

# Lessons learned from deployment of a 100% electric bus fleet

Selected experiences



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**Ruter#**



# Agenda

1. This is Ruter
2. The Ruter model
3. Implementation of E-buses
4. Challenges with winter operations
4. Key learnings
5. Summary



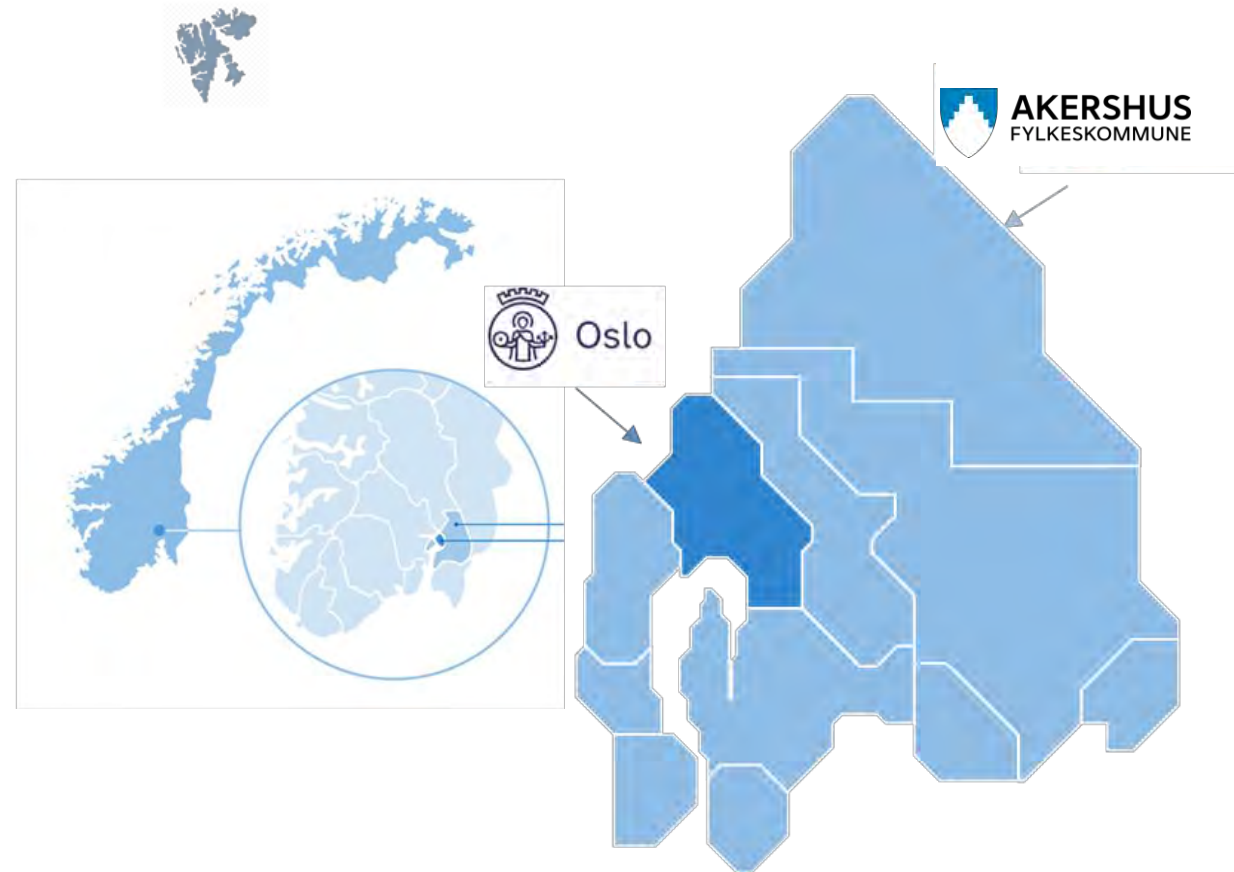
# **This is Ruter**



# This is Ruter

Public transport authority of the Oslo region, 370 employees.

- *Plan, procure and promote* public transport in Oslo and Akershus county
- Contribute to Oslo region reaching set political goals in the transport sector
- Publicly owned by The City of Oslo (60%) and Akershus County (40%)
- Approx 1.400 buses in operation. 22 bus depots.







