SBB CFF FFS

Time-optimized Power Consumption: Towards a Smart Grid for Rail Infrastructure

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Agenda.

1. SBB: Swiss Federal Railways.

2. Top Program Energy Saving.

3. Power Management of Thermic Consumers.

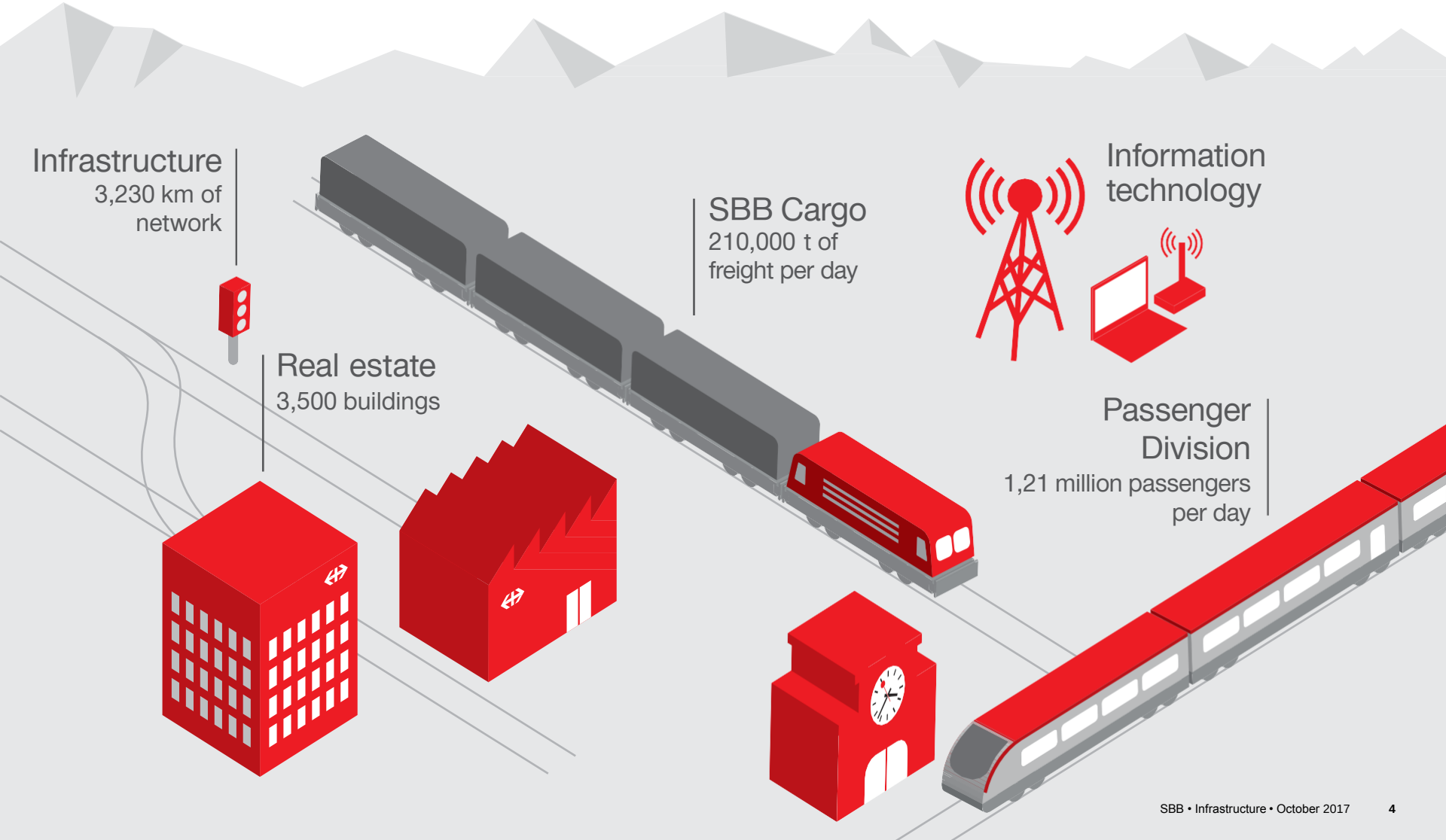
4. Questions & Answers.

With 33,000 employees from 95 countries in 150 different professions, SBB is the country's fourth-largest employer.

SBB: Swiss Federal Railways.

SBB.

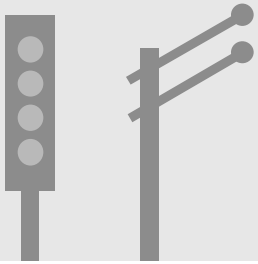
We keep Switzerland moving.



SBB Infrastructure.

