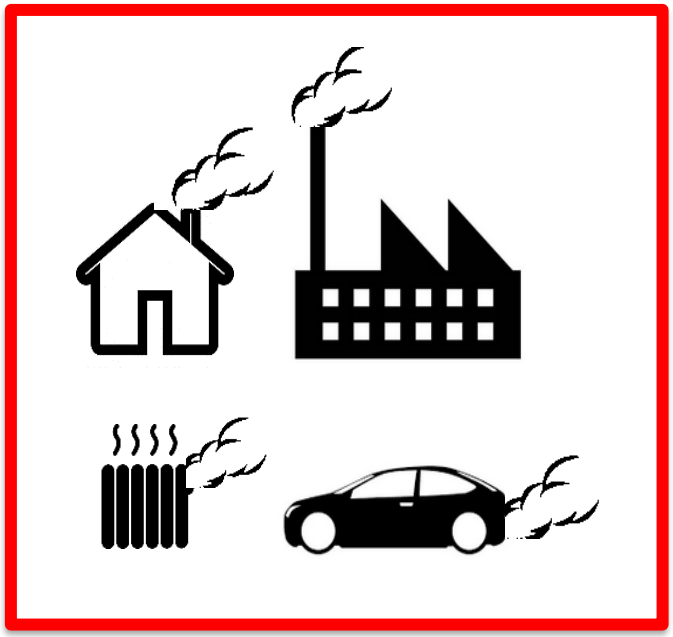
Energy Transition: Result No. 02
= New structure, new tasks, new issues





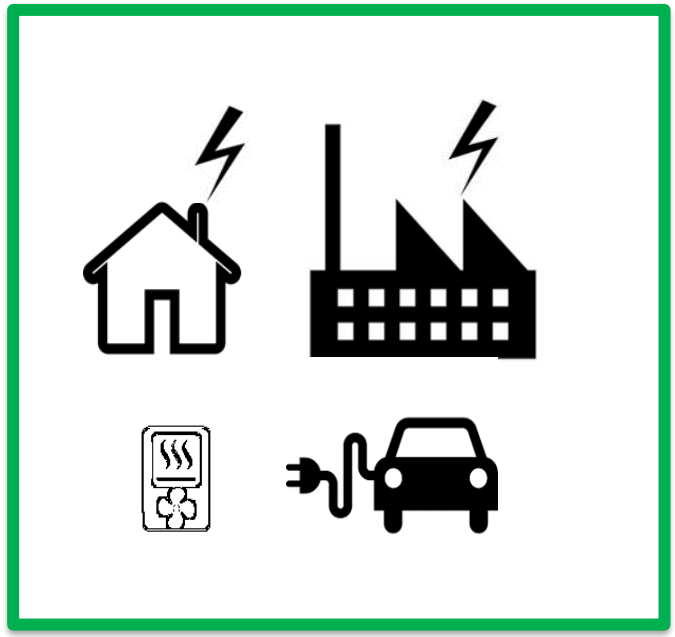
Energy Transition: Result No. 03
= Power is the new currency

FOSSIL AGE



Energy is sufficient.

ELECTRIFICATION WAVE



Power is needed.

„The 3 D's" =

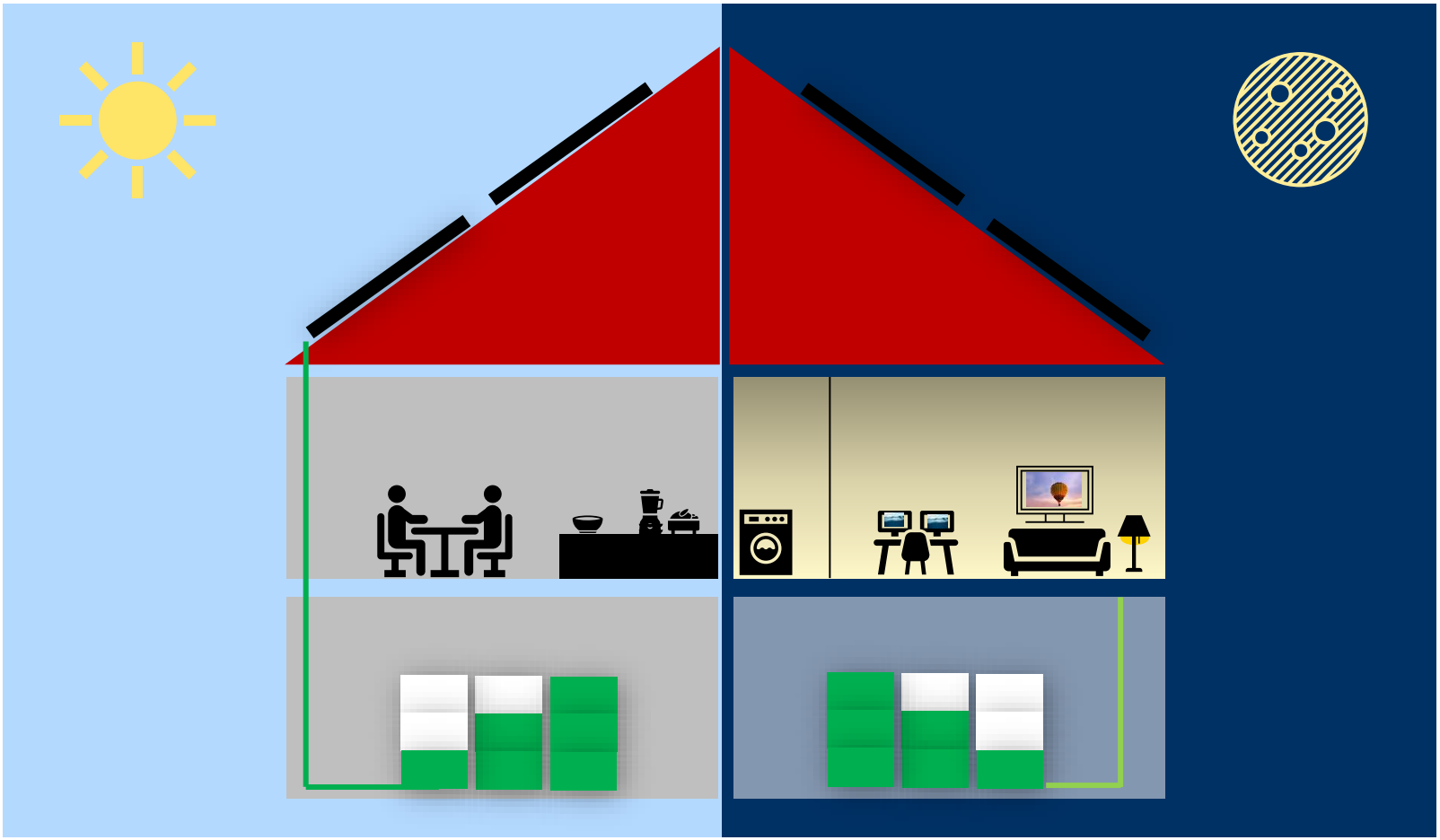
- **Decarbonization**
- **Decentralization**
- **Digitalization**

Local availability »» **Temporary availability**

- Renewable Energies can be generated ANYWHERE.
- But not ANYTIME.
- ANYTIME Awailability: ONLY with storage.