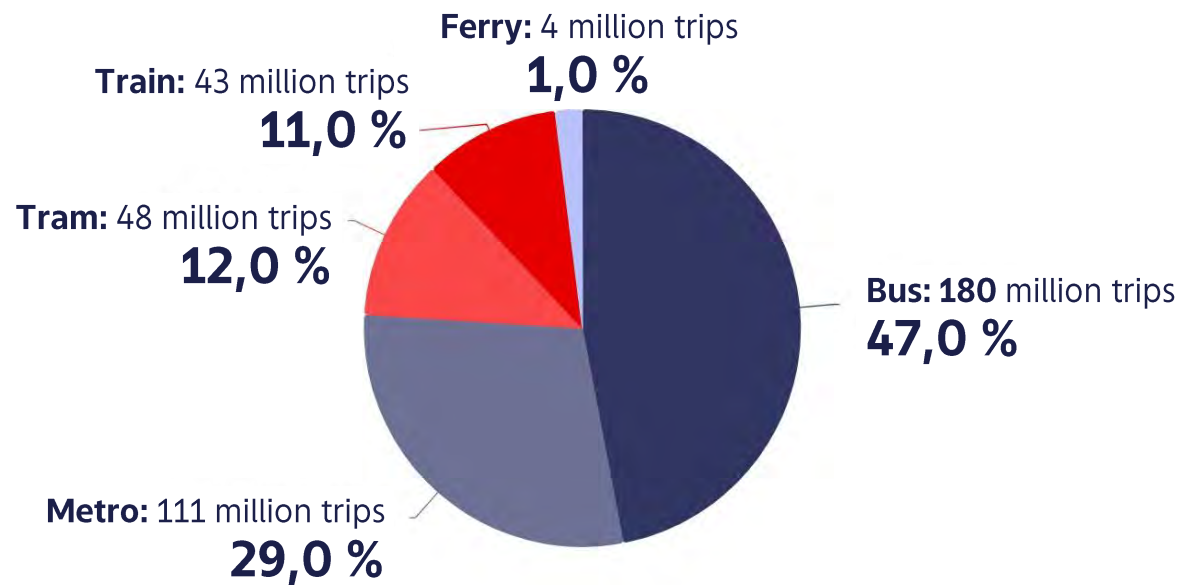
Over 40 % of Norway's population live their lives in the Oslo region.

55 % percent of Norway's public transport trips are carried out by Ruter.





