10 Wrong memes

Organic farming and battery electric vehicles

Kai Neumann

Systemic context

The contexts of agriculture and mobility are expansive and include a number of factors to consider. One would be the need to transform into a circular economy based on renewable energy. Another people's fear of change fed by the lobbying of singular interests. Crucial are also potential disruptions from a mixture of effects from climate change, digitisation, demographic change and continued growth of material wealth in developing countries. It is therefore only logical that the nexus between resource efficiency and greenhouse gas emissions needs to be tackled systemically integrating natural, psychological, social, economic, technical and political aspects. People's fear of change and the discomfort that arises from being questioned about our lifestyles and values combined with the lobbying of specific interests foster so-called memes (Dawkins 2016) that hinder the much-needed transformation towards sustainability. This work combines a set of cause and effect models to gain a systemic understanding of the potentials and hinderances of change in these two sectors. In particular, it features a simulation model on Germany's potentials for organic farming and one for a global battery electric mobility. Added to them is the socio-psychological context of change.

Memes and emotional efficacy

Memes are arguments launched and transported via publications, media, social media and through our everyday conversations – planting and manifesting opinions within larger parts of the population. Since they are not necessarily based on facts, they often stem from a normative perspective that some regard as right and others as wrong. The memes, in this case, are the counter-arguments against organic farming and battery-powered electric mobility that people believe despite being debunked by proper science.

These memes are a crucial element of the so-called lock-in effect (Neumann, Grimm & Heinrichs 2014) that is featured in another chapter of this book. Unfortunately, it is not just the need to debunk these memes.

We also need to develop a narrative around emotionally effective (Hamann et al. 2016) alternatives that can pave their way into public discussion. This is based on the insight that human behaviour and the development of civilisations are mostly based not on rational but emotional motives. Therefore our emotions are the crucial drivers for everything, change as well as resistance to change. If actions feel good or if we are criticised for past actions and feel bad we become reluctant to change, and any argument that supports our behaviour is welcomed. If the alternative, however, also feels good, then there is an increased chance for behavioural change. However, in order to be emotionally effective, these alternatives need to be fostered by people around us with effective narratives (Gladwell 2001). After all it is a battle of narratives or memes, for example on one side the argument that we need meat and industrial farming and on the other that organic food and living vegan are better (Wolf 2017). On one hand, that there are not enough resources for battery electric vehicles (BEVs) and the additional electricity is dirty in any case so we should improve our internal combustion engines (ICEs), and on the other side that BEVs are part of a socially appealing large-scale change that we need to start now (Dambeck & Nefzger 2019).

Demographic change, digitisation, climate change and the increase of wealth

The four terms from this subchapter's heading that are crucial for the future of transportation and agriculture are already highly interdependent without mobility and agriculture. More wealth leads to few children and an increase in age. Digitisation can lead to more wealth but also to more inequality. More wealth can lead to more climate change but also help to mitigate the consequences. Climate change, of course, results in most cases to less wealth. Digitisation also could help to mitigate climate change but indirectly also increase it. However, regarding transportation and agriculture we can expect that with the increase of wealth and people there will be a parallel need for more food and more transportation. Both of these demands carry the potential to increase climate change and thus, in turn, threaten the wealth and health of all of us and our future generations. These threats would be the effect of a more or less business as usual (b.a.u.) scenario of more people demanding meat and fish in their diets and more people driving cars and flying as well as more goods being transported around the world.

An alternative would be a change of diet, a change of agriculture, and a different kind of mobility. Digitisation could mean both a more industrialised agriculture, even from things like high tech vertical gardening systems or artificial intelligence-powered robots, or the renaissance of labour-intensive farming, for example, by agroforestry (Armengot et al. 2016) and a wider bioeconomy (Anderson et al. 2019) compensating for the jobs that will be lost from the disruptive developments of digitisation. That change could be accompanied by a change of diet away from industrial meat production and

the domination of corn crops towards healthier vegetables and legumes (Muller et al. 2017; Rööß et al. 2018).

The alternatives for business as usual mobility could be both the electrification of public transportation and individual mobility. Integrated systems of public trains, busses and autonomous vehicles including even so-called personal aerial vehicles (PAeVs) may play a role. The transportation of goods and resources could be minimised by shifts towards regional and circular economies with decentralised 3D printed goods (Diamandis & Kotler 2016). Of course, these developments, in general, could be accompanied by either more growth or more self-sufficiency and degrowth depending on the geographic context.