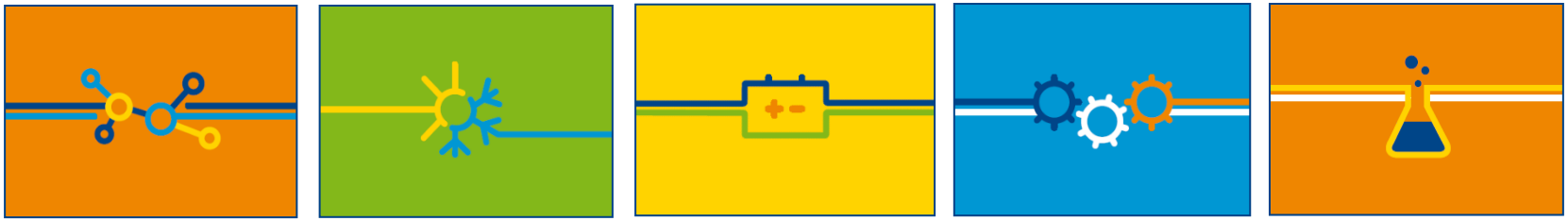
No Storage =

No electricity, no power, no heat during night



STORAGE TECHNOLOGIES AND APPLICATIONS

A basket full of technologies…



WÄRME/KÄLTE ZU WÄRME/KÄLTE (THERMISCHE ENERGIESPEICHER)

- Sensibel
  - Wasser (FactSheet»)
  - Salzschmelze und andere Flüssigkeiten (FactSheet»)
  - Feststoffe (FactSheet in Arbeit)
- Latent
  - fest-flüssig Niedertemperatur (FactSheet»)
  - fest-flüssig Hochtemperatur (FactSheet»)
- Thermochemisch
  - Sorption (FactSheet»)
  - Chemische Reaktion (FactSheet»)

BVES BUNDESVERBAND ENERGIESPEICHER

SPEICHERTECHNOLOGIEN STECKBRIEF

Li-Ionen Stromspeicher

ALLGEMEINE BESCHREIBUNG:

Form der Energieaufnahme und -abgabe: Strom zu Strom

Kurzbeschreibung des Speicherprozesses: Stromspeicher dienen zur Speicherung von … zu einem späteren Zeitpunkt zu nutzen.

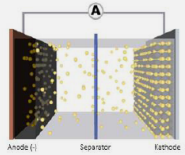


Abb. 1: Schematischer Aufbau einer Lithium-Ionen-Zelle[1]

Die Kathode besteht überwie… Aluminiumträger. Häufige M… sind u.a. LCO (Kobaltoxid), Li… (NickelMangan-Kobaltoxid) b… aber auch LFP (Eisenphosph… aus Kohlenstoff (alternativ z… Kupferträger (alternativ: Alu… materialien sind z.B. Graphit; Kathode sind durch einen Se… ionenleitenden Elektrolyt ve… der Anode und Kathode sow… wesentlichen Einfluss auf die… Zelle wie Spannung (V), Kapa… Temperaturabhängigkeiten,

Beim Laden gibt die Kathode (Pluspol[2]) eingelagerte Lithium-Ionen in den Elektrolyte… ab. Die Li-Ionen (Li+)… gen sich zur Anode (Minuspol[2]), werden dort eingelagert u… auf. Beim … Verlauf umgekehrt. Dieser Einlagerungs-vorgang (Interkali… … (Konversion, z.B. bei Blei-Säure, NiCd), der den hohen V… …lzyklenfestigkeit) erzeugt.

… einer Batterie in das Anlagendesign bzw. and Strom… …egier entweder auf der Gleichspannungsebene (z.B. …spannungsebene (z.B. Stromnetz) erfolgen.

… Anschluss des Stromspeichers im Wechselstromkreis, also nac… …h Wechselrichter. In diesem Fall wird der Solarstrom an die Verbraucher geleitet und ein eventueller Überschuss in den Speicher und/oder das öffentliche Stromnetz eingespeist. Die entsprechende Leitung der Ströme erfolgt über eine Steuerungseinheit. Stromspeicher können an eine Vielzahl von Generatoren angeschlossen werden: Wind, Diesel, BHKW, PV, Wasser oder auch zur Sicherung der Netzstabilität in das öffentliche Netz eingebunden werden.

[1] Quelle: Karlsruher Institut für Technologie [2] Erläuterung Anode und Kathode siehe Glosser.

BVES | Januar 2016 1

STROM ZU GAS/FLÜSSIGKEIT (CHEMISCHER ENERGIESPEICHER)

- Wasserstoff
  - Power to Gas (FactSheet»)
- Synthetisches Methan/ Methanol
  - Power to Gas (FactSheet»)

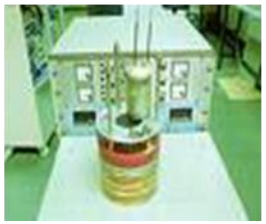
STROM ZU STROM (STROMSPEICHER)

- Elektrochemisch
  - Vanadium Redox Flow Batterie (FactSheet»)
  - Hochtemperatur Batterie (FactSheet»)
  - …ctSheet»)
  - …Sheet»)
  - …FactSheet»)
  - …rke (PSW) (FactSheet»)
  - …cher (CAES) (FactSheet»)
  - …icher (LAES) (FactSheet»)
  - …ische Energiespeicher
  - Kondensatoren

www.bves.de

Storage of Electricity

- **Storage of electrical energy**



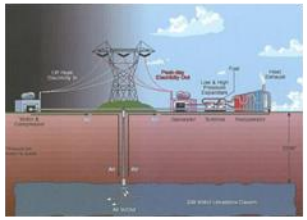

  - Super-conducting Magnetic Energy Storage (SMES)
  - Super-capacitor

- **Electrochemical storage of electricity**



  - Natrium-Sulphur batteries(NaS-Cells)
  - Lead acid batteries
  - Redox-Flow batteries

- **Mechanical storage of electricity**

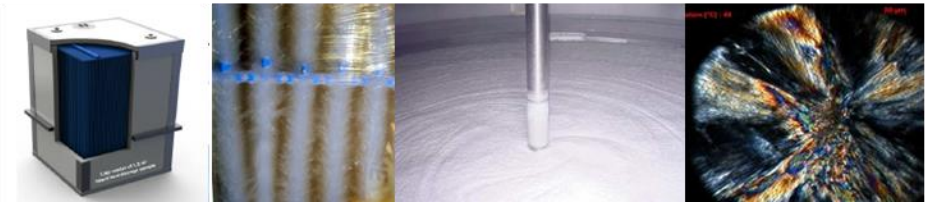

  - Hydro pump storage
  - Compressed-air storage (CAES)
  - Fly wheel

Thermal Energy Storage

- **Storage of sensible heat**

  - Hot-water accumulator
  - Underground Thermal Energy Storage (UTES)

- **Storage of latent heat**



  - Phase change material (PCM) PCM-device
  - Slurries

- **Thermochemical storage**

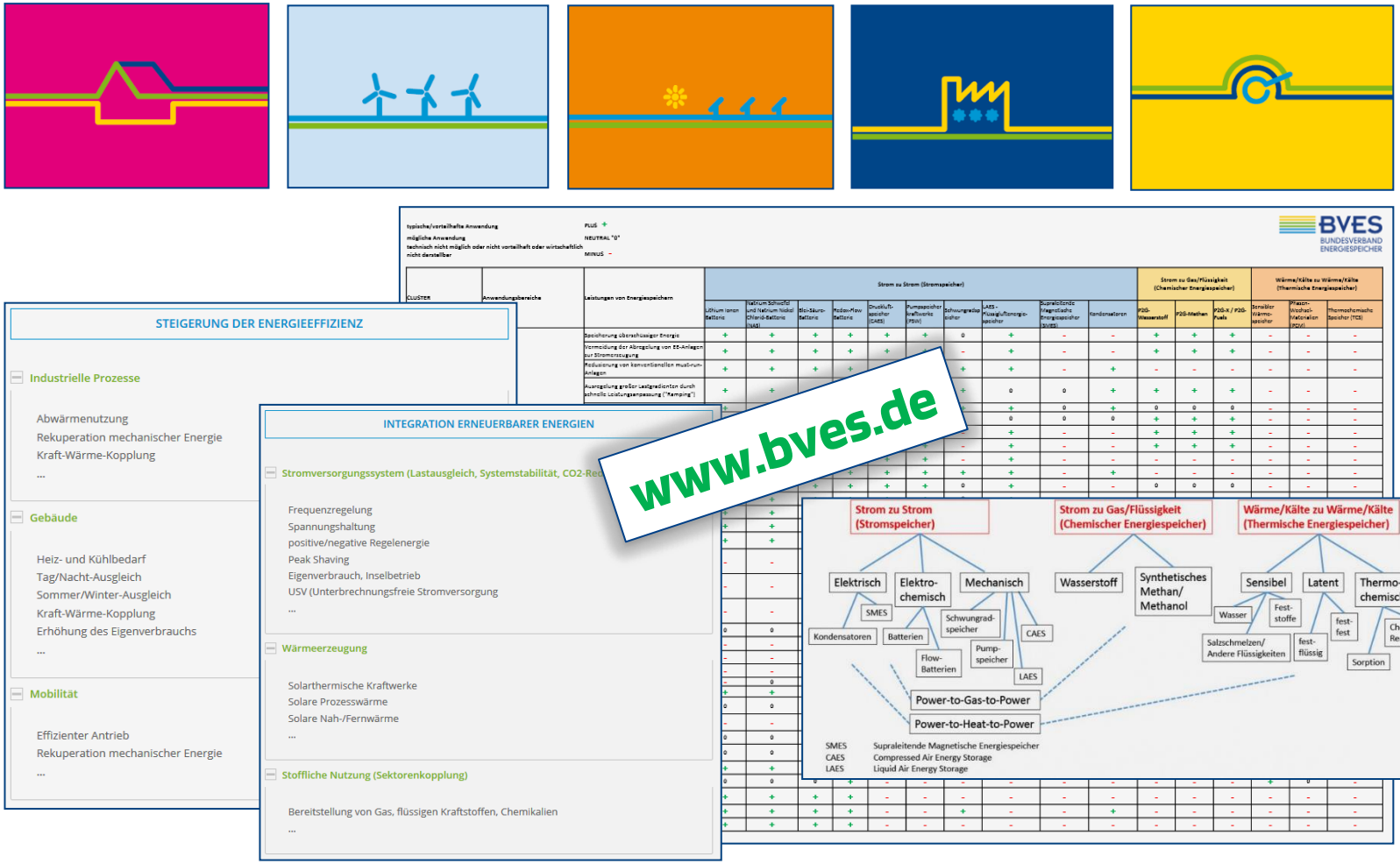
  - Adsorption-(zeolite) and Absorption-storage (LiCl)
  - Thermochemical materials (TCM)

