

FORECASTING AND MARKET REALITY: EXPLORING THE FUTURE OF E-MOBILITY



Source: Swissgrid, Strategic Grid 2025

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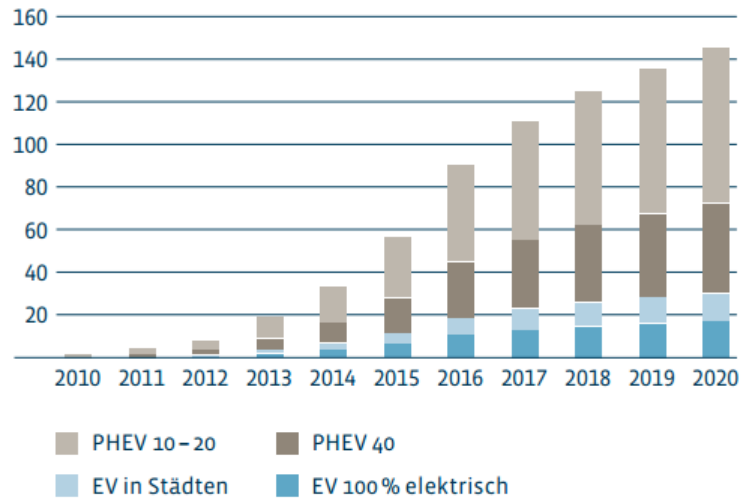
Company Presentation of the BKW Group

#REMforum 2017
May 11 & 12, 2017 - St.Gallen

Forecast for the development of the e-mobility market in Switzerland

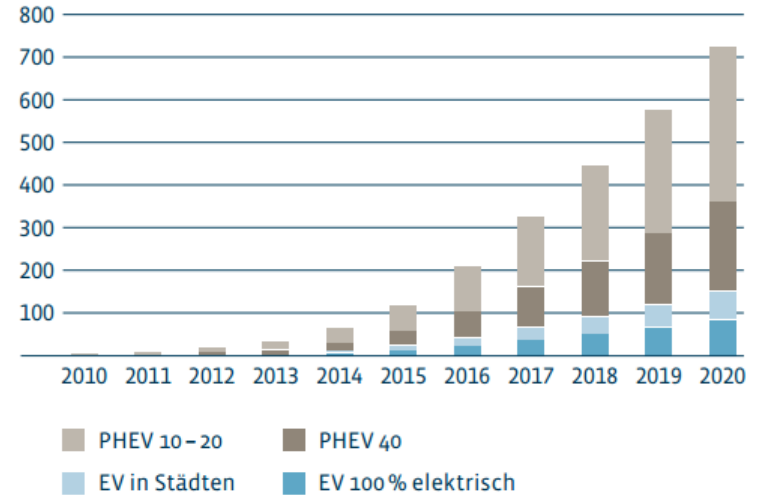
Swiss Road Map to e-Mobility (Vision 2020)

New Registered e-Cars for 2020 [1'000]



Quelle: Protoscar

Total Sum of e-Cars for 2020 [1'000]



Quelle: Protoscar

In 2020 there will be 720'000 e-Cars.

Source: Schweizer Forum Elektromobilität; Schweizer Road Map zur Elektromobilität, 2012 and Alpiq, 2010

Today's' status vs. Swiss e-Mobility Vision 2020

| E-Mobility | Today (Q1/2017) | 2020 (Targets*) |
|---|---|---|
| Passenger Cars: - BEV - HEV | ~ 11'000 ¹ (+ 1051 Q1/2017) ~ 65'000 ² (+ 556 Q1/2017) | 720'000 e-Cars (15% Share) |
| Charging Infrastructure : - Charging Places - Plugs | ~ 2'500 ~ 6'000 | <ul style="list-style-type: none"> • 600'000 sleep&charge (Home Plug) [400V/10kW] • 60'000 work&charge (Business & Office) [400V/10kW] • 30'000 shop&charge [DC fastcharge 50kW] • 150 coffee&charge (superfastcharge station with multiple plugs) [DC 150_{Tesla}-350_{CCS}kW] |

~10% of Target

640'000 more e-Cars and 680'000 more infrastructure items in less than 3 years?

How realistic is it, to sell or build more than 220'000 each year until 2020?