For a change of transportation as well as for that of agriculture and diet we need to take first steps now, starting with debunking two major counter-arguments: organic farming would not work for all the people of this planet, and there would be not enough resources for universally accessible battery-powered e-mobility.

Organic farming

The model shows there are at least three main arguments supporting organic farming: the effects on greenhouse gas emissions from conventional farming from both soil degeneration and the use of artificial fertiliser, the ecological and thus indirectly economic benefits from less contamination of soil, water and wildlife, and the potential shift towards higher quality food and hence less money for meat that causes its own greenhouse gas emissions and contaminations.

The arguments against organic farming are basically that there is not enough demand for organic products and that food would become too expensive and scarce to feed the whole world. The second argument stems from a direct comparison of yields from organic and conventional farming, which clearly shows that conventional acres outperform organic ones in this regard (Seufert et al. 2012). Besides, it is argued that lower productivity would mean the need for more agricultural land, equating to less forests and biodiversity.

To take a closer look at the potential of organic farming, we have developed a quantitative cause and effect model to run simulations on the land use, land-use change and forestry (LULUCF) of Germany. It is a rough model that makes the artificial assumptions that what we eat is what we cultivate and vice versa. This simplification makes sense because we are roughly exporting the same amounts of agricultural products that we import. Also, to evaluate changes we shouldn't assume that a change in agriculture would imply a change in what we eat and vice versa.

The model features numerous aspects from the consumption of different kinds of animal products to the different kinds of forests and the conversion of areas for buildings and infrastructure. The simulation of scenarios reveals some dynamics. For example it shows the shift from less consumption of animal

products and hence less manure towards more use of mineral fertiliser. Later comes the shift towards organic farming practices with lower yields. Also there should be the regeneration of wetlands and the conversion of green spaces as well as the minimisation of food waste in order to maximise the reduction of greenhouse gases while potentially feeding the same number of people. All in all, it shows that there are scenarios with a massive reduction in meat consumption and food waste even with increased forestation that nearly allows for feeding the same number of people (Figure 10.1).

What is even more interesting is that the realistic increase of yield from organic farming would potentially lead to a much-improved outcome. This increase could stem from a shift towards different crops, especially legumes, and other farming practices, e.g. agroforestry where applicable. While unrealistic for many industrialised parts of the world, other regions should reconsider an increase of labour productivity in farming and instead try labour-intensive farming practices like permaculture that would increase soil productivity and the conversion of CO_2 from the atmosphere. This argument is bolstered since otherwise for these countries; there seem to be few economic perspectives and job opportunities in an increasingly competitive and automated global economy.

Figure 10.1 Simulation results from a scenario of less food waste (rose), less consumption of animal products (white), 100 per cent organic farming, increased yields from organic farming (light blue) showing less CO_2 (red) and the dynamics of the potentially fed number of people (orange).

Source: Screenshot from model.

The challenge, however, is that either there needs to be the demand for different farming practice, for example, from a change of values in our societies, or international politics need to pave the way towards a more sustainable future limiting the otherwise destructive forces from the supply side. Such forces will otherwise simply continue overusing soils and converting forests to acres with more and more use of machinery and chemical inputs leading to the slow but inevitable processes of soil degradation, erosion and water contamination. For politics to act there probably needs to be a publicly communicated indicator (Jackson 2016) for the quality of land use.

Battery-powered electric mobility

Mobility needs to change, as well. The model examines three scenarios:

- 1 one to electrify today's way of transportation that would increase with the growth of material wealth in other parts of the world;
- 2 one that would include even personal aerial vehicles and other kinds of drones; and
- 3 one that would bring an interconnected autonomous public transportation system with few if any private vehicles.

No matter which path mobility takes it needs to leave today's internal combustion engines (ICEs) behind. The mere substitution of fossil fuels through synthetic fuels from renewable electric energy is not an option in a broader context because they are needed for long-distance flights, ships and the generation of electricity in times with no wind or sun. This argument stems from the GEE(R) simulation model to examine scenarios for a global transition towards renewable energy and its need for resources. The model shows with all scenarios that it would indeed be possible to end the use of fossil energy, but the peak demand for some vital resources would imply high costs that would increase the need to choose the most efficient paths without losses from unnecessary conversion of renewables to synthetic fuels.