# The Oslo region public transport in numbers - 386 mill trips (2023)



# The Ruter Model



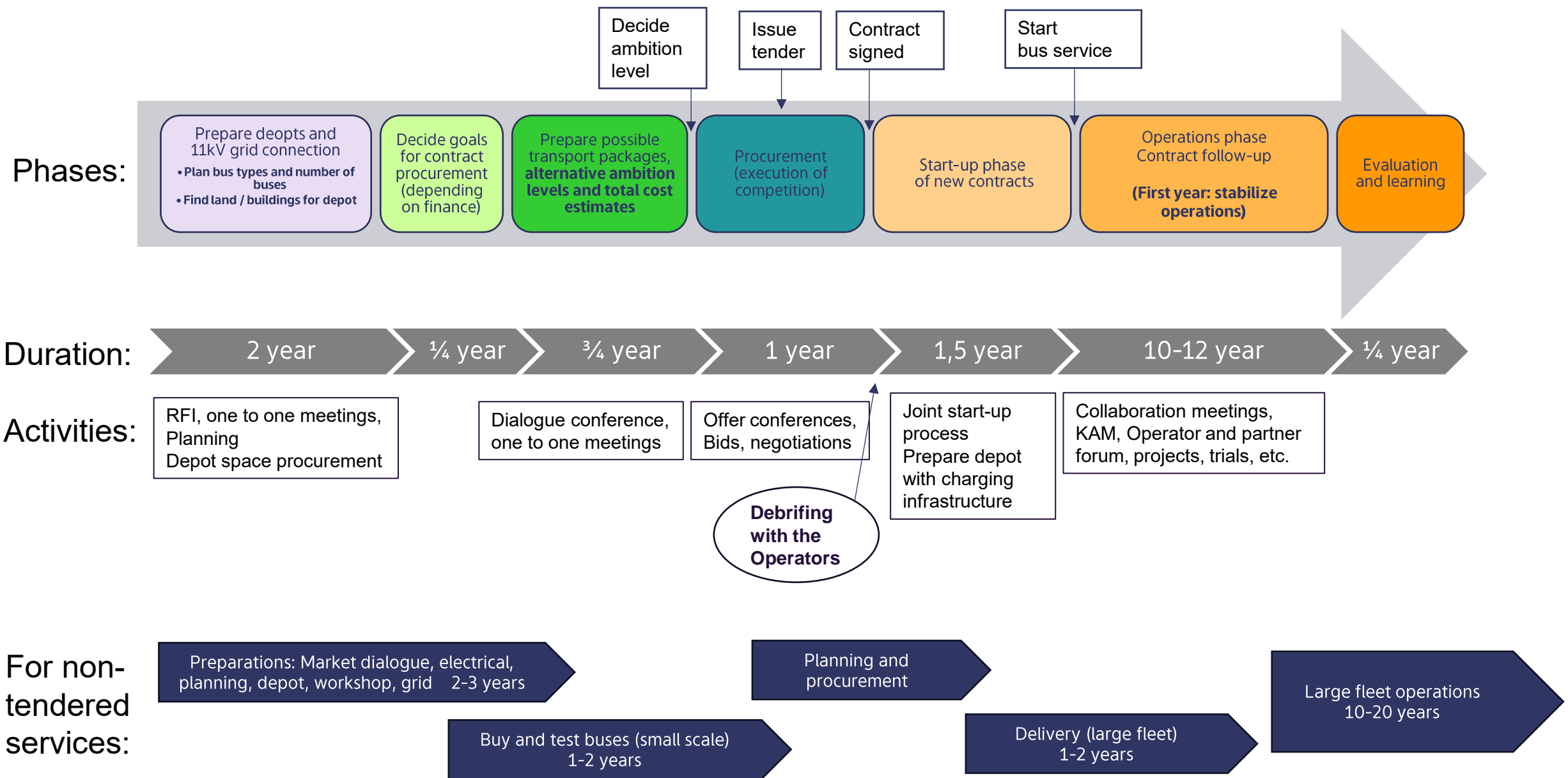
# Ruter model

- Ruter (PTA) buys bus services from Operators (PTO's) as a tender (10+ years)
- Ruter plans routes and depots including 11kV grid connection and decides a combination of minimum requirements and functional requirements
  - The PTO's choose type of vehicle, energy carrier and energy infrastructure.
  - Charging plugs must be CCS2 (main choice). Pantographs must be bus mounted type (less used).
  - Ruter gets ownership of infrastructure after contract end. (offered for free in next tender)
  - Oslo city: Emission-free is now requirement
  - Akershus county: Emission-free over biogas
- Good dialogue and interaction with operators and bus manufacturers / charging suppliers is important
- Promotes learning and innovation. Requires higher competence at PTO's.
- We want to lead the change, rather than wait for market maturity





# The tender process in Ruter – dialog and interaction with the market





# Civil works alongside full operations...



**uniBUSS**







# Implementation of E-buses

Photo: Unibuss AS [www.unibuss.no](http://www.unibuss.no)



# Implementation has been gradual and over time:

Trial phase: 6 E-buses used to test feasibility of a fully electric system.

**2017-2019**

**2019-2020**

Scale-up:

Test, Romerike and West – First scale-up with E-buses as part of contracts. In total 155 buses

**2022**

Overachievement:

Ruter asked for 25% E-coverage in Oslo South – received 100%, in total 109 buses.

**2023**

Normalization:

The first three contracts which asked for 100% E-coverage: Oslo inner city og East. In total 261 busses



# Challenges with winter operations



Photo: [www.nab.no](http://www.nab.no)





# Winter operation 23-24

December 11th

Delays and cancellations due to **problems with charging infrastructure**.

December 13th

Temporary adjustment secures **stable energy supply** to charging stations.

January 8th

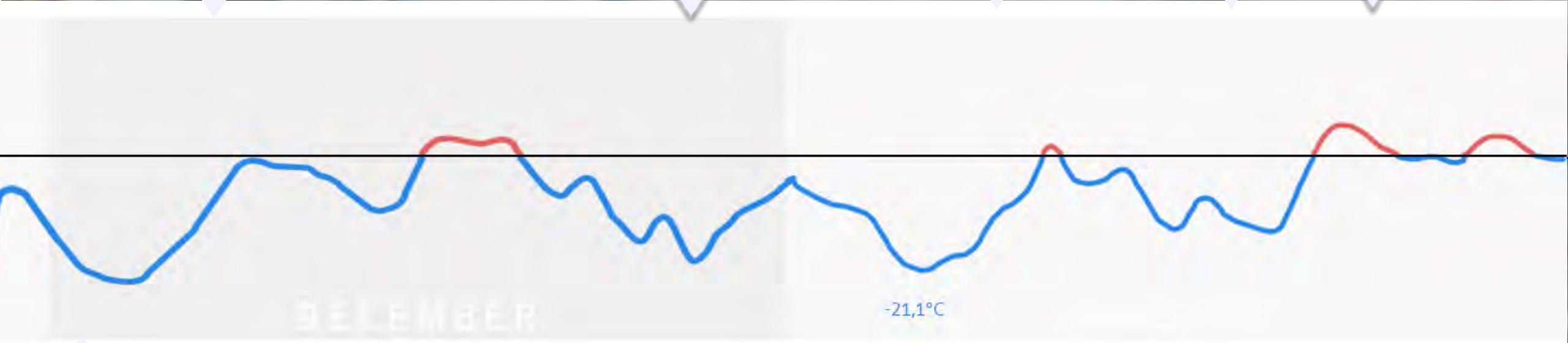
Delays and cancellations as a result of **extreme cold temperatures**.

