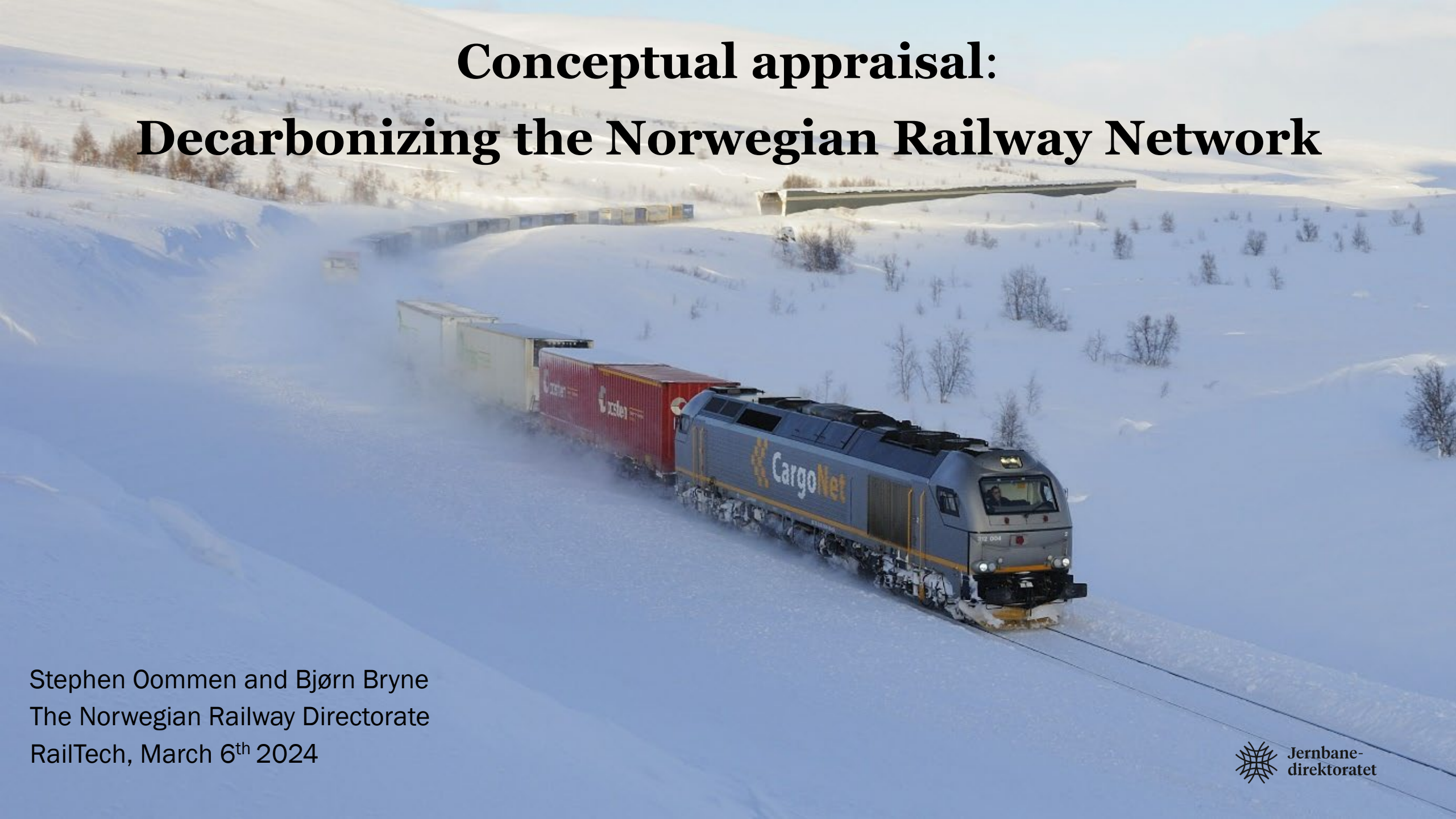
Conceptual appraisal:
Decarbonizing the Norwegian Railway Network



Stephen Oommen and Bjørn Bryne
The Norwegian Railway Directorate
RailTech, March 6th 2024

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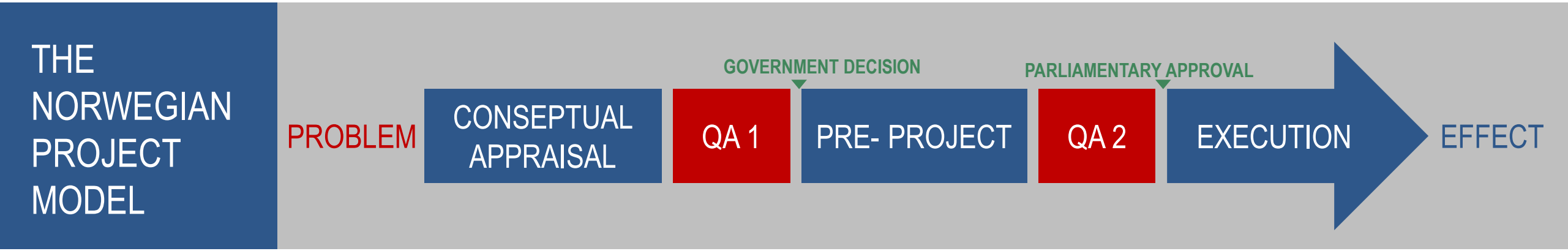
«The Norwegian Railway Directorate shall ensure that the railway sector is operated as efficiently, safely and environment friendly as possible for the good of passengers, freight transport and society in general»

Why a Conceptual appraisal?

- Mandatory requirement for all public investment projects budgets anticipated to exceed NOK 1 billion. (=100 M€)
- Alignment with National and international commitments.
- Investigate alternatives that reduce emissions.
- Assessment of infrastructure requirements, replacement or retrofitting of rolling stock, maintenance machinery and shunting locomotives.
- Comprehensive analysis of the pros and cons of various alternatives, including socio-economic factors, energy efficiency considerations, and emissions contributing to the Norwegian GHG inventory.



