

HCT and ERS in Sweden

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Abstract

In this paper we describe which steps and measures we are taking to be able to introduce HCT in Sweden. We will describe how we in Sweden manage and collaborate on the issue of HCT-cooperation between industrial groups, agencies, academia and government. Which projects we have started and results from some completed projects. We describe the results from two assignments that we got from the Swedish government both about having HCT introduced at Swedish road network. This together have placed Sweden in the front of HCT research in Europe.

We will also briefly describe the process of developing and funding two demonstrators of ERS. The project is (what we know) one of the biggest pre commercial procurement carried out in Europe. It has engaged the Swedish heavy truck industry as well as providers of electrical road systems and other public authorities in Sweden.

Keywords: High Capacity Transport (HCT), Sweden, Freight transport, Heavy Vehicle Trucks, Electric Road Systems (ERS)

1. Background

The Swedish transport system is under pressure. It competes for public funding with other public areas such as schools, health care, while it is dominated by four major problems - energy, climate change, lack of capacity and safety for people, animals and goods. In addition there is a lack of knowledge and different views about in which way the various parts of the transport systems should contribute to overcome these problems.

The transport sector is facing a major challenge to reduce energy consumption and limit environmental impact, both in relation to carbon dioxide emissions and emissions of regulated emissions (NO_x, CO, HC and PM). The transport sector is the only sector of society that has not yet succeeded in finding a potent tool to reverse the trend of increasing carbon emissions and energy use. This is especially true for heavy goods transports on roads.

So what will be the characteristics of the future transport system?

- No fossil fuels
- Higher grades of automation
- Connected vehicles and infrastructure
- Comodality / multimodality
- Specialised solutions for different applications

There are a few different ways to meet these characteristics and to tackle the problem with carbon dioxide emissions from heavy duty trucks. Due to capacity problems in the railroad system, there are very limited options to transfer goods from the Swedish road system to the railroads. So our main conclusion is that the road bound heavy traffic must be liberated from the dependence of fossil fuels by measures within the road system.

This situation is not special for Sweden alone. In Europe some 26% of all GHG emissions comes from the transport sector and about 25% of these emissions originate from heavy duty vehicles on the road, figures from Ertracs Roadmap. So even though there is a common understanding that transports must move from road to rail and waterways, this is not always possible.

The parliament of Sweden has set up a goal for 2030. By then the vehicle fleet should be independent of fossil fuels and by 2045-2050 the society as whole should be carbon free. Sweden is determined to set an example for the world by becoming the first carbon free industrial society.

This will not be an easy task. The heavy road transports are in STA freight prognosis forecasted to increase by about 60 % by 2030 (STA 2016).

So our strategy is multiple.

The energy efficiency must increase. HCT is one possibility to do this. We have very positive results from test projects which show very strong reduction of energy usage per ton goods freighted. We also think that HCT is a way to better use the existing infrastructure.

Another way is to consider electrification. Batteries for heavy duty traffic is no option, If a 40 ton regular truck should be electrified by batteries the weight of the batteries is in Ertracs Roadmap calculated to 20- 30 tons given the same action range as a diesel propelled vehicle. So we have looked into Electrical Road Systems (ERS). The electricity for propulsion is delivered continuously while the truck is moving forward. STA (Swedish Transport Administration) is cofounding two demonstrators aiming to show the possibility of ERS in real life on our roads.

Other fuels must also be considered; both biofuels and electro fuels. These are probably both parts of a feasible solution, but they do not require any major alterations of the road infrastructure. So STA is not at this moment engaged in developing these possibilities.

2. HCT

2.1 Research program for HCT

Purpose

The HCT program aims to increase knowledge and create conditions for the introduction of High Capacity Transport (HCT) on a designated part of the Swedish road network. To do this we need to describe problems, agree on common goals and possible solutions and to test and demonstrate these solutions together. This includes developing new and different vehicles and vehicle combinations designed for higher capacity than the vehicles of today.

Both the HCT program and the ERS project helps to fulfill transport policy and industrial benefits by:

- Increasing accessibility by utilizing the capacity of existing transportation systems.
- Increasing the return of previous infrastructure investments.
- Reducing the need for new infrastructure investments.
- Increasing the competitiveness of the Swedish automotive and transportation industry as well as for exporting industry.
- Reducing energy consumption and carbon emissions
- Reducing emissions of regulated emissions (g / ton * km of NO_x, CO, HC, PM)

Set up

A multidisciplinary taskforce with representatives from industry, administration and academia has developed a Research and Innovation program with a common roadmap for HCT on roads, thus creating a framework for future actions. We have set goals and steps we know are crucial for introduction of HCT in Sweden.

