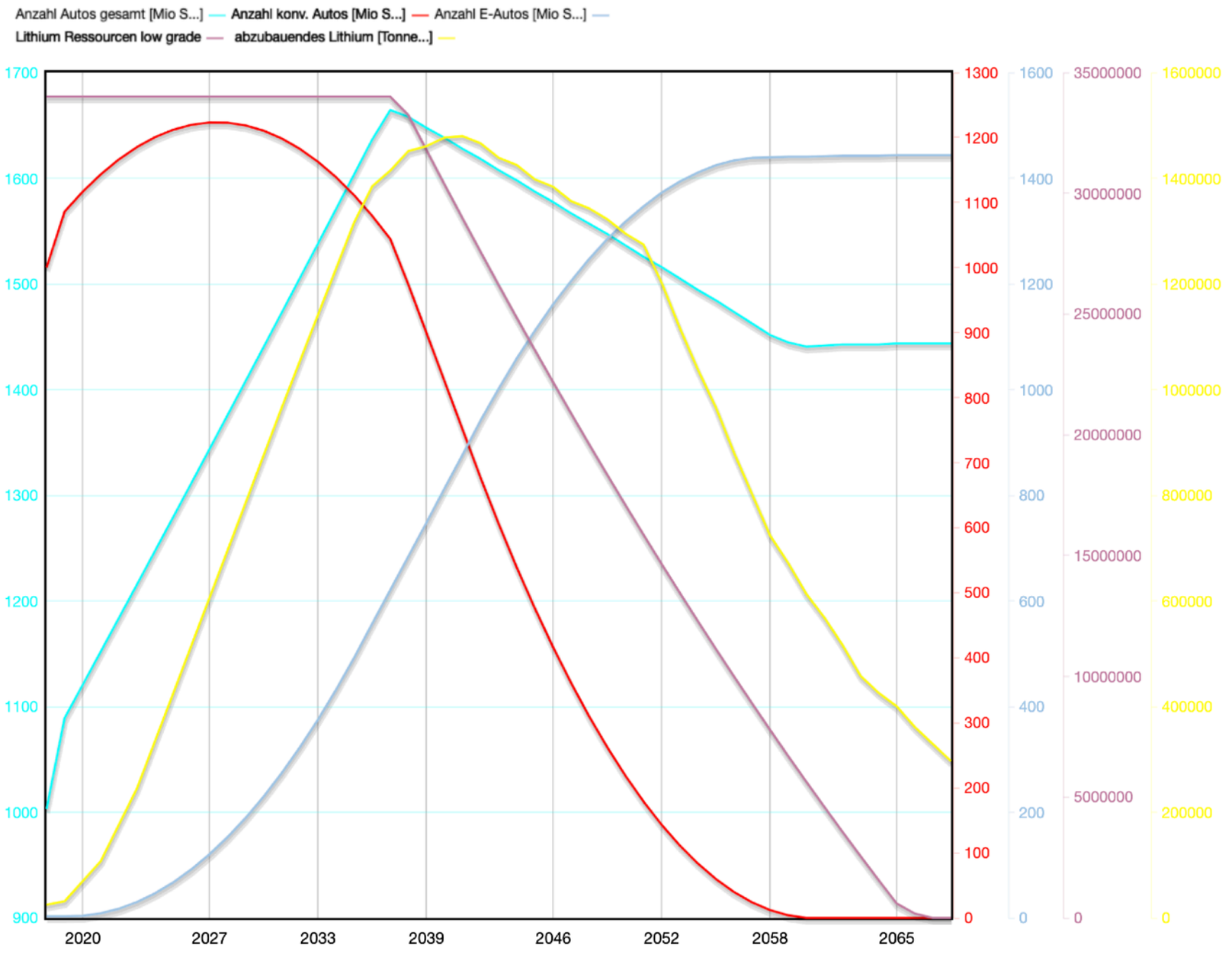
Battery-electric mobility - no H2!