The Norwegian Rail Network

- 4200 km
- 2500 km is electrified
- 740 tunnels
- Mostly single track

Lines	Length	Bridges	Tunnels	Height	Max incline
Nordland line	729 km	361	156	680 masl	19 ‰
Røros line	384 km	223	6	670 masl	15 ‰
Solør line	94 km	31	1	183 masl	8 ‰
Rauma line	115 km	103	5	660 masl	20 ‰

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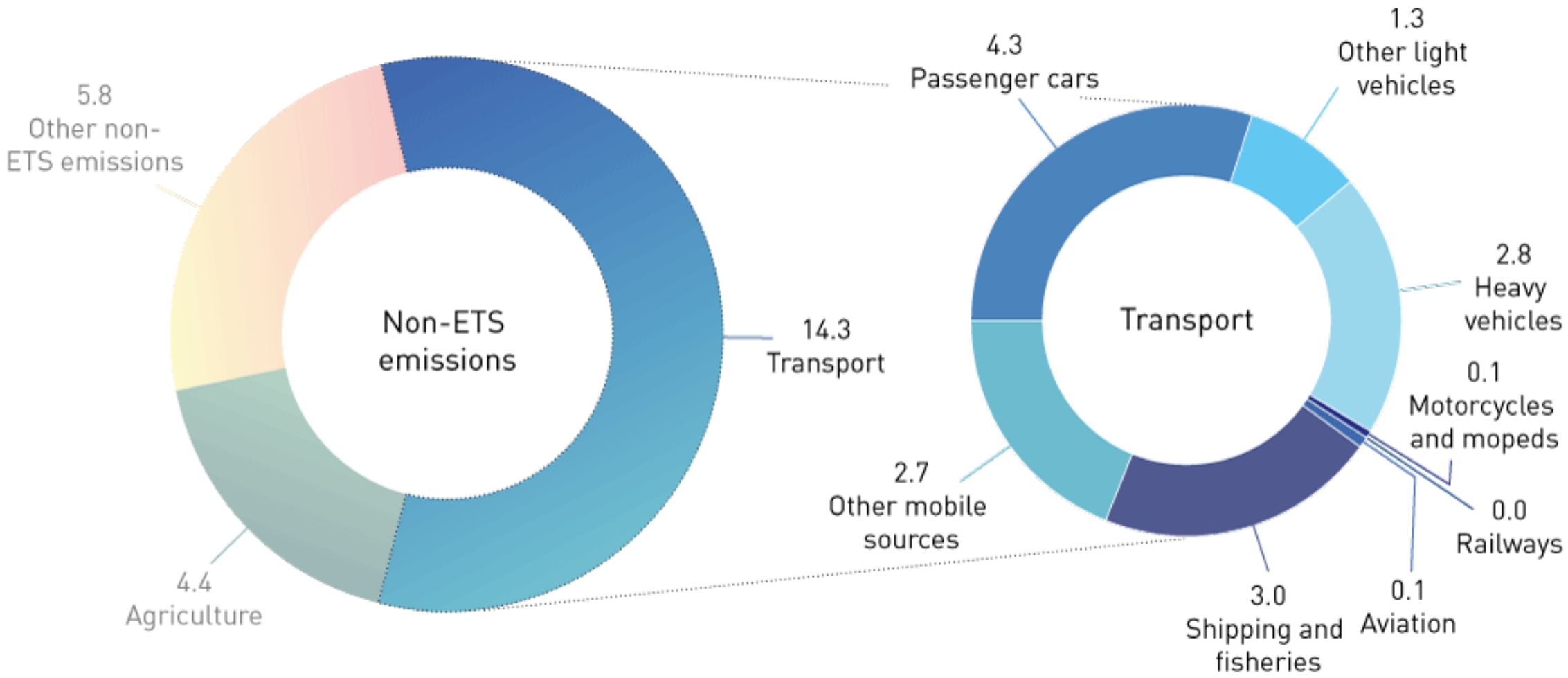
Problem – Norway's GHG emissions



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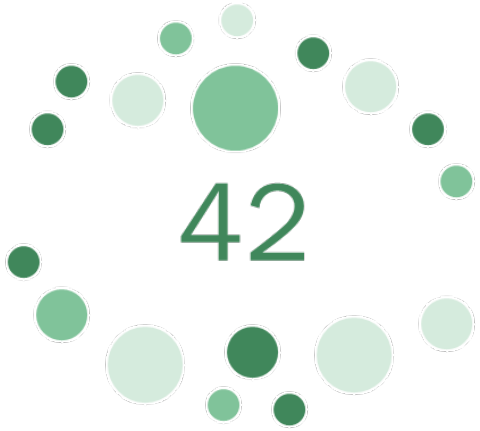
Scoping and Identified Alternatives