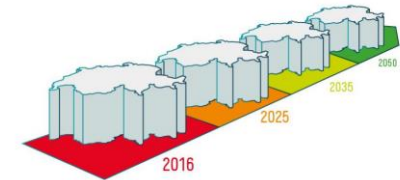
¹ 6'366 by end of 2015 (0,2% of the entire stock of 4.5 million passenger cars), 3'525 in 2016, + 1'051 Q1/2017

² 62'660 Hybrids by Q1/2016, + 556 Q1/2017

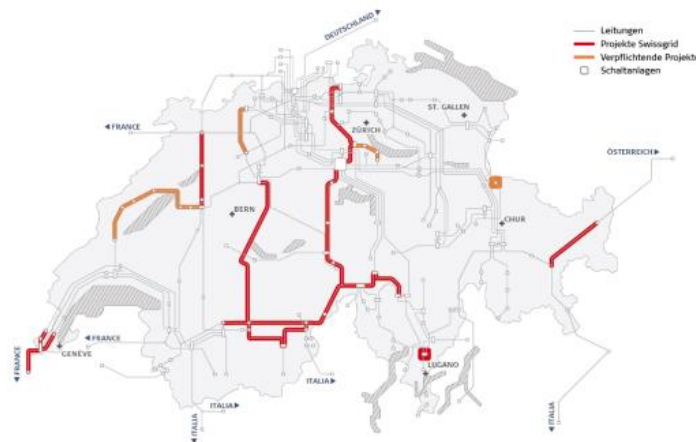
Impacts from the Energy Strategy 2050



STRATEGIE STROMNETZE AUSGANGSLAGE



ENERGIESTRATEGIE 2050 NACH DER
SCHLUSSABSTIMMUNG IM PARLAMENT



Quelle: Swissgrid

Handlungsbedarf bei den Stromnetzen

- Engpässe und Erneuerungsbedarf im Übertragungsnetz
- vermehrt dezentrale Energieversorgungsstruktur

Aber: Schleppende Weiterentwicklung

- Diverse Interessenkonflikte
- Ungenügende Transparenz der Prozesse
- Fehlendes Verständnis der Bevölkerung
- Mangelnde gesellschaftliche Akzeptanz

Key Take Aways

Forecast for the development of the e-mobility market in Switzerland

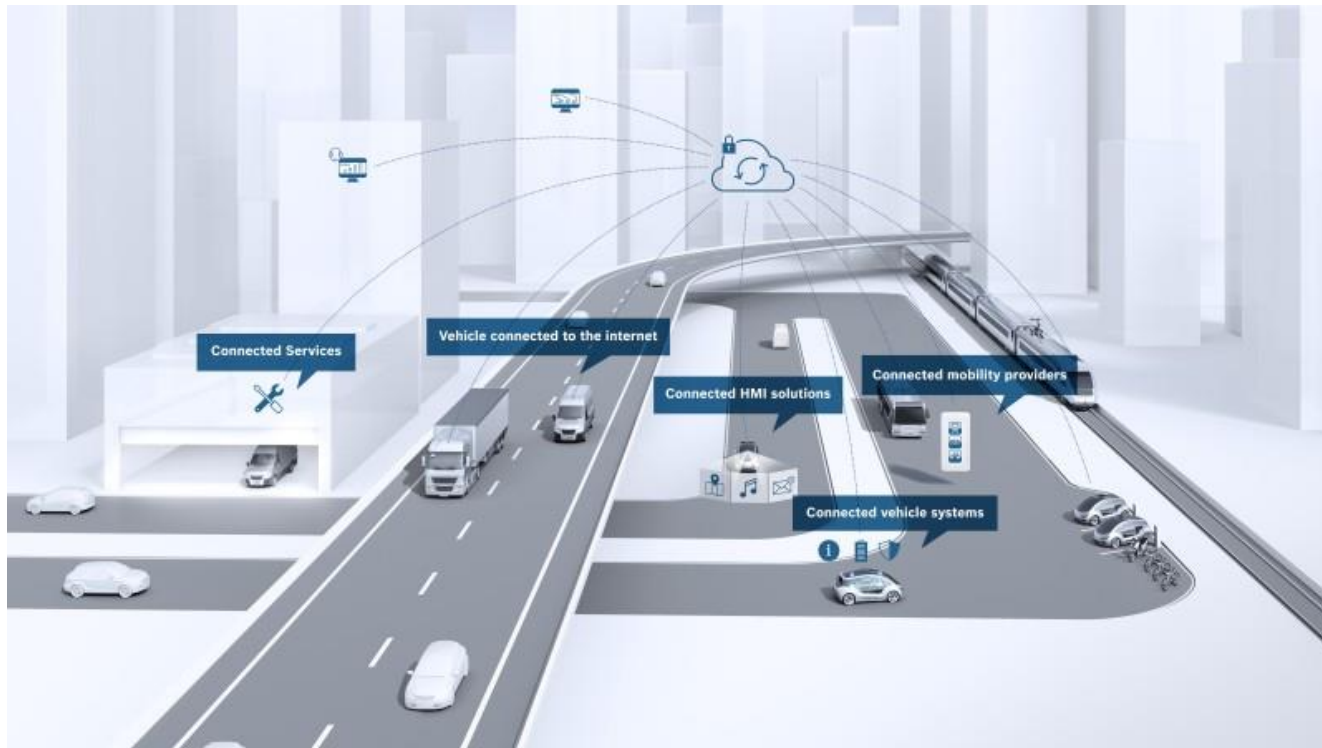
- The envisioned 720'000 e-Cars in 2020 seems to be not reachable with the actual speed of 1'100 cars per quarter, compared to an average of 70'000 cars per quarter. However, even with less e-Cars, the increase of e-Cars brings a lot of technical and political challenges.
- The Swiss Road Map to e-Mobility does not address the storage capacity of about 42 GWh on the streets that we will have to handle (5,6 times the Grimsel PHSP with a daily production of 7,5GWh).
- E-Cars and the electrification of the entire fleet of buses make the grid expansion more expensive: In order to supply electricity to the car charger, the electricity network must be significantly expanded¹. We are facing a lack of social acceptance, the private person is not willing to pay for all the upcoming costs (15% e-Cars share in 2020).
- e-Mobility and the Internet of Things (IoT), have to be considered a major disruption for the grids and the utility industry. The upcoming internet of cars, with its billions of intercommunicating devices, needs new technologies and regulations. New entrants will change the rules, like Uber or AirBnB did in their industry.

