Norwegian experience – energy efficiency and cost reducing measures in the railway electricity network

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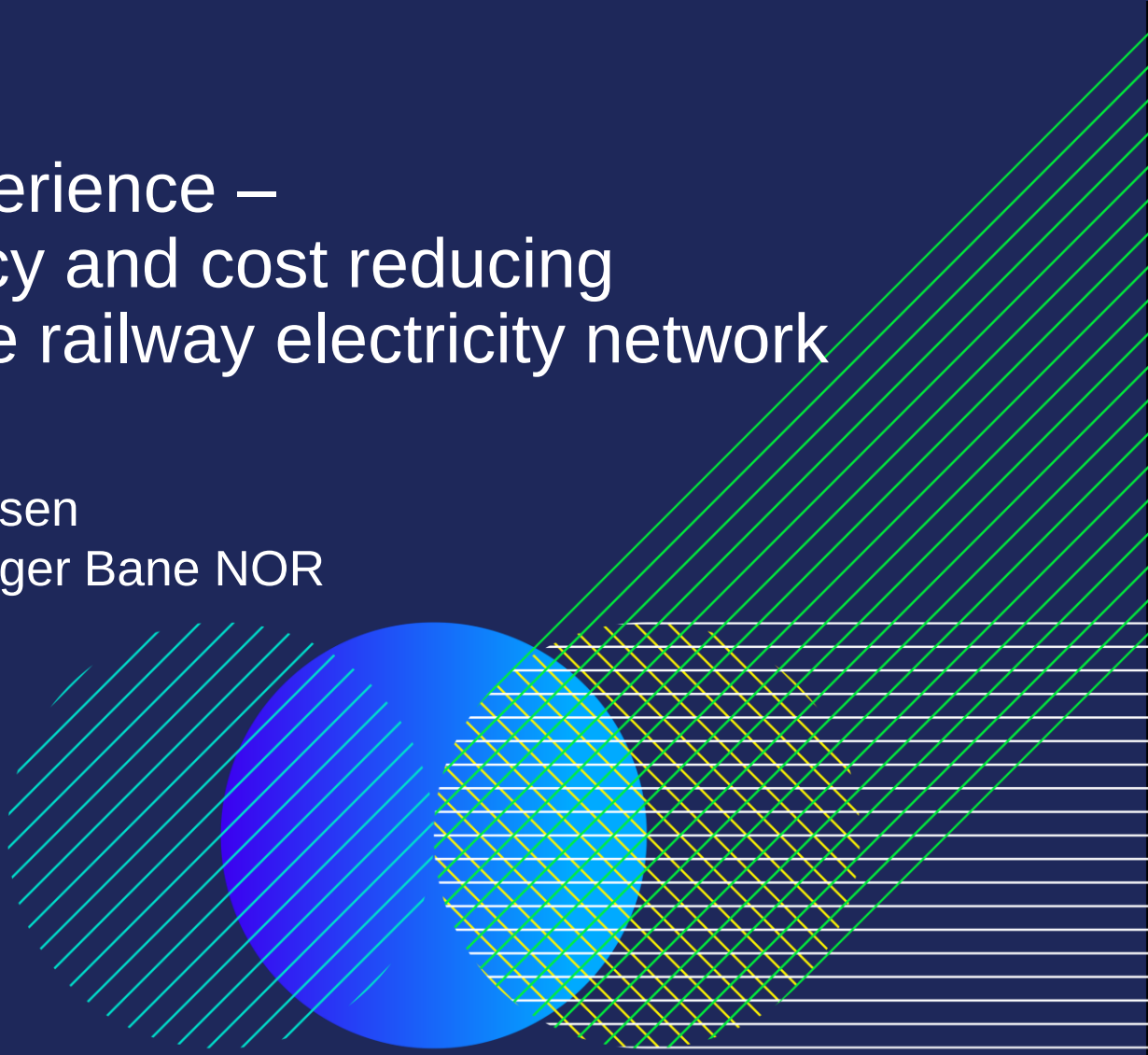
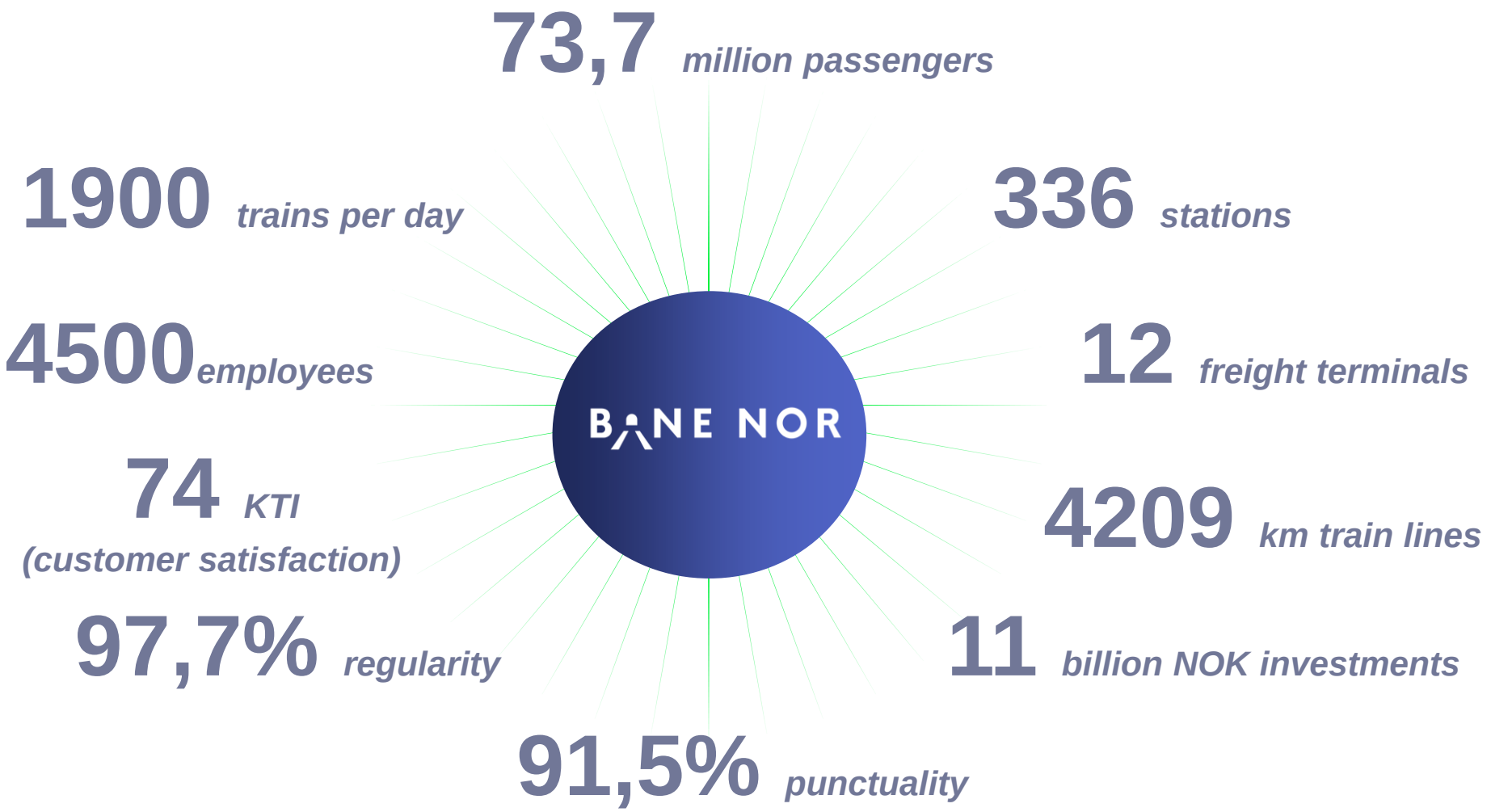