Requirements

Performance goals

7

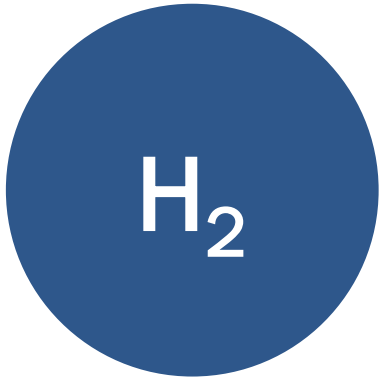
Identified possibilties

Concepts

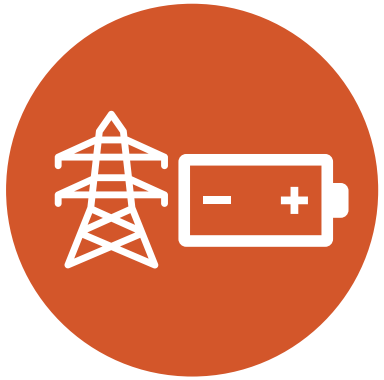
0 Fossil diesel

1a Biodiesel

2a Hydrogen

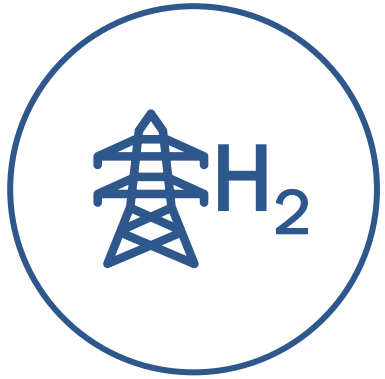


3 Battery with partial electrification



4 Electification

1b Biodiesel with partial electrification



2b Hydrogen with partial electrification

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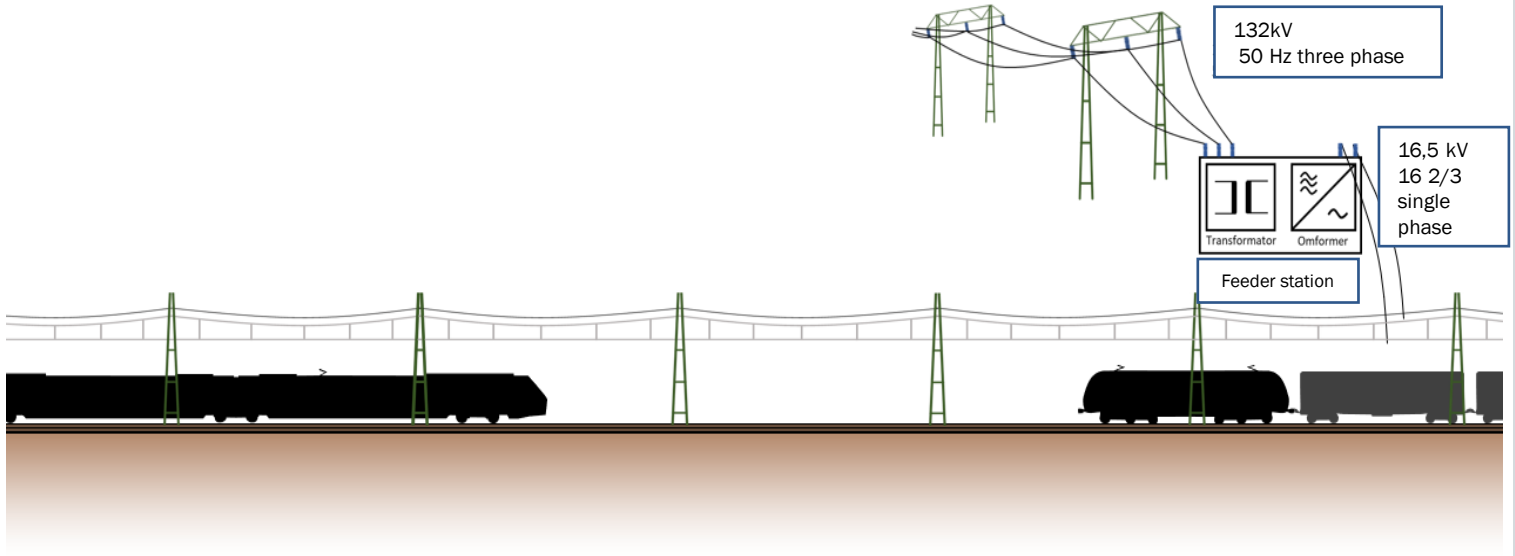
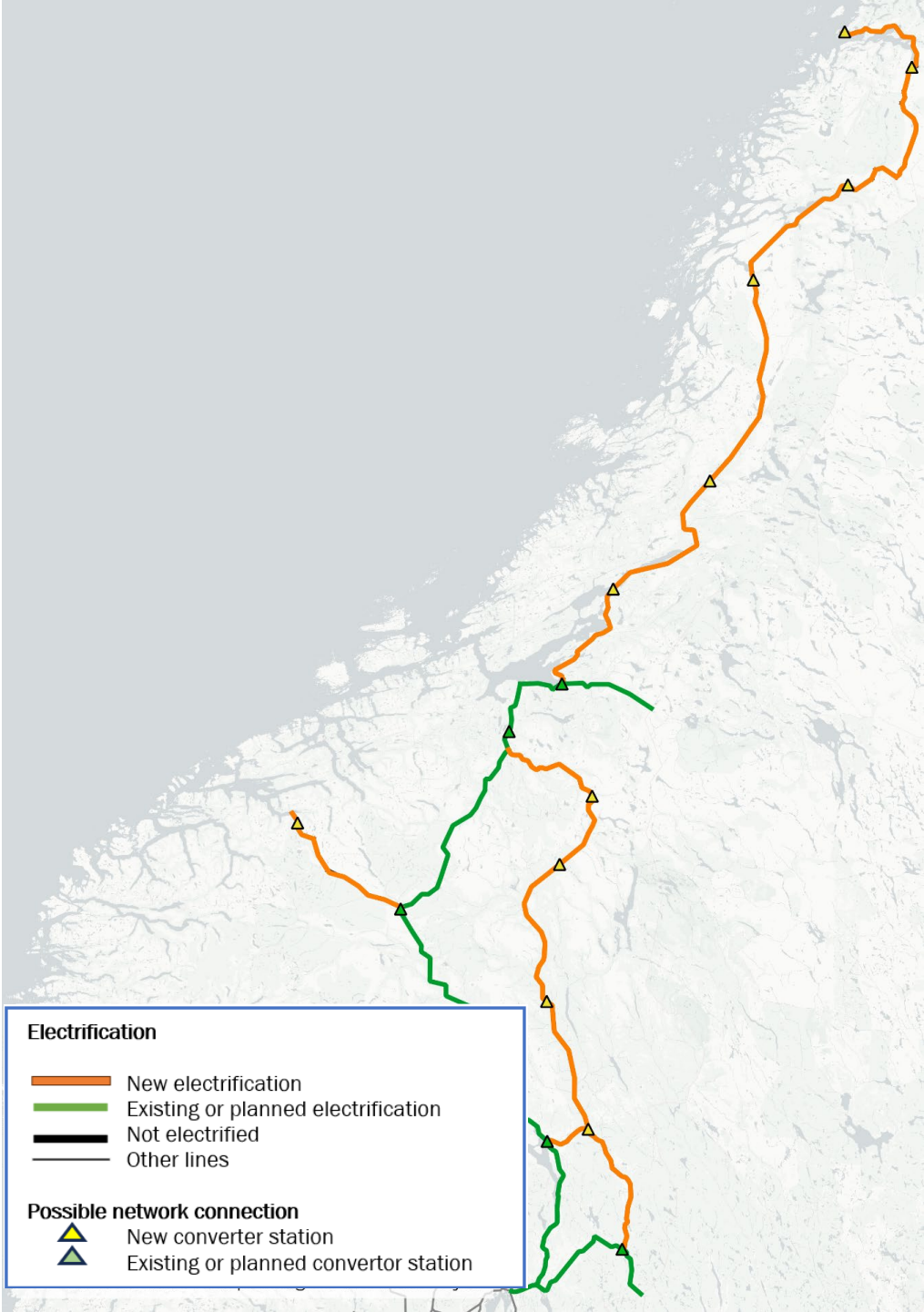
Concept