Important steps we need to take is.

- Parallel R&D projects in
 - road safety including literature studies, field tests, simulator studies
 - telematics IAP (Intelligent Access Program), OBM (On Board Mass systems)
 - PBS (Performance based studies)
 - Configuration of vehicles
 - Knowledge of conditions and systemic effects of the progressive introduction of HCT

- Reviewing and adapting the infrastructure
- Developing a new regulatory framework

What has made this possible?

- A strong base of common interests.
- Cooperation between industrial groups, agencies, academia, administration and government in Sweden.
- Cooperation with Australia primarily TCA is very important because Sweden is the first country in Europe to test longer vehicles.
- Research funds from different donors.

With these in mind, the priority development needs for the period 2013 - 2017 following summarized in the following work packages / project areas / projects. Each work package is coordinated by one or more organizations (in parentheses), but a lot of more organizations are participating in each work package.

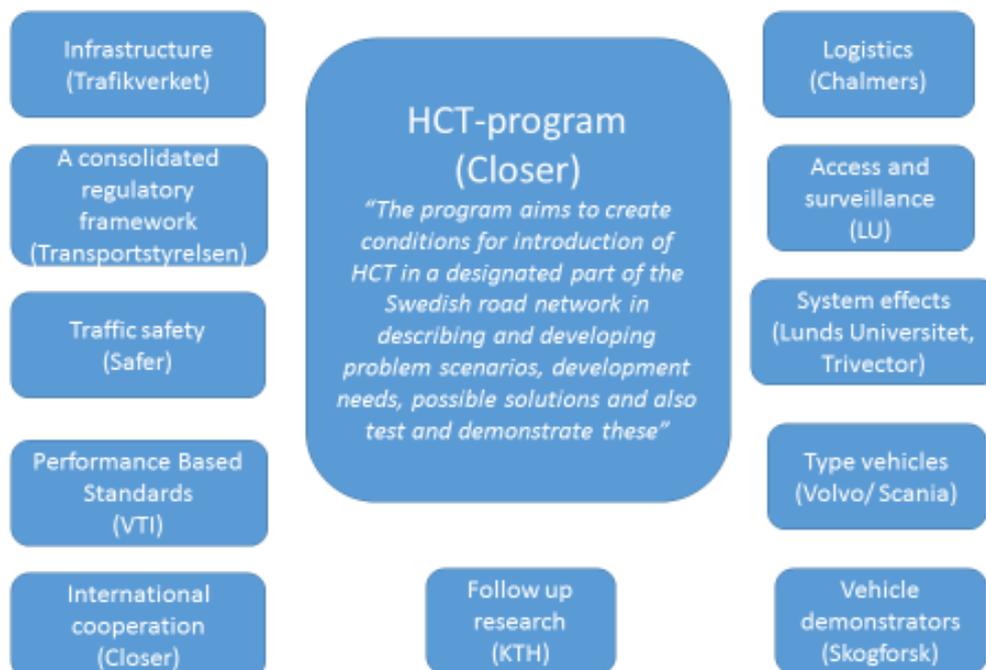


Figure 1 – HCT-program in Sweden

Methods

The program develops and uses several methods to achieve desired results. This means that several scientific and practical skills will interact within the program.

- Business environment studies (including doing literature studies).
- Surveys and interviews.
- Modelling and statistical analysis.
- Technology and logistics development.

- Demonstration and verification of technologies, logistics and marketing solutions.
- Implementation methods.

Organization and management

A multidisciplinary group with representatives from Closer, STA, Chalmers, Schenker, Vinnova, Swedish Transport Agency, the Forestry Research Institute, University of Lund, Volvo AB and Scania AB has set up the program and a road map for future measures. The program is thus a part of Closer arena for transport efficiency at Lindholmens Science Park in Gothenburg. Linked to this group by a MoU with the STA is also Transport Certification Australia (TCA). TCA is also an operational partner within the IAP demonstration that has been built up, starting in 2012.

The main goal for the group is to generate projects, qualify and prioritize them and help find funding for them. Competences and skills in the program group match what is identified as critical for the development of an independent and innovative R & D - industry, government, academia, and innovation and entrepreneurship. New actors and stakeholders that will strengthen this competency profile are welcomed to the program group.

The group is led by a chairman from the STA, a vice chairman from the industrial partners, and an operational program leader whose mission is to lead and develop the program in the projects and subprojects to content, management and finance. The host operates with Closer as a base.

A more loose reference group is built around players in adjacent projects, which are already in progress or started.

Funding

Each project or activity within the program must find its own funding, primarily through project stakeholders. The main sponsors are found among Vinnova Innovation Agency, the Swedish Transport Administration, the strategic vehicle research and Innovation program (FFI), the automotive and transport industry and academia through its strategic research money.