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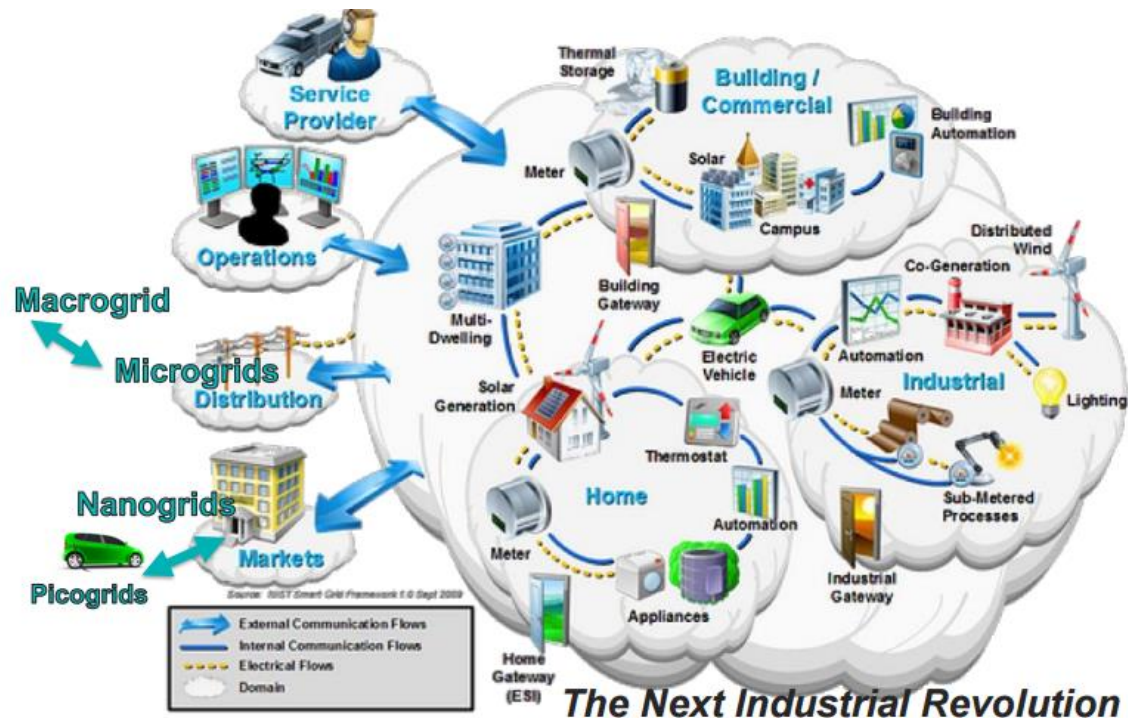
Future business opportunities associated with e-mobility in Switzerland