3 Networks: Rail, Telecom, and Energy.

31,266 signals



12,997 sets of points

10,000 employees

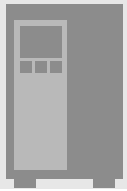
5,926 bridges

3,230 km of track

10,000 Trains each day for **20** RU

317 tunnels

7 Frequency converters

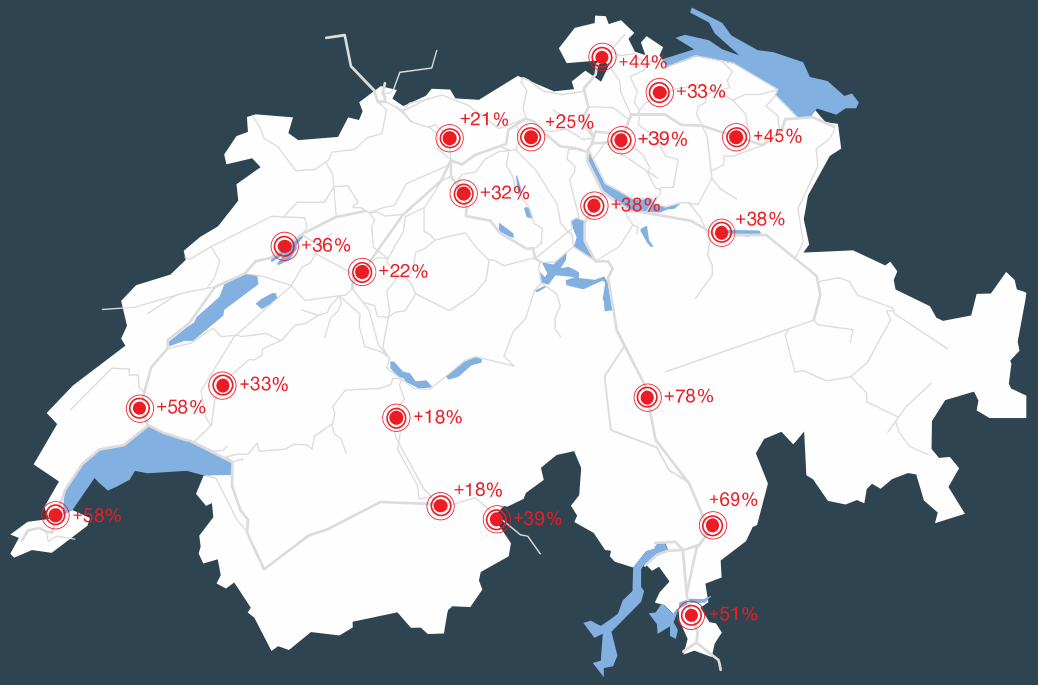


hydroelectric plants **6**

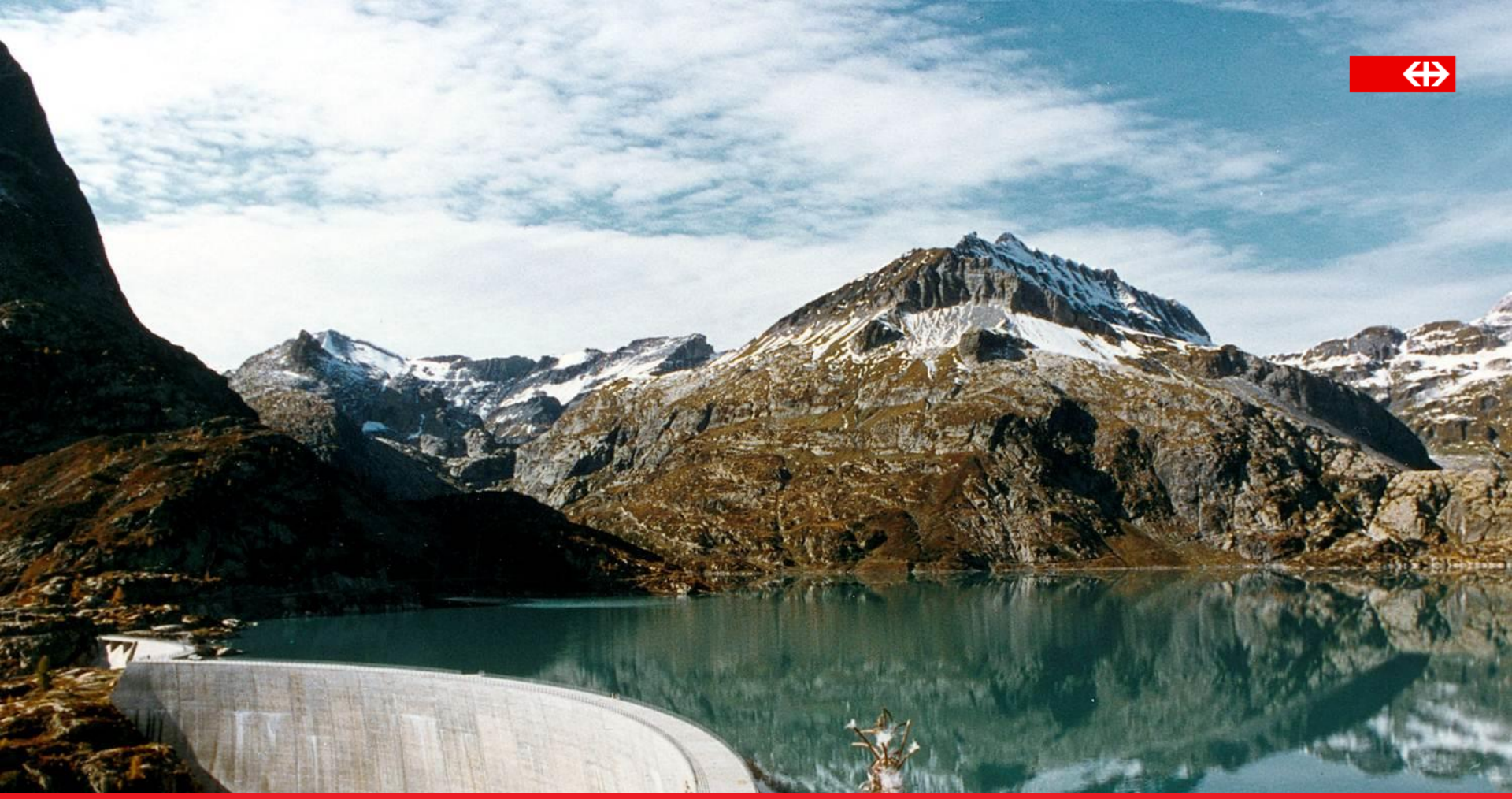
2 GSM-R operation centres

Forecast 2030: Growth.

Ever-increasing numbers of passengers & freight.



Overall growth in rail demand (pkm) of 20% to 80% between 2012 and 2030.

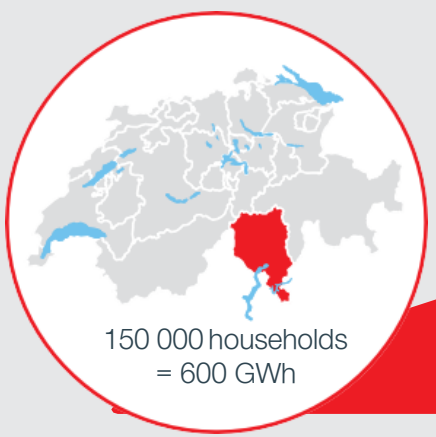


By 2030 SBB expects an average increase of
demand for energy of +25% — at peak times even up to +40%.

Top Program Energy Saving.