4 Elektrifisering





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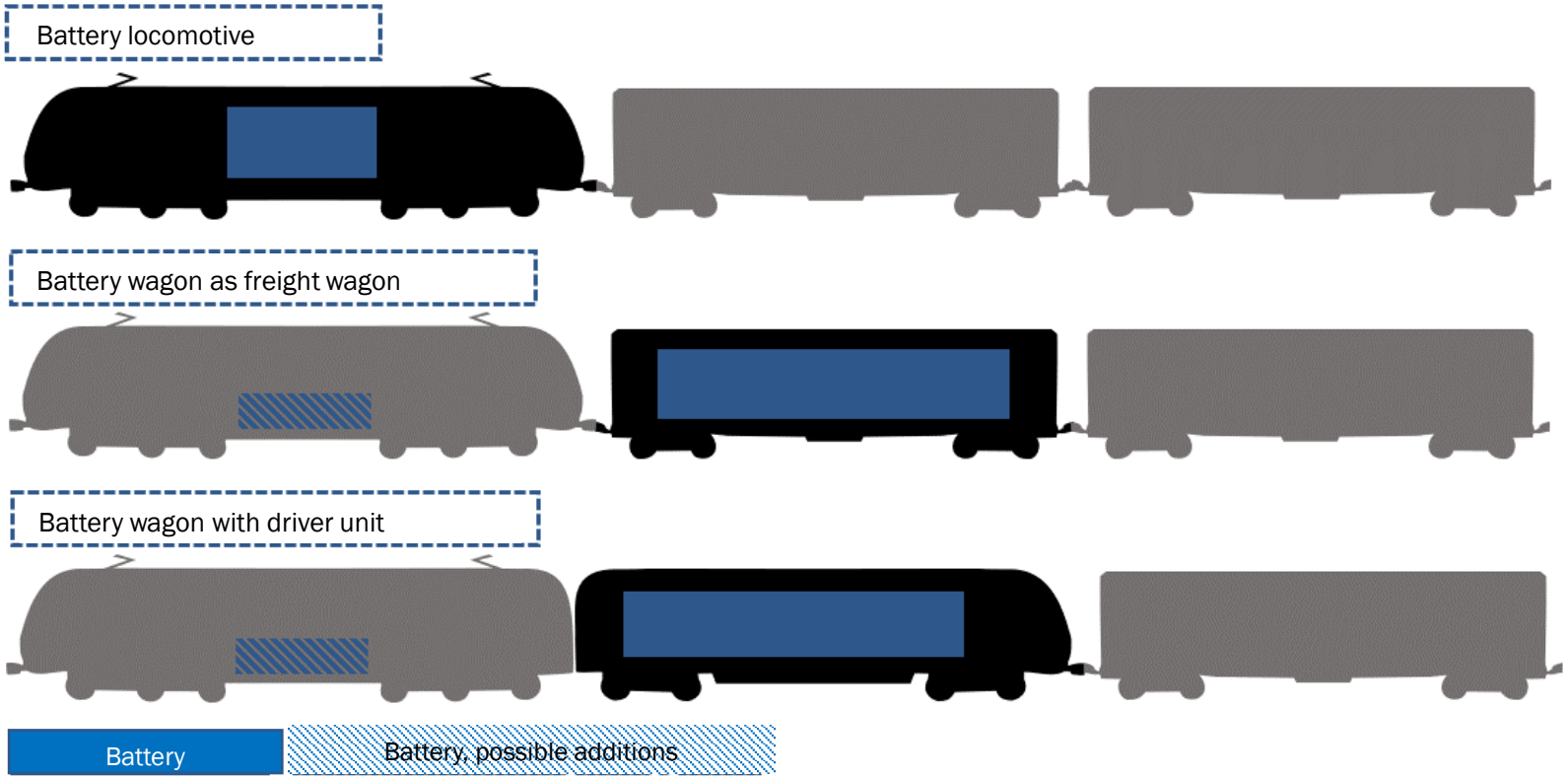
Concept