Bane NOR is the dominant player in the Norwegian railway sector

- Management, operations and maintenance, as well as infrastructure renewal
- Operational responsibility for the railway, including traffic management
- Analyses, strategic planning and construction projects
- Property management and development
- Responsibility for safety, preparedness and crisis management

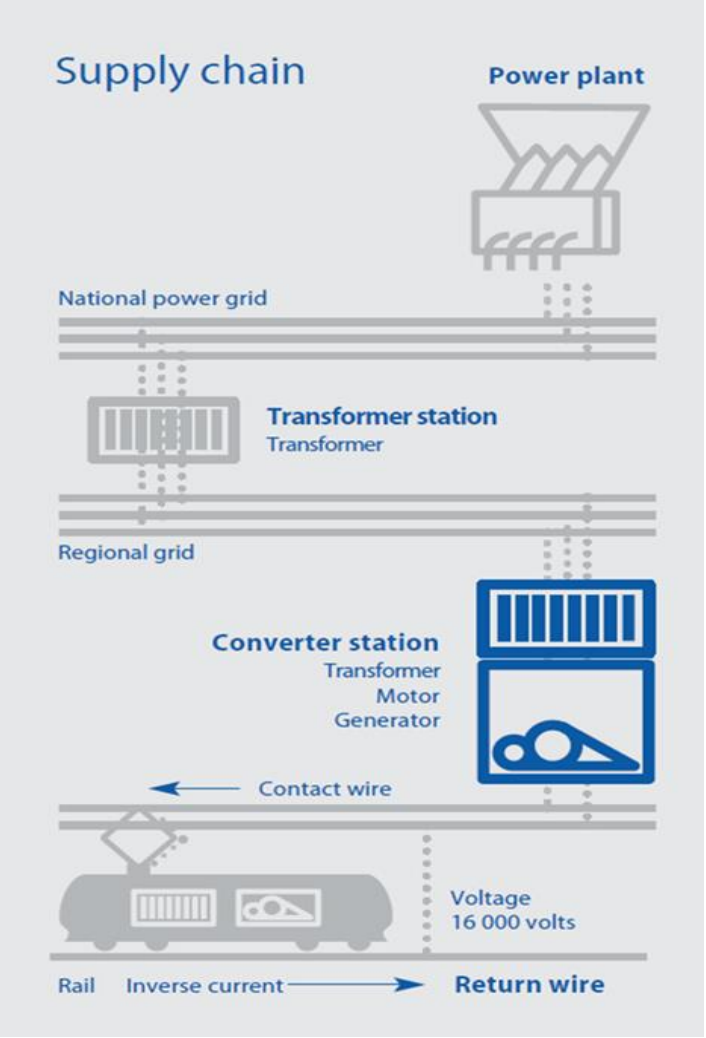
BANE NOR


73,7 million passengers
1900 trains per day
336 stations
4500 employees
12 freight terminals
BANE NOR
74 KTI
(customer satisfaction)
4209 km train lines
97,7% regularity
11 billion NOK investments
91,5% punctuality

BANE NOR

Power supply in Bane NOR

- Bane NOR is responsible for the power system supplying electrical power for train operations in the Norwegian traction energy network
- Bane NOR converts electrical energy from 50 Hz to 16.7 Hz for the entire Norwegian railway network
- Electric traction energy is bought directly in the Nordic energy marked Nord Pool (Spot) and eSett (unbalance)



BANE NOR

772 GWh

100% renewable hydro

35 converter stations and 1 hydro power plant

836 MVA installed power capacity

2459 km electrified tracks

10 train operating companied

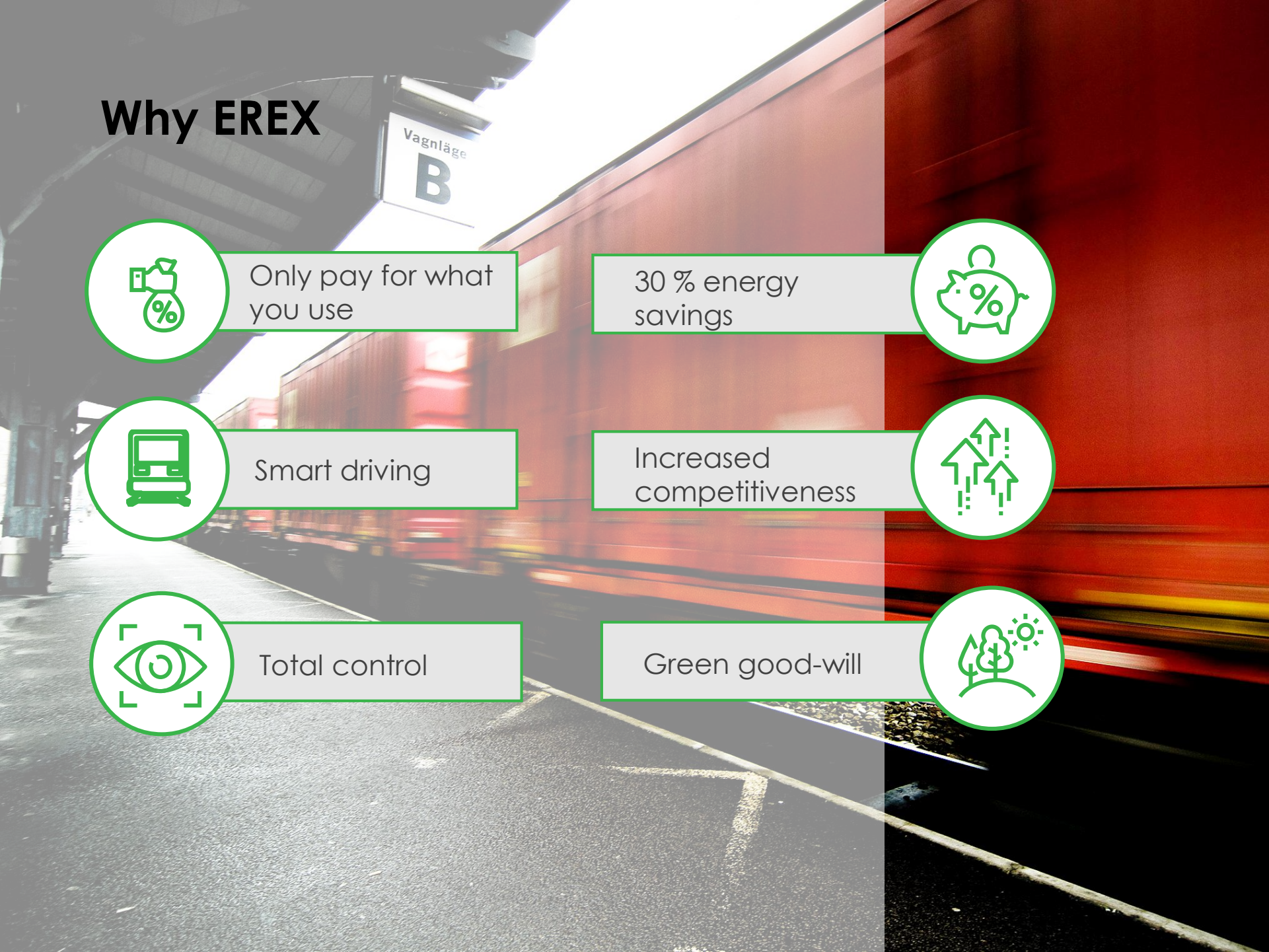
BANE NOR

Eress & Erex

What is Eress?