Chemical Energy Storage

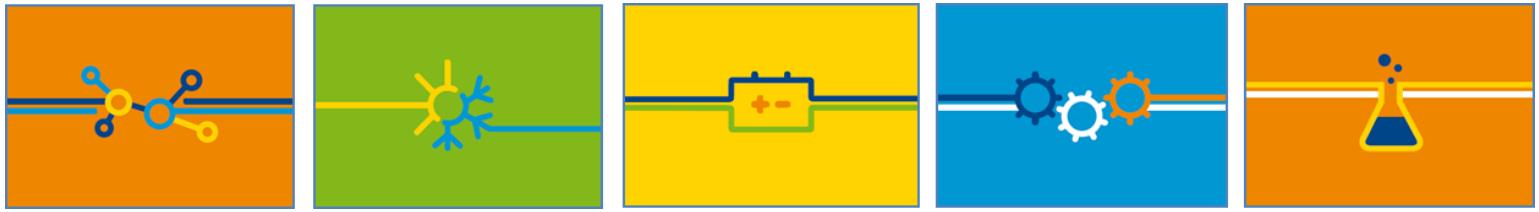
Production of hydrogen and storing of hydrogen.

- Hydrogen is the energy-richest power fuel (in relation to its inertia)
- Lossless long-time storage
- Production of electricity with fuel cell / H_2-turbine

A basket full of applications...



THE APPLICATION DETERMINES THE STORAGE



- The technical and economic requirements for a storage device are determined by the exact use of the storage in the supply system.
- An assessment of different storage technologies (and a comparison) is only possible on the basis of a specific applications.
- The application specifies technical requirements (form of energy, power, storage capacity, response time).
- The application also defines the economic environment (e.g. which energy prices can be set, depth of use, etc.).

Matrix Technologies/Applications

CLUSTER	Anwendungsbereiche	Leistungen von Energiespeichern	Strom zu Strom (Stromspeicher)										Strom zu Gas/Flüssigkeit (Chemischer Energiespeicher)			Wärme/Kälte zu Wärme/Kälte (Thermische Energiespeicher)		
			Lithium Ionen Batterie	Natrium Schwefel und Natrium Nickel Chlorid-Batterie (NAS)	Blei-Säure-Batterie	Redox-Flow Batterie	Druckluft-speicher (CAES)	Pumpspeicher Kraftwerke (PSW)	Schwungradspeicher	LAES - Flüssigluftenergie-speicher	Supraleitende Magnetische Energiespeicher (SMES)	Kondensatoren	P2G-Wasserstoff	P2G-Methan	P2G-X / P2G-Fuels	Sensibler Wärme-speicher	Phasen-Wechsel-Materialien (PCM)	Thermochemische Speicher (TCS)
Nutzung und Integration erneuerbarer Energien	Stromversorgungssystem (Lastausgleich, Systemstabilität, CO2-Reduktion)	Speicherung überschüssiger Energie	+	+	+	+	+	+	0	+	-	-	+	+	+	-	-	-
		Vermeidung der Abregelung von EE-Anlagen zur Stromerzeugung	+	+	+	+	+	+	-	+	-	-	+	+	+	-	-	-
		Reduzierung von konventionellen must-run-Anlagen	+	+	+	+	+	+	+	+	-	+	-	-	-	-	-	-
		Ausregelung großer Lastgradienten durch schnelle Leistungsanpassung ("Ramping")	+	+	+	0	0	+	+	0	0	+	+	+	+	-	-	-
		Momentanreserve / Frequenzhaltung	+	+	+	+	+	+	+	+	0	+	0	0	0	-	-	-
		Primärregelleistung	+	+	+	0	0	+	-	0	0	0	+	+	+	-	-	-
		Sekundärregelleistung	+	+	+	+	+	+	-	+	-	-	+	+	+	-	-	-
		Minutenreserve	+	+	+	+	+	+	-	+	-	-	+	+	+	-	-	-
		Beitrag zur gesicherten Leistung	+	+	+	+	+	+	-	+	-	-	-	-	-	-	-	-
		Kurzschlussleistung	+	+	+	+	+	+	+	+	-	+	-	-	-	-	-	-
		Eignung zum Redispatch	+	+	+	+	+	+	0	+	-	-	0	0	0	-	-	-
		Schwarzstartfähigkeit	+	+	+	+	+	+	0	+	-	-	-	-	-	-	-	-
		Blindleistungserbringung	+	+	+	+	+	+	+	+	+	+	0	0	0	-	-	-
		Spannungshaltung	+	+	+	+	+	+	+	+	+	+	0	0	0	-	-	-
		Bereitstellung von Spitzenlast (Peak Shaving)	+	+	+	0	+	+	+	+	+	-	-	-	-	-	-	-
	Wärme-Erzeugung	Nachfragegesteuerte / Verstetigte Wärmebereitstellung von solarer Nah-/Fernwärme	-	-	-	-	-	-	-	-	-	-	-	-	-	+	0	0
		Nachfragegesteuerte / Verstetigte Wärmebereitstellung von solarer Prozesswärme	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+
		Nachfragegesteuerte / Verstetigte Leistungsbereitstellung in Solarthermischen Kraftwerken	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	0
		solare Kombisysteme	0	0	0	0	-	-	-	-	-	-	-	-	-	+	0	0
	Stoffliche Nutzung (Sektorenkopplung)	Bereitstellung von Gas	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
		Bereitstellung von flüssigen Kraftstoffen	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
		Bereitstellung von Chemikalien	-	-	-	-	-	-	-	+	-	-	+	+	+	-	-	-
Steigerung der Energieeffizienz	Industrielle Prozesse	Nutzung industrieller Abwärme	-	0	-	-	+	-	-	+	-	-	-	-	-	+	+	+
		Rekuperation mechanischer Energie	+	+	+	+	-	-	+	-	-	+	-	-	-			
		Entkopplung Strom-, Wärme- und Kälteerzeugung in KWK-Anlagen	0	0	0	0	+	-	-	+	-	-	0	0	0	+	+	0
		Bereitstellung alternativer Brenn-/Rohstoffe	-	-	-	-	-	-	-	-	-	-	+	+	+			
	Gebäude	Ausgleich von Heiz- und Kühlbedarf	0	0	0	0	-	-	-	-	-	-	-	-	-	+	+	+
		Entkopplung Strom-, Wärme- und Kälteerzeugung in Micro-KWK-Anlagen	0	0	0	0	-	-	-	-	-	-	-	-	-	+	+	0
		Tag/Nacht-Ausgleich	+	+	+	+	-	-	-	-	-	-	-	-	-	+	+	+
		Sommer/Winter-Ausgleich	0	0	0	+	-	-	-	-	-	-	-	-	-	+	0	-
		Erhöhung Eigenverbrauchsanteil (z.B. Heubatterien)	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
	Mobilität	Rekuperation mechanischer Energie	+	+	+	+	-	-	+	-	-	+	-	-	-	-	-	-
		Effizienter Antrieb	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-

