

# ENERGY SAVING WITH SENSOR DATA

## Support to decision-making for energy saving for urban rail transport

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### Nyttor och effekter

Based on sensor data from rail vehicles, energy saving potential with focus on propulsion system, auxiliary power and operation of urban rail transport has been studied. With the upcoming implementation of the EU Energy Efficiency Directive (EED), which strengthens requirements for systematic energy management and reporting, the report and its tools and examples of energy-saving measures are expected to be highly useful for PTAs such as Trafikförvaltningen, particularly in new traffic contracts with PTOs.

Several technical models to assess different possibilities and quantify the relevant benefits have been built. To support decision making for implementation, a sensor data-based decision-making framework for energy-efficient rail operations has been developed, supporting business case development with technical data. Several measures for energy saving have been analyzed: building reversible substation, time tabling, optimizing driving strategies, adjusting setpoint temperature, practicing parking modes, passenger-control door opening and geothermal switch heating, etc. A series of small-scale tests have been performed for validation and future implementation. The benefits are energy saving and cost saving for train operator as well as the public transport authority.

### Aktörskonstellation

The key partners in the constellation are:

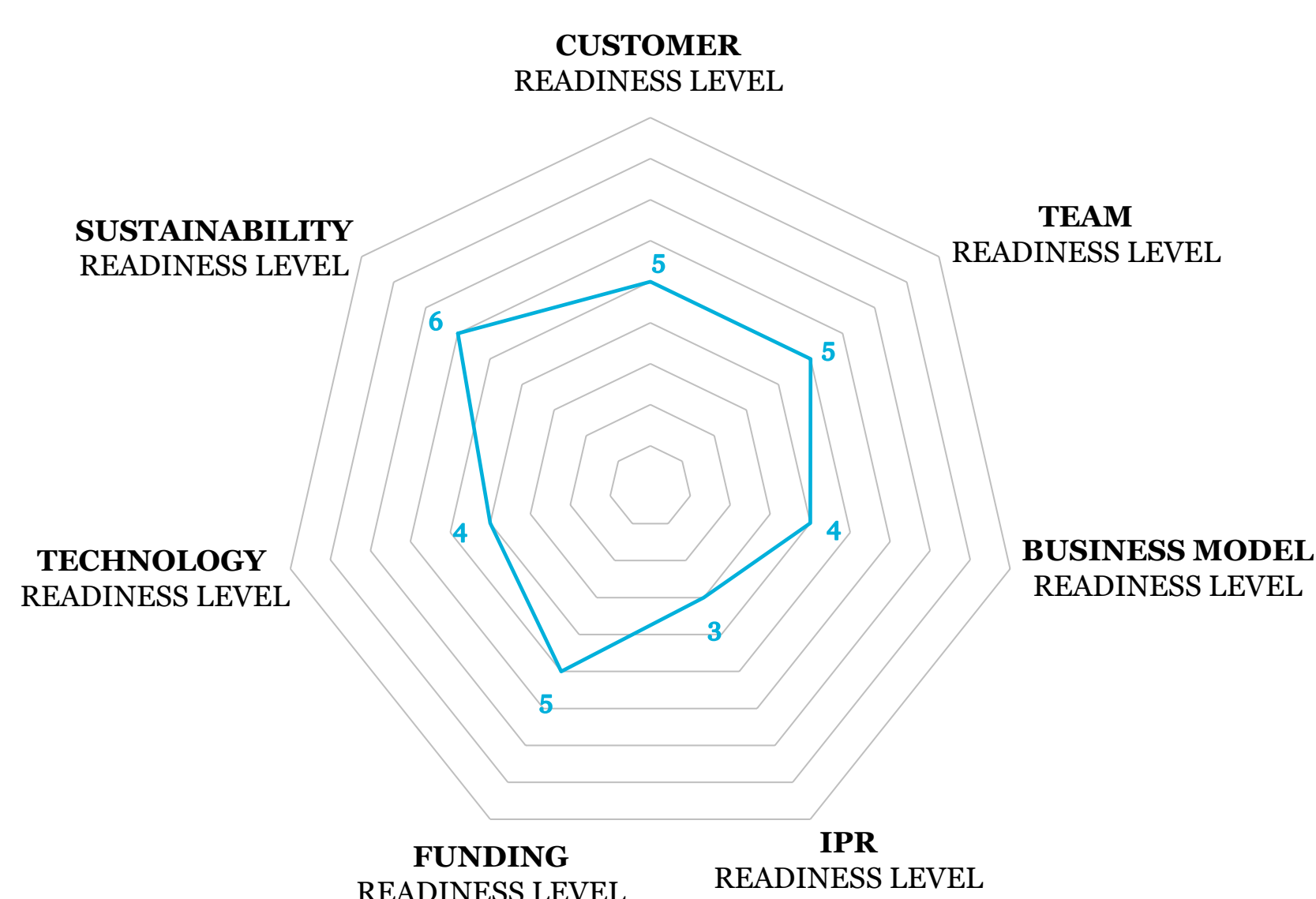
- MTR (metro operator) giving access to vehicles and data.
- Trafikförvaltningen (public transport authority) to collect and analyse the data and project management.
- KTH to perform modelling and data / cost analysis to balance energy consumption and ensure comfort
- Alstom (train manufacture) providing technical support on hardware and software of the trains
- SJ (commuter train operator), potentially for future applications
- Passengers, the final consumers – the energy saving measures must not negatively affect passenger comfort.

### Leveranser

The followings are expected to be delivered:

- Definition and access of the data required
- Technical models for propulsion, auxiliary power and operation of urban rail transport
- Sensor data-based decision-making framework for energy-efficient rail operations
- Business model canvas (BMC) for the different measures
- Test plan with respect to different features of corresponding system
- Implementation plan for future research and application.

### Innovationsstatus



The main client for the measure is *Trafikförvaltningen* who receive cost and energy savings in line with their strategy for green transition, and also provide data for their sustainability reporting and follow up of their own sustainability and business goals.

The team and funding is secured for modelling (technical and business) has been done. First test of the energy saving measure *Parking mode* in real-world environment is planned in Q1 2026.

The other two studied measures *Driving optimization* and *Timetabling* will be implemented at KTH's train driving platform for virtual demonstration in 2026 and 2027. The funding has been secured.



### Vidareutveckling och implementering

Based on the research findings and the gained competence from this project, there are two clear areas for further development and implementation:

#### Refining decision support framework

The framework will be used in the application of all the concerned measures and will be adjusted and refined to best suit the stakeholders' needs and create most benefit. More aspects, e.g., system reliability, costs of implementation, etc., will be taken into consideration. Benefit will be both energy savings and cost savings without challenging the system reliability and low costs for implementation.

#### Testing and demonstration of measures

The studied measure *Parking mode* is in test planning stage. The test should be performed Q4 2025 or Q1 2026. Following this there may be further tests and evaluation before a recommendation for implementation. Following the decision support tool and also for the interests of the actors involved.

The other measures *Driving optimization* and *Timetabling* are related to operation. They will be virtually implemented and demonstrated with a train driving simulator at KTH in 2026 and 2026. If they are proven to be safe and effective, they will be studied for future implementation.

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