A regional development perspective on the electrification of transport

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#1 The administrative context
Regional responsibility for development
Region Västra Götaland - authority with five missions

Health Care - Public Transport – Culture – Development - Infrastructure

Overall mission: “contribute to a good life for the people in Västra Götaland.”

Overall transition challenge: “through collaboration with other actors develop a future regional economy that is independent of fossil origins”
# Regional Sustainable Transportation Program 2017 – 2020

**Goal:** Reduce emissions through 'transition'. Strengthen competitiveness through collaboration and partnership. Develop technology and services that has a global market potential. Develop the future public transport system through collaboration and partnership.

*Horizontal goal: support equality, social integration, internationalisation and environment/climate*

The program account for global trends in transportation and challenges for environment and the climate

<table>
<thead>
<tr>
<th>Area 1</th>
<th>Area 2</th>
<th>Area 3</th>
<th>Area 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Energy efficiency</em></td>
<td><em>Renewable fuels and electricity</em></td>
<td><em>Transport efficiency</em></td>
<td><em>Automation and connectivity</em></td>
</tr>
</tbody>
</table>

**Regional context:** Vehicle industry, transport industry, chemistry industri, technology consultants, institutes, universities, R&I initiatives

**Regional role for R&I:** Contextual adaptation/matching between “what needs to be done” and “what can be done” through collaboration between actors in the region
#2 The industrial context
Two primary Swedish vehicle industry clusters

The two regional clusters are “complete” (OEM, supplier, consultants, research, manuf.)

Concentration of industry to Västra Götaland

Capacity to transform to electric propulsion and autonomous vehicles and automated traffic
Vehicle industry

What is at stake in the electrification challenge?
Västra Götaland Cluster

Västra Götaland share of Swedish vehicle industry by sub sector in 2014

- Personbilsindustri: 98%
- Lastbilsindustri: 49%
- Elektrisk/Elektronisk utrustning: 38%
- Tillbehör motorfordon: 27%
- Karosserier: 6%
Vehicle industry is the single largest sector in the regional economy.

Regional "GDP", 2015

Vehicle Ind.

Development of direct employment in the region in vehicle industry, 2007 to 2015

Please note that employment in transport industry is of similar size.
It is by far the largest export sector
Vehicle industry has the largest ‘multiplicator factor’ of all sectors

The ‘multiplicator factor’ is a way to account for the link between direct employment in industry and this industry’s effect for employment in other sectors.

In reality the number is probably larger (due to how SCB data is annotated)

<table>
<thead>
<tr>
<th>SEKTOR</th>
<th>Direkt sysselsatta</th>
<th>Andel av Sverige</th>
<th>Multiplikator Västra Götaland</th>
<th>Multiplikator Sverige</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handel</td>
<td>123 000</td>
<td>22%</td>
<td>1,17</td>
<td>1,77</td>
</tr>
<tr>
<td>Utbildning</td>
<td>96 000</td>
<td>20%</td>
<td>1,08</td>
<td>1,41</td>
</tr>
<tr>
<td>Vård och omsorg</td>
<td>93 000</td>
<td>20%</td>
<td>1,05</td>
<td>1,37</td>
</tr>
<tr>
<td>Byggverksamhet</td>
<td>64 000</td>
<td>20%</td>
<td>1,26</td>
<td>1,99</td>
</tr>
<tr>
<td>Hälso- och sjukvård</td>
<td>61 000</td>
<td>20%</td>
<td>1,13</td>
<td>1,59</td>
</tr>
<tr>
<td>Offentlig förvaltning</td>
<td>48 000</td>
<td>18%</td>
<td>1,14</td>
<td>1,64</td>
</tr>
<tr>
<td>Hotell och restaurang</td>
<td>32 000</td>
<td>20%</td>
<td>1,18</td>
<td>1,69</td>
</tr>
<tr>
<td>Fordonsindustrin</td>
<td>31 000</td>
<td>50%</td>
<td>1,84</td>
<td>3,44</td>
</tr>
<tr>
<td>Landtransport</td>
<td>26 000</td>
<td>19%</td>
<td>1,35</td>
<td>2,07</td>
</tr>
<tr>
<td>Bevakning, säkerhet, fastighetsservice m.m.</td>
<td>25 000</td>
<td>18%</td>
<td>1,13</td>
<td>1,53</td>
</tr>
</tbody>
</table>
Vehicle industry employment in the region is highly concentrated to a few large firms

