Fossil-free freight options for forest industries

SEI brief
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Björn Nykvist

Olle Olsson

IMAGE (ABOVE): Autonomous battery-electric Timber-pod concept, designed by Einride © EINRIDE

Key messages

- **Transport of forest biomass and products represents around 25% of the heavy truck transport work on Swedish roads, and is among the most demanding transport applications, typically using heavy goods vehicles with a total weight of 64 tons or more.**
- **Decarbonizing road freight for forest industries is essential in order to reach Sweden's climate goals, but progress to date has been too slow.**
- **In this project, SEI, Skogforsk, Einride and forest industry stakeholders will evaluate fossil-free road freight options for Swedish forest industries and their potential to accelerate progress towards Sweden's climate goals.**

Fossil-free freight

Decarbonization of the Swedish transport sector needs to accelerate in order to meet Sweden's climate mitigation goals. On current trends, the transport sector looks set to achieve only half of the intended CO_2 emission reductions by 2045 (Klimatpolitiskarådet 2019).

The main pathways to fossil-free heavy goods vehicles (HGVs) being considered to date in Sweden have been based on biofuels. But rapid developments in battery technology have raised vehicle manufacturers' interest in battery-electric drivetrains. Several Swedish companies both well-established HGV manufacturers and newcomers such as Einride, are now developing electric HGVs.

This project aims to advance thinking on fossil-free road freight alternatives to meet the transport needs of the Swedish forest sector (i.e. industries producing and processing roundwood and residues). The project partners are SEI, which is leading the work; Skogforsk, the central research body for the Swedish forest sector; Einride, a new freight solutions company; Skogsindustrierna, (the Swedish Forest Industries Federation); and forest industrial companies SCA, BillerudKorsnäs, Södra and Sveaskog. It is co-funded by Trafikverket (the Swedish Transport Administration) via the TripleF consortium, Skogsindustrierna, and the participating forest industry actors.

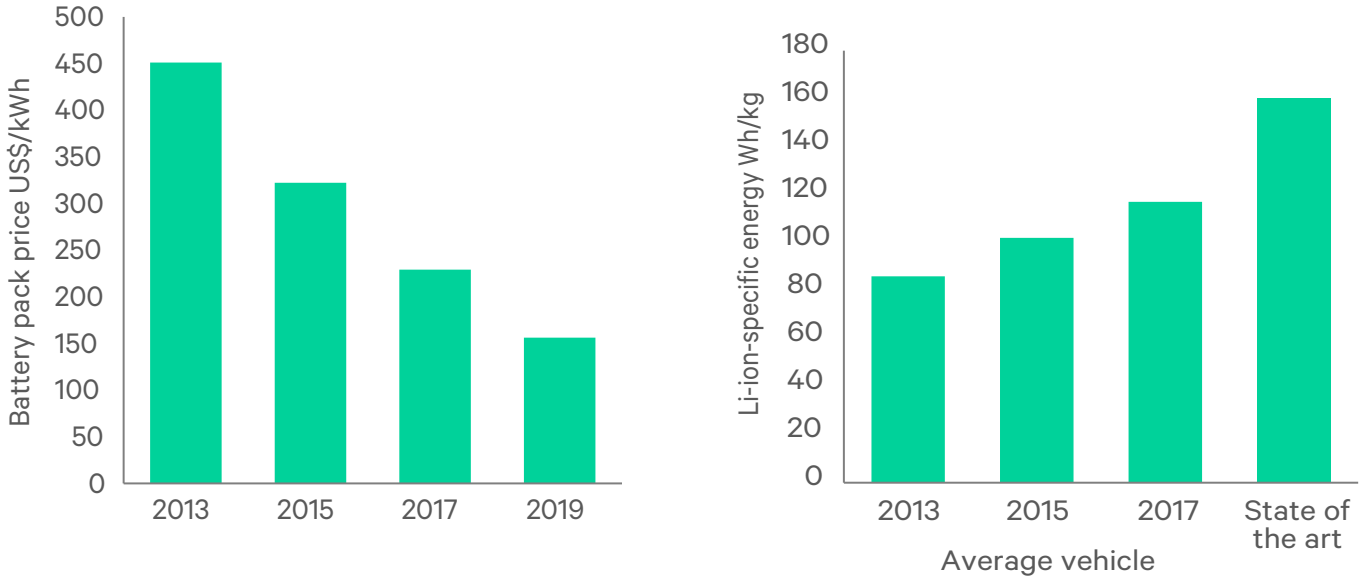
Focus on electrification

The decarbonization of Sweden's transport system will likely involve a mix of solutions. Research by SEI has shown that electrification is becoming an increasingly viable option; in the long term battery electric vehicles seem

set to become a competitive solution for a range of road freight applications (Nykvist et al. 2019; Nykvist and Olsson 2019). Figure 1 shows recent trends in two critical variables for battery-electric freight vehicles and the rapid development warrants a specific focus on the feasibility of electrification of HGVs.

The project will assess the viability of novel battery-electric HGVs, and compare this with selected state-of-the-art biofuel-based solutions. The goal is to recommend those solutions most suitable for further piloting and demonstration projects in the forest sector in the near term.

Figure 1. Key technological trends in Li-ion vehicle batteries



The charts plot battery pack price (in US$ per kilowatt-hour) and battery pack energy density (in watt-hours per kilogram) over time. For energy density, historical data show the average values for vehicles introduced in that year, and "state of the art" the highest value among recent models.