www.bves.de

Multi Tool Energy Storage

Increase of Energy Efficiency

Optimization of Self-Supply

Positive/Negative Control Energy

Peak-Load-Smoothing

Reactive Power Compensation

Black Start Capability

Charging Infrastructure

Off-Grid Supply

Power Capacity Increase

Back-Up Energy

Uninterrupted Power Supply

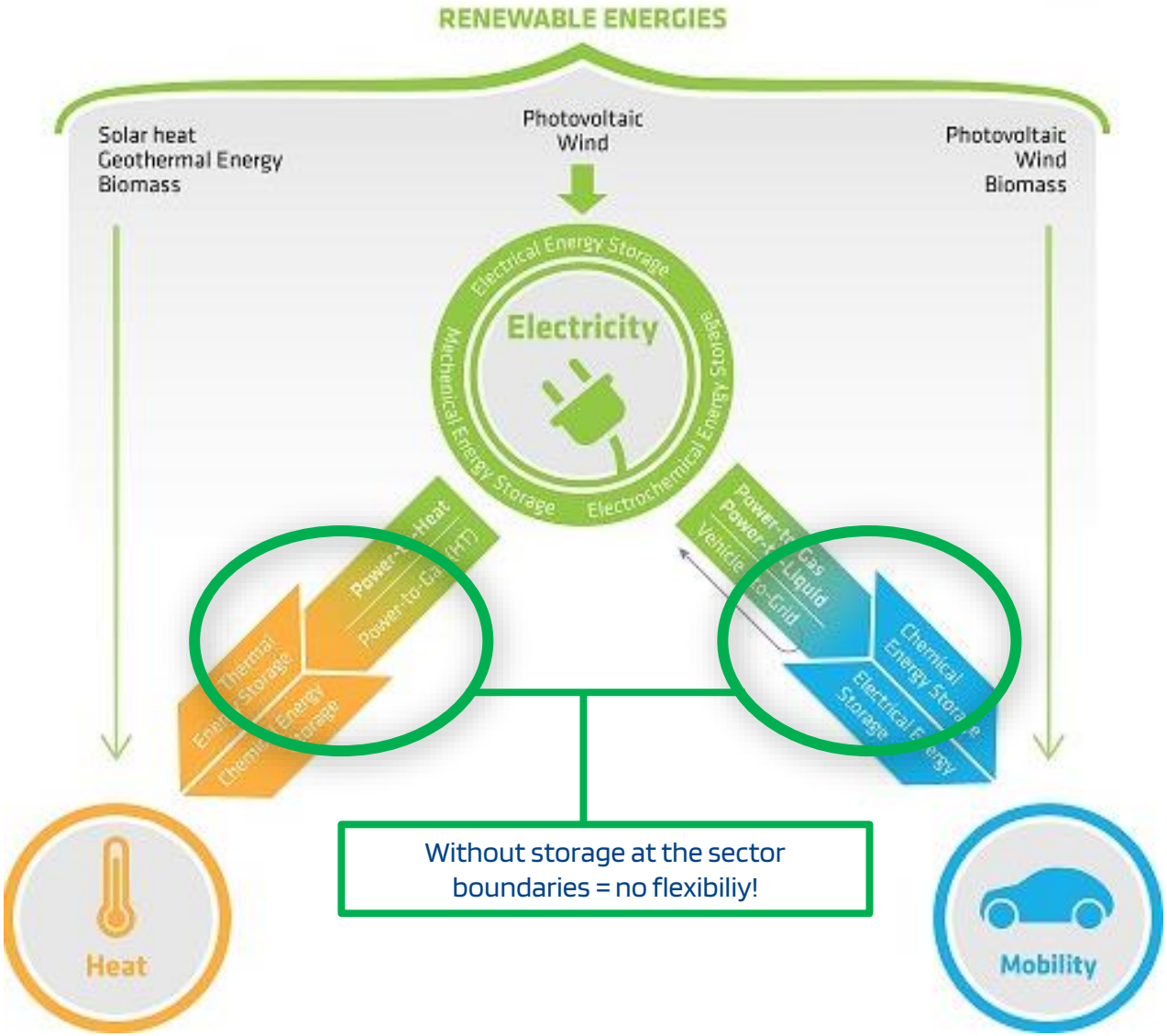
Sector Coupling

Shifting Excess Energy to Other Sectors

Frequency Control

Decarbonization

Flexibel Sector Coupling

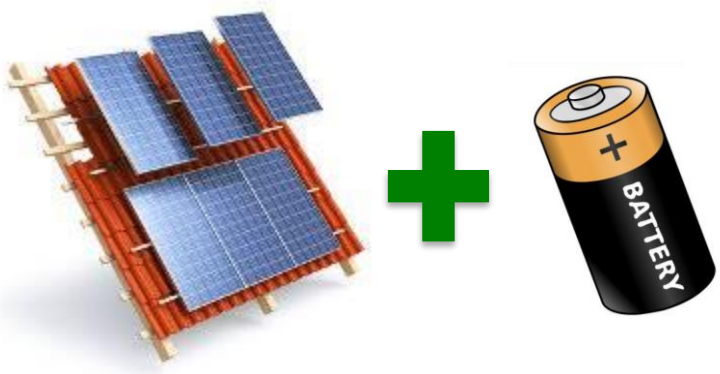


Quelle: BVES, ZAE Bayern

CURRENT MARKETS FOR STORAGE

Residential Storage Market

Self consumption ~ 35 %

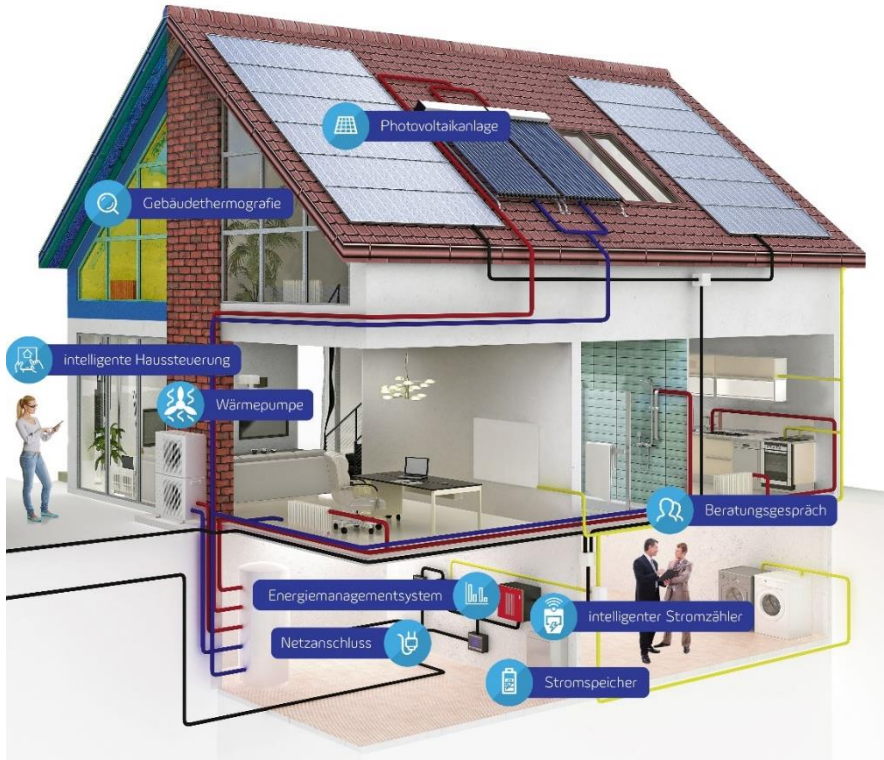


Self consumption ~ 70 %

Own generation and consumption Electricity (+ Heat)