Approx. 90% of people work in 5% of the companies

Our contribution to electrification globally depends on the activities within these 5% ... through their global export
**Regional competence landscape**

*Challenge*: the right competence, in sufficient volume, at the right time, and place

*We know there is resilience*: Sectors “share” generic profession/capacity

*Rapid growth*: When different sectors demand similar competence at the same time we experience this a lack of competence

Will we have a specific “BEV profession” in the future?

Source: Henning, M. et al, Tillverkningsindustriell omvandling
- kompetensbehov inom industri och industrinära tjänster i Västra Götaland
#3 Climate context
The role is not only reducing emissions locally but reducing global emissions through leverage effect from export to global markets.

**Share of greenhouse gas emissions**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden, all sectors included</td>
<td>0.15%</td>
</tr>
<tr>
<td>EU28, all sectors included</td>
<td>10%</td>
</tr>
<tr>
<td>Transportation sector, globally</td>
<td>15%</td>
</tr>
<tr>
<td>Transportation sector, share in EU28</td>
<td>20%</td>
</tr>
<tr>
<td>Transportation sector, share in SE</td>
<td>30%</td>
</tr>
</tbody>
</table>

Share of fossil energy use by sector in Sweden

![Graph showing share of fossil energy use by sector in Sweden]

Source: Energimyndigheten (2014)
Energiindikatorer 2014, s. 57
Large potential for reducing energy use in transport using HEV, PHEV and BEV

About 75% of the 92 TWh are in sectors where HEV, PHEV and BEV will reduce energy use significantly.

Large scale use of biofuels requires that the total energy use is reduced.

...Electrification and biofuels therefore are two sides of the same solution.

Energy use per vehicle type:
- Cars
- Distribution truck
- Buses
- Heavy truck
- Two wheelers

(SOU 2013:84, Fossilfrihet på väg, s. 385)
Regional electrification in public transport (PT)

City bus – high capacity bus traffic – regional buses

Ferries
Historic data: renewable fuels in public transport
/share of vehicle km, 2007-2016/

- Biodiesel: -50 to 60%
- HVO: -70 to 90%
- Biogas: -70 to 100%
- Renewable electricity: -100%

Reduction of fossil CO2:

- RME: -50 to 60%
Example of implementation in the future regional public transport system (buses)

- **Regional buses**
  - Fossil diesel
  - Flytande biodrivmedel
  - Biodiesel
  - Biogas
  - Battery electric

- **City buses**
  - Biogas
  - Battery electric

Aprox. 2000 buses
Public transport (PT) represents an early market

- Buses represent a small share of transport energy use (about 8% in Sweden)
- Public transport in the region is already "fossil free" (>90%)
- Electrification of buses allow biofuels from PT to be used in other sectors
- The industrialisation of electric buses pave the way for electrification in other sectors, primarily transport of goods
Electrification is not only a “problem” for infrastructure planning - it also allow new degrees of freedom.

Closer integration between transport and city

Large reduction of energy use and emissions

Cost effective high-capacity transport, and increased flexibility

Lesser noise and more flexibility for city planners
The elusive electric vehicle

- BEV was considered an exclusive car for city use (120 years ago)
- Its market declined in the 1910-20s, primarily because it remained 3-4 times more expensive than the ICE automobile
- BEV was expected to re-emerge (40s, 70s, 80s, 90s,...), however proponents failed to realise that the step from ICE to BEV is too large, and that it would benefit from HEV/PHEV as stepping stone, for volume and industrialisation
- Using a ”computer system metaphor” - HEV/PHEV is both backward and forward compatible, which is effective for a systemic transition from ICE to BEV
- Conclusion: BEV will probably happen faster if policy support PHEV (with increasing all-electric range). This is because industrialisation on a global scale matters for cost reduction and product dev.