Presentation of charging infrastructure suppliers

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Introduction

- In June, Ruter published a RFI «Electric charging infrastructure for 168 articulated buses at Stubberud»
- An RFI (request for information) is a formal process for gathering information from potential suppliers of goods and services
- The aim of this RFI is for Ruter to gain insight into how one can plan/build “big scale” efficient and smart electric charging infrastructure for bus depots with 100 % electric buses.
- In order to gain this insight, Ruter asked for feedback, primarily from suppliers of charging infrastructure equipment, on a case study with some accompanied questions
- Ruter has invited the responders to the RFI to present their solution to the case study
- There are no ties between Ruter and the Companys who are presenting here today

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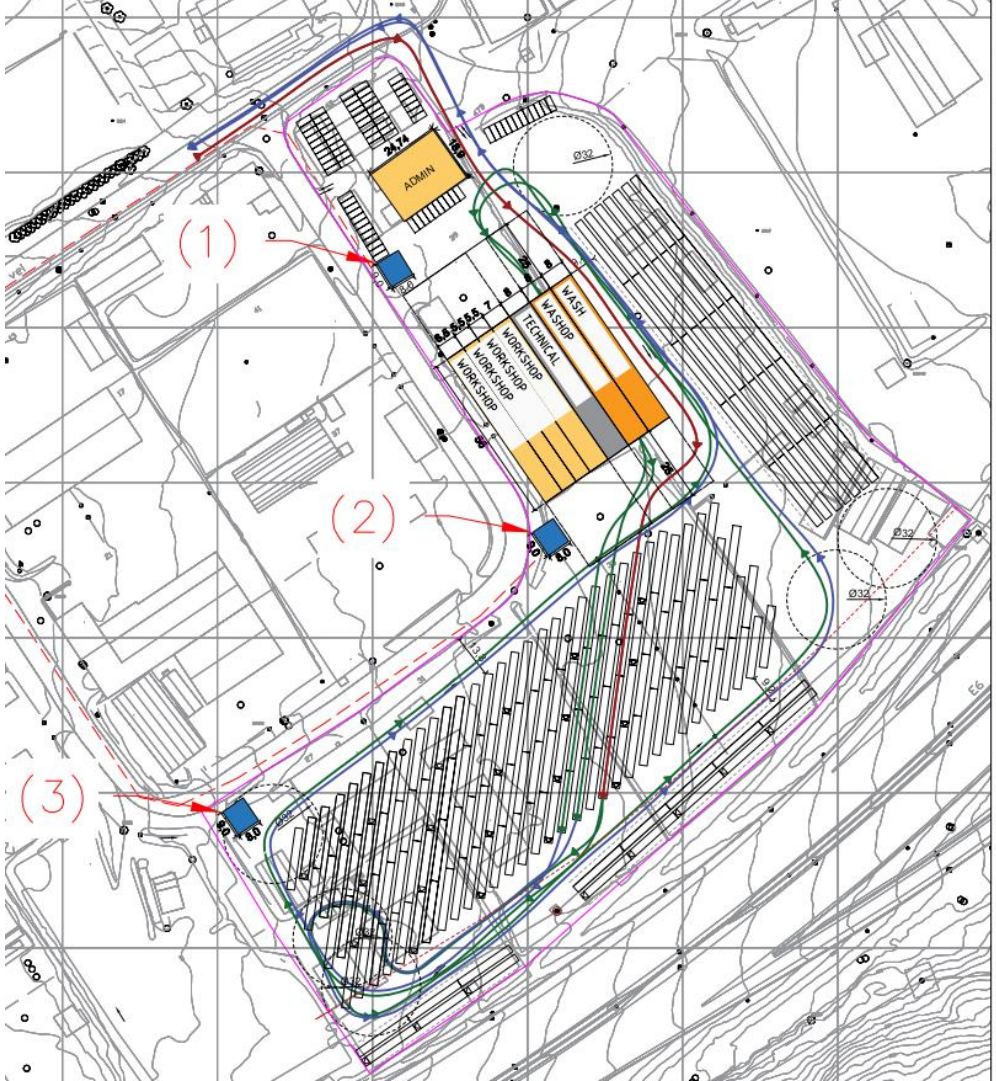

The bus depot is designed for 47 double articulated (25 meter) buses, and 121 articulated (18 meter) buses.

(1), (2) and (3) shows possible locations for the distribution substations. These substation will be the interface with the DSO, as shown in figure 2 in the RFI. The exact location and the number of the distribution substations shall be determined by the case-study.

The DSO will provide the supply power cables to the distribution substations. The number of cable sets will depend on the final solution and power-demand, but the supply cables has a limit of ca. 5MW. For 15MW charging capacity in total, its probably required 3 x (3x1xTSLF 400mm^2 AL or similar). The routing of the power cables will be determined by the DSO.