3 Battery with partial electrification



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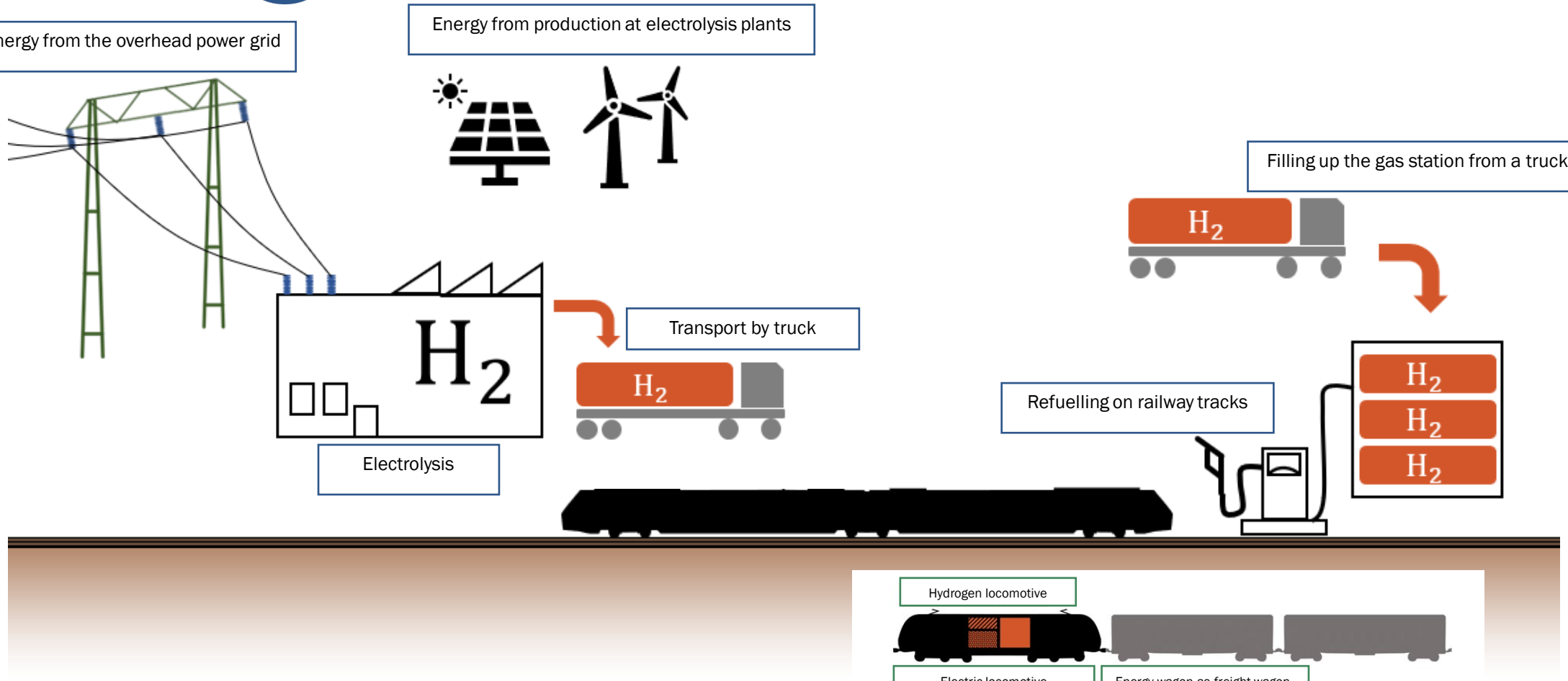
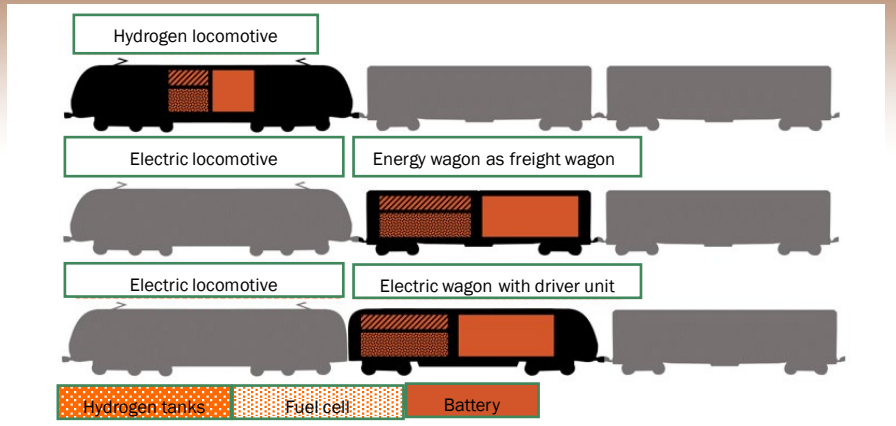
Concept