Consideo - Kai Neumann, Franc Grimm



Größe Akku E-Autos	50
Recycling Quote Lithium E-Batterien	90
Kapazität Schwer E-LKW	960
Kapazität Abbau Lithium	Data
Entwicklung Lithium basierter Batteriespeicher	Data
Entwicklung IKT etc. mit Lithium	Data
Bedarf Lithium Leicht E-LKW	0,07
Bedarf Lithium E-Schiffe	3000*0.15/1
Bedarf Lithium E-Flugzeuge	0.15
Anteil Straße Schwerlast-/ Fernverkehr	70
Anteil Straße Personenverkehr	63
Anteil E-Bahn Schwerverkehr	40

Click here to add a model parameter

The simulation shows how, with today's technology, we would have 1.5 billion passenger cars and battery sizes of 50kWh, and with a recycling rate of 90 percent, the lithium reserves known today would be used after 2065.

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SYSTEMIC INSIGHTS OUT OF THE BEM-SIMULATION MODEL FOR THE FEDERAL ENVIRONMENT AGENCY

Abstract

In a simulation model for the German Federal Environment Agency, Consideo has answered the question of whether enough lithium would be available for battery-electric mobility (BEM) of not only cars, but also trucks, buses, short-range aircraft and ships. Scenarios allow to vary the number of vehicles, the technology of the batteries (size, efficiency), the needs of other applications and also the deposits of lithium.

The baseline scenario examines today's technology and common predictions of global vehicle population (passenger cars from 1billion today to 1.5billion in 2060). According to this, lithium supplies would run out in 50 years. However, this also means that with smaller batteries, with foreseeable double efficiency, with high recycling, and with smaller vehicle inventories that also make sense for other reasons, lithium stocks do not appear to be depleting.

In the context of global renewable energy expansion (see paper on the GEE(R) model), these results mean that the high efficiency of e-drives and batteries is preferable to the comparatively much lower efficiency of hydrogen and synthetic fuels (e-fuels), especially since these are needed for reverse power generation during dark periods and for ocean shipping and long-distance flights.

A successful BEM must start in time and build up high lithium mining capacities closely followed by recycling capacities.