SBB’s overall strategy.

To reduce energy and power consumption by 20%.



Efficiency goal:
600 GWh/year from 2025

Technology

Service planning

Railway production

Anchor energy efficiency in the company

Create transparency and manage energy consumption

Our goal.
Power from 100% renewable energy.

Increasing energy efficiency:
By 2025, SBB will **save 600 GWh** of energy **per year**.
This is equivalent to savings of around CHF 80 million a year.

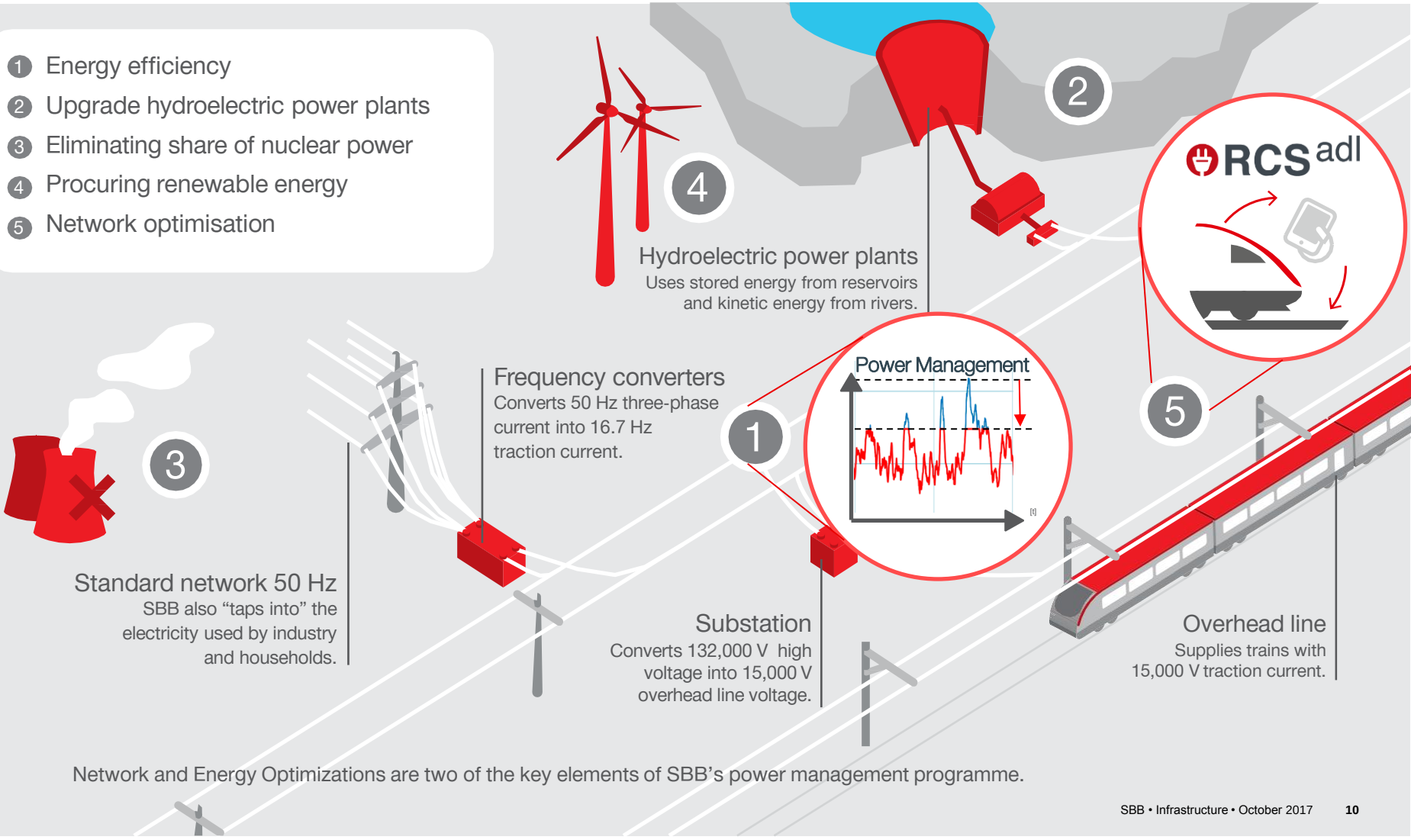
Procuring renewable energy:
SBB promotes the **build-up** of **renewable energy**.
In parallel, SBB implements a power management system
to **actively influencing** the **demand** of energy over time.