The operational activities is to its greatest part funded by the STA R & I programs together with industrial partners In-Kind funding. A rough estimation of the total funding (including industrial In-Kind) from 2009 up to summer 2016 is well over 20 million Euros.

Results

The main result so far has been the governmental assignment STA got 2014 about preparing for implementation of 74 tons on parts of the Swedish network. This was ahead of our planned schedule and not anticipated at that time.

More results of the work of a number of the program's work packages will be presented in other lectures during the conference HVTT.

2.2 Governmental assignments around HCT

Purpose

STA have had two assignments, one 2014 and one 2015, from the Swedish government and delivered two reports,

- Trafikverket 2014; Heavier vehicles at public road network
- Trafikverket 2015; Further analysis of heavier vehicles at public road network

In these reports should STA describe how we can introduce heavier vehicles 74 ton but with the same maximum length as now 25.25 m.

Results

A short summary of what STA propose in the answer to these assignments from the government is that we need:

- to decide on a new bearing capacity class BK4 (<74 tons and <25.25 m) as previously proposed.
- to a long-term goal should be to the whole state BK 1 road network to be made available for BK 4
- under responsible forms grant a limited road network for BK4 in the near future (12 months from the award)
- under continued responsible forms gradually expand BK4 road network, focusing on the main roads and priority roads in the forest counties (total cost around 1,5 billion Euros)
- to change the weight of the rules of BK1, so that they harmonize better with the weight rules for BK4

Specific conditions that should be considered when introducing proposals described above is:

- Control system, including technical requirements for vehicle combinations, which contribute to the increased likelihood of compliance and to maintaining the high level of security.
- Tire configuration, STA proposes initially to a requirement for twin tires should be considered as a priority occurs for roads for the forestry industry.

As a result of this, the Swedish minister of infrastructure has said that the government this year (2016) will take a decision concerning the introduction of 74-tonne vehicles.

Then we have done cost-benefit analysis have we seen that longer vehicles has a much better potential so we are still waiting on decisions about that. In Sweden is longer vehicles more controversial because discussions about the risk of moving goods from rail to road transport.

3. ERS

3.1 The ERS development in Sweden

The STA (Swedish Transport Administration) first encountered serious ideas of ERS late in the first decade of the 2000. Some years later 4 different systems was known to be developed; conductive systems by rails in the road by Alstom and Elways, a conductive system by hanging lines by Siemens and an inductive system by Bombardier. The Alstom and Bombardier system were compared and evaluated in a research project named "Slide in" by Volvo and Scania together with the Swedish Energy Agency and STA.

Early in 2012 STA, the Energy agency and the Swedish innovation agency (Vinnova) agreed to challenge the industry in order to find out what had been accomplished and what could be tested on public roads. The common strategy was to meet each system at their level of maturity. By the end of the year there was an agreement that some kind of innovative procurement was suitable for the challenge.

While these 3-part discussion were carried out a cooperative platform named “The forum for transport innovation” was formed, with partners from the industry the academia and the administration. In this platform it was decided that a common roadmap for ERS should be elaborated.

So by 2013 there were two processes about ERS converging; a common roadmap and an innovative procurement. In both processes mostly the same persons participated and the processes were also managed and coordinated by some of these.

About the same time (late in the first decade of the 2000) the framework for pre commercial procurement was developed both in Sweden and in the EU. The primary characteristics of a pre commercial procurement was to be; a transparent process, competition between different consortia, gradually elimination of entries in several steps and no commercial contract in the end. In terms of TRL levels a typical pre commercial procurement operates between TRL 2 and 7.