H_2 **2a** Hydrogen





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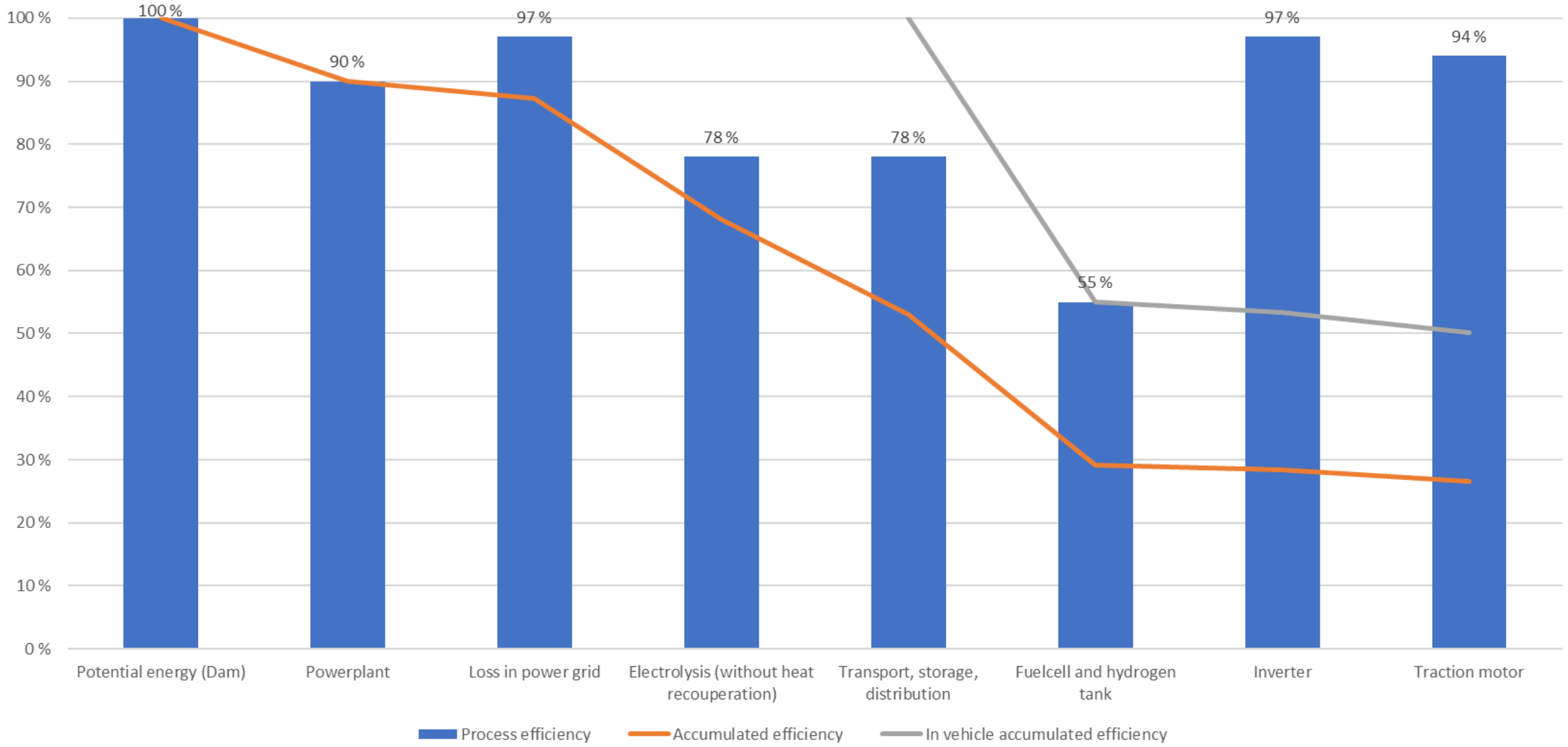
Well to wheel- energy efficiency

H_2 **2a** Hydrogen



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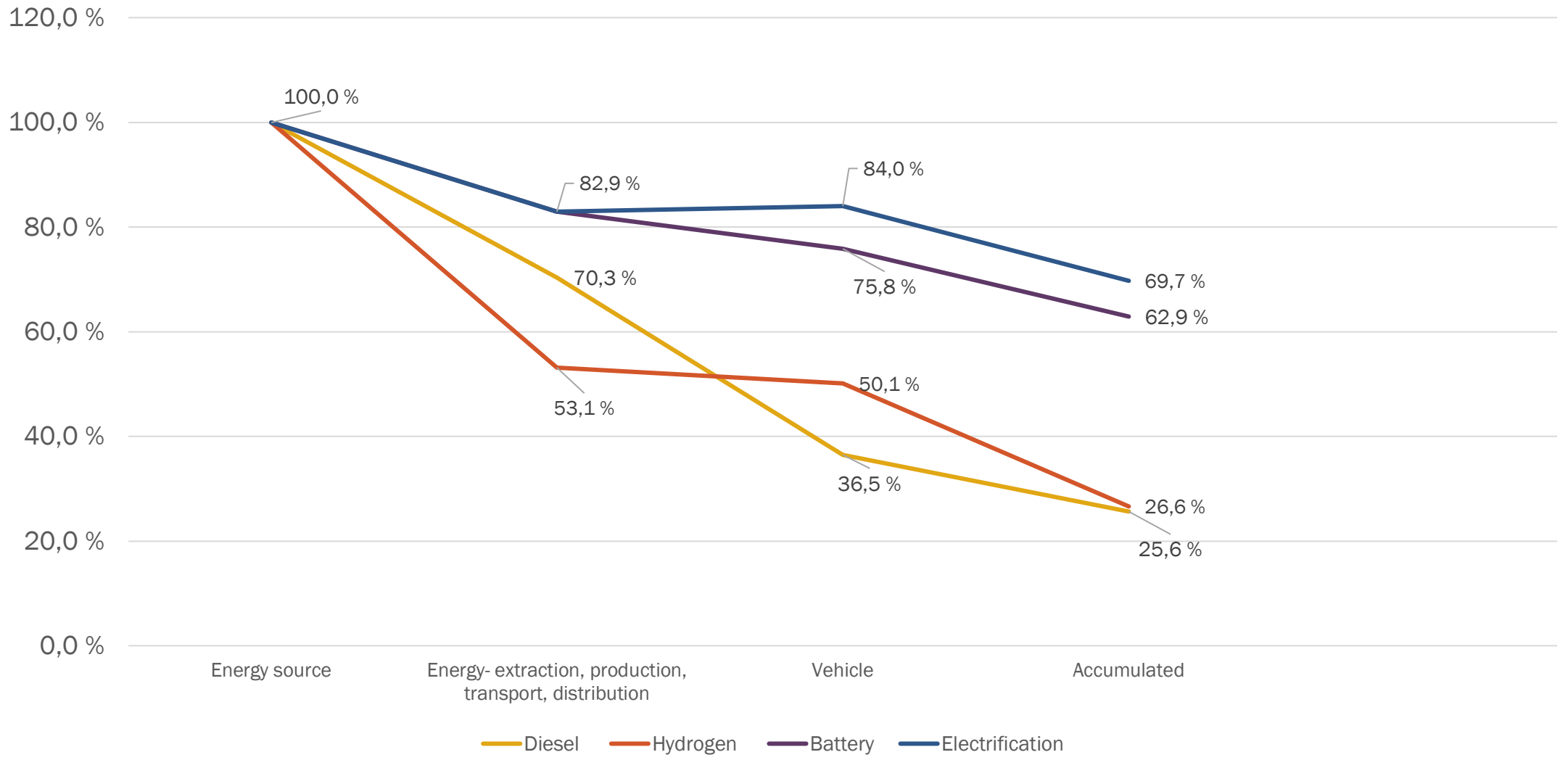
Well to wheel- Energy efficiency