Dezentralisierung:

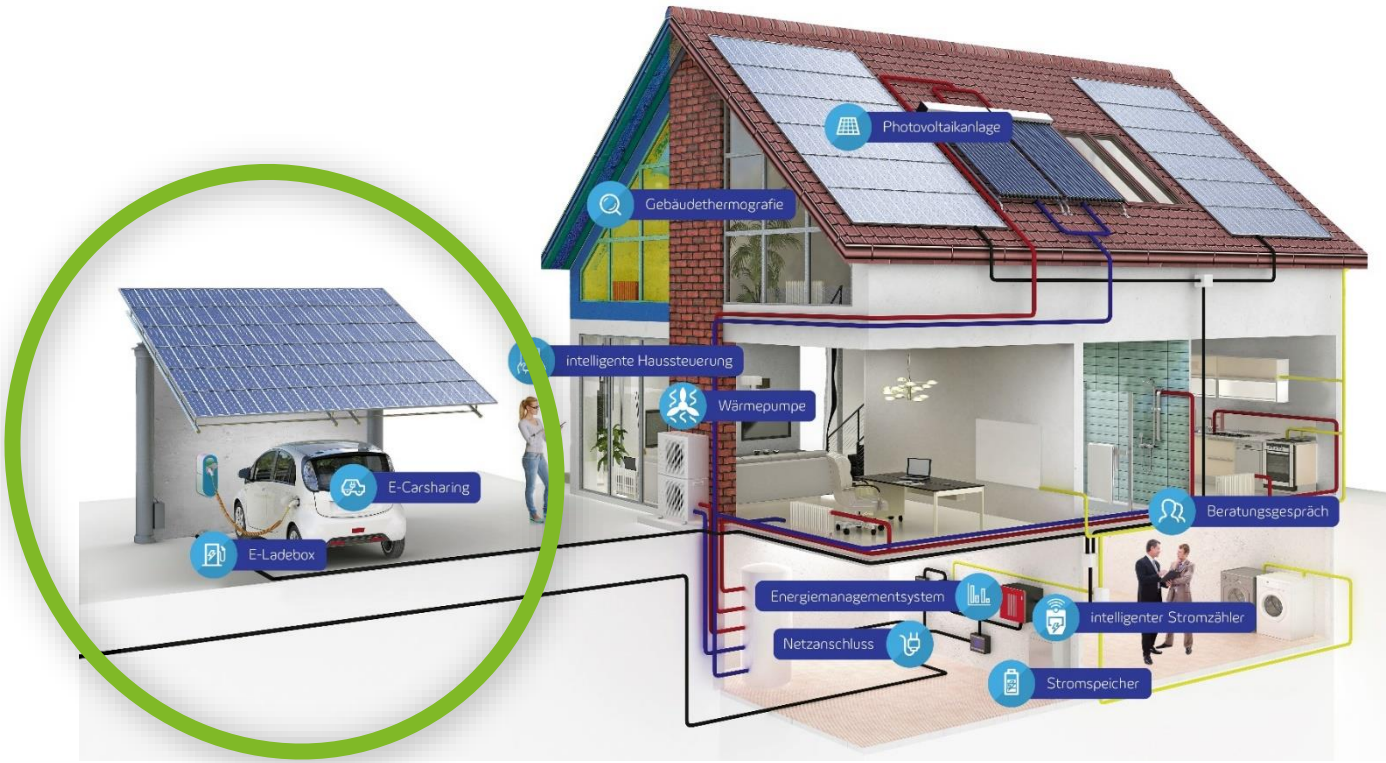
- Ca. 350.000 Storage Systems installed.
- Ca. 2.000.000 Rooftop-PV.
- New installations mostly incl. Heatpump
- Huge retrofit potential



Quelle: enviam

Trend: Electricity + Heat + Mobility

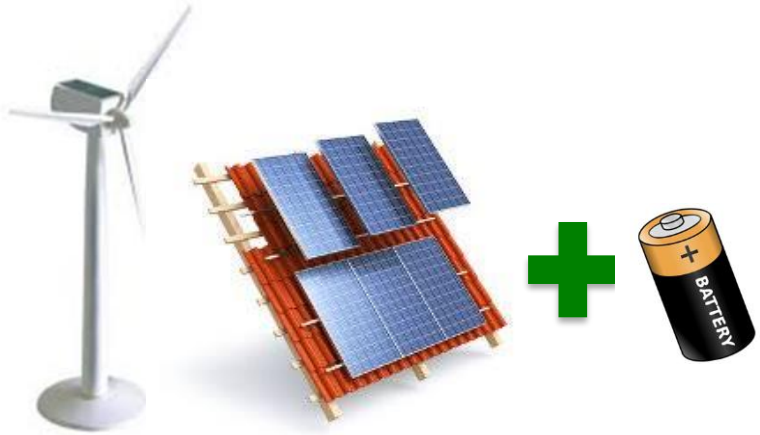
Carefree package for all enery needs.



Quelle: enviam

Industrial Storage Market

Self consumption



Self consumption

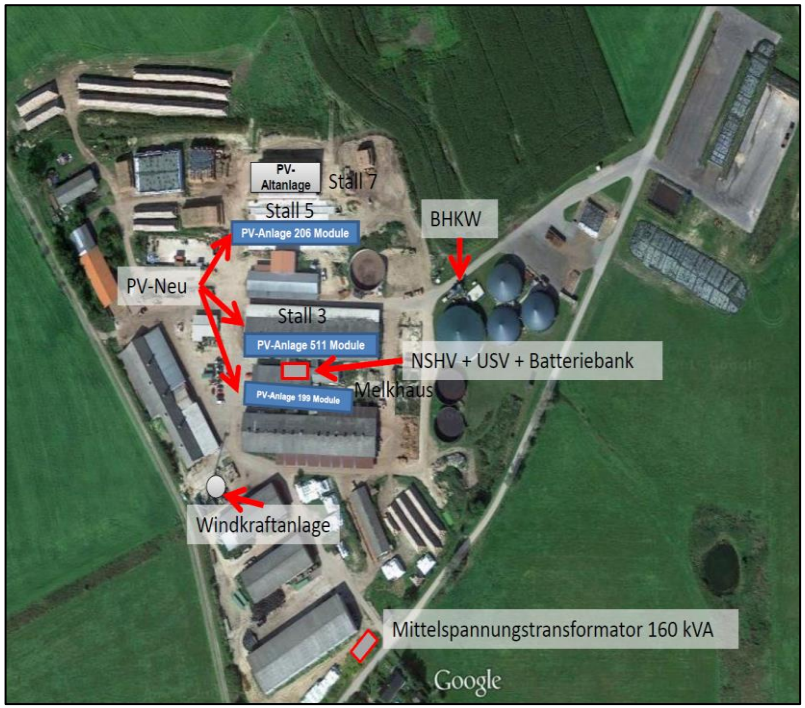
+ UPS + PLS + Backup Power + no Diesel

Electricity, Power, Heating, Cooling + Mobilität

Industry: ca. 1600 Projects in Germany

Multi-Use in Agriculture:

PV + wind + biogas plant + Li-ion battery + heat storage = 100 % autarchy



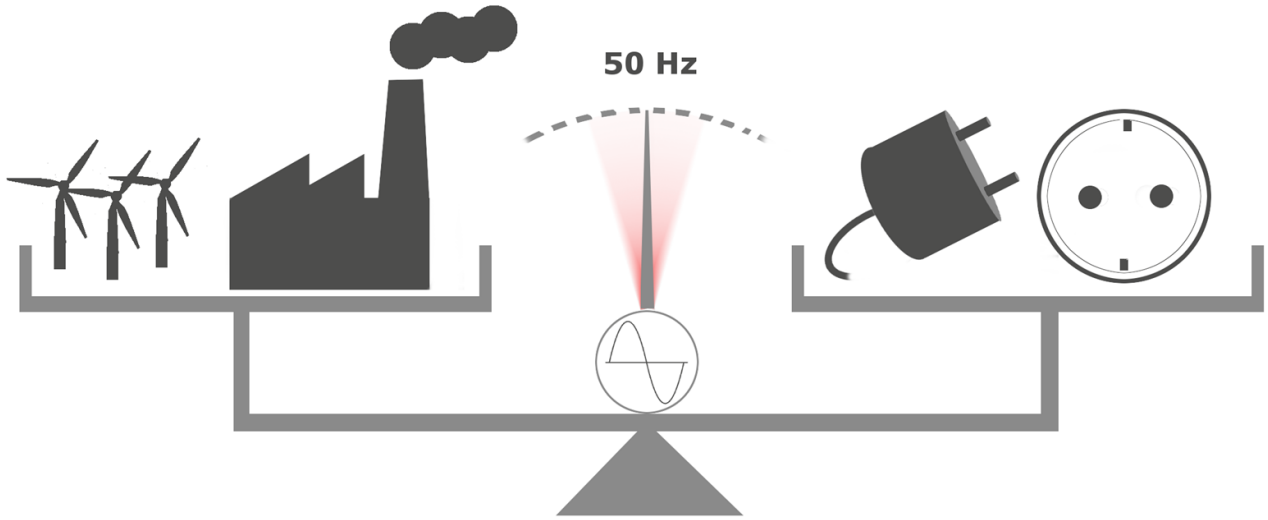
Reduction of energy costs: 0,3 € cent/liter

Game Changer: E-Mobility

NEW + Additional application: FAST CHARGING INFRASTRUCTURE

New business models, new players
= new added value

Large Scale Storage Market



Managing and balancing the grid:

- Inertia reserve
- Control energy
- Reactive power
- Blackstart capability
- …

BVES

Large Storage Systems for Electricity Infrastructure

Control Energy, System Services, Flexibility (Grid Booster)

Pump Storage
ca. 7 GW

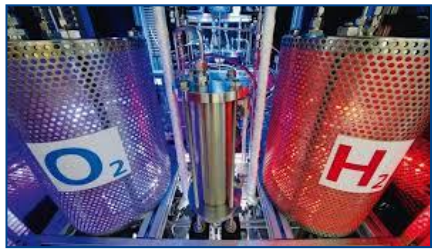
Battery Storage
ca. 450 MW

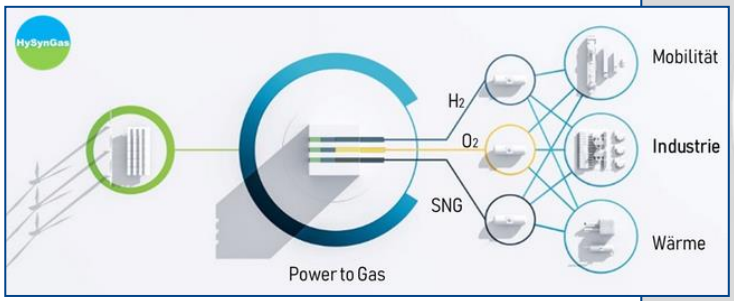
Hydrogen / PtX

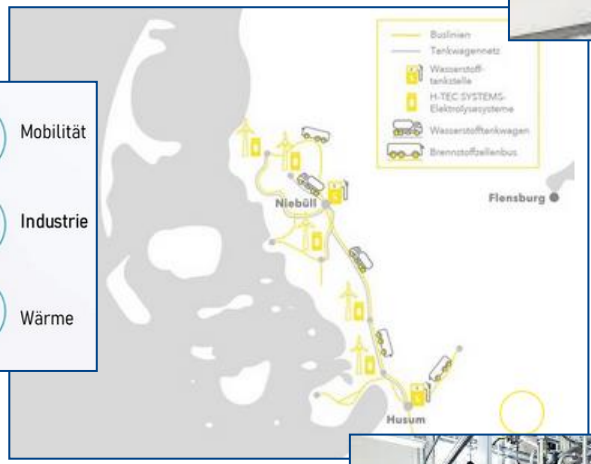
Battery Storage Systems for Mobility Infrastructure

BVES

Hydrogen – how much is there? A way to go...

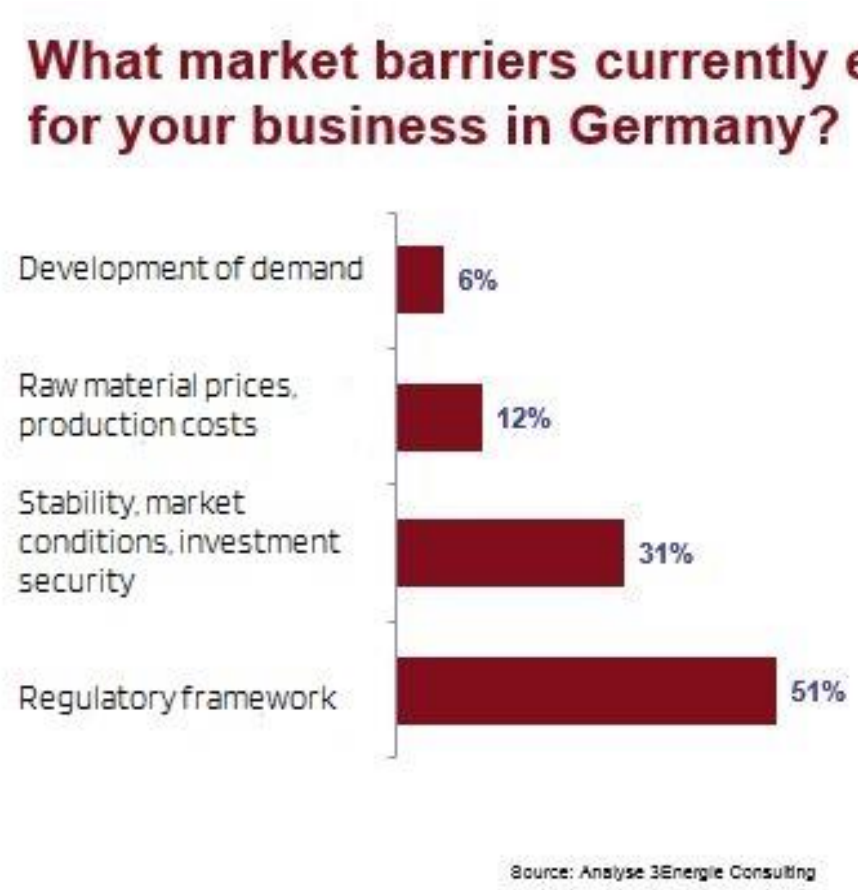






Legal Framework

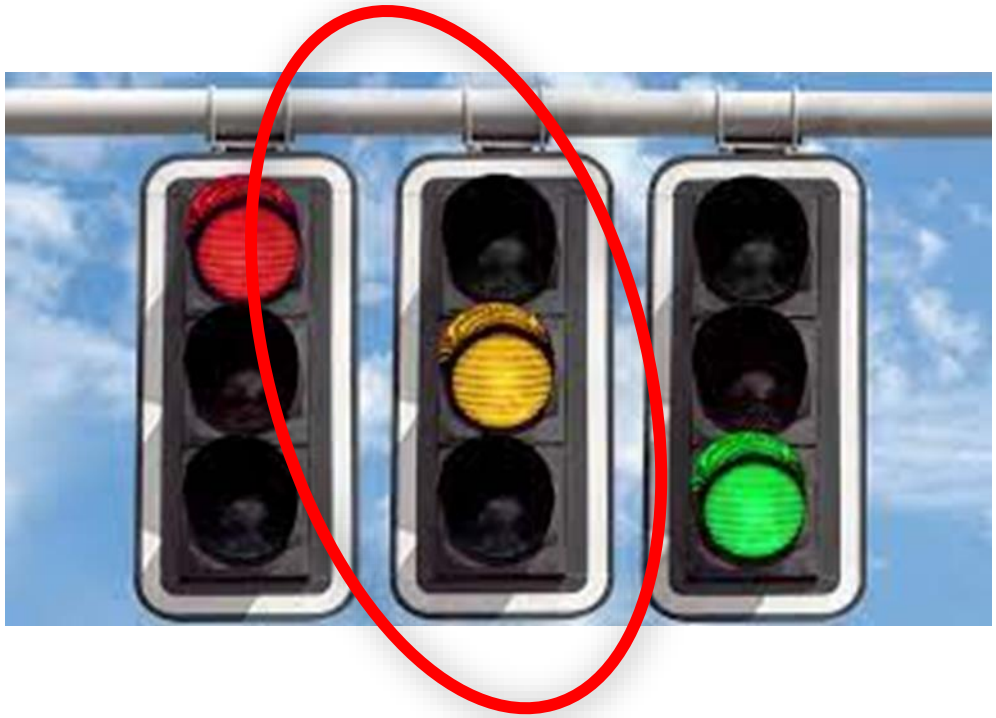
The regulatory framework is the biggest obstacle to growth