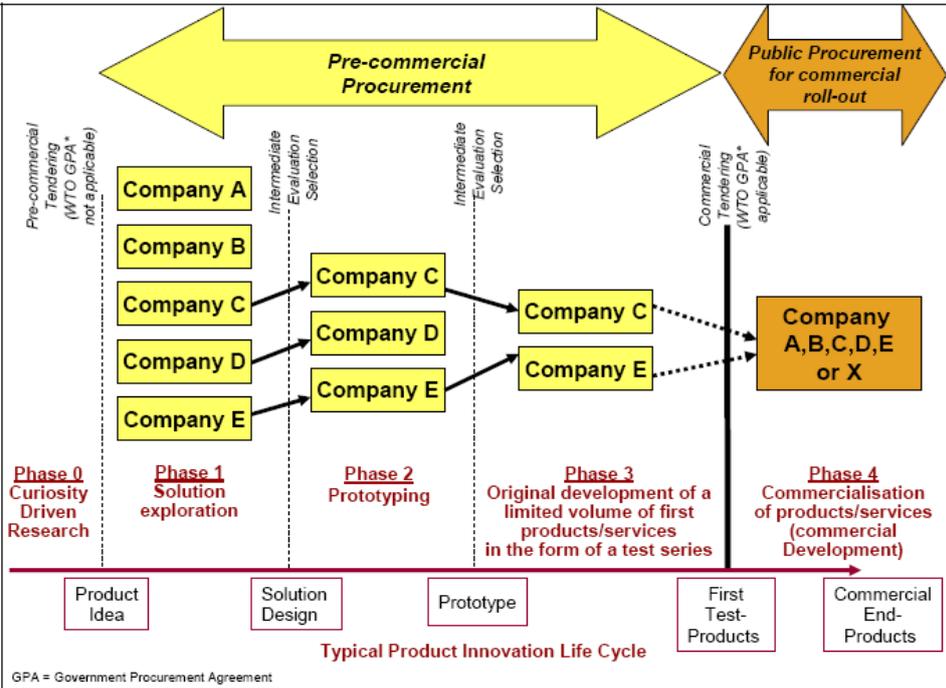


Figure 2 - Principles for pre commercial procurement according to EU.

During 2012 and 2013 a 4-step pre commercial procurement was elaborated between STA, the Energy agency and Vinnova. The aim was to validate and demonstrate ERS for vehicles over 16 tons in public transports, city distribution or long haul freight transports under a period of at least two consecutive winters. The steps were:

1. Pre-qualification. In order to enter the procurement process each consortium should show experience of Development of ERS, vehicle design and production, road maintenance and management of big research and innovation projects. (11 entries)
2. An outline of the demonstration the consortium wanted to take on. (10 entries)
3. Design of the demonstration. (4 entries)
4. Building and operating the demonstration. (2 entries)

The length of the whole process, from designing the procurement until the ending of the demonstrations, will be almost 6 years. The budget is approximately 200 MSEK (20 MEuro) with public funding of 125 MSEK. The result so far is that two systems are being demonstrated, each with a length of 2 kilometers; the Siemens e-Highway conductive system (current through hanging lines) demonstrated by Gävleborg region together with Scania outside the town Sandviken, and the Elways conductive system (current through a beam in the road) demonstrated outside Arlanda international airport.



Figure 3 - The Siemens e-Highway system demonstrated outside Sandviken in Sweden.



Figure 4 - The Elways electric beam on a test site.

In June 22 the Siemens system outside Sandviken was opened by the Swedish ministers of energy and infrastructure together with the director generals of STA and the energy agency. This is still, to our knowledge, the first ERS system for long haul freight transport on public roads.



Figure 5 – Pleased ministers and director generals at the opening of the Sandviken demonstrator.

3.2 The strategic situation

There are similar reasons for ERS as for HCT.

- Electrical Roads reduces energy use.
- Electrical Roads reduces CO2 emissions.
- Electrical Roads utilizes existing infrastructure in a smart way.
- Electrical Roads creates a new national field of knowledge and a new industrial branch.
- Electrical Roads is great field for cooperating between the political, administrative and industrial entities.

The demonstrators will mostly give us information of how well they function, their reliability and how the systems integrate with “normal” traffic. It will not give us much strategic knowledge.

Questions like: What are the societal effects? How can ERS be financed? What kind of roads are suitable? How should the electric grid be designed? How will the roads be maintained? What are the environmental effects? What are the effects for shippers and operators? How will ERS develop in a future European context?

To answer these and similar questions, and to get knowledge enough to decide on further development of ERS in Sweden, a four year research program has started this autumn. The program partners are from academia, industry and administration and is managed by Swedish Viktoria institute. Already the research agenda has started with projects about eco systems for business models and payment systems. ERS applicability and feasibility in a societal context is also being studied in the Swedish and European projects “Sisters” and “Fabric”.

It is obvious in Ertracs Roadmap that ERS is considered to be a part of the future road transport system and that especially for:

- Buses in metropolitan areas
- International freight corridors
- Long haul national freight corridors
- Short haul freight corridors

While electrification used to be considered only for passenger cars, now electrification is entering buses, distribution trucks and even long haul heavy duty trucks. EU states that lower running costs for transport will benefit the whole society and that Europe must not lag behind when it comes to fuel efficient vehicles and new low emission technologies. The development foreseen is not only ERS but also the fast development of battery technologies. How these technologies (ERS and Batteries) will develop and how they will interact, will probably be revealed in the next 5 to 10 years.

And it is also likely that ERS will play an important part of liberating the heavy duty trucks from the fossil fuels.

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