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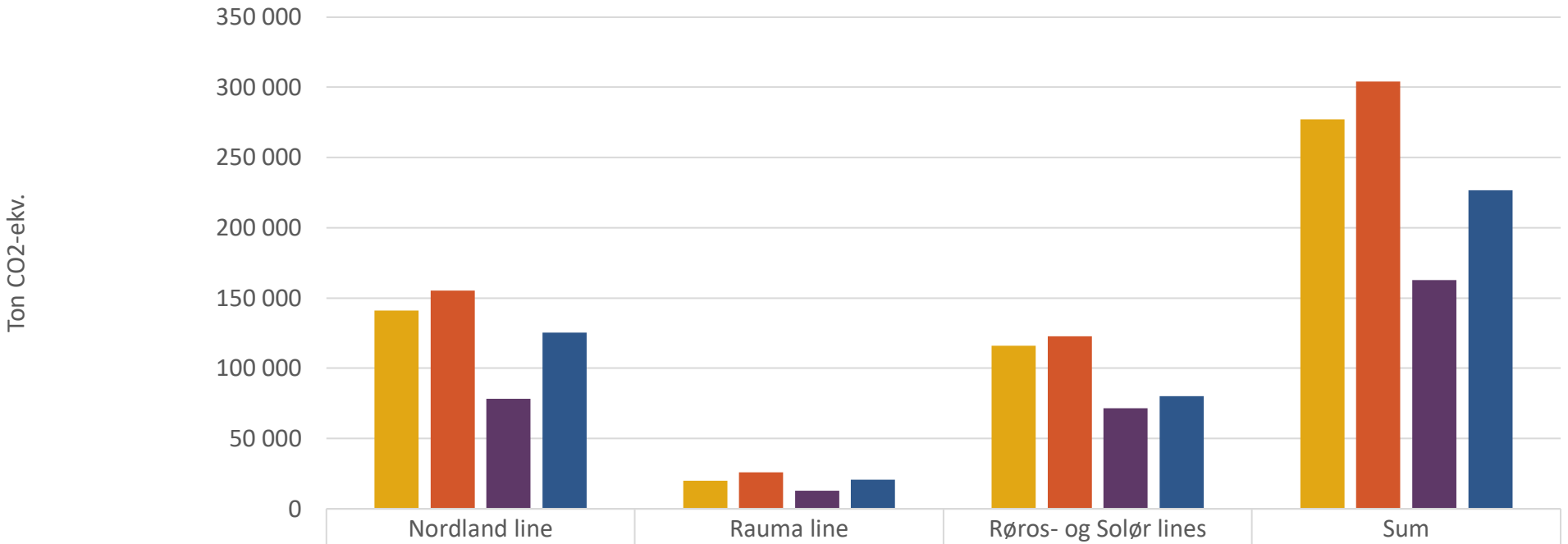
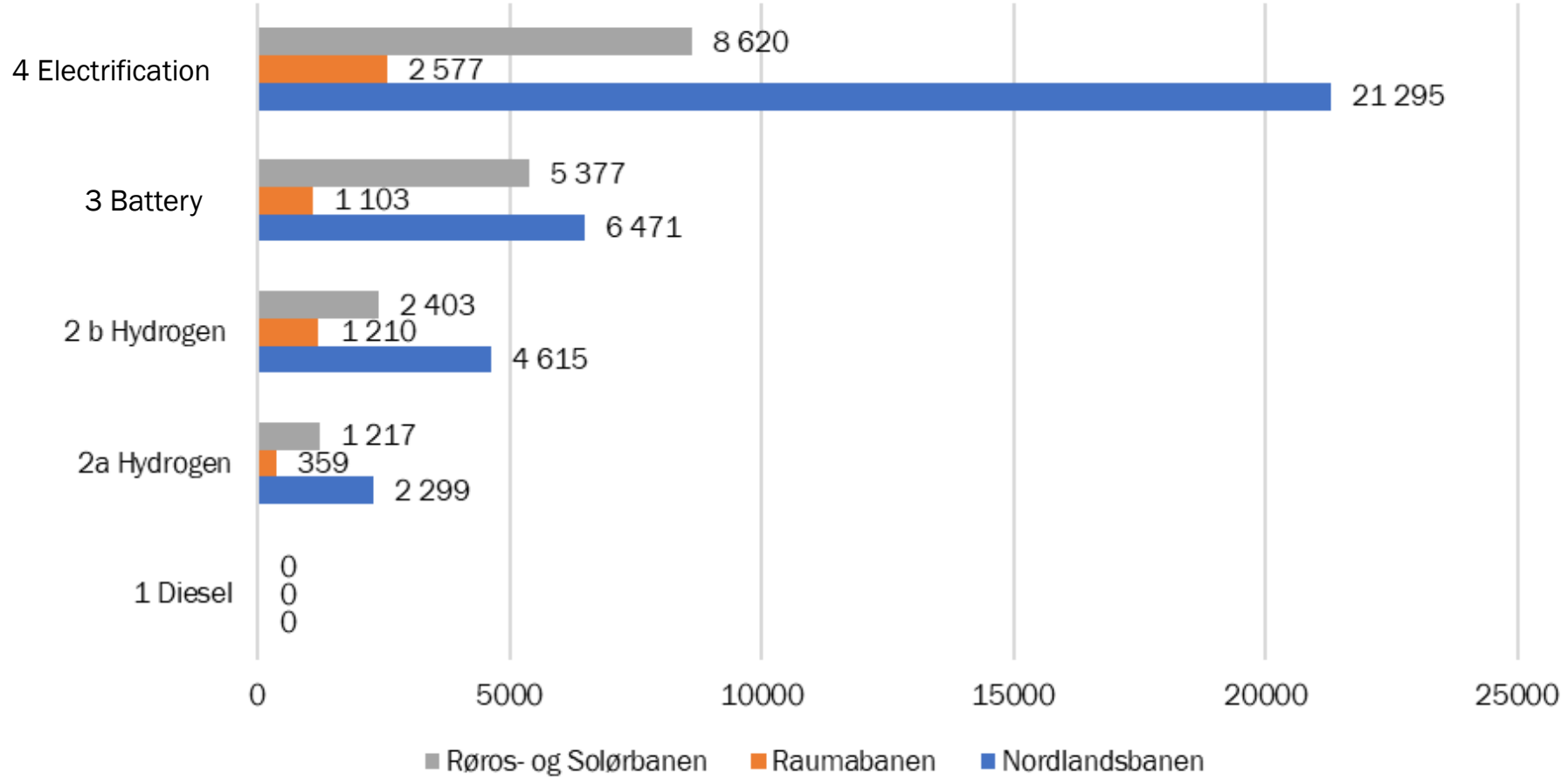
GHG over 75-year analysis period

