



## Perspective

# What opportunities could the COVID-19 outbreak offer for sustainability transitions research on electricity and mobility?



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## ABSTRACT

The COVID-19 pandemic is a major landscape shock that is having pervasive effects across socio-technical systems. Due to its recentness, sustainability scientists and other researchers have only started to investigate the implications of this crisis. The COVID-19 outbreak presents a unique opportunity to analyze in real time the effects of a protracted landscape-scale perturbation on the trajectories of sustainability transitions. In this perspective, we explore the ramifications for sustainability transition research on electricity and mobility, drawing from selected examples in Finland and Sweden. The long-term consequences of the COVID-19 pandemic are likely to trigger more permanent changes connected to the digitalization of work and other daily activities, thus reducing mobility needs and overall fossil-energy consumption. The crisis may encourage governance systems to be better prepared for different types of shocks in the future, while it also contains a threat of increasingly populist or undemocratic political responses and increased securitization. These developments can guide research by addressing the reproduction of new practices arising from the COVID-19 outbreak to accelerate sustainability transitions, enhancing understanding of the role of governance in transitions, and bringing to attention the ethical and political implications of landscape shocks.

## 1. Introduction

In March 2020, the World Health Organization [1] declared COVID-19 to be a global pandemic. Three months later, the contagion has infected millions of people and resulted in hundreds of thousands of deaths worldwide. As nations around the world struggle to mitigate the spread of COVID-19, we have not yet comprehended its full societal implications. Economic growth in many countries slows as major financial and industrial markets experience significant decline, international supply chains break down, borders have closed, and tourism has paused [2]. In many countries, governments have shut schools, restaurants, cinemas, sporting facilities, libraries, and museums. However, a few countries, most notably Sweden, have imposed far fewer restrictions on people with the recommendation for (but not enforcement of) people to physically distance themselves. Such cases though are the exception, and an incongruous outcome of the COVID-19 pandemic, at least in the short-term, has been improved urban air quality and reduced greenhouse-gas emissions due to less mobility and industrial

activity [3].

Since its recent onset, researchers have increasingly begun to investigate the impact of the COVID-19 outbreak on sustainability. The pandemic offers a unique opportunity to analyze in real time the effects of a massive landscape shock on transition trajectories. For example, it can shed more light on how global security crises can affect sustainability transitions. In this perspective article, we address potential consequences of the COVID-19 pandemic for research pertaining to sustainability transitions. We focus in particular on its possible impacts on the electricity and mobility sectors, taking a Nordic perspective and drawing on selected examples from Finland and Sweden. We have selected these two countries, because they are home to us, and we have first-hand experience with relevant developments. In addition, Finland and Sweden have adopted different approaches to managing the COVID-19 outbreak in terms of imposing restrictions on the movement of people.

A prominent theoretical framework in the field of sustainability transitions is the multi-level perspective (MLP) [4,5]. This approach

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argues that transitions – fundamental shifts from one kind of socio-technical system to another – are manifested through dynamic processes within and between three analytical levels: 1) niches that are protected spaces within which radical innovations emerge and are nurtured; 2) regimes which represent established and dominant sets of rules such as the institutional structuring of existing socio-technical systems that are often characterized by various forms of lock-in; and 3) exogenous landscape pressures influencing regimes and niches. The landscape represents long-term gradual developments, such as climate change and demographic trends, as well as rapid abrupt events including natural disasters and wars (and are described as landscape “shocks”) [6]. Transition researchers have to date rarely explored these perturbations in detail and the risks associated with infectious disease epidemics have not previously been addressed in this literature. The MLP is distinguished by a systemic approach and tensions between stability and change at the three analytical levels of structuration. For instance, niche innovations may break through and become widely adopted if landscape developments put pressure on the regime that leads to buy in, cracks, and windows of opportunity.