The Internet of Cars

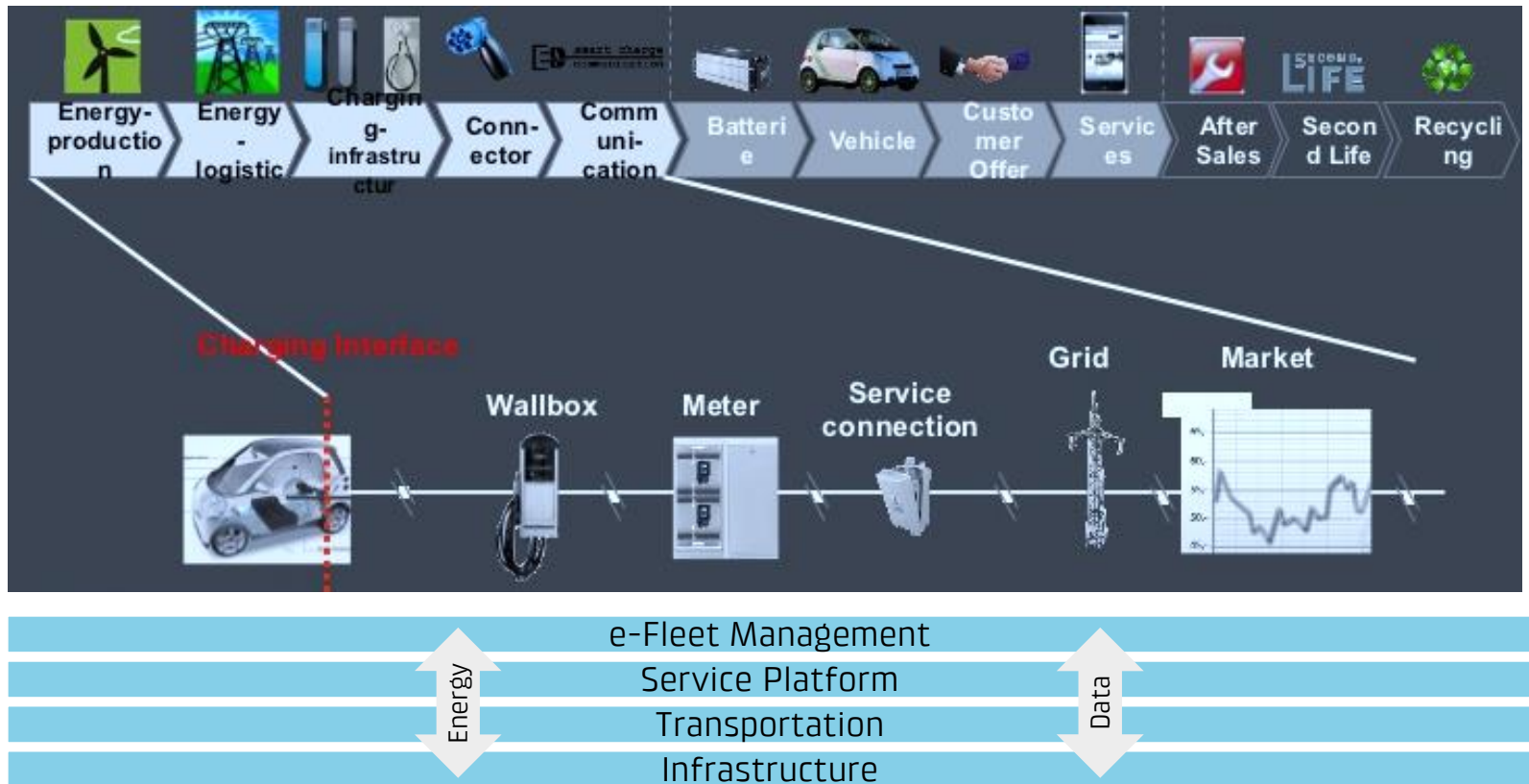
Until 2020, 26 billions of devices will be connected with the grid



Making Smarter & Integrated Sectors for Grids & Vehicles & Buildings & Industries is a Key



Being part of the e-Mobility value chain



BKW SmartGrid Solutions (extract)



Grid Box

- Informs when and where and how much current flows in the grid.
- Pilot project BKW, ewz, with the support of the BFE.
- Devices with later control and management functionality.



Intelligente Rundsteuerungsanlage (SmartRSA)

- Enables flexible adaptation of today's ripple-control technology, which is used for switching on and off water boilers, heat pumps and electric storage heaters.
- Software supported calculation of the accumulated current load several times per day.



Regelbarer Ortsnetztransformator (RONT)

- Delivers the required amount of electricity into the households and regulates the supply voltage.
- The amount of solar electricity flowing back into the grid is difficult to calculate. RONT ensures network stability.

BKW's biggest solar carport in Switzerland

Extending the e-Mobility Value Chain



Video (aerial view): <https://vimeo.com/182192417>

Key Take Aways

Future business opportunities associated with e-mobility in Switzerland

- Building of a reliable infrastructure is a major problem, also with regard to plugging and charging capacity. SmartGrid and SmartMetering are the key.
- Roaming of e-Cars batteries that return unmanaged (uncontrolled) power needs new technologies for Demand Response Management.
- An increasingly interdependent new ecosystem of entities are collaborating and competing to establish their position in the e-mobility solutions and energy market. Utilities can focus on the infrastructure or endeavor in new business models.
- Extend or be part of the e-Mobility value chain: Vehicle2Grid, Demand Response Management, Identifying the customer, measure the electricity delivered, and handle billing.
- With "The Digital Future of Grids", the author addressed the digitally enabled grid posing the question of what the future of the utility distribution business would be.
- The merge with Information and Communication Technologies is unavoidable. Future Business Models will be based on Blockchain and Cloud, Intelligent (smart) Home and decentralized Energy Production, Preventive Maintenance, and Open Technologies (e.g. Open Source for Software).