Omnipresence of renewable energies

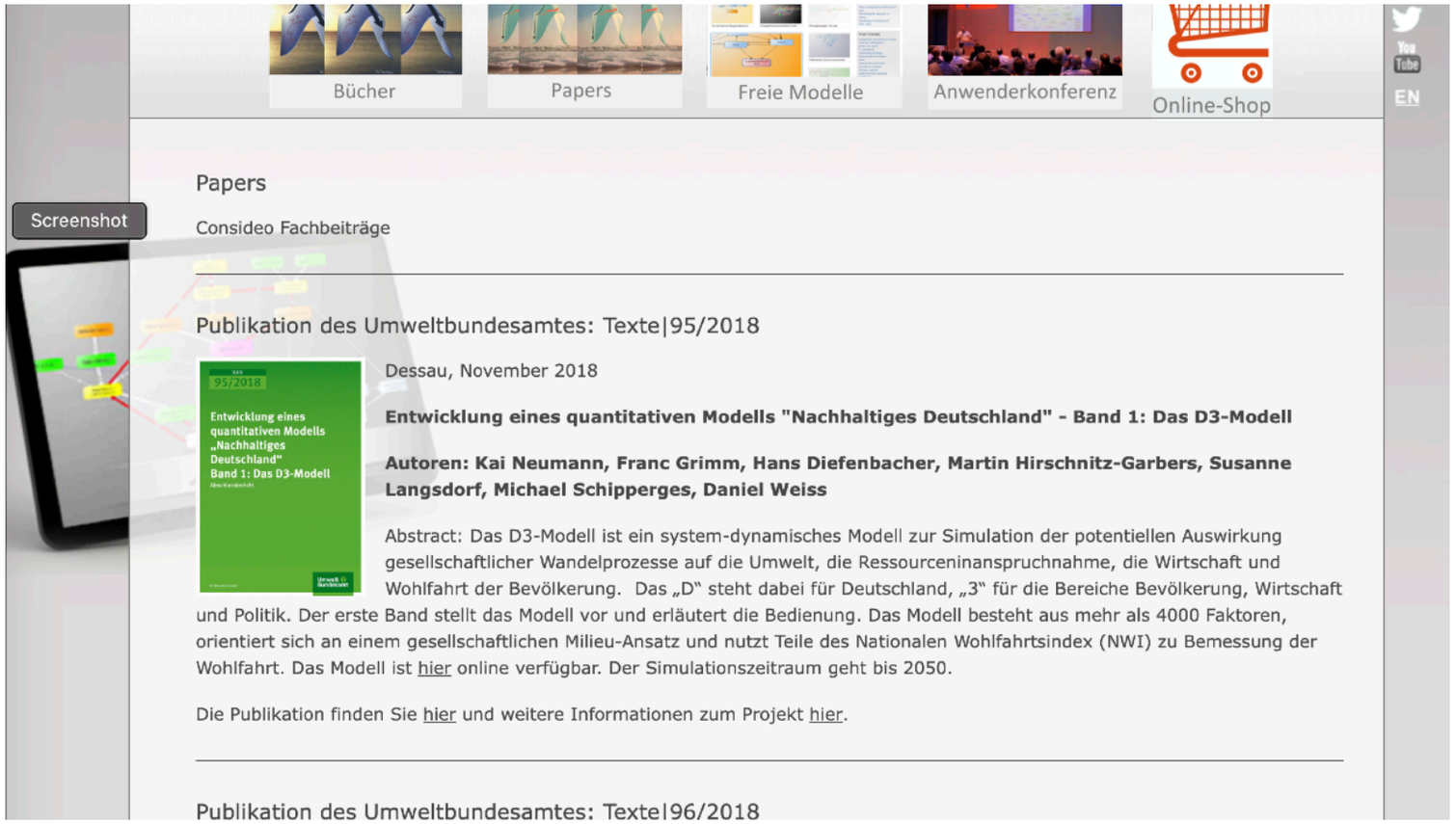
The ‘grey series’

Studies do not seem to reach policymakers at all, are usually too specific for the general public, and are all too often perceived as competition by other scientists or are then not taken up.

We can reach policy makers through the public, and for the scientific community we will continue to write official project reports and also peer-reviewed articles. But for the public, we want to offer an attractive format to read that gets to the heart of findings and action to be derived from them - our 'gray series' in reference to the term "gray literature."

"Battery Electric Mobility - No H2" is an important contribution to the current debate on e-mobility. Although the number of cars in the world should be significantly reduced, lithium is not a reason not to switch to efficient, battery-electric mobility. Inefficient hybrid technology, hydrogen powertrains or even synthetic fuels do not make sense wherever batteries can be used (including trucks, airplanes, ships).