Replacing the share of nuclear power:
Energy efficiency will allow us to save energy, and thereby,
cut out the **nuclear power demand** of our portfolio.

Strategical directions of impact.

Five focus areas to reaching our goals.

1. Energy efficiency
2. Upgrade hydroelectric power plants
3. Eliminating share of nuclear power
4. Procuring renewable energy
5. Network optimisation



Network and Energy Optimizations are two of the key elements of SBB’s power management programme.

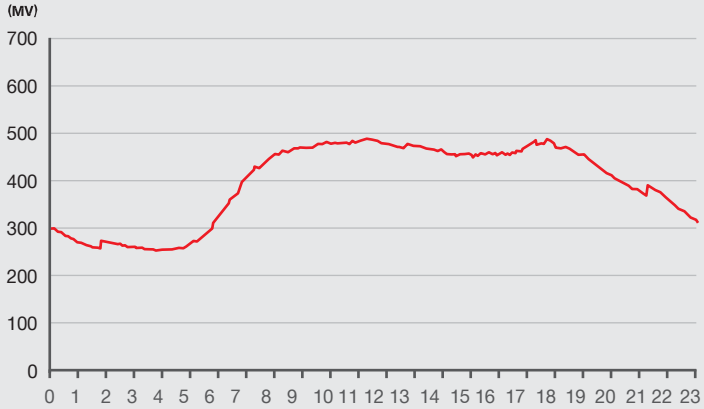
Introduction of power management to reduce peaks by controlling electrical consumers of up to 150 megawatt [MW] by 2025.

Power Management of Thermic Consumers.

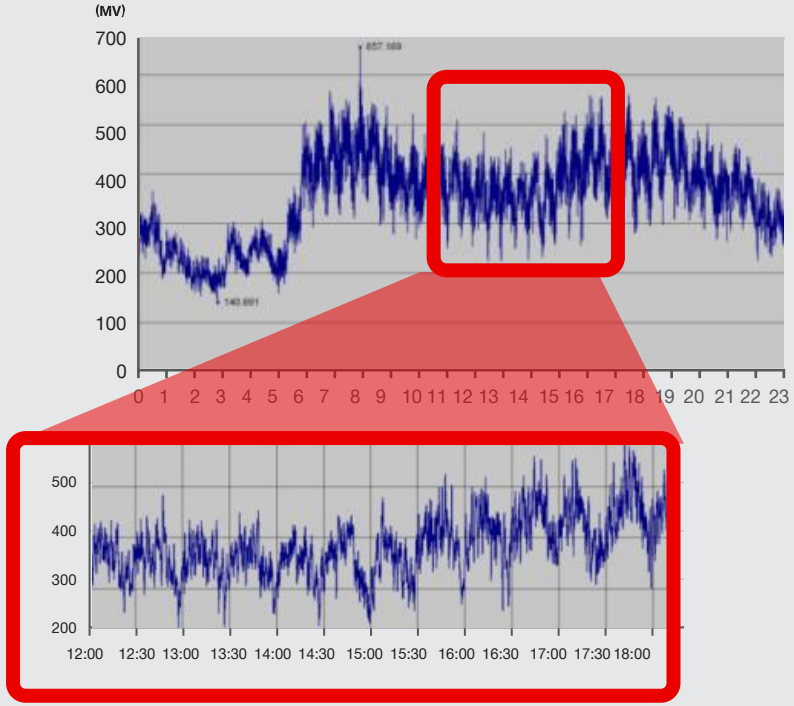
Traction current network vs. 50 Hz network.

Load dynamic in short time periods makes the difference.