A key question for transition researchers is how the COVID-19 pandemic – given its representation as a landscape shock – will influence the trajectories of currently unfolding sustainability transitions and what its long-term impacts will be on society more generally. Sustainability transitions have frequently been described as long-term change processes taking several decades to fully materialize (e.g. [7,8]). However, the COVID-19 outbreak offers the possibility to question such assumptions by showing vividly that some systemic and deeply structural changes in socio-economic systems can under certain circumstances occur quite rapidly.

One of the more pessimistic outlooks of the current crisis, presented in media, is that no long-term immunity is generated, and it takes far longer than expected to develop an effective vaccine (or for that matter one is never discovered) (e.g. [9,10]). This scenario, if it were to come to pass, would have consequences for transitions in energy and mobility that would be quite different from previous landscape shocks such as, for example, the 1970s oil crises, the Chernobyl nuclear accident in 1986, and the Fukushima nuclear accident in 2011. In such a situation, COVID-19 would represent a sudden shock but with long-term implications on ways of life. The pandemic has also become a key human security issue that has impacts on the internal stability of states, international relations and security of supply.

We combine three insights to bring a novel angle on the emerging debate on COVID-19 and sustainability transitions. First, we conceptualize an infectious disease pandemic as a major landscape shock which incorporates both suddenness and longevity in shaping the trajectory of sustainability transitions in electricity and mobility. Second, we highlight the COVID-19 outbreak as a security question, which both influenced the political action and governance responses based on special status and emergency acts, representing in transition terms ‘disruptive policies’, and the unfolding of electricity and mobility transitions. Third, we empirically situate our perspective in the Nordic context, drawing from examples in Finland and Sweden which, despite a similar context, have adopted very different responses to managing the pandemic. On 9 June 2020, Finland had 7025 confirmed cases of and 324 deaths from coronavirus (1268 and 58 per 1 million people), while Sweden had 45,133 confirmed cases and 4694 fatalities (4471 and 465 per 1 million people).<sup>3</sup>

The rest of this paper outlines some of the governance responses to managing the COVID-19 pandemic with examples from Finland and Sweden. This is then followed by reflections of how the pandemic affects transitions in mobility and electricity. We conclude by identifying selected research themes that transition researchers may want to explore in the wake of the COVID-19 outbreak.

## 2. Governance responses

In responding to the COVID-19 pandemic, governance structures have changed faster than perhaps ever before. Governments have been implementing various policies to curb the spread of infection, enforcing curfews, and imposing other limitations on people’s freedoms based on special status and emergency acts. Millions of people have already lost their jobs, company revenues are shrinking, and legislatures and finance ministries are enacting stimulus packages to address the increasingly dire circumstances. Calls have been made that these initiatives should be designed in ways that also address global sustainability challenges [11]. What the COVID-19 pandemic is making apparent is the powerful role of governments in crisis situations, influencing the practices of individuals, communities, and businesses. The decision making of governments on COVID-19 is, however, influenced to varying degrees by political (even populist) debates and scientific factors [12]. More so, rapid data and information sharing on the outbreak has led to a stream of speculations and theories on the source of COVID-19 which can potentially jeopardize governance efforts to tackle it [13].

COVID-19 is an issue of national security. For example, the risk of pandemics and their potential impacts on a range of sectors and on security of supply has been noted in Nordic policy strategies (e.g. [14,15]). Issues identified as security questions may become securitized, which means that issues framed as security questions are essentially political acts that legitimize what needs protection or “present [s] something as an existential threat” [16]. This influences the nature of decision-making processes, and sometimes decisions on security questions by-pass normal democratic decision-making procedures.