- Europe's leading train settlement system and an open partnership for infrastructure managers in Europe
- Established 2007
- Working for a common railway energy standard in Europe
- A non-profit organization jointly owned by its partners
- 7 Current partners (Banedanmark, Infrabel, Bane NOR, Trafikverket, Liikennevirasto, SBB AG and Vivens)
- Partners own and decide on development of Erex
- Using the jointly owned IT-system **Erex** to exchange and settle energy across borders

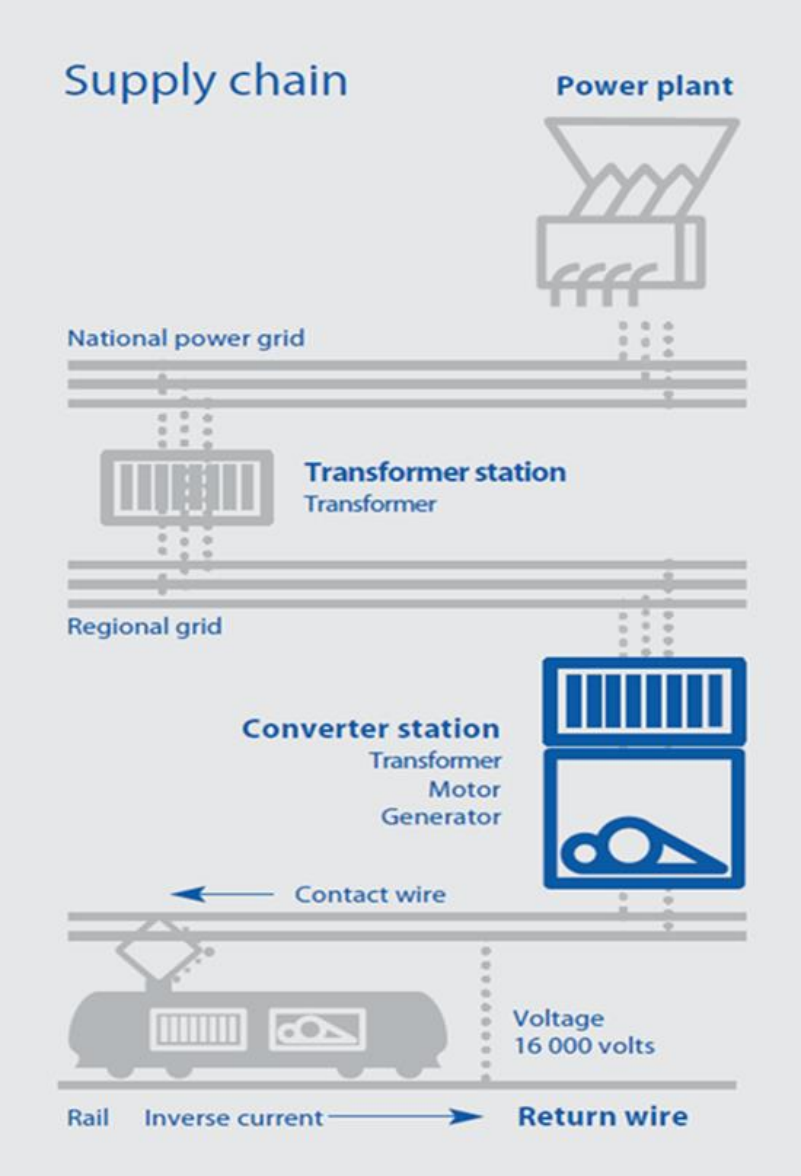
Why EREX



- Only pay for what you use
- 30 % energy savings
- Smart driving
- Increased competitiveness
- Total control
- Green good-will