1 day in Zürich city



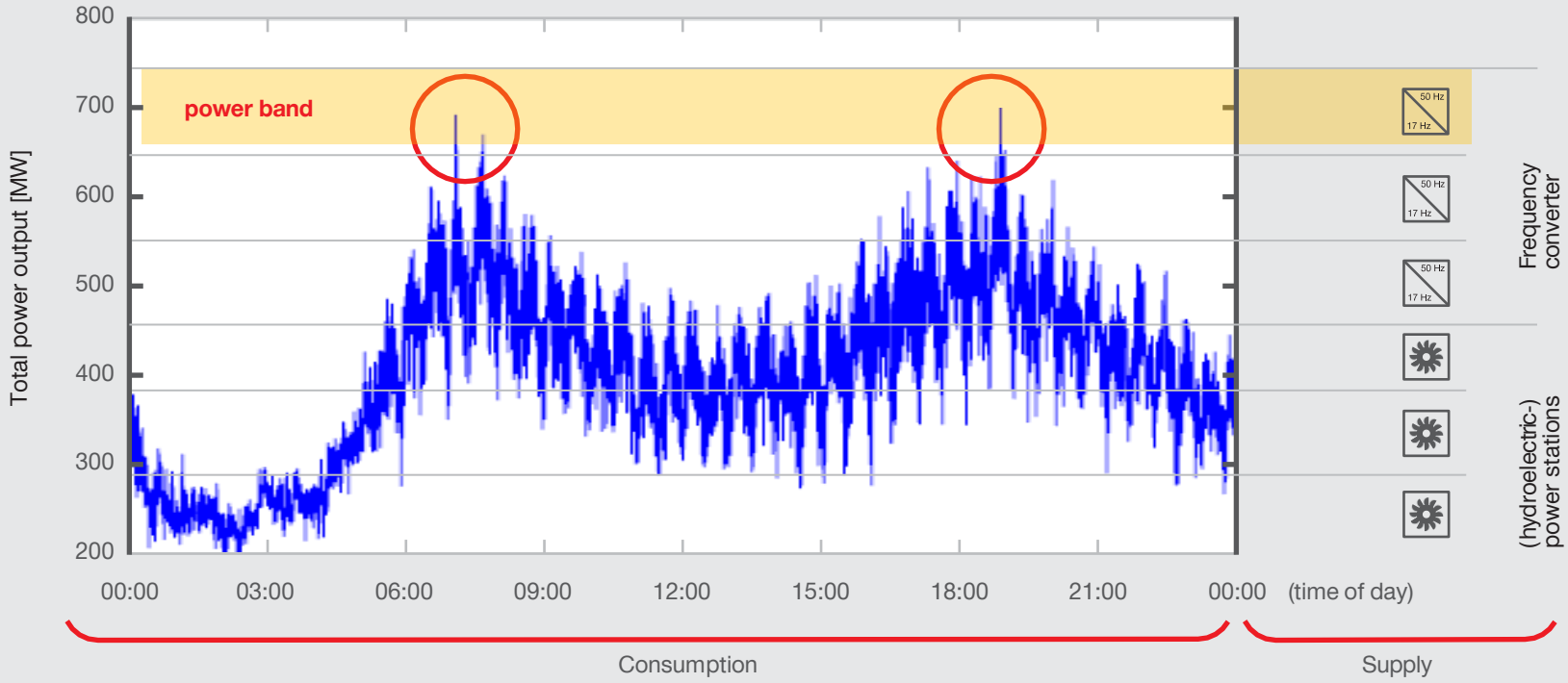
1 day at SBB



Load changes	Zürich city	SBB
daily	up to 250 MW	up to 500 MW
within 15 min.	up to 35 MW	up to 300 MW
	~7% of the daily maximum load	~50% of the daily maximum load

The traction current network is highly dynamic → management & control is challenging

