ELECTIN – summary report

Electric heavy-duty transport: Energy needs, locations, grid and charging stations for heavy duty (larger) vehicles

Project supported by NORA

And additional support from Veitur and Samorka

Dissemination level: Public

All publications from the project are public

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Project partners:
Icelandic New Energy, coordinator
Beyonder
Umhverfisstövan
Blámi
Nuukisiorfiit

Additional partners:
Federation of Trade and Services Iceland
Federation of Energy and Utility Companies in Iceland (Samorka)
Icelandic Student Innovation Fund

ELECTIN final report – Overall summary

Early in the project it became evident that collecting data would be more challenging than thought in the beginning. Also, that it would be more complex to both collect the detailed data and do detailed TCO calculations within the project boundaries. As truck charging is still taking its first steps into the market, since battery electric trucks have just been commercially introduced (2022), the project decided with key stakeholders that the most important current step would be to collect as detailed information from truck operators as possible so that a kind of “heat (electric)” map could be made. Such information would be of highest value currently to energy and utility companies as they are preparing for increased use of renewable energy in trucks during the years to come.
It was also realized that this ELECTIN project would not be able to answer all questions as technical development is happening very fast these days within the truck segment. But with the data collected and mapped it would be a key input for all other plans regarding charging infrastructure not only for trucks but also far battery electric vehicles (BEV´s) and potentially regional buses and coaches, applications that seemed further into the future but are advancing relatively fast also.
The hydrogen (H_2) part of the project is slightly simpler as dispensing large quantities of H_2 is not that complex, if it is compared to charging many large battery trucks at the same time. However, there are other attributes to H_2 that need considering, i.e., production, distribution, cost etc.
This short report is only a summary of the project but the overall project findings consist of 4 separate documents and this summary. The final documents are:

1. Model results – truck charging in Iceland.
   a. Main author: Ágústa Loftsdóttir & Atli Guðjónsson from EFLA consulting
   b. Subcontractors to Icelandic New Energy
2. Cost Evaluation of Hydrogen Fuelling Infrastructure.
   a. Main author: Til Tzschöckel working for Icelandic New Energy.
   b. Additional funding was provided for Til through the Icelandic Student Innovation fund
3. Use of batteries in truck charging stations
   a. Main author: Omar Shagouri, from Beyonder.
4. Model results – Faroe Islands.
   a. Memo – main author: Ágústa Loftsdóttir and Atli Guðjónsson (EFLA)

All documents are public as the purpose is to support all or any work aiming towards utilizing alternative energy instead of fossil fuels in truck transport.
This is way beyond the original scope of the project. As stated the main obstacle was data collection which the partners new would be complex but no as complicated as it actually became.

Introduction

The primary objective of this project is to develop an understanding of the electricity consumption and thus infrastructure needs by electric trucks at various depots in Iceland. By analyzing data on factors such as truck type and truck routes, we can gain insights into the key determinants of electricity usage. This information should enable stakeholders to make informed decisions regarding charging infrastructure investments.

A crucial factor in the project was to collect data from truck operators. For this the project group had to be extended which later led to the overall activities in the project. To be able to obtain data the project contacted the truck transport group of the Federation for Trade and Services (Samtök Verslunar og Þjónustu) in Iceland. They were eager to participate as the interest in zero emission trucks was growing fast within their members. They therefore became part of the project group and the same happened to the Federation of Energy and Utility Companies in Iceland (Samorka) when approached for interest in the project and their potential role in providing the future energy for trucks. Both federations were already thinking how to act but the ELECTIN project kind-off created the platform for them to move forward.
For the Faroese case Umhverfistövan was the primary data collector and contacted one large truck operator and their route was simulated for electric truck route. It is therefore only showing the results for that single operation – but can in the future be expanded to a larger pool of trucks.
The case of Greenland was never calculated as no data was provided by the Greenland team. There participation was very active in the beginning of the project but with changes of people there interest diminished.

Data collection

Even with the transport group from the federation on board data collection became a very complex and difficult part of the project and was the reason for a ½ year delay in the project. First it became necessary to establish communication and provide information to the Competition Authority in Iceland that all the data needed and collected would not jeopardize and competition laws/regulations in Iceland. This alone took almost 2 months. Following this data sheets were distributed for data collection of the movement of the trucks. A handful of companies responded immediately and provided good data. But to collect the rest became a nightmare. It was far from their core operation to provide data of the movement of the trucks, where they stop, how far they travel, do they return, where do they sleep, etc. Vital if to map the power needs of the fleet in different locations. If the original application is viewed then the original idea was only to create case studies of handful of vehicles or locations. But when both federations showed such high interest, and were willing to contribute financially and with work, then the data collection was expanded. Main cause of project delay.
However, after 6 months of pushing for the data most truck companies had handed in data and mapping of charging could be done and is one of the deliverables in the project. This is a vital map for the energy and utility companies to estimate the potential power needs and at what time the need is. Unfortunately, it was not possible to create a TCO calculation of the potential charging infrastructure. This is a bit premature there is not a full understanding of what kind of charging infrastructure, i.e. size of charging 250kW, 350 kW, 600 kW or even a 1 MW charging. Same applies to the building of the power lines and how to strengthen that. The utilities and the energy companies now have the potential charging profiles of the trucks and can now evaluate how and whereto provide the energy if the bulk (or all) of the trucking becomes battery electric.
Data collection was neither simpler in the Faroe Island and therefore only one case (one operator) provided data. So that is more showing an example of results.