The total greenhouse gas emissions (tons of CO2 equivalent) from the alternatives over the 75-year analysis period



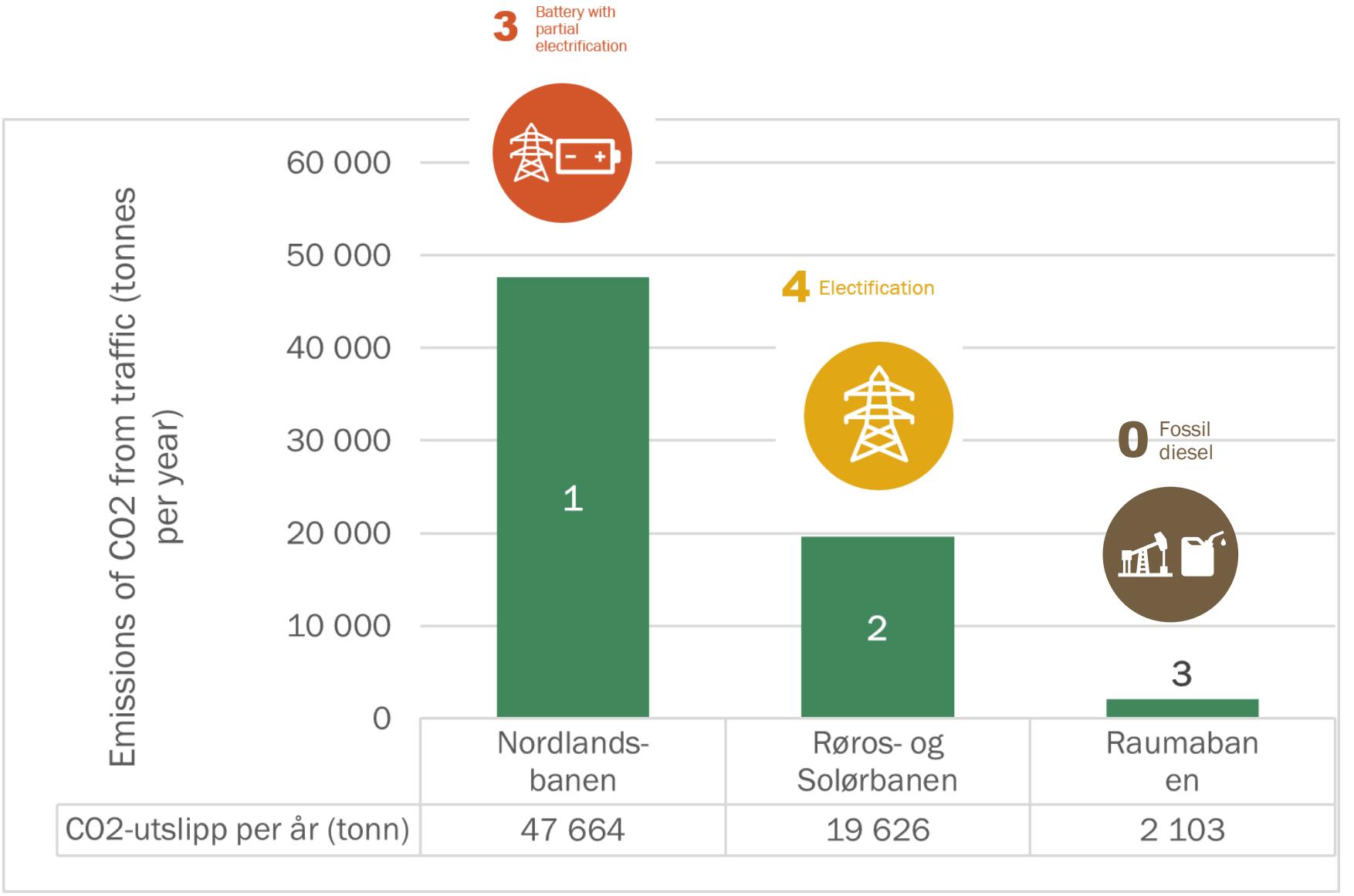
	Nordland line	Rauma line	Røros- og Solør lines	Sum
2a Hydrogen	141 244	20 160	115 951	277 355
2b Hydogen med partial el	155 425	25 897	122 775	304 097
3 Battery	78 363	12 809	71 566	162 738
4 Electrification	125 555	20 801	80 282	226 638

Costs of introducing a new form of energy



Total investment costs for the infrastructure (MNOK)

Our recommendations



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Thank you for your attention!

For Norwegian readers further information is available here - KVU GREEN

For further information do contact:
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