- Regulatory market barriers remain dominant, in particular:
- The classification of energy storage as a final consumer
- Prolonged authorization procedures
- Grid connection conditions with impracticable metering and billing concepts
- Lack of transparency of the current rules
- The influence of the Chinese market and access to battery cells are increasingly seen as obstacles

BVES

Technolgies are Ready, but...



Lack of legal classification.

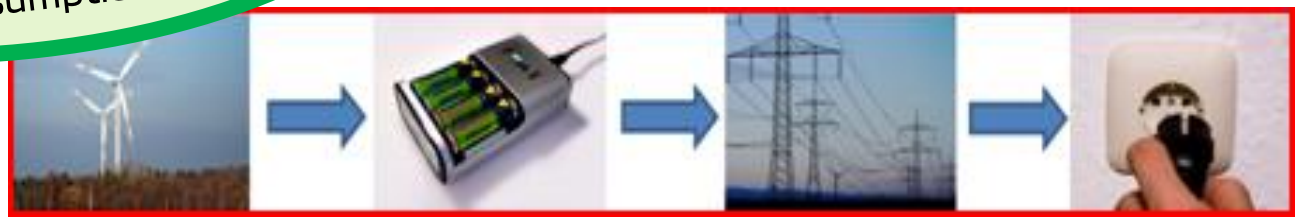
Lack of Legal Classification

The absurd situation of charging twice...

Concession fee
§ 19(2) Strom NEV
Interruptible loads surcharge

Grid usage fee
EEG surcharge
CHP surcharge
surcharge
VAT
+
Concession fee
§ 19 NEV surcharge,
Interruptible loads surcharge

We need a definition of storage as 4th column of the energy system – besides generation, transport and consumption



Source: BVES + DIHK, Faktenpapier Speicher, p. 11

The EU is moving forward!

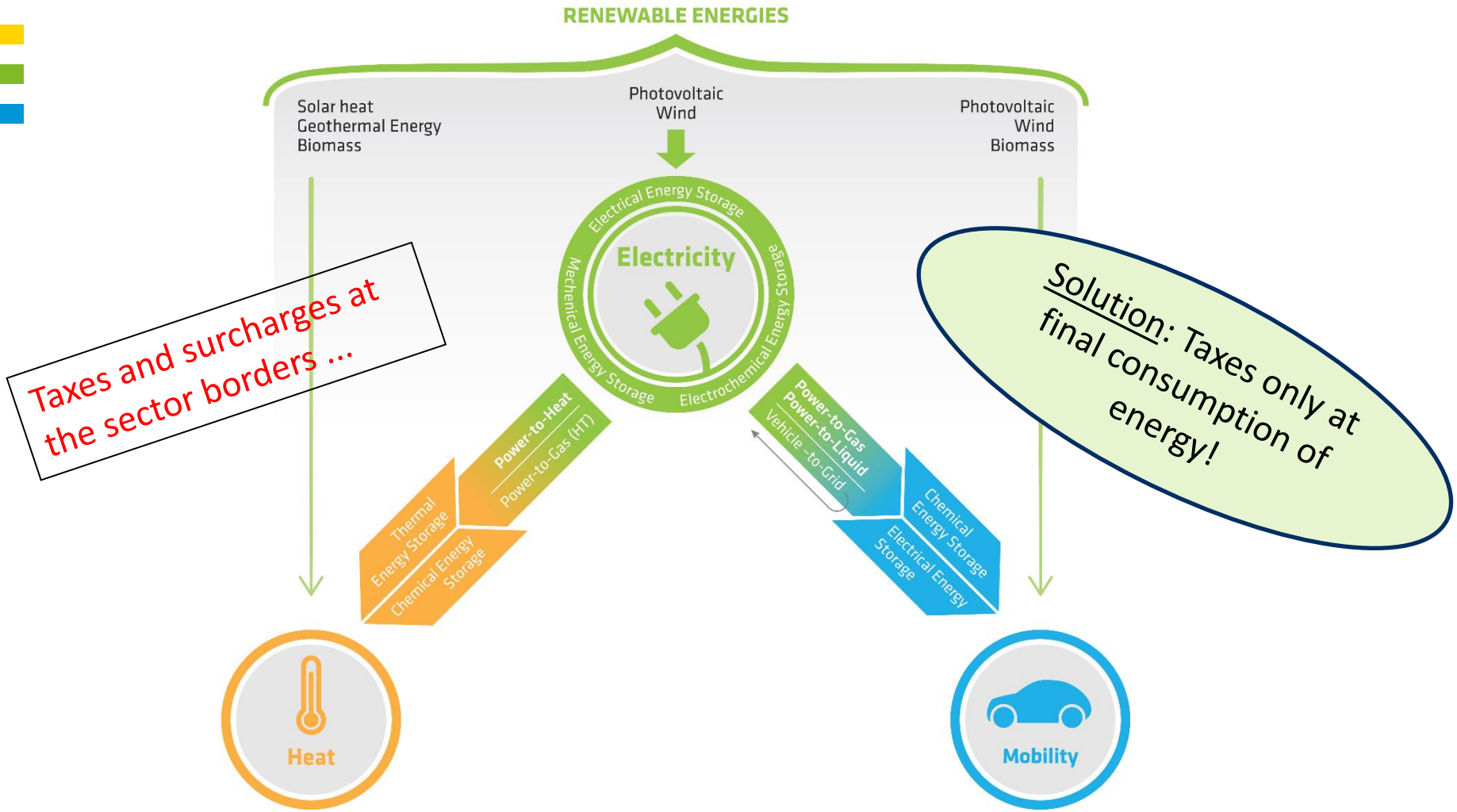
EU Market Design Directive (EBM-RL)

- Energy storage as an essential element for flexibility and stability in the energy system.
- Suitable Definition of energy storage: Storage as a **time shift of energy**.
- Opening up the energy markets for the active customer (Prosumer).
- The decentral active customer is a main player in the future energy system
- The Right for multi-use of the energy storage system (also for large storage systems in the tender by network operators and operation by third parties.)
- Elimination of double burdens on stored energy.
- Lower bureaucratic hurdles for measuring and counting.

The EU is moving forward
...and Germany is (almost) following (in electricity sector)

- Energy storage as an essential element for flexibility and stability in the energy system.
- Suitable Definition of energy storage: Storage as a time shift of energy.
- Opening up the energy markets for the active customer (Prosumer).
- The decentral active customer is a main player in the future energy system
- The Right for multi-use of the energy storage system (also for large storage systems in the tender by network operators and operation by third parties.)
- Elimination of double burdens on stored energy.
- Lower bureaucratic hurdles for measuring and counting.