While especially the car manufacturer Tesla has proven that battery-electric mobility would be feasible even for heavy trucks there are still memes in society that perpetuate the claim that there is not enough lithium and that range remains an issue, as do weight and costs.

A continued increase of global transportation is not sustainable, yet with a simulation model for the Federal Environmental Agency of Germany, we examined the potential to switch from ICEs to BEVs, even for commercial vehicles, short distance ships and airplanes. The model uses conservative assumptions from the World Energy Outlook with a considerable increase in worldwide demand for transportation and looking only at lithium as a critical resource. High and low-grade lithium are distinguished based on today's known reserves. The model also considers the increased use of lithium

from other sectors, like information and communication technology (ICT). Although there are trials to substitute lithium for the less critical magnesium, today it seems more likely that the energy density of lithium-based batteries will be increased. All other materials will not be as critical, since for example cobalt already can be substituted.

The scenarios looked at both the current technology and what could be expected to change in the future. The results show that passenger cars are the most crucial element as they can opt for smaller battery capacities while commercial vehicles have a predefined capacity because of their more or less constant utilisation. While we will probably run out of high-grade lithium before 2040, we might run out of reserves for low-grade lithium if we continue to oversize the batteries in our cars (>35 kWh) and manage to nearly double today's number of roughly one billion cars within the next 50 years. On the other hand, if we double the efficiency of lithium-based batteries we will run out much later provided that the recycling of lithium starts early and becomes efficient quickly.

While the number of commercial vehicles and their need for battery capacities plays a role, the additional demand for lithium for short distance planes and ships seems to be surprisingly small. Figure 10.2 shows how high-grade lithium would be exhausted by 2039 while from today's known resources of low-grade lithium still quite a lot would be left in 50 years.

The model doesn't feature aspects like grid stabilisation from intelligent charging, the spread of personal aerial vehicles, the benefits (smaller batteries) and trade-offs (for example, marginalisation of railroads) of overhead electric power-lines for trucks, or the potentials for improved utilisation of vehicles from self-driving vehicles (SDVs).

The bottom line is that there is enough lithium and no need to continue using ICEs and less efficient synthetic fuels. Yet the need for capacities to extract lithium, to build batteries, and to recycle them is extreme, and it implies that mining companies in the foreseeable future will face a massive shift from extraction to recycling.

The battle of interests

So yes, we could eat 100 per cent organic and run our vehicles on batteries powered by renewable energy. The actual development, however, will be a battle of interests. The established car industry wants to keep its value creation derived from selling ICEs with support from the oil industry. The agrochemical industry, food industry, and others supported by a strong pro industrial agriculture mindset will oppose any major transition towards organic food production. The consumers, after all, have a demand for inexpensive mobility and food, and they rely on attractive offers. Many of the consumers will 'fight' for their inexpensive meat, dairy products, and fast cars – and they will keep spreading the memes that BEVs and organic food are the wrong way.

Figure 10.2 Simulation results from a scenario battery electric mobility including commercial vehicles, short-range ships and planes assuming a global increase of mobility, improvement of energy density of lithium batteries, and downsizing of capacity for passenger cars showing the number of cars (blue), the reserves of high-grade lithium (green), low-grade (violet), the needed mining (yellow) and recycling (light green) capacities.
Source: Screenshot from model.

Nevertheless, there is a chance for a subsequent change of values that could foster the demand for alternatives. However, both the food system and the market for mobility solutions are global, as are consumer trends. That means the rest of the world could slow down a transition or fuel the demand for it.

Actually, it would be easy for politics to reward sustainable behaviour by subsidising the right solutions financed by the taxation of unsustainable actions with no adverse effect on either jobs or social justice. However, particular interests spreading wrong memes prevent the political process from achieving this and for now the majority of people are quick to agree that they do not want to pay an extra CO₂ tax on diesel, milk, and flights. This sentiment exists even though low-income individuals would get a refund from 'their' CO₂ budget so that basically only the rich with a bigger ecological footprint would pay more.

Abbreviations

b.a.u.	business as usual
BEV	battery electric vehicles
CO ₂	carbon dioxide
GEE(R)	Globale Erneuerbare Energien in Abhängigkeit von Ressourcen (model's name)
ICE	internal combustion engines
ICT	information and communication technologies
kWh	kilowatt hours
LULUCF	land use, land use change and forestry
PAeV	personal aerial vehicle
SDV	self-driving vehicle

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