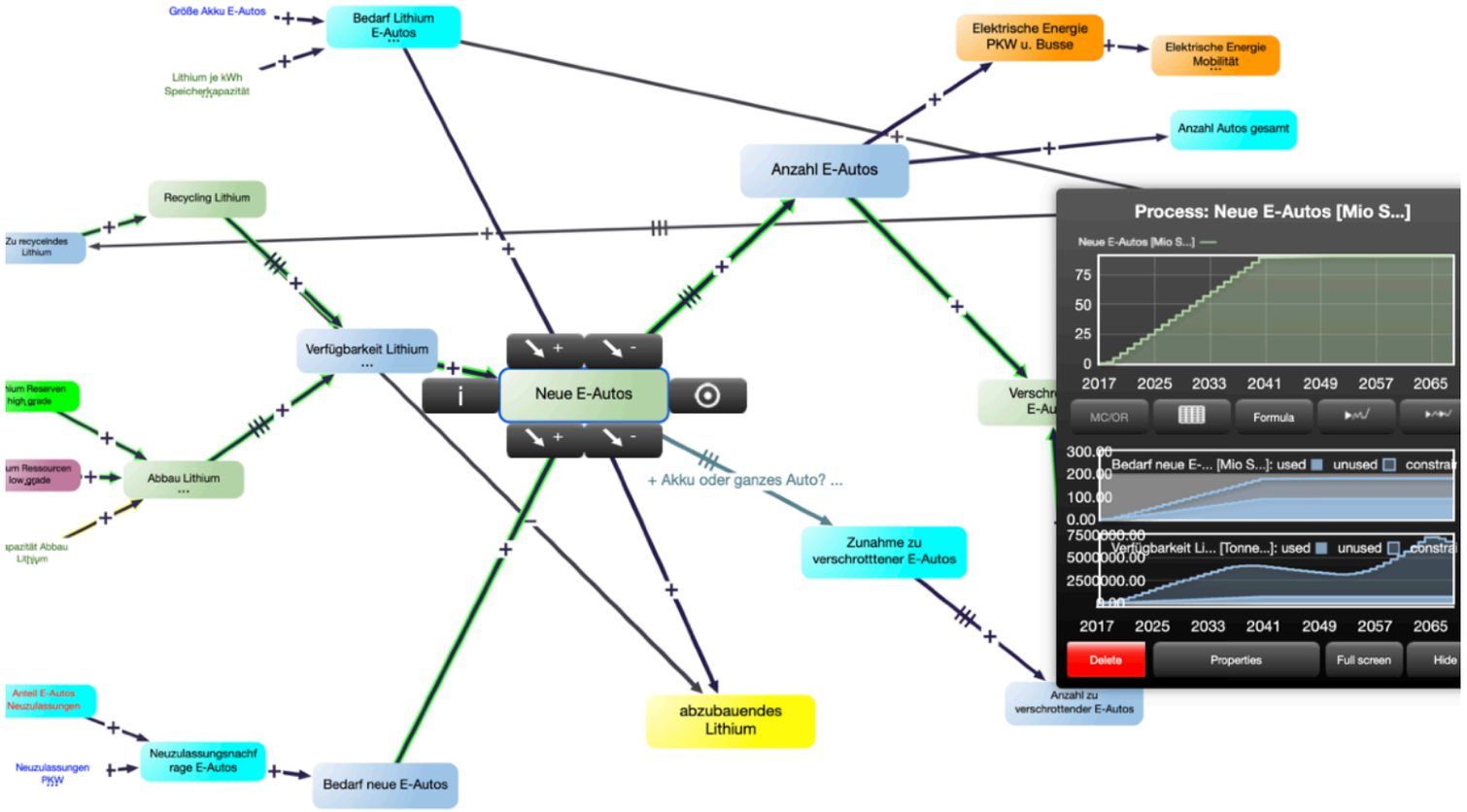
The GEE(R) model adds that much electricity can be provided from renewables, and hydrogen is needed elsewhere.



Screenshot of the Consideo website with the project reports and scientific publications linked there (www.consideo.de/papers-33.html)

The BEM Model

The BEM model is a 193-factor process model that simulates the evolution of demand for new cars, trucks, buses, short-range aircraft, and short-range ships as a function of lithium availability. Lithium is supplied by processes from high grade, low grade, and recycling. New registrations are linked to industry forecasts, the share of e-vehicles is a set screw, and recycling occurs as a process corresponding to the end of the average useful life.



Screenshot aus dem BEM Modell mit drei eingeblendeten Ebenen aus der Perspektive des Prozesses "Neue E-Autos"

The processes lead to inventories - in the case of additional, newly registered conventional drives, to inventories that can only be replaced by more climate-friendly e-drives with a significant time delay. Today's registration figures already significantly increase the number of passenger cars in the future.