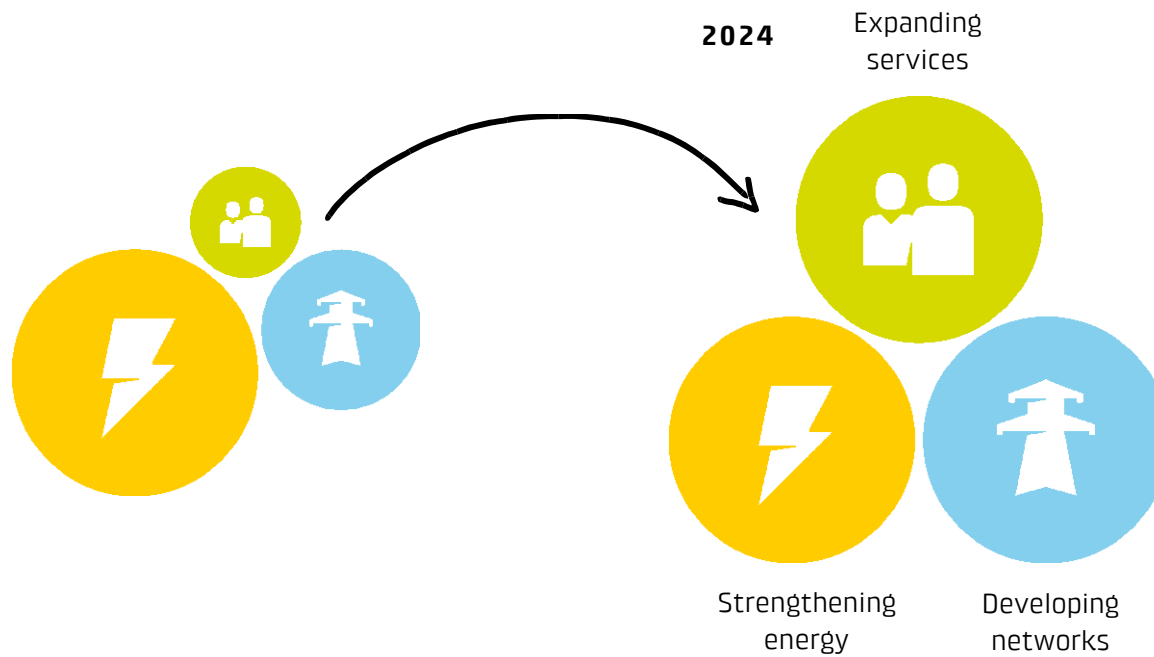
The BKW Group

COMPANY PRESENTATION



Our strategy at a glance

We are evolving from a traditional electricity producer to a leading provider of energy and infrastructure services