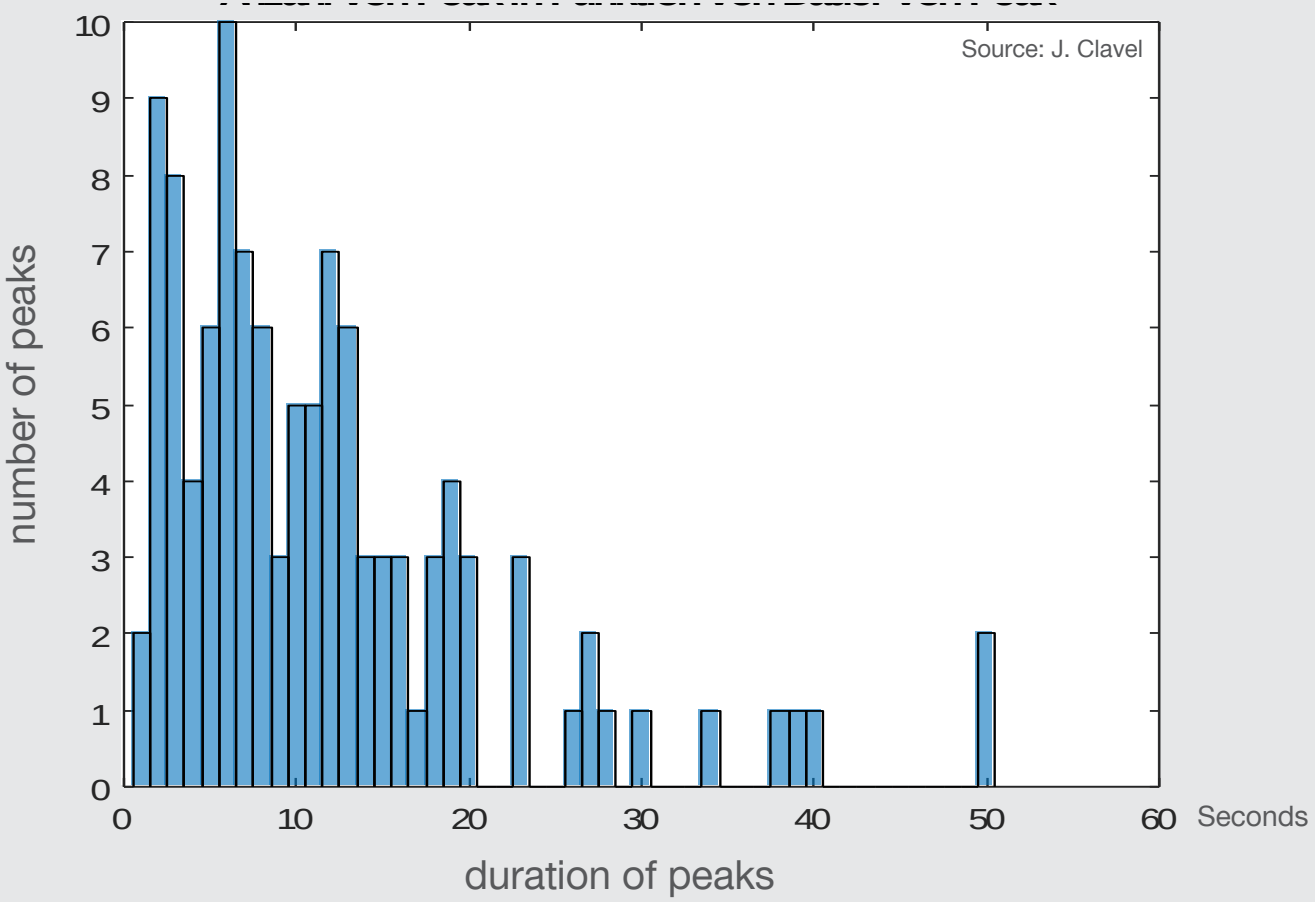
First step towards power management.
Peak shaving.



- → Peaks occur only for a short period of time; typically less < 1 minute
- → Peaks are steep: ascending up to+25 MW/s; descending up to -15 MW/s
- → A few peaks a year require the supply of an additional power band

Peaks occur typically < 1 minute during winter the winter.

Distribution of peaks according to their duration.



Peak shaving approach.
Background and objectives.

Increasing energy efficiency in rail power at peak times.

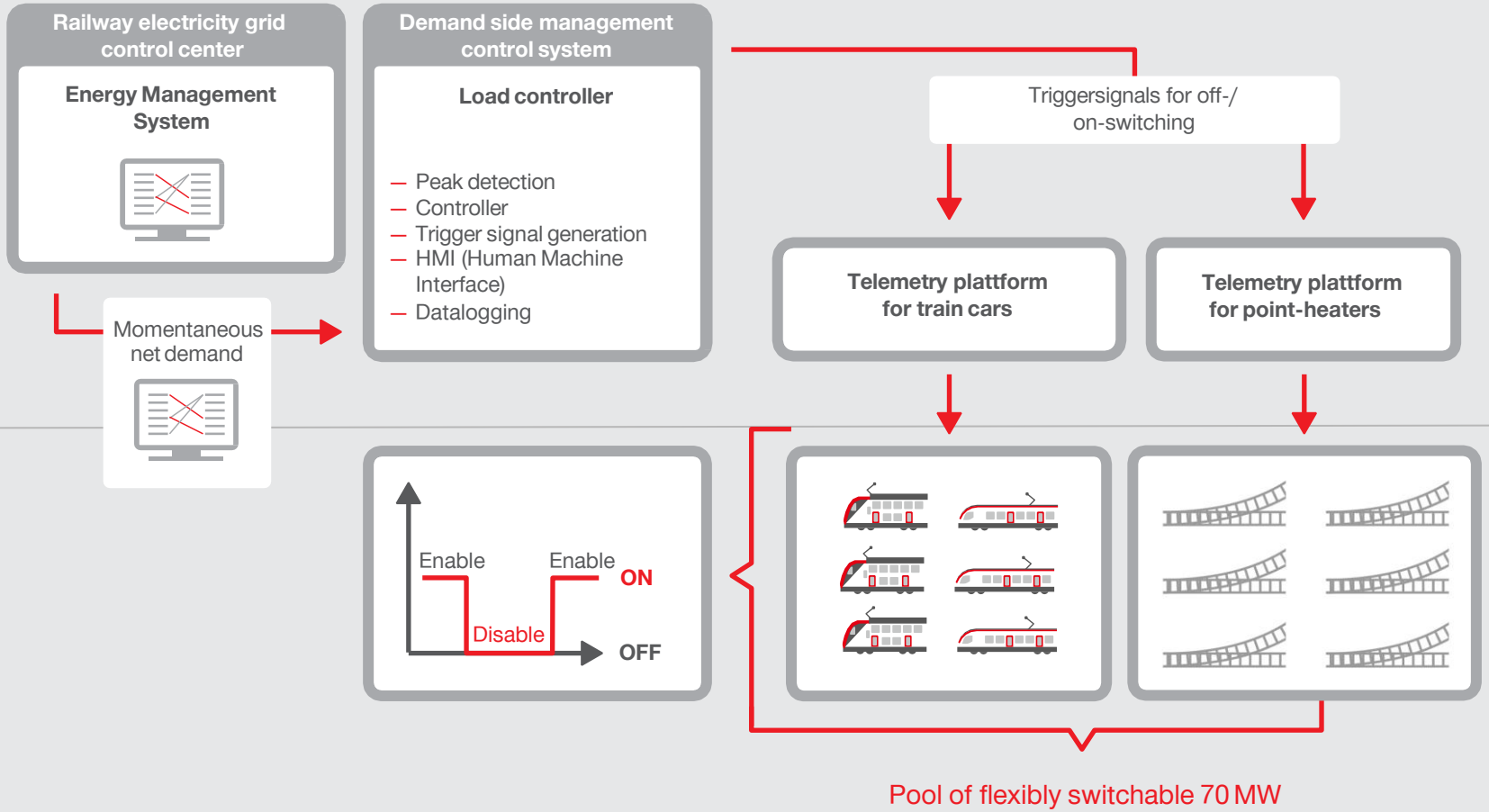
- ➔ Using existing infrastructure at maximum capacity thanks to optimal operation.
- ➔ Avoiding additional invests due to ever increasing peaks power peaks.