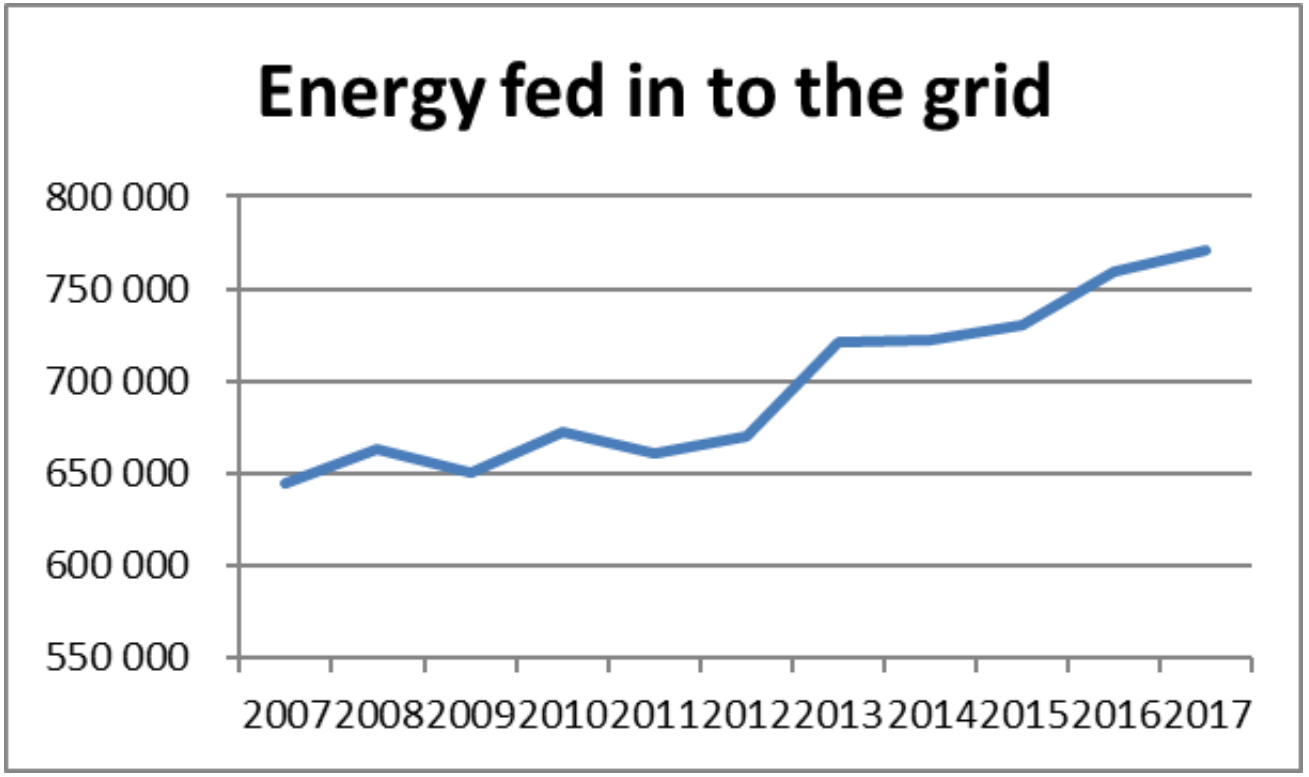
For more information and registration
www.eress.eu