We are investing in the future

Investments in CHF between now and 2024

New investments in renewable energy

approx. 1 billion

Expansion of the service business

approx. 1 billion

Maintaining infrastructure

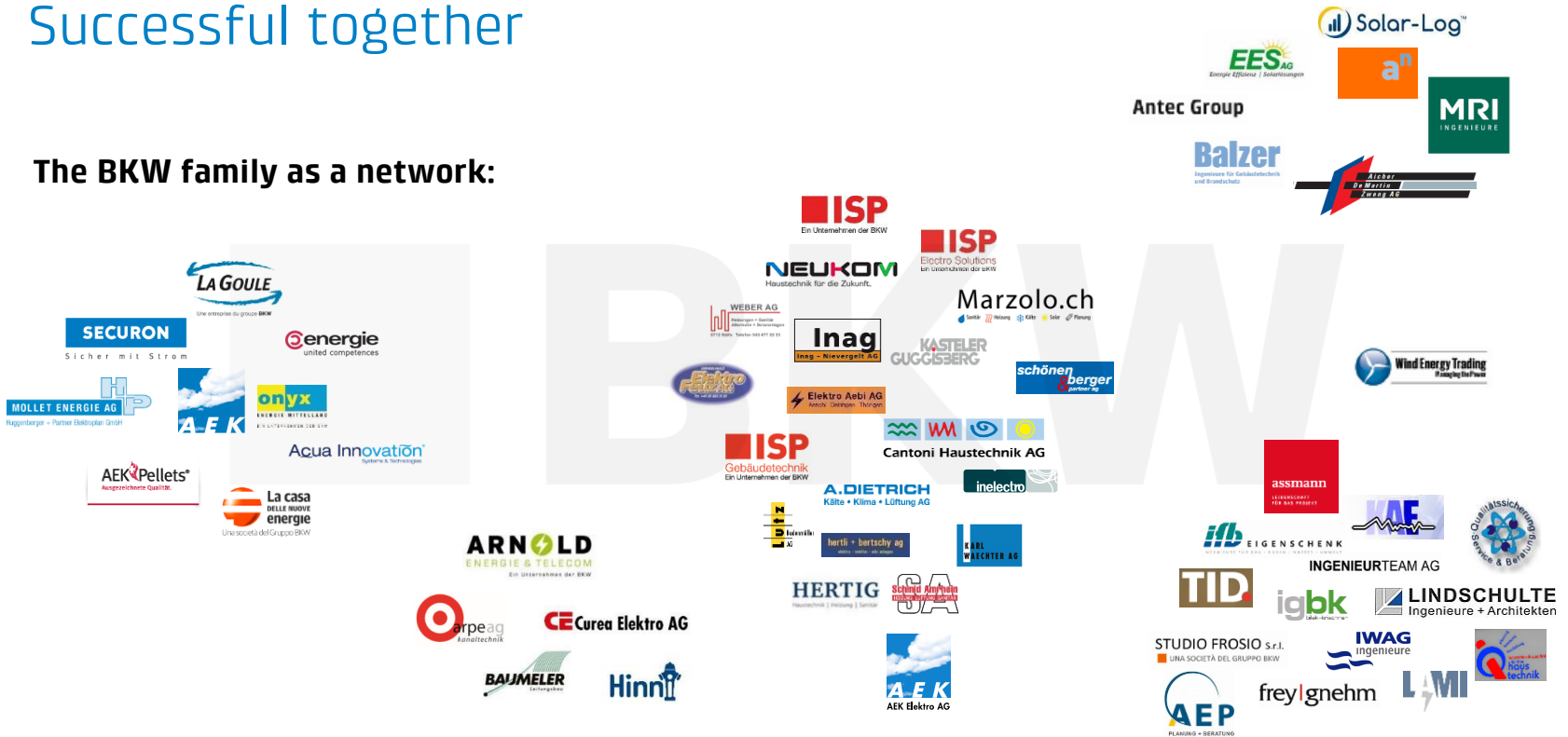
approx. 2 billion

(1 billion in networks)

} approx. 4 billion

Successful together

The BKW family as a network:

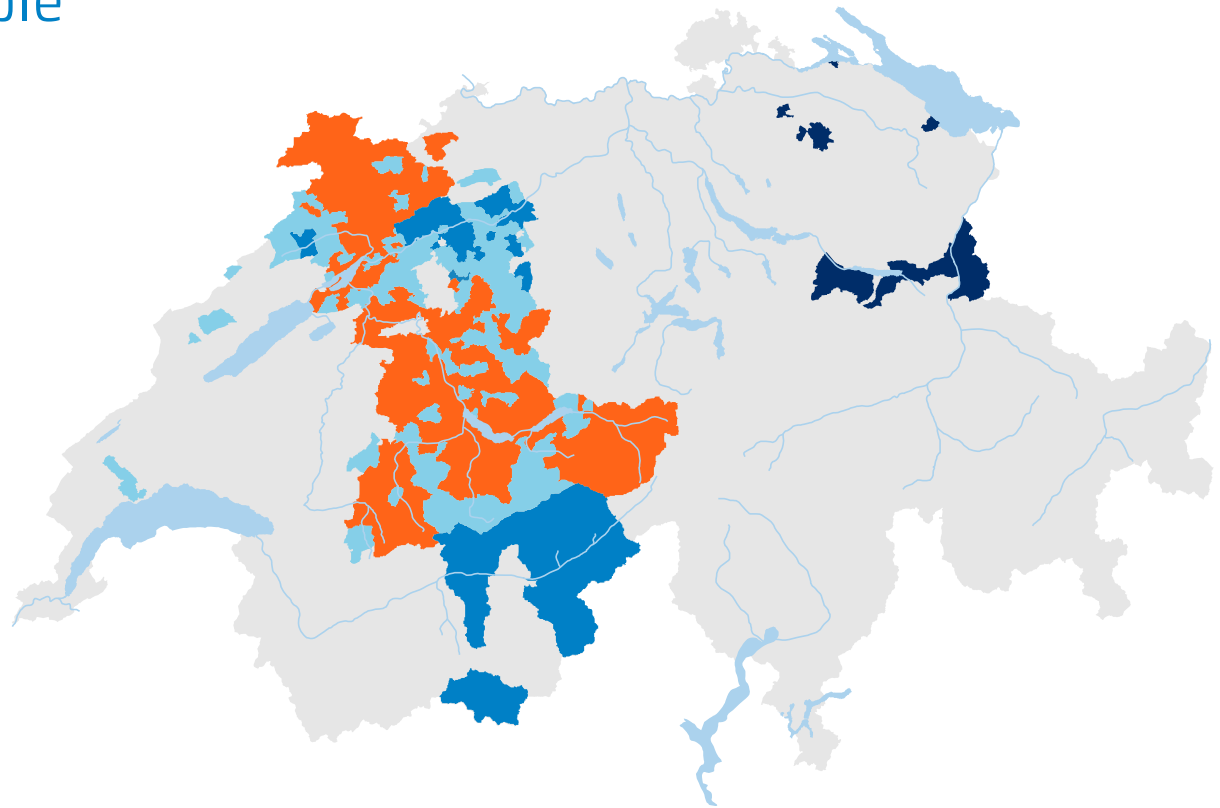


Combining expertise for our customers.

More than 6,000 qualified and motivated employees are the basis of our success in Switzerland and abroad.