While the battery capacity for trucks, buses, aircraft and ships is largely predetermined, there is a margin for passenger cars between what is sufficient and what is currently in demand in terms of oversized batteries. The scenario on the cover of this paper assumes 50kWh batteries in passenger cars.

Passenger cars more than all

The number of passenger cars and the size of their batteries is much more important for the availability of lithium than trucks, buses, airplanes and ships. The forecast of 1billion today to 1.5billion cars by 2060 is also relevant for other commodities. Car sharing and autonomous vehicles with increased utilization to save vehicles are therefore equally interesting against this background, as are foreseeable battery technologies that can halve the need for lithium.

E-Fuels we need elsewhere

The GEE(R) model has established the importance of power to liquid/ gas (e-fuels, hydrogen by electrolysis, synthetic fuels) for bridging so-called dark periods. Crucially, converting renewables to P2L/G has significantly lower efficiencies compared to direct use of electrical energy and also compared to storage in batteries.

P2L/G is also required, according to the current state of the art, for long-distance flights, maritime shipping ,parts of industry and reverse power generation during dark periods.

Whether batteries should be used instead of electrolysers for reverse power generation to intercept the peaks and bridge the dark periods is a question of cost. Batteries may well be more efficient, and vehicle batteries could be given a "second life" as grid storage, assuming a certain standardization, but keeping the sheer quantity available could be expensive and, in terms of lithium availability, only possible at all with improved efficiency in lithium batteries.

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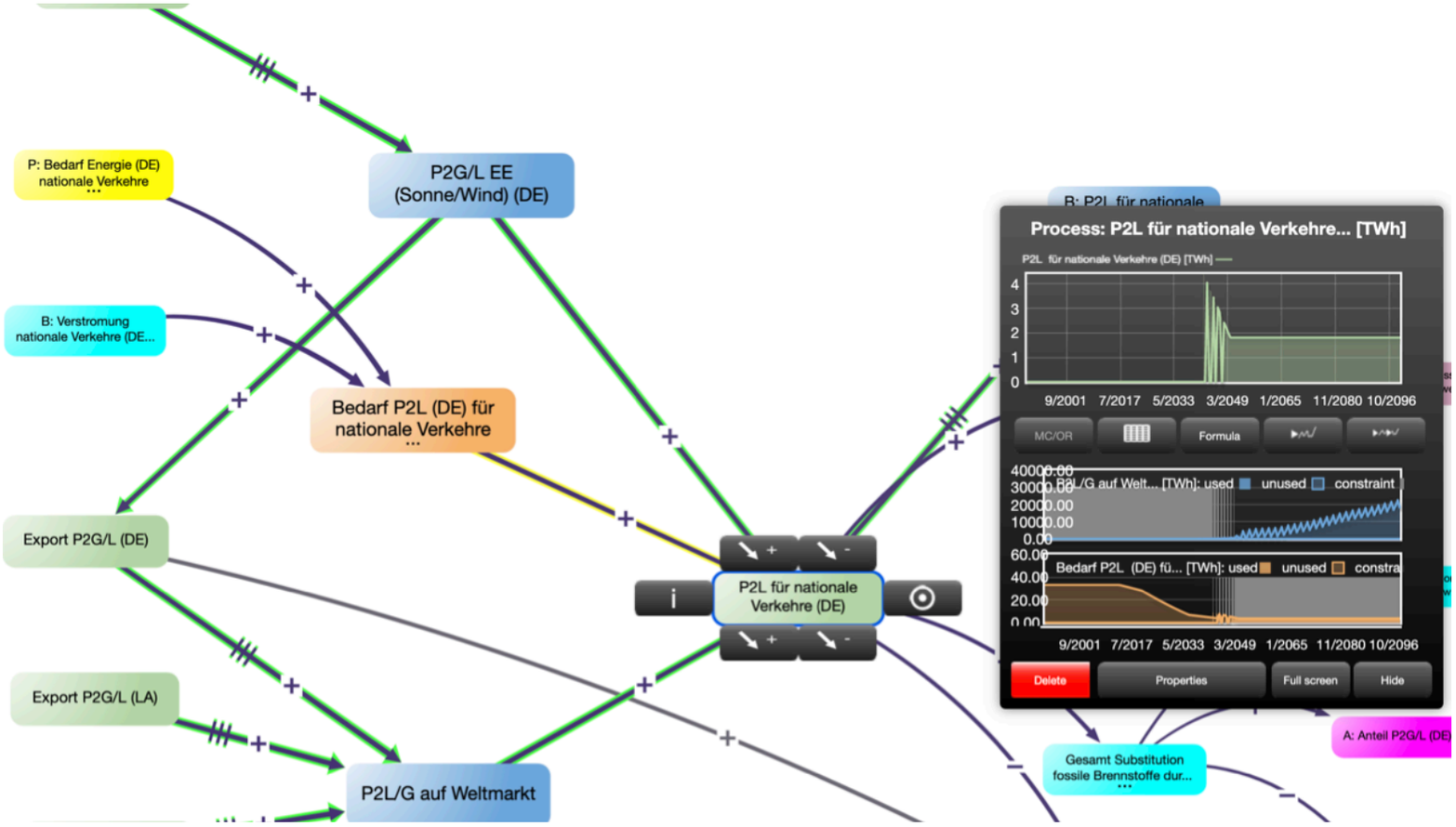
One of the few hydrogen refuelling stations