Get increased control with measuring



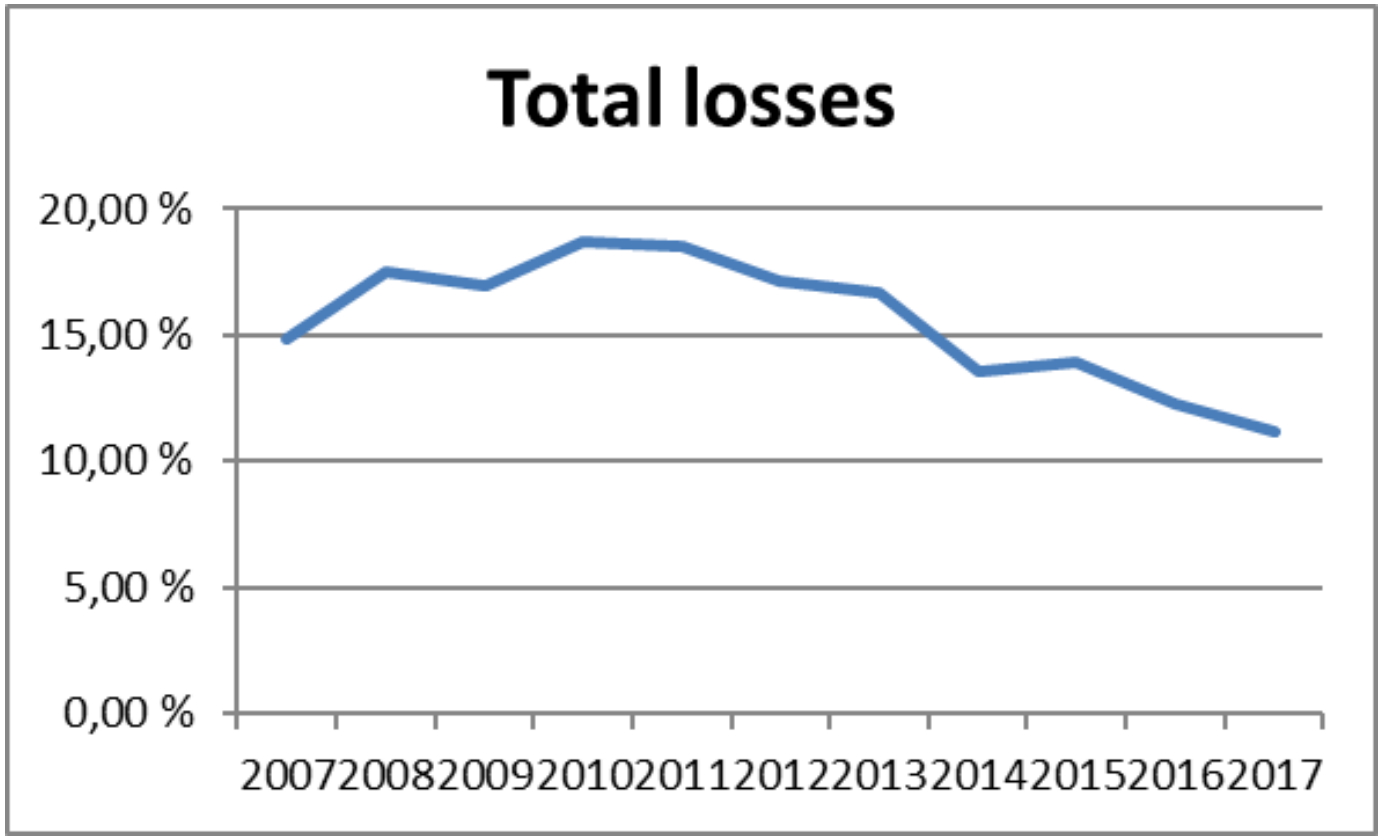
BANE NOR

Increasing amount of energy feed in to the grid



BANE NOR

Significant reduction in system losses



BANE NOR

Apply autotransformer technology

Increase voltage level from 15 kV to 30 kV

Reduce transport losses the overhead contact line system with 56%

Increase the distance between converter stations from 80 to 120 kilometres

Isolated, a high cost measure

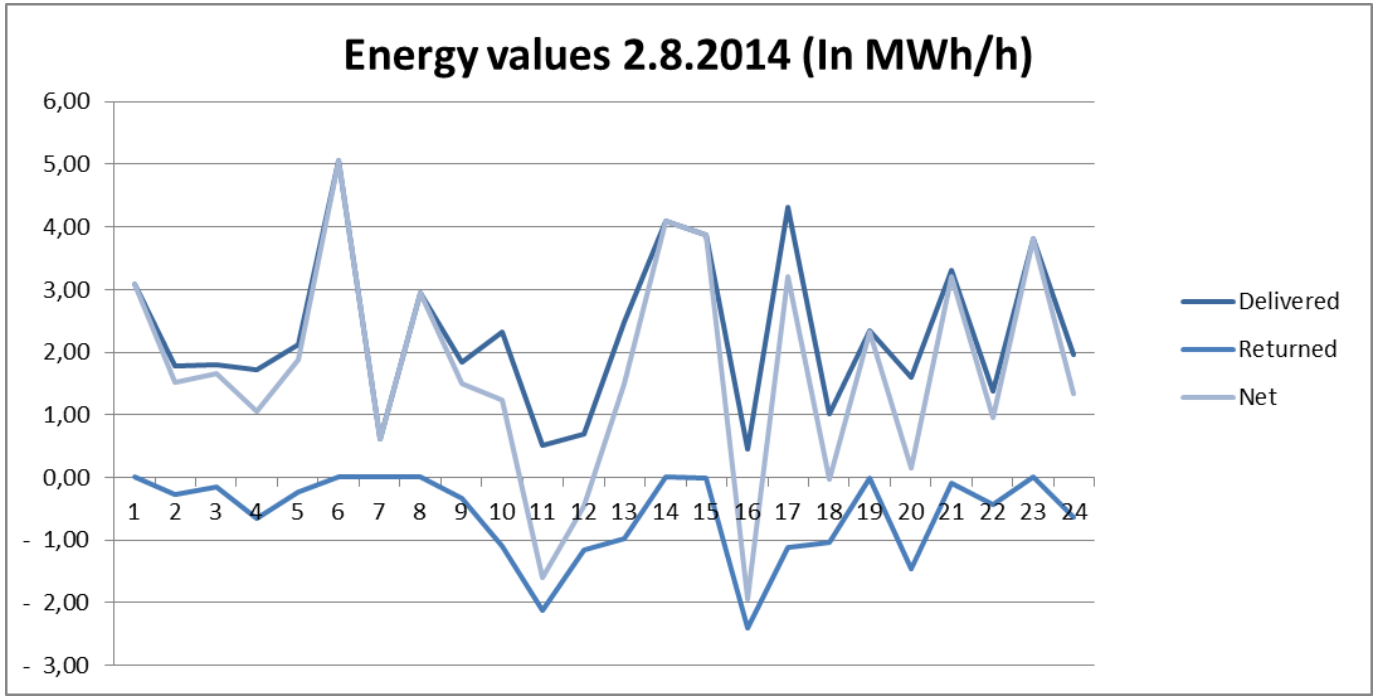
Applied as standard on all new lines and when renewing existing lines