January 17th

All busses canceled part of the day as a result of **heavy snowfall**

January 24th

Delays and cancellations caused by **weather change**



December 8th

Low temperatures over long period. E-buses experience **very short range**.

**Charging error** at Alnabru.

December 10th

Start of **new contract**, with MAN e-buses being put into traffic.

January 2nd

Delays and cancellations as a result of **heavy snow**.

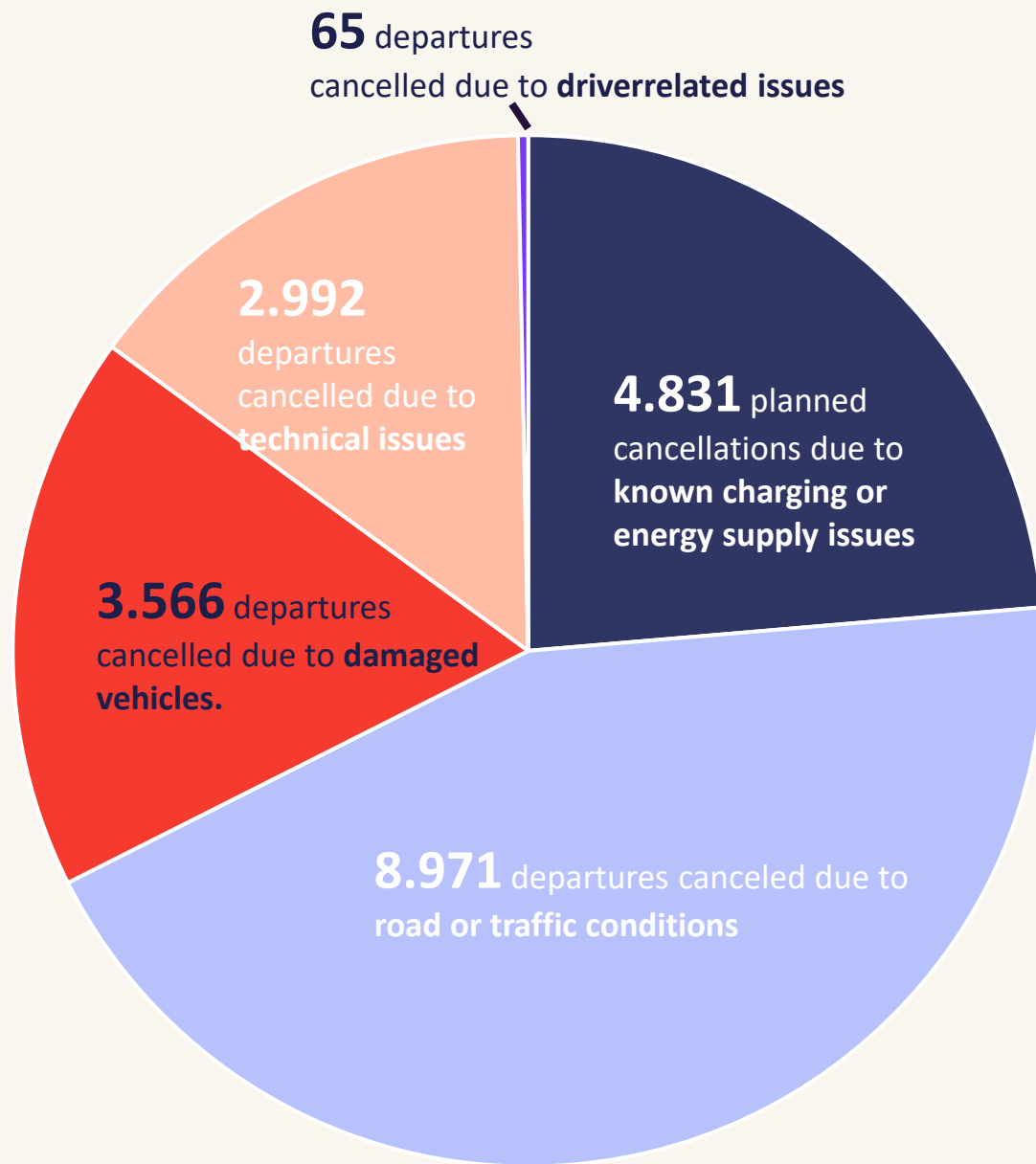
January 15th

Public demand for action to improve services before next cold period.