Some relevant questions and the background for the RFI

- How would a charging infrastructure supplier build a green field depot where all the buses are electric?
- What factors in Ruter's business model for charging infrastructure is constraining the optimum design?
- What does it entail that the charging infrastructure supplier is given an increased scope of supply?

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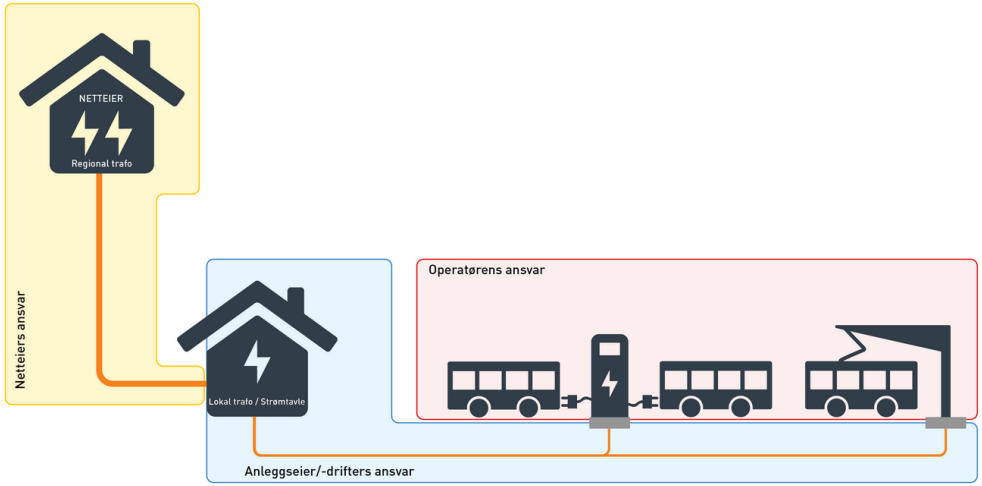
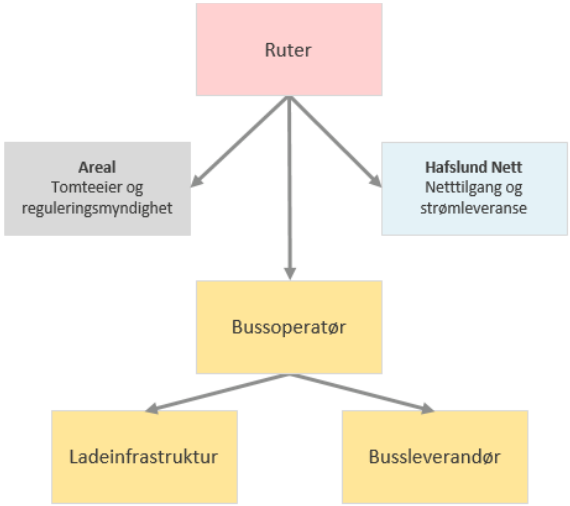
Who has the incentive to find the optimum design in this fragmented structure?





Ruter's business model for e-buses and charging infrastructure used in todays PTO contracts

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Some key topics

- Today's solutions for charging infrastructure on depots require extensive site works investments
- In this RFI Ruter askes the responders to present solutions that can reduce civil works investments and supply
- Prefabricated solutions that are easy to assemble on site is preferable. Increasing FAT and reducing SAT.
- Grid owner has stringent (and costly) requirements for high voltage buildings/rooms.
- Moving the high voltage interface requires a NVE site concession (Anleggskonsesjon)
- Can we increase the distribution voltage? Increased voltage = reduced cable cost.
- Centralized rectifiers with DC-distribution vs AC-distribution?