BANE NOR

Rethinking link with energy marked

Defining converter station as exchange point, rather than end consumer

Reduced energy cost with 25%



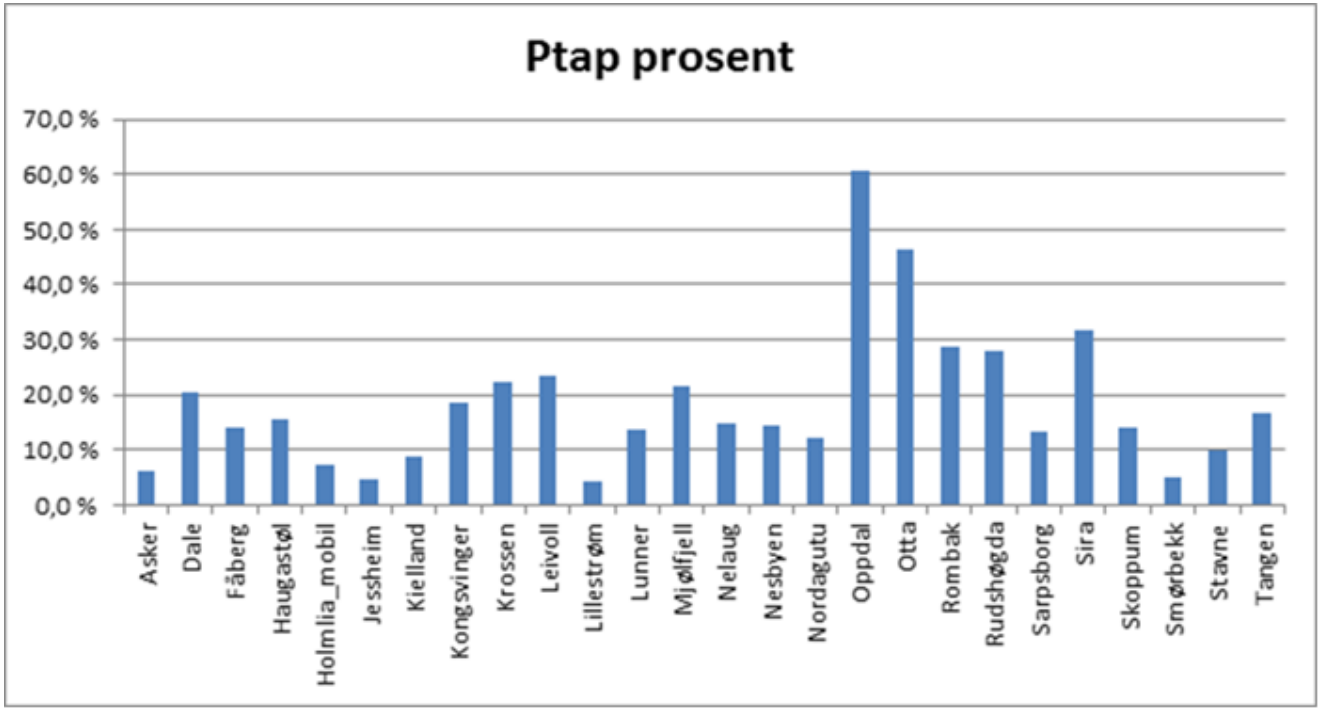
BANE NOR

Optimize operation of converter stations

75 % of all converters in Norway are older rotating with high losses

Focus on applying automatic operational plans and start/stop functionality, and to better follow the load peaks