The Nordic countries have generally taken less restrictive approaches in comparison to other nations but still display between themselves large differences in their governance responses to the COVID-19 pandemic. For example, Finland enforced its emergency legislation – designed after World War II but never previously used – to close schools and other public facilities and for a period closed off the region of Uusimaa (the greater Helsinki area) from the rest of the country. By contrast, Sweden has imposed fewer restrictions on the movement of people with several parts of the economy such as public transport, schools, and restaurants remaining open. Thus, one could interpret that the contagion has become a more securitized issue in Finland than in Sweden, and even more so in many other European countries. While this kind of securitization may be necessary in the short term, it creates a risk of non-democratization of political decision making regarding important issues that may affect the pace transitions depending on the political parties in power. Thus, governance responses to COVID-19 need to be well thought-out and justified, as they can have significant consequences on people’s rights and opportunities for democratic participation.

Transition scholars have argued for the need for phase-out [17] and other “disruptive” policies [18] to break away from unsustainable energy and mobility systems. The adoption of such policies in practice has largely been too slow and sporadic, despite the introduction of coal phase-out policies in some countries. Government responses to COVID-19 present such disruptive policies to people’s everyday lives in many respects. Thus, the government-level developments now taking place offer transition scholars an opportunity to analyze the impacts, including the political and ethical effects, of rapid and major “disruptive” policies to inform policy making for sustainability transitions.

## 3. Mobility transitions

The COVID-19 pandemic is causing “disruptive” change not only by potentially kick-starting transformations in established socio-technical systems, but also by affecting emergent sustainability niches. In the mobility sector, low-carbon transport through electrification and biogas use and new mobility services are promising examples of such niches.

<sup>3</sup> <https://www.worldometers.info/coronavirus/>.

Finland and Sweden have been leaders in developing the concept and applications of mobility-as-a-service (MaaS). The concept comprises a wide range of transport services, including peer-to-peer ride-sharing such as Uber, services that attempt to optimize the connection between personal cars and public transport, and specific “packaged offerings” with intermodal planning, booking, and payment functionalities, and multiple transport modes and mobility packages [19]. The diffusion of these types of promising shared mobility solutions, presented as alternatives to private ownership of combustion engine-based vehicles, may experience a slowing down of their initially promising progress as people take their distance from each other.

In transition terms, MaaS can be conceptualized as a series of niche innovations aiming to break into the dominant regime of individual car ownership. Most of these strategies remain in an early phase of their deployment and, to scale up beyond their current niches and to reach mainstream markets, there is a need for extensive buy-in from regime actors such as public transport operators and end-users. However, with the threat of infectious transmission, acceptance and collaboration will at least temporarily recede as people shift their focus to maintaining their health and safety. For the foreseeable future, individual vehicles such as cars and bicycles are likely to be perceived as more secure in the absence of a vaccine to protect against COVID-19. For example, like many other countries, Finland and Sweden have experienced a significant decline in the number of passengers on public buses, trains, and trams resulting in the loss of income and calls for increased public financial support (e.g., [20]), while many people working in essential sectors still rely on public transport. However, the reduction of travel overall and the move to homeworking and virtual meetings by a segment of the population may, in turn, make the ownership of a car seem unnecessarily expensive or redundant, hence potentially favoring MaaS. Sampo Hietanen, CEO of MaaS Global, also sees opportunities arising from COVID-19. He observes, “The central idea of MaaS is a promise that we will get you where you need to go, but how we get you there is not fixed. At a time of an emergency or a disruption, the need for alternative modalities and maybe new alternative packages is accentuated” [21].

By contrast, the impacts of the pandemic may be more favorable to the diffusion of electric vehicles (EVs), a niche which is more supportive of existing individualized mobility practices. Nonetheless, the expansion of this niche to parts of the mobility regime may decelerate, because the economic effects of COVID-19 have, at least in the short-term, significantly reduced sales of EVs and this trend has been amplified by declining oil prices which has lowered the cost of operating a gasoline-powered car [22]. However, combined autonomous EVs may increase in popularity, as when they become more widely used, they will decrease health risks compared to traditional taxis or shared transport by reducing human contact in the absence of human drivers.