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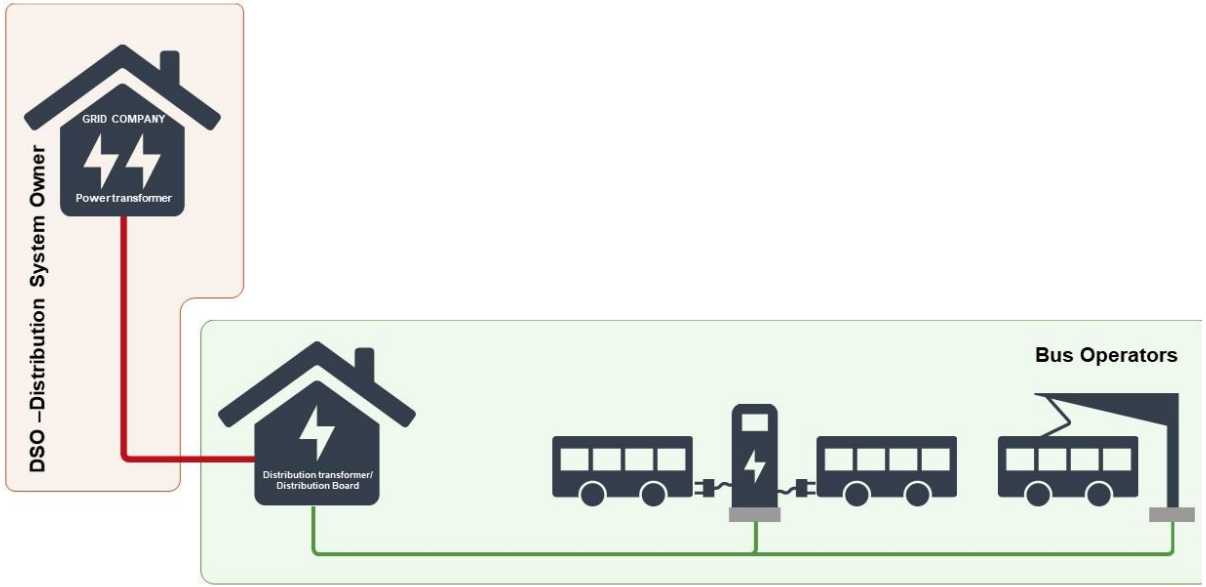
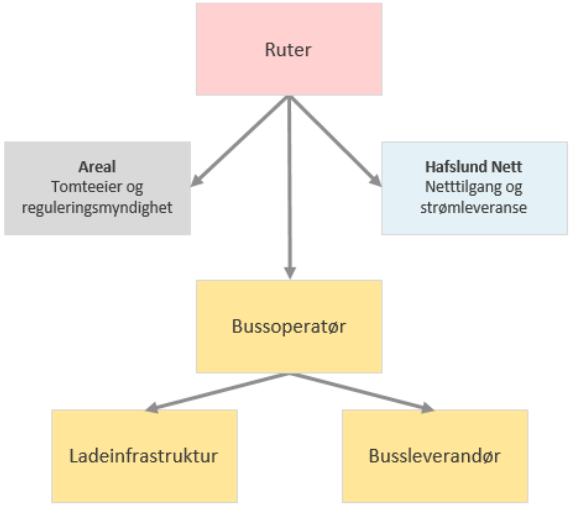
In this scenario: The Bus Operators has the incentive to find the optimum solution





Ruter's business model for e-buses and charging infrastructure the RFI's case study

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Case Study is as follows

A new temporary bus depot for the Oslo inner city buses is in the planning phase. The depot will be in use for a limited number of years, at which time the bus depot and the charging infrastructure will be moved.

The task: what is the least costly and most effective charging infrastructure solution for this bus depot with 168 articulated buses?

Ruter is especially interested in prefabricated containerized solutions. These solutions could take the form of a single container with both transformer from 11 kV to 400 V, and rectifier and charger providing DC power to a number of charging points outside of the container.
Another possibility is to have containerized substations, transforming the 11 kV high voltage to 400 V low voltage, and separate containers with rectifiers and chargers providing DC power to the charging points.

The presented case solution must include all necessary equipment from the grid interface until bus interface. We would like a suggested complete solution, with the placement of transformers (substations), rectifiers, chargers, charging cables or pantographs, all drawn on the map.

You are free to propose the positioning of the substations, or combined transformer/chargers on the site. You are free to propose cable or pantograph charging. You are free to propose the type of connectors to the charging equipment. The complete solution should be drawn on top of the attached map of the site.

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Questions asked in the RFI

1. Can your company provide solutions with an 11kV (10 400V) high voltage interface?

2. Regarding the above question, what is your desired system voltage on the secondary side of the transformer?

3. How many transformers do you estimate are needed for powering 168 articulated buses and how should they be placed on this facility? See the attached site plan (can also be distributed in a dwg.-format)

4. Ruter have estimated an installed power of 15 MW as a worst case for providing 168 city busses with power. How can your company contribute to lower power usage? The Norwegian grid fees have a “power tariff” part. This “power tariff” uses the highest energy used in a single hour throughout the month today, the day in the future. This means that the system should both decrease the maximum installed power, and the maximum energy consumed per hour.

5. The bus depot might be used for only five years. How can your company build this facility so that the equipment can be reused for bus depots on other locations?

6. What are your solutions requirements with regards to extent of civil work?

7. How can your company provide the bus operators with “Driftsleder” – Responsibilities for management for high voltage facilities according to Norwegian regulations in FSE §6?

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Presentation schedule

	Company
1	ABB Hitachi Power Grids
2	Ekoenergetyka
3	Heliox
4	Jemaenergy
5	Kempower
6	Loubinsen
7	Wave
8	Wennstrom

There will not be a Q&A session, please contact the company's directly if you have questions

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Responders to the RFI

	Company	Contact information
1	ABB Hitachi Power Grids	ismir.fazlagic@hitachi-powergrids.com
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4	Jemaenergy	e.segura@jemaenergy.com
5	Kempower	erling.sandstad@kempower.com
6	Loubinsen	n.nurtdinov@luobinsen.org
7	Wave	viktor@waveipt.com
8	Wennstrom	mats.lundh@wennstrom-net.com
9	SBRS	martin.westermann@sbrs.com
10	ABB	anders.toppe@no.abb.com

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