Goal to reduce losses with 8% or 10 GWh



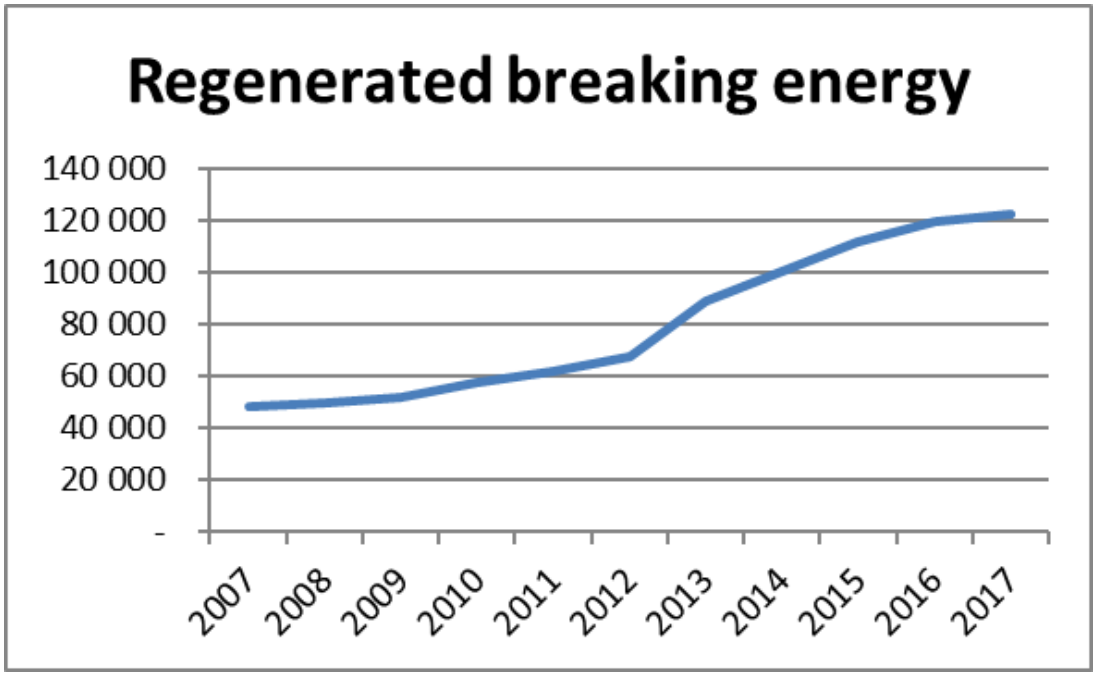
BANE NOR

Motivation for energy efficiency in settlement rules

All regenerated breaking energy sold to marked price

Incentive to train companies to become more energy efficient

Increased the regenerated breaking volume with 154%



BANE NOR

Power is the challenge

BANE NOR

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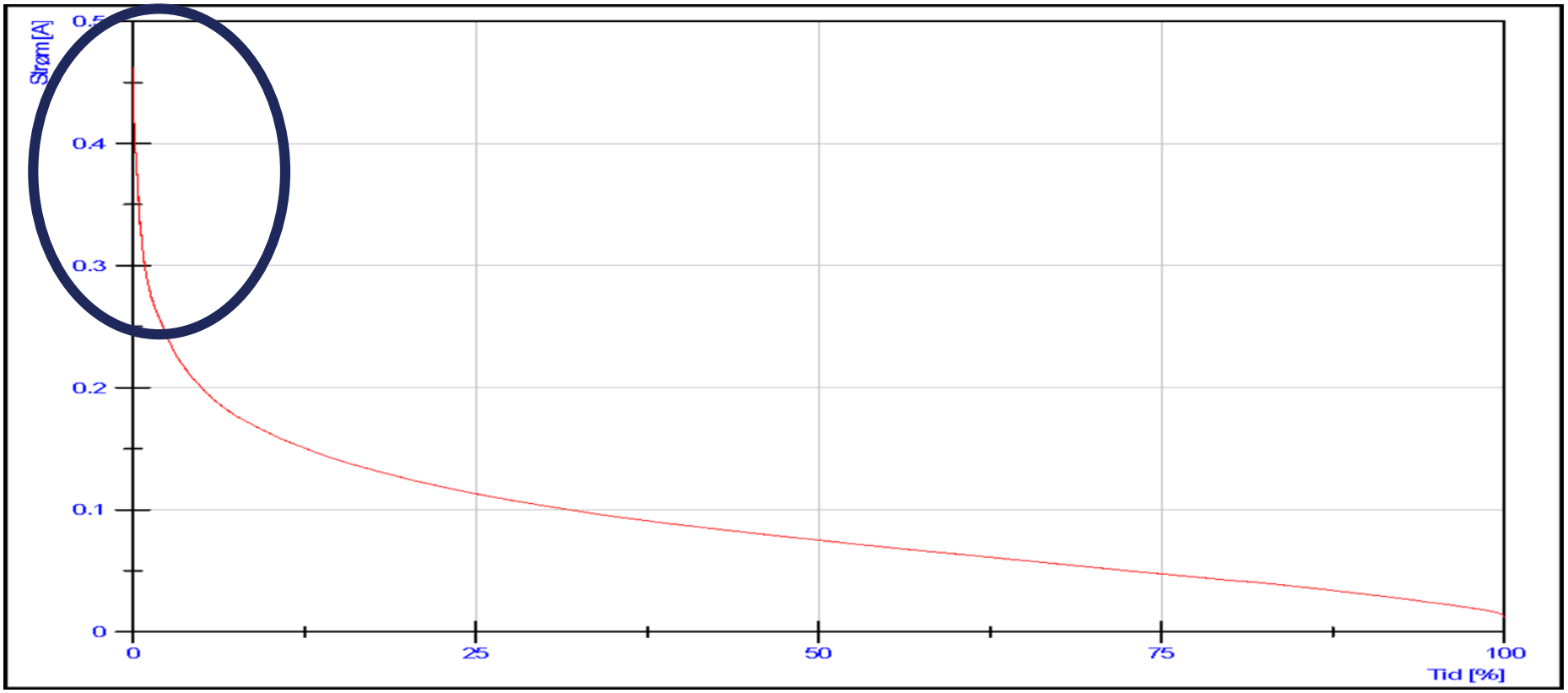

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