First step: Peak shaving of thermic consumers.

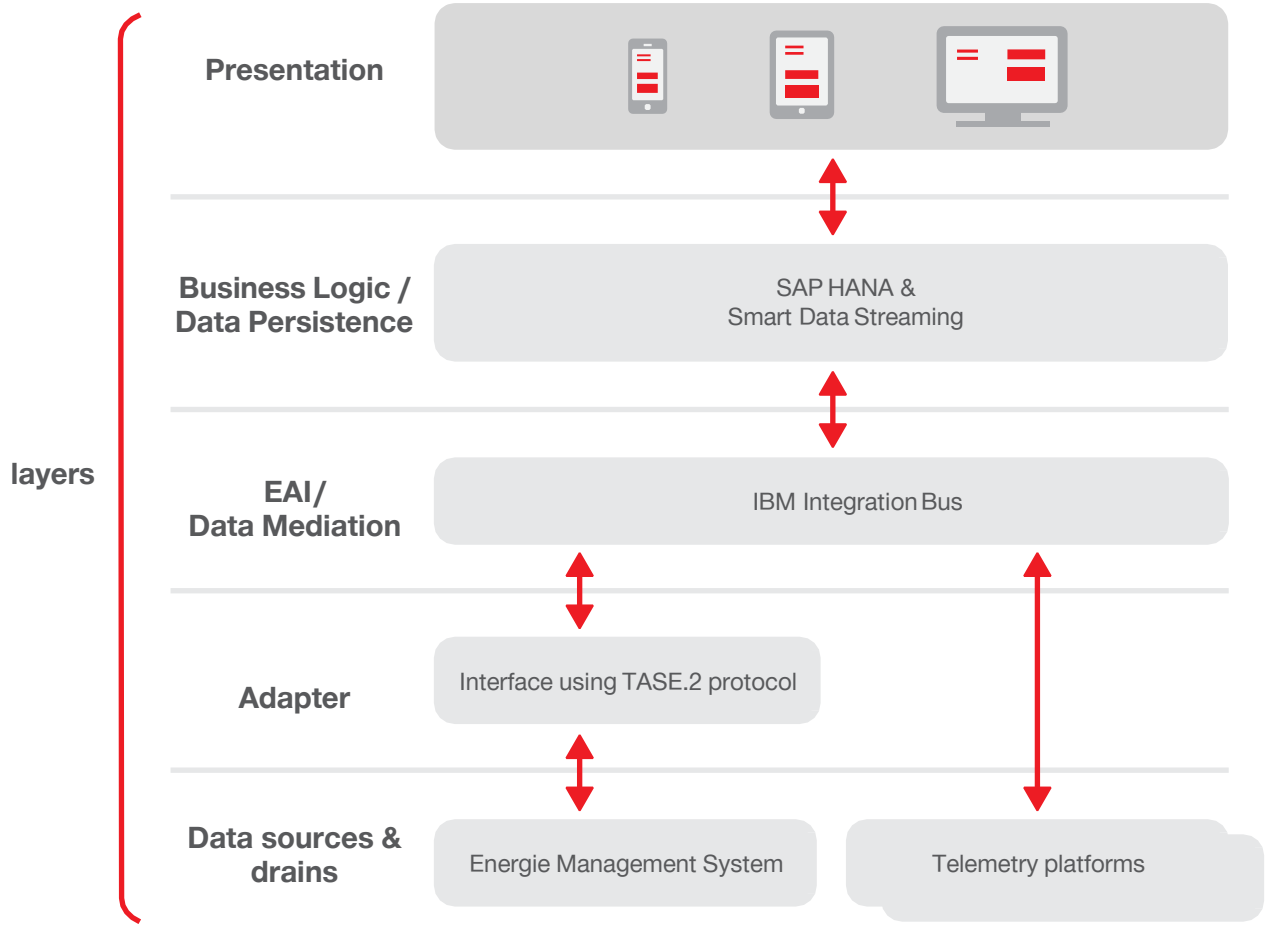
- ➔ Detection of threshold violation in real-time within fractions of a second.
- ➔ Load peaks will be clipped by up to 70 MW by shutting off thermic consumers.

