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Christian Doppler Laboratory "Anthropogenic Resources"
TU Wien, Institute for Water Quality, Resource and Waste Management
Karlsplatz 13/226
A-1040 Vienna, Austria

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STATUS QUO AND FUTURE DEVELOPMENT OF ECOLOGICAL FOOTPRINT, RESOURCE CONSUMPTION AND DIRECT CO₂ EMISSIONS OF THE VIENNESE PUBLIC TRANSPORT SYSTEM

Georg KANITSCHAR^{25*}, Andreas GASSNER**

* *Institute for Water Quality, Resource and Waste Management, Vienna University of Technology, Karlsplatz 13/226, 1040 Vienna, Austria*

** *Resource Management Agency (RMA), Argentinierstraße 48, 1040 Vienna, Austria*

Introduction

Public transportation had a share of 39% of the Viennese modal split in the year 2012 (Wiener Stadtwerke, 2013). In order to sustain this high level of public transportation on the modal split, the Wiener Linien, carrier of the Viennese public transport system, need to expand their service, as Vienna is expected to increase in population by 300.000 to about 2 Million residents in 2035. To assess the sustainability of expanding a public transport system, we developed three scenarios and compared the effects on the Ecological Footprint and the direct CO₂-emissions of the Wiener Linien, including the effect of the source of electricity on these indicators. Additionally, resource consumption to implement each of these scenarios was calculated.

We used real inventory and energy-consumption data directly from the Wiener Linien. These data were supplemented with production and consumption emissions as well as life-cycle inventory data from the ecoinvent-database (Ecoinvent Centre, 2007).

Cases studied

The scenarios cover three development-strategies for the public transport layout of Vienna. The traffic-calculations, including number of vehicles, transport capacity vehicle-kilometres and others, were done by the Austrian Institute for Spatial Planning (Deußner, 2007).

The first scenario does not include large expansions. Current projects are finished, and then service expansion is halted. This scenario would lead to a drop in modal split, due to increased population without then adequate transport capacities. The resulting increase in motorised individual vehicle-traffic (MIV) would slow down the trams and busses, creating a self-sustaining negative feedback-loop.

In the second scenario, a major subway line is added to the existing system. Accompanied by adaptations in tram service and a slight reduction on the busses this scenario is the logical

²⁵ georg.kanitschar@tuwien.ac.at

continuation of the public transport strategy of the City of Vienna. Although building a new subway line through the heart of the city poses a technical and financial challenge, this scenario is to be implemented in reality.

The third scenario massively expands tram-service, resulting in a traffic system of equivalent capacity as in scenario 2. This scenario would require substantial political back-up, as the required tram-lines would further compete with the motorized individual traffic for space on the surface. Additionally, tram-lines would be built through areas with high building density, causing conflict with the local communities.

Results

The **Ecological Footprint** of the Wiener Linien in the year 2012 amounts to 71.000 ha, Figure 1 shows the contribution to the Ecological Footprint for each scenario. Per seat-km the Ecological Footprint amounts to 0.04 m²/a. The specific Footprint of the modes “subway” and “tram” are about the same 0.04 m²/a, while the mode “bus” has a specific Footprint of about 0.08 m²/a. With regard to passenger-km the Ecological Footprint is 0.8 m²/a. (subway 0.9 m²/a; tram 0.5 m²/a; bus 0.9 m²/a).