Hydrogen

This data was also used to evaluate hydrogen as an option for the trucks. In this case the key was to understand the sizing of the hydrogen refueling stations (HRS) and evaluate the TCO for the HRS depending on the size of the HRS. It was decided to exclude the production and transport of the H_2 as there is a large difference if the H_2 is produced on site, at a power plant or in conjunction with another hydrogen user like an e-fuel production. As can be seen from the report (separate deliverable to this report) it can be seen that there is a great difference between the TCO of an HRS depending on the potential amount of dispensed H_2. As can be seen then when a large station is in operation it is estimated that the levelized cost of hydrogen refueling (LCOHR) is just above € 3 per kg H_2. But can be very high, far beyond any economic operation, if the dispensed H_2 is at a very low amount. However with total operating (lifetime) cost below € 4 at current CAPEX[1] levels H_2 can be dispensed competitively with current diesel costs. Of course at the onset of any H_2 installations cost is expected to be higher, and even with the inflation since the report was concluded this cost has increased.

Grid and battery truck charging stations

The utilities are best suited to calculate costs if the grid needs to be strengthened or upgraded for increased use through truck (heavy vehicle) charging. Also they are best suited to evaluate different options within a region based on the power needs in each region provided by the truck companies. It is likely due to the high peak demand of trucks, i.e. lunch and dinner times, as examples, that it might be "cheaper" to provide part of the peak demand from battery charging stations. Here the indication is that each MWh of capacity at such a stations costs around 1 million USD, 15 year lifetime. Such battery solutions could be of benefit while the new systems are built up as they are movable and can be deployed while the first truck fleet is being initiated on certain routes. Also it is expected that the range of battery electric trucks will increase in the near future (3-7 years) and therefore the density of charging stations might be reduced. Stationary battery solutions might therefore be a solutions while development is taking place, while the market is forming and potentially a permanent solution where grid costs are high.

Conclusion

Unfortunately, at this point it is not possible to compare the cost of each kWh with the cost of each kg. H_2 or maybe more importantly the cost of driving a battery electric truck each km vs. using H_2. A general comparison of fuel cost will also just give one parameter. There is a major difference between the two vehicles, for example range, refueling time, maintenance cost, etc. Frequently stakeholders and policy makers are making this comparison on completely incorrect basis.

Still the findings are of extremely high value. For the first time energy and utility companies can see the challenge ahead if all trucks will travel around the island as battery electric. On top of the truck consumption battery electric vehicles will also need charging (already more than 10% of the passenger vehicle fleet is BEV in Iceland) and also regional public buses and coaches. It will now be in the hands of the energy and utility companies to prepare for this massive new customer, given that truck operators will choose a battery solution. If H_2 will be used in larger quantities the e-fuel industry now can visualize the potential need for H_2 when the truck fleet starts using H_2. However, the most likely scenario is that there will be a mix. Already the first small fleet of battery electric trucks has arrived in Iceland (spring 2023) and customer´s using them for inner city distribution and near warehouse (within 50 km radius) distribution are very happy with the performance. This first generation of battery trucks is not suitable for long haul distribution. The OEM´s of these trucks have though stated that the range will increase relatively fast during the next few years and therefore should be able to service a larger customer group. The actual cost of charging trucks should now be possible to calculate by the energy and utility companies, given that they know the actual cost of the

[1] With increased production of stations the CAPEX is expected to drop.

chargers themselves. Also, it should be know how many chargers are needed if full service (no waiting) is to be provided. Still there are more variations. To reduce potential grid cost battery container solutions (electric storage) can be installed to shave the peak demand for the trucks. There are now solutions being introduced to the market for this and in the cost calculations for the electric service for the trucks this can be added if it is cost effective.

Therefore, it is not know yet if the TCO for a truck operator will be higher or lower with a battery electric one or a H_2 one. For shorter range vehicles it is very likely that the battery solution will be cheaper. But for all the other solutions, technical development and the truck customer´s preference will have a massive impact during the next few years.