Supplying power to over a million people

- Abonax
- Deviwa
- Direct supply region
- Youtility
- Group companies La Goule & AEK onyx



| | |
|-----------------------|-------------|
| Residents supplied | > 1 000 000 |
| Private customers | 362 204 |
| Business customers | 3 055 |
| Distribution partners | 148 |

22,000 km in length - half an orbit around the globe

Network levels 2 to 7

99.99% uninterruptible power supply in 2013

1'235 employees ensure the grid quality

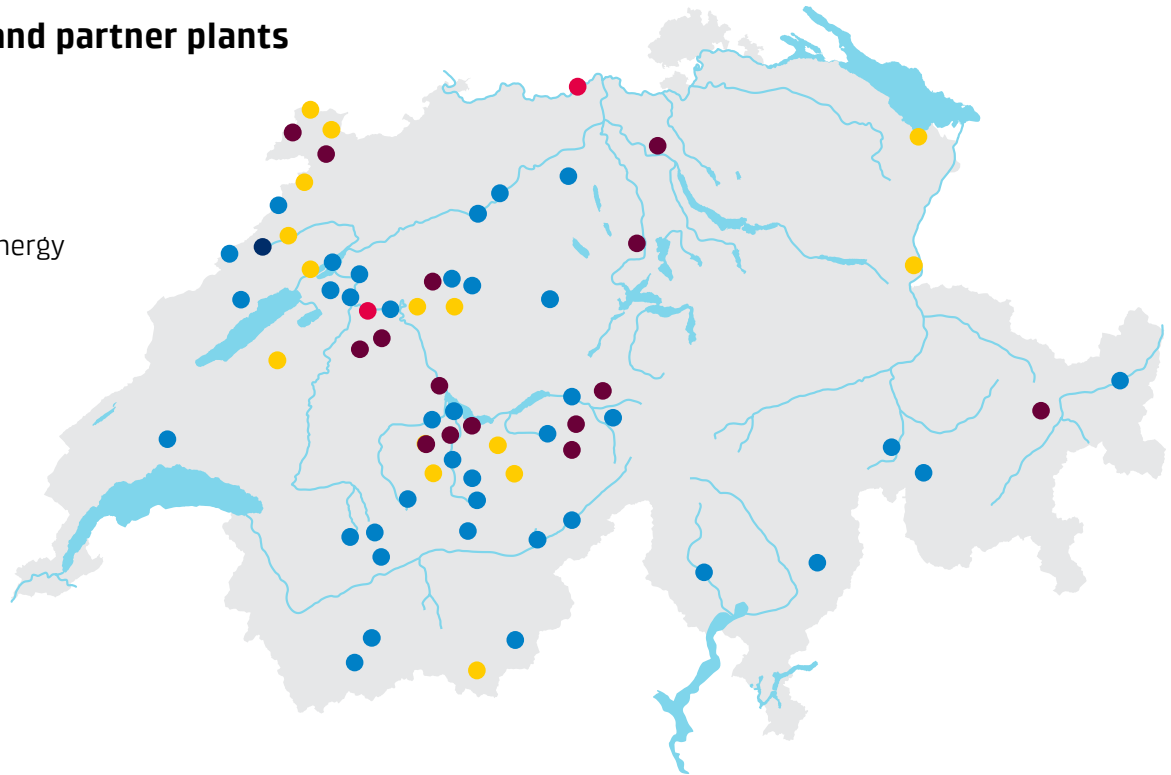
Management of the Integrated Operations Control Center in Mühleberg (24/7)

BKW owns the largest distribution network in Switzerland.

Production capacities for reliable and sustainable supply

BKW power plants and partner plants

- Hydro power
- Nuclear power
- Solar power
- Wind power
- Biomass and thermal energy