January 22nd

Delays and cancellations because of **weather change**





## Regularity and cause of cancellations

of buses in Oslo, January 2024

**208 718** planned departures

**20 425** cancellations

**90,21% regularity**



# Key learnings



# Key learnings summarized (1):

## 1. Vulnerability and Dependencies:

- A system with 100% E-buses has less robustness and is more vulnerable
- If any component fails, the consequences can be significant.
- Logistics/charging plans need to be more robust during winter conditions.
- Better planning and understanding of dependencies in the value chain are essential.
- Adequate training of drivers essential to operation, both to operate the buses and to be able to drive in winter conditions. **PTO's choose winter tire types each season.**
- Change and adjustment takes time and competent resources

## 2. Start of contracts:

- Challenge: The new operator must be in full operation from day one of contract start.
- Full-scale testing before the start date is difficult (need all buses and drivers).
- Lack of time for comprehensive testing can lead to operational issues.
- **New complex operations take time to stabilize. Now: 1-2 years. Later: months?**

## 3. Charging Infrastructure:

- Charging infrastructure plays a crucial role. Complex civil works projects at depots.
- Function testing and full-scale use are important.
- Consider preheating buses 1-2 hours before charging.
- Do not underestimate the number of chargers needed





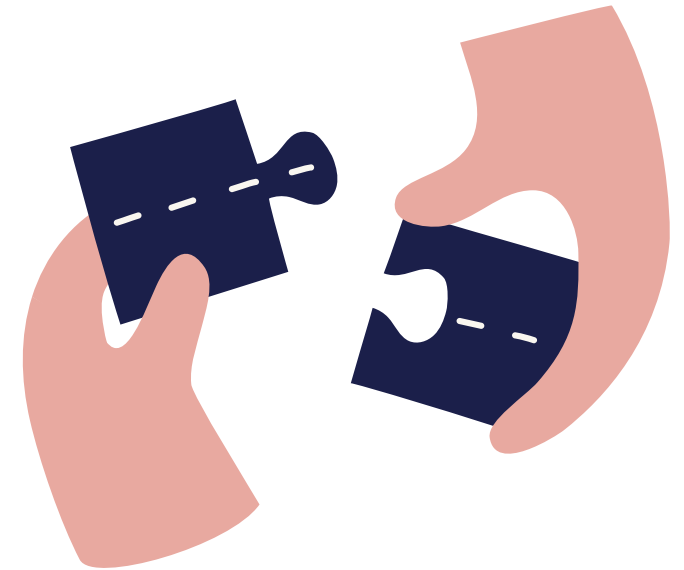
# Key learnings summarized (2):

## 4. Energy Consumption and Batteries:

- The energy consumption was miscalculated, especially regarding electric heating of cabin and battery.
- Lack of experience-based data led to deviations.
- Measurement standards for bus energy consumptions are less developed than for passenger cars.
- Doors opening at all stops on city buses results in energy loss.
- Increased rolling resistance on winter roads and unfamiliarity with electric buses affect energy consumption.
- Need higher number of high power charging points during daytime
- **Buses with CO2 heat pump still consume 2,5-3,5 kWh/km at -20C**

## 5. Procurement:

- Ruter buys services, not buses nor charging infrastructure
- We have to trust the operators, who trust the bus manufacturers, etc.
- Better dialogue and interaction with operators and manufacturers



# Summary



## A summary:

- The climate challenges require Zero Emission in the transport sector
- Ruter uses our purchasing power to lead the way - and wants more people to learn from this
- We have had start-up problems in our 100% E-bus contracts – but the challenges are not solely related to the E-buses
- All the challenges can be solved; battery, heater, charging infrastructure - build in more back-up and robustness in the start up phase
- Change and adjustment takes time and competent resources
- Electric buses are the future - both for the climate and for well-being in urban environments. Benefit: the city is more quiet! 😊