Tear down walls …
From an electricity- to a united energy-system



Tear down walls …
From an electricity to a united energy system

RENEWABLE ENERGIES

Solar heat
Geothermal Energy
Biomass

Photovoltaic
Wind

ovoltaic
Wind
iomass

Taxes and surchar
the sector borde

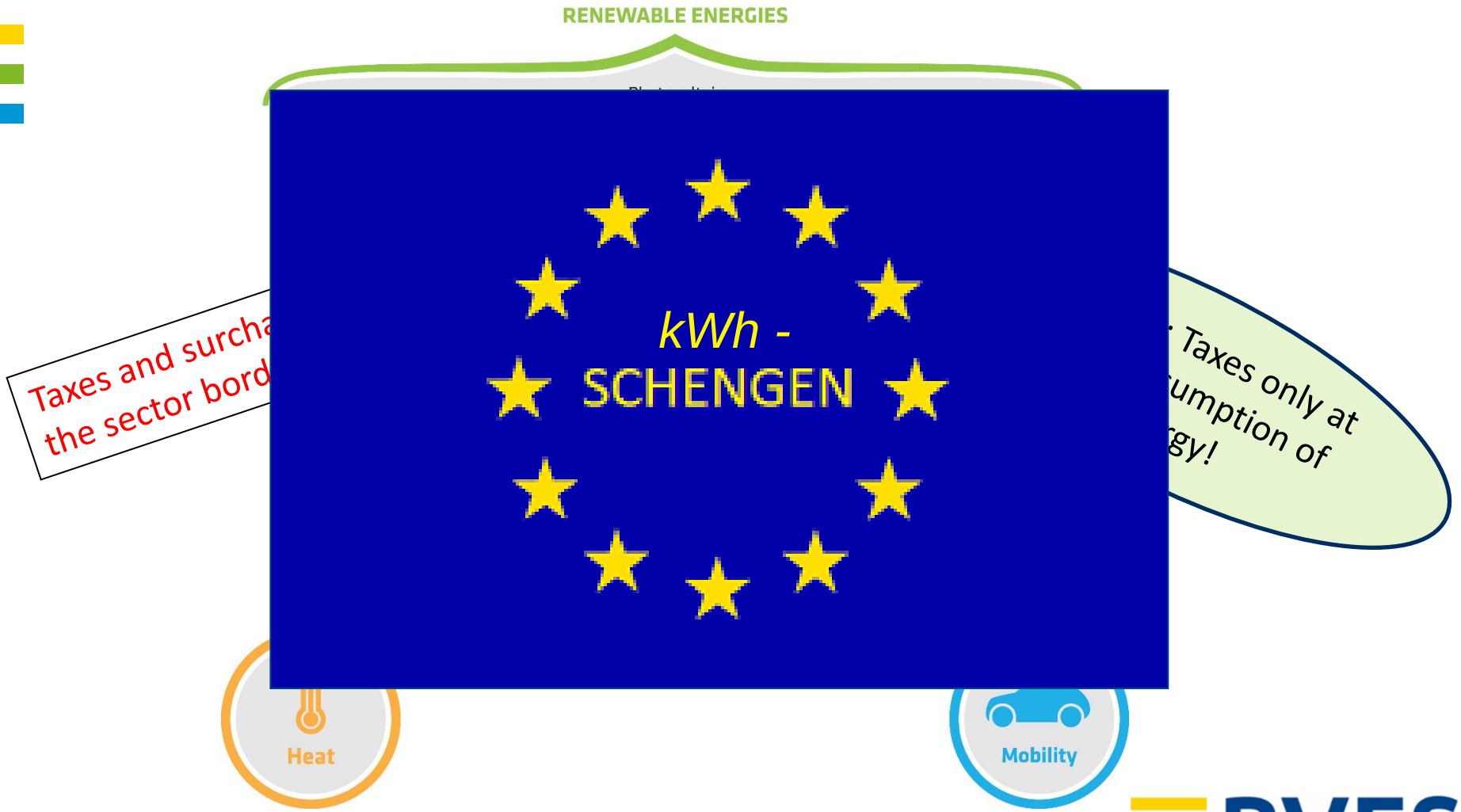
Solution: Taxes only at final consumption of energy!

Heat

Mobility

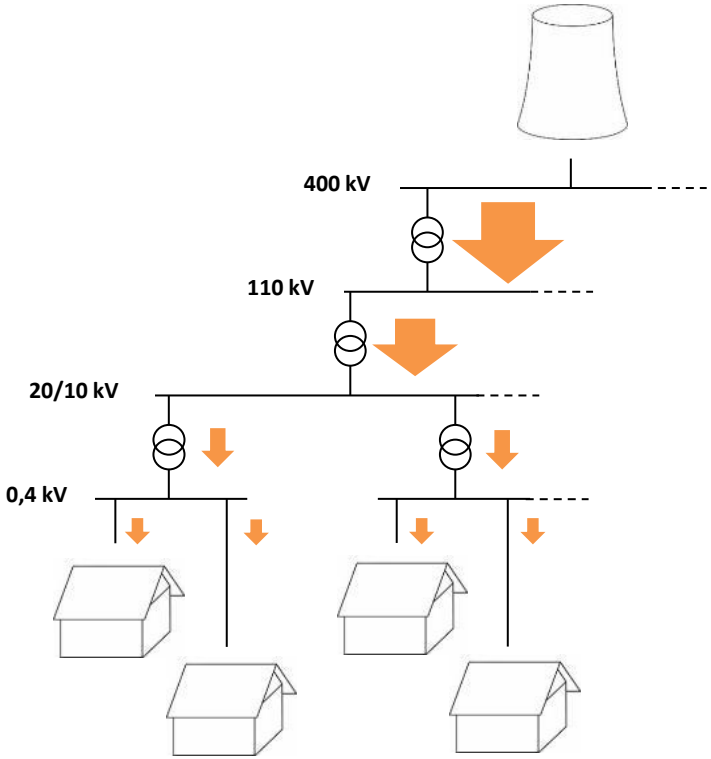
BVES
Energie·Speicher·Systeme

Tear down walls …
… and let it flow! A Schengen Agreement for the kWh

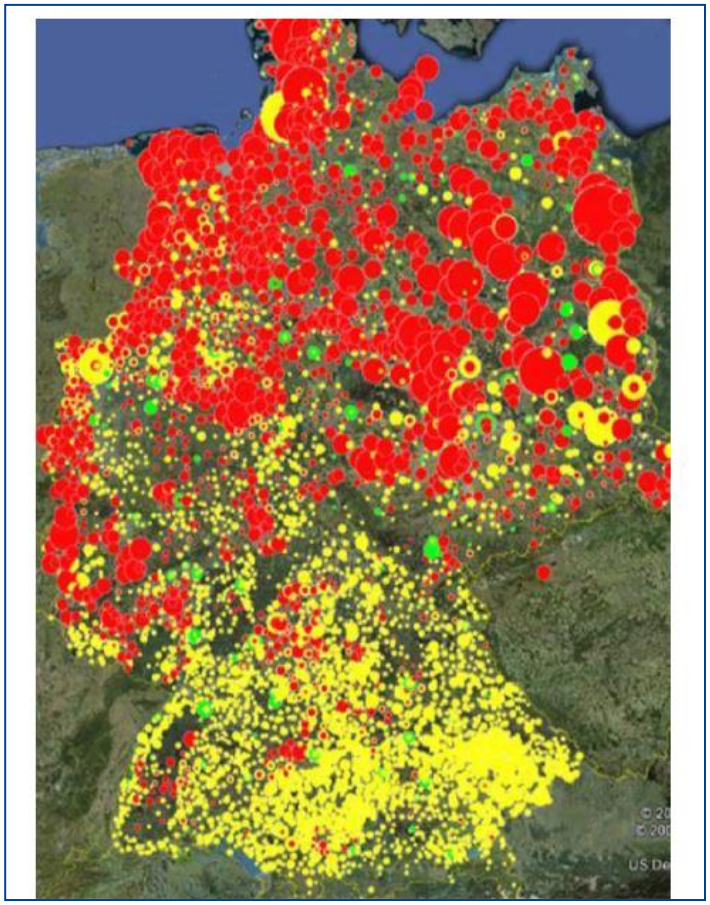


BVES
Energie·Speicher·Systeme

Energy law is mainly still based on the old energy system...



...and not suitable for the new energy reality!



Thank You!

Follow us:

@BVESeV:

www.bves.de