Renewables in Rail Transport: Approaches and Examples

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Grasp the Scale*

The graphs above show the potential of renewables in rail transport. Rail transport in Germany accounts for 0.87% of the total energy consumption and for 2.9% of the energy consumption in the transport sector. Electricity accounts for remote 2.3% of all propulsion sources used in the transport sector. Energy wise, transport on rail only holds responsible for a small amount of the total energy consumption in the mobility sector.

*BMVBS, 2012

**Note: 1 petajoule is $10^{15}$ joule
3.6% of the total number of passengers are served by rail-based modes of transport. However, almost 7.5% of the total passenger mileage is carried out on rail. Apparently, railway services are more efficient in their km-traveled-to-energy-consumption ratio than other modes of transport. More so, within the rail sector zero emission transport might be possible if the energy supply is completely switched to green sources. In this document, efforts to achieve zero-emission movement of passengers on rail are summarized.
Emissions in Public Transport

Public transport is pollution control in itself. For Germany it is estimated that 15 million tons of carbon dioxide are saved each year by people opting for buses and trains instead of cars. Compared to cars, local public transport produces only half the amount (or even less) of carbon dioxide per passenger kilometer.*

In general, public transport is environmentally-friendly. The priority in emissions reduction is therefore to encourage people to shift from individual modes of transport to public means of transport. However, to further advance in pollution control and to take a role model position in zero emission policy, renewable and green energy sources are becoming more and more important in public transport.

Electrification of the rail network in Germany is 60% and is aimed to reach 70% by 2020 (role model Switzerland is close to 100%). Deutsche Bahn states that already 90% of their trains are powered by electricity. Data on electrification of trams and metros is not available but is assumable close to 100%. This document focuses on rail traffic because electrification of railway services is a tested and proven concept and does not require further innovations or unpredictable infrastructure investments. For services powered by electricity the energy mix can actively be regulated. Providing green energy for railway services might therefore be easier and more affordable than for other modes of public transport. Therefore, renewables in rail traffic are not only having a positive impact on the environment, they might also function as a zero-emission role model for other means of public transport.**

<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>g/plkm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airplane (Inland)</td>
<td>205</td>
</tr>
<tr>
<td>Overland Bus</td>
<td>30</td>
</tr>
<tr>
<td>Intercity Train</td>
<td>42</td>
</tr>
<tr>
<td>Car</td>
<td>140</td>
</tr>
<tr>
<td>Local Public Transport</td>
<td>74</td>
</tr>
</tbody>
</table>

Source: VDV, undated

*VDV, undated
**Allianz pro Schiene, 2012
Deutsche Bahn

German railway company Deutsche Bahn (DB) is the largest single consumer of electricity in Germany with almost 12 billion kWh per year consumed by their trains. However, only one quarter of their energy usage is green; three quarters still come from fossil and nuclear sources.* Therefore DB is now planning - and has already taken - first steps on their transition towards low emissions practices: approximately five million BahnCard customers, season ticket holders, or bahn.corporate eligible customers use intercity transport on a regular basis. For those subscribed customers Deutsche Bahn can exactly track how many kilometers they have traveled and in doing so calculate how much energy has been consumed with their travels. DB’s promise is to exactly purchase the equivalent amount of electricity from renewable sources and feed them into their electricity mix.**

*SWR, 2013
**DB, undated
Deutsche Bahn - Vision

DB’s vision is to steadily increase the share of renewable sources in their energy mix from current 24% to 35% in 2020. By the year 2050 their goal is to completely rely on green sources with zero carbon dioxide emissions to power their rolling stock. Especially for 90% of their trains already running on electricity, DB can actively regulate the energy mix. To ensure reliable energy supply, DB has to look into all renewable sources as wind, sun, and innovative propulsion. Traditionally, the main share of energy still is expected to come from hydro-electric power as the assumable most reliable source. As stated by DB, an important piloting project is the recent construction of a hybrid-plant (hydrogen, wind, biogas) in Prenzlau, which particularly aims to exemplify the reliability of wind energy. To achieve their zero-emission-2050 goal, DB is cooperating with other companies forming the ‘Eco Rail Innovation (ERI)’ initiative to clear a path towards their set goals. However, while DB is almost without competition in inter-city offerings, in achieving the long-term zero-emissions goal it has to be considered that now 25% of the freight and regional transport are not carried out by DB but by other contractors on the rail market. This further reduces the opportunities provided by efforts taken towards usage of green energy by DB from an overall energy consumption point of view.*