System components.

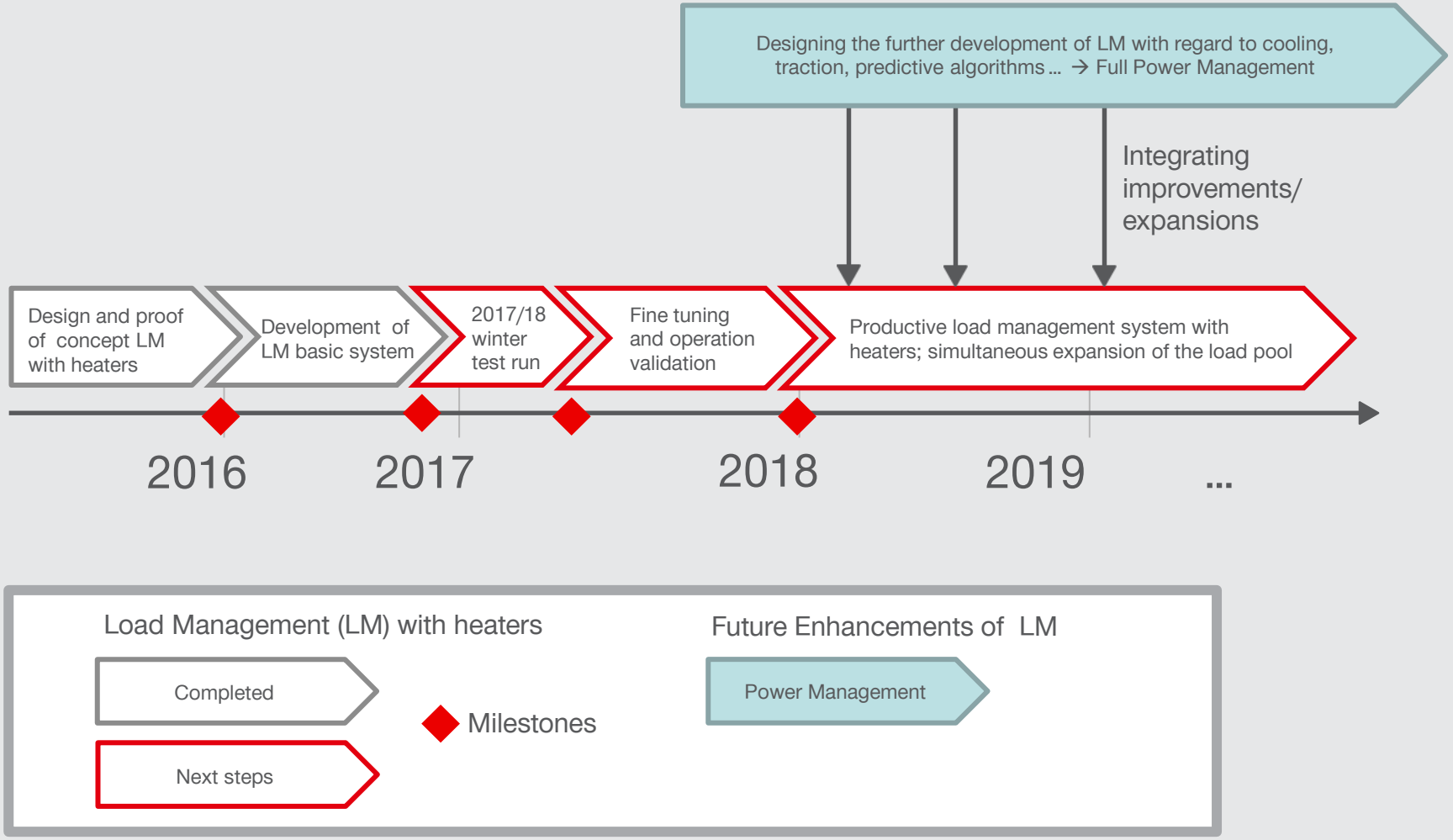
Load management with point- and train car-heaters.



Laying the ground for the future.
High-level system architecture.



Time line.
Next steps and future enhancements.



Questions & Answers.

Contact.

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