The most significant impact of COVID-19 by far on the mobility regime, however, has been on air travel. Many airlines are already in significant financial trouble and with prolonged implications of the COVID-19 pandemic, the increased health risk and bankruptcy of airlines combined may drastically reduce the future number of long-distance flights. Perhaps, long distance domestic and international travel will become more infrequent, longer in duration, and with new infrastructure for alternative transport modes – in particular fast trains and ferry connections will emerge as a substitute for commercial aviation.

Research is needed on how the new – presumably temporary but potentially longer term – practices adopted during the pandemic will influence people’s perceptions of different mobility options and needs and perhaps contribute to processes whereby the previously dominant everyday user practices are “unlearned.” Moreover, research should also examine how the COVID-19 pandemic evolves as a landscape pressure, and how in coming years it influences social and technological innovation in the mobility sector.

#### 4. Electricity transitions

The energy sector in some countries has been profoundly impacted by the COVID-19 pandemic, resulting in falling demand and price reductions for oil, gas, and electricity [23]. Specifically, electricity demand in countries, such as the UK, has declined over the last months as a result of factories and other businesses halting operations [24], and patterns of demand and supply changing by domestic demand increasing and commercial and industrial demand dropping [25]. However, the power market operating across Nordic and Baltic countries, NordPool, showed unaffected total production of electricity in March and April 2020 compared to previous years [26]. The COVID-19 pandemic had not yet had significant effects on industrial production in these countries. In general, Europe has experienced a record collapse in electricity prices, with power prices turning negative in many countries as evident in data from the NordPool [23]. For example, Finland’s area price for electricity was only half of that last year [26]. Lower prices have led to reductions in the cash flow of utility companies and some broader impacts on the electricity sector, such as delays and halting plans to construct new facilities and infrastructure. Major impacts on security of electricity supply have not thus been observed in the short-term. The medium to long-term implications of the pandemic are, however, harder to predict, and can be influenced by the ways in which, for example, stimulus packages are targeted. Such stimulus packages could be used simultaneously to support economic recovery and energy transitions, when targeted on, for example, renewable energy technology adoption or energy efficiency improvements.

The pandemic has underpinned the importance of electricity in society as many people have shifted to digital modes of remote work, information sharing, communication, and some industries have shut down. If overall electricity demand drops, the share of generation from renewable sources can be significantly increased and sustained due to a potential decrease in the need to use non-renewable energy sources to meet electricity demand [27].

COVID-19 is an unprecedented event due to its scale and severity. The effects on the Nordic energy sector will likely depend on how the crisis impacts regions globally with valuable minerals required for renewable energy, smart grids, and energy storage technologies. Thus, the security of both resources and other industrial supplies will be affected by mining, manufacturing, trade routes, and internal stability in many regions, which already before were prone to internal security conflicts. For example, the delivery of equipment to power plants across the world (including the Nordic region) has already been affected by the impact of COVID-19 in China, a global producer of many clean energy technologies such as solar panels, wind turbines and batteries [23]. Essentially, renewable energy projects face delays as many companies are unable to meet deadlines and finances are being redirected towards “essential” investments. The shortages of fuels or resources may also reinforce international security issues, especially if they are used as political leverage.

Transition scholars have been interested in understanding how displaced based factors, such as institutional settings, local industry structure, infrastructures, and resource endowments shape the shift from one socio-technical system to another [28]. Taking this lens, the impact of the COVID-19 pandemic on electricity transitions can be studied, paying attention to regional variations in and the longevity of changes in electricity demand and supply patterns, questions of security of supply of minerals and components, influence on technology diffusion (e.g. smart grids and energy storage), and the subsequent effects of the above on the overall electricity transition. Furthermore, research should examine how the geographic context together with institutional or cultural change stimulated by COVID-19, industry structure and resource endowments affect energy transitions. Transition researchers should start to track these developments in real-time to analyze in a few months or a year how substantial or periodic the effects have been, and what kinds of societal disruptions have ensued from the COVID-19

pandemic which can provide valuable lessons on how to facilitate transitions further.