*DB, 2014
S-Bahn Hamburg

Since 2010, the City of Hamburg relies to 100% on green energy from hydro-electric plants to cover the energy demand of S-Bahn (metro) trains. Compared to a business as usual scenario the city improves its carbon footprint of about 60,000 tons of carbon dioxide per year. Around 700,000 daily customers now travel carbon-free and, compared to a car-use baseline scenario, save up to 200,000 tons of carbon dioxide per year. Additional costs of about 3% are covered by the City of Hamburg. Hamburg is leading the way as the first city in Germany to completely operate S-Bahn (metro) trains with green energy. Just recently, the contract to use hydro-electric power has been extended to 2016.*
SPNV Saarland

Saarland is the first federal state to completely switch its energy supply for local rail services to renewable sources. Since July 2010 passengers (71 million in 2012 for Saarland and Rheinland-Pfalz) have been using green energy for their travels. Like in Hamburg a fare hike is not expected nor intended. In total 30 million kWh are now supplied by zero-emission hydro-electric sources of DB Energie GmbH (DB subsidiary company) and estimated 13,000 tons of carbon dioxide emissions are therefore avoided per year. The use of green electricity is part of Saarland’s overall effort to implement sustainable transport practices and reduce the overall carbon dioxide footprint.*
Subways and Light-Rail

Deutsche Bahn, the City of Hamburg, and the federal State of Saarland are the examples of renewable energy use for intercity services, regional rail transport, and metros (heavy-rail) in Germany. Examples for renewables in light-rail and subway services in Germany are:

1. **Frankfurt**: Since 2011 all of VGF’s subways and trams – around 350 – in Frankfurt am Main are powered by renewables. Mainova AG supplies 140 million kWh of hydro-electric power and helps to avoid estimated 53,000 tons of carbon dioxide per year. More than half of the additional costs of about €600,000 is reinvested in new renewable energy sources (notably photovoltaic).*

2. **Nürnberg**: Public transport operator VAG purchases around 80 million kWh to completely power their subways and trams with renewables. Again, the energy comes from hydro-electric sources to save 30,000 tons of carbon dioxide. Additional costs compared to a business as usual scenario are marginal with one-tenth of a cent per trip.**

3. **Darmstadt**: Heag mobilo GmbH in Darmstadt was the first transport operator to completely switch their energy use for trams to renewable sources in 2005. 48 trams are now operating on 41 kilometers of track with zero-emissions. Per vehicle and year savings of 257 tons of carbon dioxide are estimated. To set Darmstadt apart: energy comes from multiple sources including hydro, wind, sun, and biogas.***

4. **Freiburg**: Since 2009, per year approximately 13 million kWh of renewable energy are purchased from local supplier Badenova to power Freiburg’s trams.****

5. **Rhein-Neckar-Verkehr GmbH (rnv)**: Since 2014 the Rhine-Neckar region with a total population of 2.4 million (including the cities of Heidelberg, Ludwigshafen, and Mannheim) is exclusively using renewables to power its trams and metros. Additionally, stop signage, train stations, and administration buildings are powered by green energy.*****

*Stadtwerke Verkehrsgesellschaft Frankfurt am Main mbH, 2011
**VAG Verkehrs-Aktiengesellschaft, undated
*** Frankfurter Allgemeine Zeitung, 2005
****badenova AG & Co. KG, 2009
*****Eltis, 2014
Sources

More information

- Sustainable Urban Transport (SUTP): [www.sutp.org](http://www.sutp.org)
- GIZ Transport and Mobility: [www.giz.de/transport](http://www.giz.de/transport)
- Capacity Building on Sustainable Urban Transport (CAPSUT): [www.capsut.org](http://www.capsut.org)
- Facebook: [https://www.facebook.com/sustainableurbantransportproject](https://www.facebook.com/sustainableurbantransportproject)
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