Source: Nykvist et al. (2019)

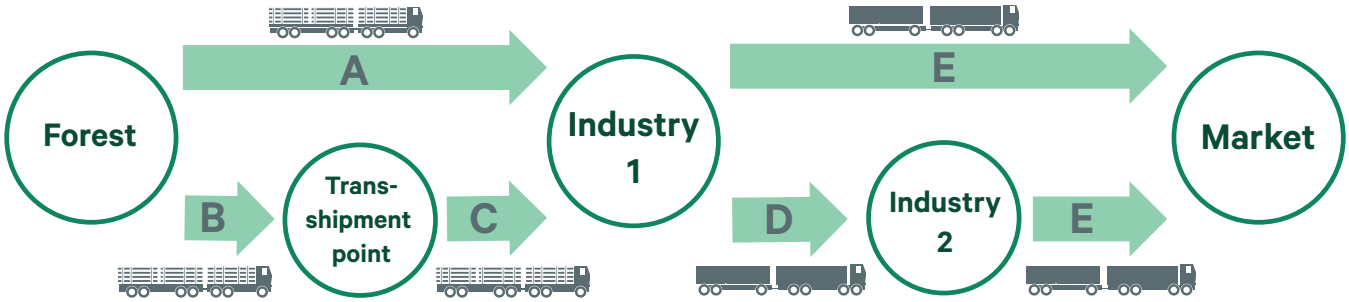
Forest sector transport applications

At a first project workshop in November 2019, the project partners identified three of the most important use cases for biomass transport in the sector, which could represent the flows in the sector at large (summarized in the five flows shown in Figure 2). Forest sector supply chains come in several different forms and sometimes follow complex routes (Andersson et al. 2007; Rönnqvist et al. 2017). The project will characterize these three use cases together with participating forest industry companies, based on detailed transport data. This will be used to represent the industry's transport needs in evaluating freight solutions .

The three flows identified are:

- from a forest ("supply point") directly to an industry (Figure 2, path A), representing transport of roundwood from the forest
- between a trans-shipment point (such as a railway freight terminal) and an industry (Figure 2, path C) – a key logistical use case
- within an industrial site (Figure 2, path D), representing a variety of use cases on private land, for which a different set of regulations – for example on vehicle weights – apply.

Figure 2. Key material flows in the forest sector



Flows A–C are of roundwood; Flow D of roundwood, industrial by-products, and semi-finished and finished products; and Flow E of finished products only

Candidate technologies

There have been significant developments in fossil-free road freight among Swedish vehicle manufacturers. For example, Volvo has started selling battery-electric vehicles of 18- to 26-ton gross vehicle weight and presented HGV concepts for both the European and US markets.

Project partner Einride is developing autonomous (driverless) HGVs. In 2019 it road tested its Pallet-pod HGV, and announced that it was developing another autonomous model specifically aimed at the forestry industry, the 26-ton Timber-pod. These would be marketed as part of integrated autonomous electric shipping systems (see https://www.einride.tech).

Looking at biofuel-based solutions, both Volvo and Scania have marketed engines for large (>64-ton) HGVs certified for 100% hydrotreated vegetable oil (HVO100, a biodiesel fuel) since 2015. Both manufacturers have also developed liquified gas engines for 40- to 64-ton HGVs compatible with liqufied biogas (LBG). These engines have been available since 2017.

Biofuel supply and vehicle technologies have been developing hand in hand in Sweden. Biogas (i.e. bio-methane) in gaseous compressed form is already a mature technology for lighter HGVs. LBG also offers a longer range than gaseous biogas, and has applications for heavier vehicles. Sweden produces significant quantities of biogas, and Swedish fuel producers have invested in further expanding production of biofuels. Both LBG and HVO1000 are thus important options to consider.

Finally, the main Swedish policy for decarbonizing HGVs is to gradually increase the mandatory share of biofuel in ordinary diesel towards 40% in 2030. Under current regulations (Energimyndigheten 2019), diesel fuel in Sweden has to contain 21% biofuel, which is predominantly HVO. In this project, diesel HGVs using the gradually increasing mandatory minimum share of biodiesel will be used as a baseline in evaluating alternative solutions.

BOX 1: BIOFUEL PRODUCTION IN SWEDEN

Sweden has been producing HVO since 2009, and biodiesel from forest residues since 2010. Their combined annual production capacity is currently around 270 000 m^3, while total diesel fuel demand in Sweden around 4.6 million m^3. Biorefineries currently under construction or planned indicate that this capacity is set to double in the near term. The pace of future expansion is uncertain, but the company Preem aims to produce 1 million m^3 of HVO fuel in 2030 (Danielsson 2020).

Evaluation of alternatives

The project team will identify a selection of the fossil-free freight alternatives available in Sweden for more in-depth evaluation. Evaluation will include how well the technologies meet the needs of the forestry sector; the full costs of implementation (including

The project is co-funded by the Swedish Transport Administration (Trafikverket), the Swedish Forest Industries Federation (Skogsindustrierna), and project partners from the forest industry.

development, vehicle, infrastructure, maintenance costs); and the potential lifecycle greenhouse gas emissions reductions available with each solution (compared to diesel-powered HGVs using mandatory minimum shares of biofuel; see Box 1).

Based on the evaluation, the project will make recommendations for further research and potential demonstration projects geared towards the needs of the forestry sector.

Timber truck © KNAPE / GETTY

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Stockholm Environment Institute
Linnégatan 87D, Box 24218
104 51 Stockholm, Sweden
Tel: +46 8 30 80 44

Author contact
bjorn.nykvist@sei.org

Media contact
ylva.rylander@sei.org

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