BKW's international activities

Production

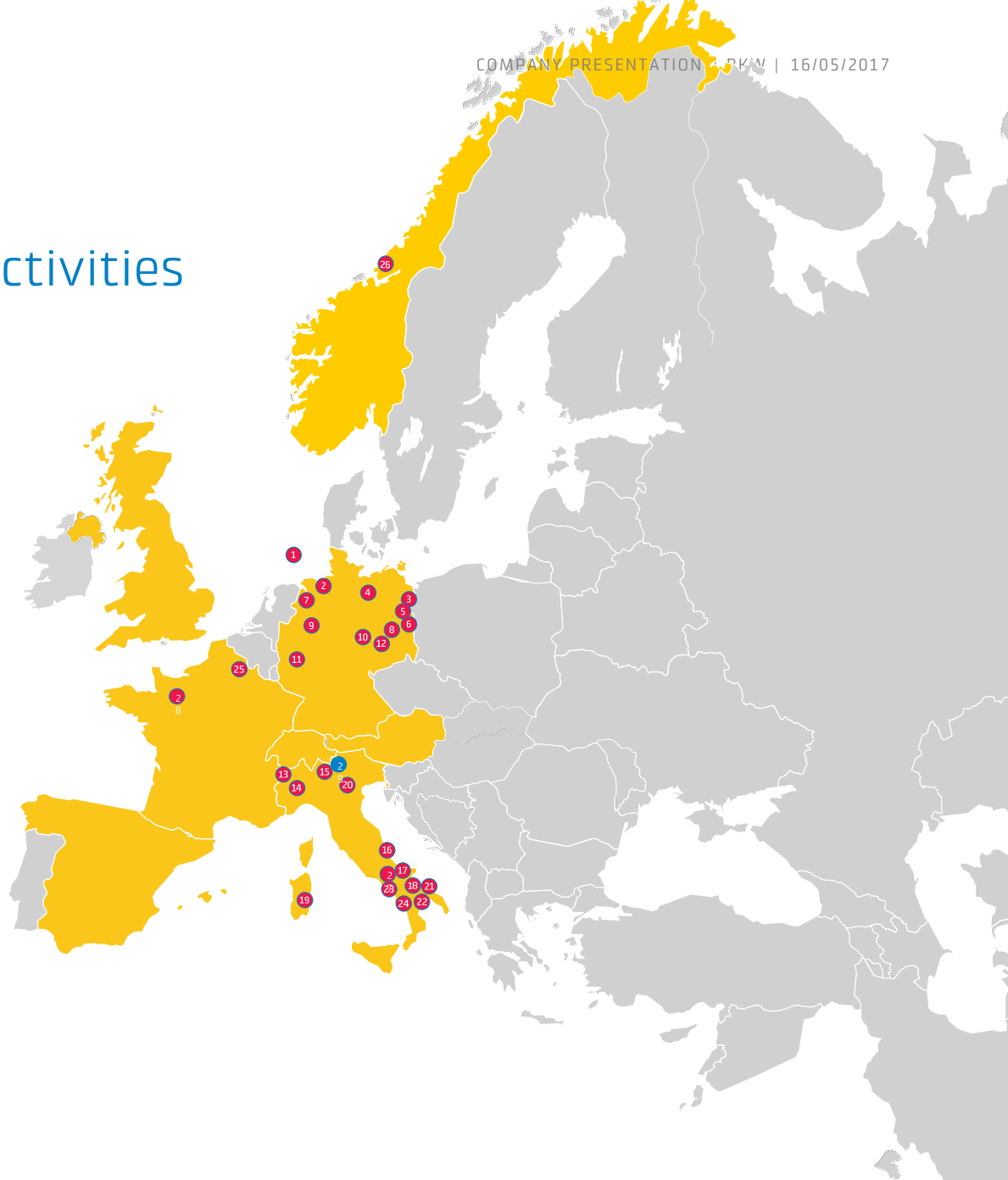
- 1 Borkum West II wind farm (4.5 %) (under construction)
- 2 Wilhelmshaven coal-fired power plant (33 %) (under construction)
- 3 Lüdersdorf-Parstein wind farm (29 %)
- 4 Gross Welle wind farm (29 %)
- 5 Prötzel wind farm (29 %)
- 6 Wülkow wind farm (29 %)
- 7 Bippen wind farm (100 %)
- 8 Dubener Platte wind farm (100 %)
- 9 Sendenhorst wnd farm (29 %)
- 10 Holleben wind farm (100 %)
- 11 Landkern wind farm (100 %)
- 12 Bockelwitz wind farm (100 %)
- 13 BKW Hydro Valle d'Aosta hydroelectric power plants (100 %)
- 14 Livorno Ferraris gas-fired and combined-cycle power plant (25 %)
- 15 Idroelettrica Lombarda hydroelectric power plants (100 %)
- 16 Tamarete gas-fired and combined-cycle power plants (60 %)
- 17 Volturino wind farm (100 %)
- 18 San Chirico wind farm (100 %)
 Monticelli wind farm (100 %)
 Spina wind farm (100 %)
 Franciosa wind farm (100 %)
- 19 BioPower Sardegna (10.5 %)
- 20 CHI.NA.CO hydroelectric power plant (100 %)
- 21 Buglia wind farm (100 %)
- 22 Green Castellaneta wind farm (100 %)
- 23 Eolo wind farm (29 %)
- 24 Ripacandida wind farm (100 %)
- 25 Fresnoy Brancourt wind farm (100%)
- 26 Fosen Vind DA wind farm (11%)
- 27 Cerreto wind farm (29%)
- 28 Ondefontaine wind farm (100%)

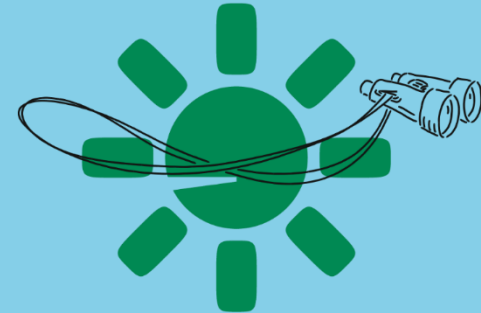
Sales

- 29 Electra Italia S.p.A. (100 %)

Trading

Electricity wholesale





Our vision

**We are shaping the future of
energy – straightforward, reliable
and networked.**



Thank you for your attention

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