BATTERY-ELECTRIC MOBILITY - NO H2!

... Why does this argumentation not also apply to drive energy? The many small drives can profit from the high efficiency of the battery, but not from the then decentralized handling of hydrogen in its own network and decentralized storage.

The grid, on the other hand, can store more or less hydrogen inexpensively with larger electrolyzers and corresponding hydrogen storage, and thus have a loss of efficiency per kWh compared to otherwise optimal batteries, but can be much cheaper.

The GEE(R) model allows to experiment with assumptions, such as a higher share of P2G/L in transport and building energy, which then requires more renewable energy additions overall, or a higher electrification, which then requires less additions but still P2L/G for reconversion. This P2L/G can be



The GEE(R) model from the perspective of the use of synthetic fuels for transport in Germany, fed by own production and the world market.

distributed on the world market via existing infrastructures. It is therefore tempting not to look at the overall system, but to declare hydrogen (P2G) as the alternative.

For synthetic fuels (P2L), in addition to the efficiency, the challenge is to find the carbon - for example from wastewater treatment plants.

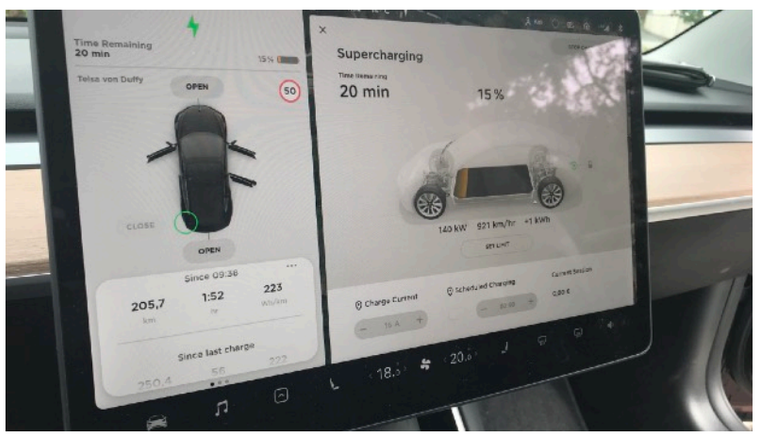
Congested cities

Street or rail

The BEM model has built in adjusting screws for a variation of the shares of rail transport in passenger and freight traffic. This could possibly only lead to utopian assumptions about the desirable reduction of road traffic. Much less utopian, however, seem convoys of autonomously driving electric trucks, which, according to Tesla, can be more efficient than rail traffic by driving in each other's slipstream.