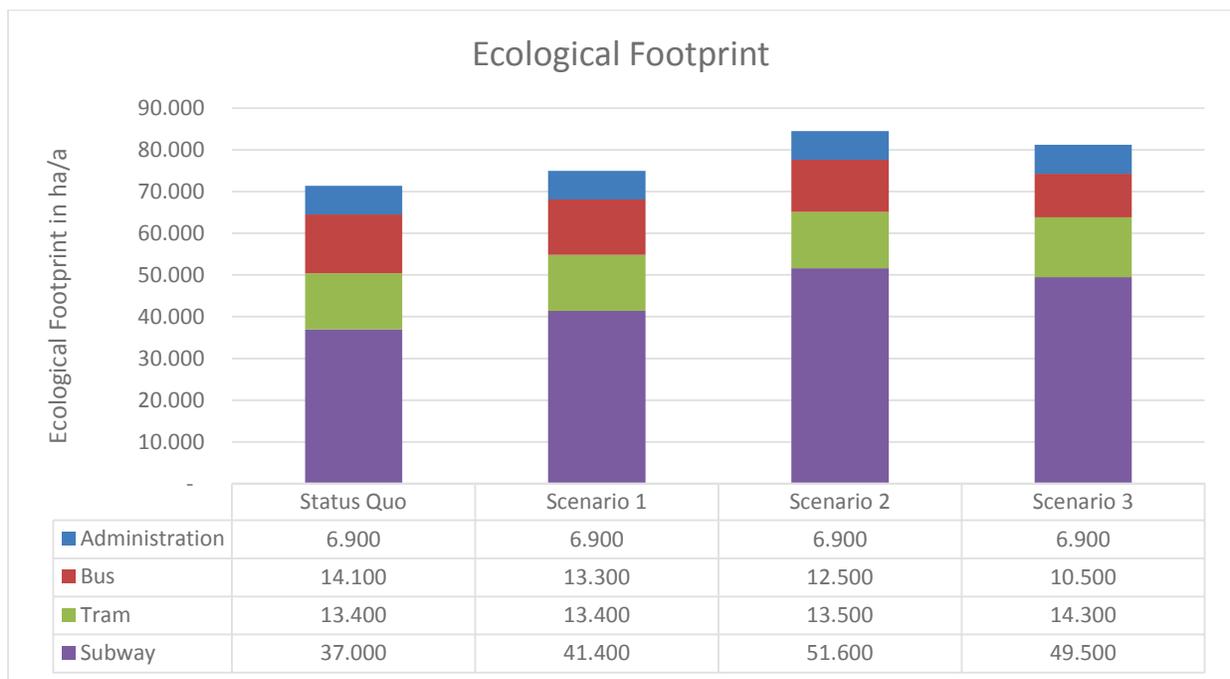


Figure 1 Ecological Footprint of the Wiener Linien – Scenarios and sectors

Depending on the development scenario until 2025 the **consumption of resources** varies considerably, from 1.1 to 4.6 million tons of material. The biggest demand (1-4,3 Mt) consists of concrete, followed by steel (65-250 kt) and aluminium (2.2-6.4 kt). The specific resource consumption for the scenarios – normalized for duration of use phase and seat-km is shown in Figure 2. Scenario 2 consumes most resources, as would be expected. The difference for plastics is not as large, due to subway trains being larger, thus using less material per

passenger. This measure for resource consumption does not distinguish, whether resources could be recovered or not. The concrete and steel built in subway tunnels is most likely not being recovered, whereas tram infrastructure can be reused (cf. Lederer et al. 2014)