Overhead lines

Overhead lines could, on the one hand, reduce the required size of truck batteries. The argument that lithium batteries are not suitable for heavy trucks or that lithium is not sufficient is technically refuted. On the other hand, the charging time could be shortened, which is perhaps less important today, with prescribed driving breaks, but could very well become interesting later, with autonomously continuously driving vehicles. On the other hand,



Not the size of the battery - its potential charging speed is decisive for range.

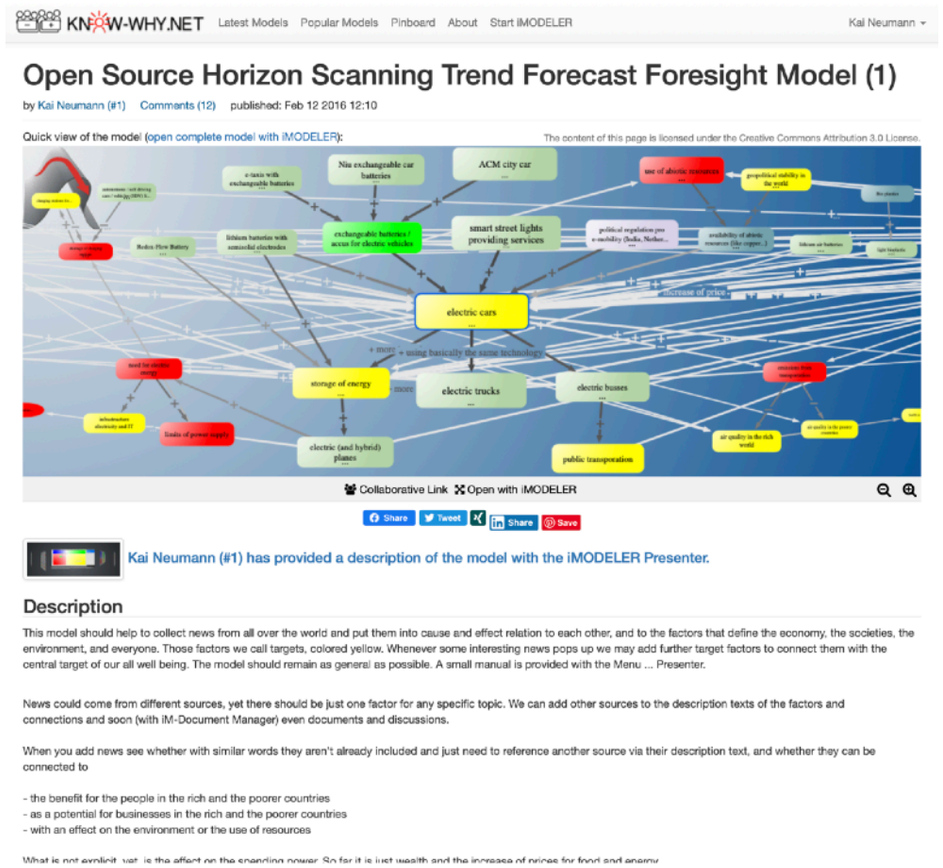
the batteries can be replaced quickly. Whether or not overhead lines make sense depends solely on economic efficiency and the availability of raw materials.

Electricity demand

The increased electricity demand of e-mobility is often cited as a counterargument. Overall, the amount of electricity can be provided globally from renewable energies (GEE(R) model). The argument that all cars will charge at the same time in the evening is nonsense. Instead, charging stations must be omnipresent and intelligently charge vehicles as needed and even contribute to grid stability via this (vehicle to grid and the like). Superchargers should only be available on long-distance routes.

Sources, links

On KNOW-WHY.NET, there is our open source Horizon Scanning Model with many glimpses of improved battery technologies.



About Consideo

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With the platform KNOW-WHY.NET we offer collective connections.

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