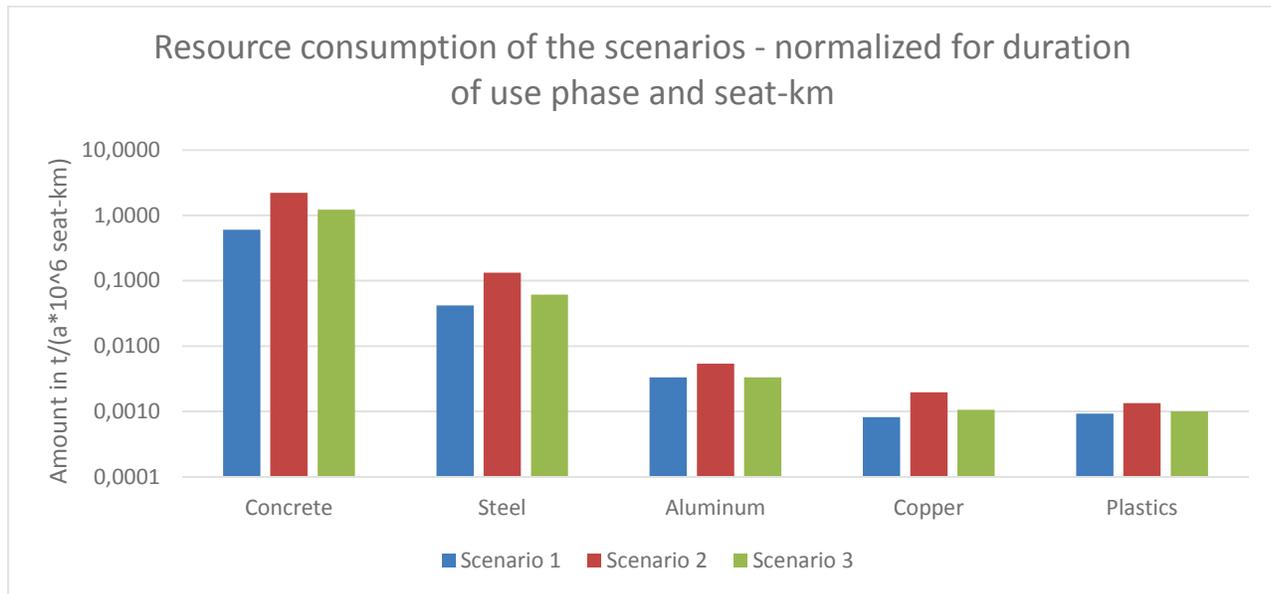


Figure 2 Resource consumption of the scenarios - normalized for duration of use phase and seat-km

For **direct CO₂-Emissions**, Scenario 3 yields the best results. This is mainly due to the expanded tram service substituting busses, which are fossil fuel driven. That effect holds true for the two more ecologically friendly sources of electricity – namely Wien Energie and certified green-energy – see Figure 3. If electricity with average UTCE is used, Scenario 1 pulls slightly ahead.

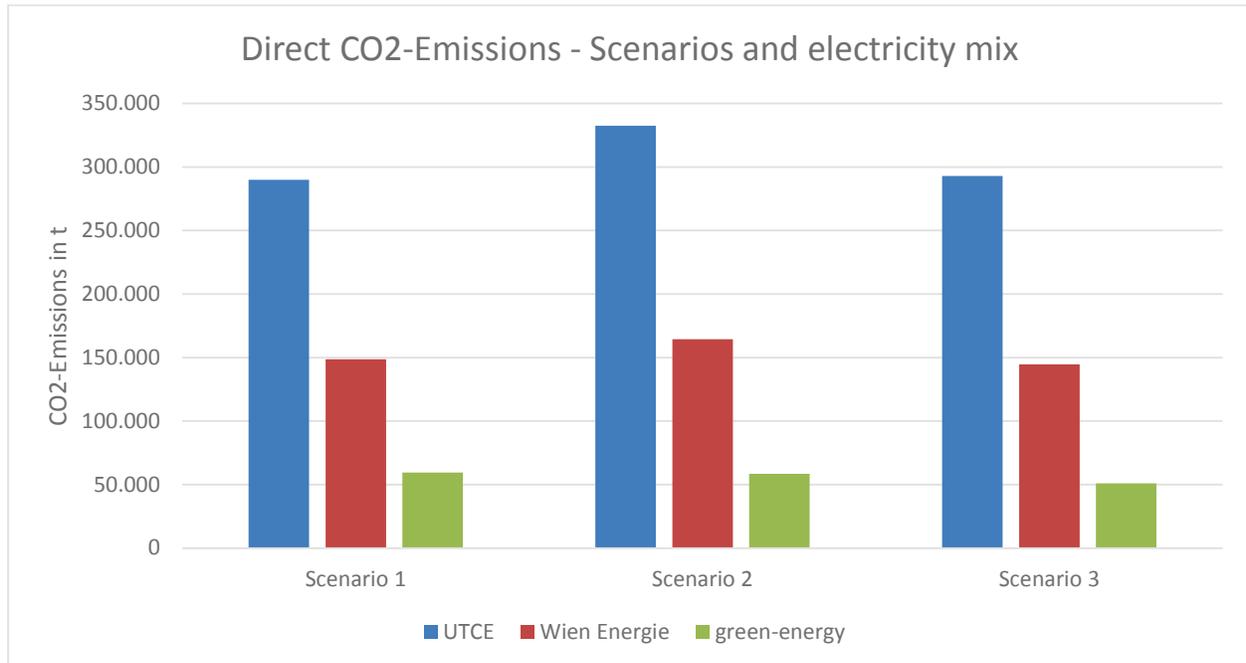


Figure 3 Direct CO₂-Emissions, for Status Quo and each Scenario as well as three sources of electricity

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