## 5. Conclusions

A final reflection on the crisis relates back to our starting question, “what opportunities could the COVID-19 outbreak offer for sustainability transition research on electricity and mobility?” Amidst a major pandemic, sustainability transitions may be regarded by some commentators as an extravagance which should not be prioritized. However, the threats caused by climate change and biodiversity loss have not vanished, and this pandemic may become a (small) window of opportunity to accelerate sustainable mobility and electricity transitions and to learn about how to make societies more resilient to face different kinds of risks. Despite the differing governance responses of Finland and Sweden to the COVID-19 pandemic, they share plans to direct economic recovery packages to support zero-carbon energy and mobility transitions.

For mobility, the long-term sustainability implications of the pandemic may link to more permanent changes connected to the digitalization of work and other daily activities which reduce mobility needs, especially air travel and overall fossil-energy consumption. However, COVID-19, if becoming a long-term safety and security issue, may also impact the types of mobility favored, thus, influencing the advancement of particular mobility niches over others. In Finland and Sweden, the earlier promising mobility-as-a-service niche is bound to be impacted by COVID-19 by reducing overall travel and public transport and directing preferences to individual transport means. In turn, the electric vehicles niche may be less impacted but suffer from economic decline. Thus, we identified at least two important research streams: changing patterns and (in)stability of practices as a result of COVID-19, and the impacts of the pandemic as an abrupt but gradually developing landscape influence on mobility transitions.

COVID-19 has lowered electricity prices all over Europe but impacts on demand and supply vary regionally from reduction in demand to no effect in Finland and Sweden compared to previous years. The changing landscape caused by COVID-19 might lead to increasing localization and improved sustainability of supply chains, and an increased resilience of different societies and communities. Thus, it may accelerate the developments already occurring in Finland and Sweden on renewable energy, localized energy solutions (e.g. heat pumps, biogas solutions) and smart grids. However, sustainable energy and mobility transitions, via the green energy tech sector, are crucially dependent on global mineral reserves and, thus, overall global trade and security developments – even if innovative solutions are developed locally. Future research here has an opportunity to track real-time developments in the electricity sector, noting down patterns of acceleration or deceleration of the electricity transition already underway – linking to security of resource supply and geography of transitions.

Across both sectors, the pandemic highlights the systemic nature of transitions, a core theme in sustainability transitions. However, it also creates conditions of a “real-life” experiment in new practices and changing landscape conditions with large impacts on mobility and energy regimes. It also makes it more vivid for ordinary people and can thus perhaps be harnessed as a leverage to accelerate sustainability transitions.

The devastating effects on national and individual economies warrant, however, even more attention to pursuing justice and equality in transitions than before. In an outlook, where vaccination or long-term immunity is not created, a recurring COVID-19 will change energy and mobility demand as people will have to live with a new “normal” of limited mobility and working via digital means while only selected parts of the economy remain open. This has more severe implications to the poorest and most vulnerable in society, financially, being more exposed to COVID-19 in travelling to work and other necessities and being the least self-sufficient in terms of mobility and energy. As the

Italian novelist Francesca Melandri [29] evocatively noted, “That boat in which you’ll be sailing in order to defeat the epidemic will not look the same to everyone nor is it actually the same for everyone: it never was.” The threat of COVID-19 may lead to increasing solidarity between people but some actions show that it has already increased rivalry between countries [30] and the super-rich have prepared by purchasing luxury bunkers and personal ventilators [31]. This points attention to the importance of analyzing the implications of the pandemic on sustainability transitions from the perspective of social justice.

The COVID-19 pandemic may change governance systems to be better prepared for different types of shocks, while it also contains a serious threat of increasingly populist or undemocratic governance systems and increased securitization. The latter unfolds quite differently in different countries based on the variation that we have observed even within a rather similar setting of culture and traditions of Nordic countries. Thus, it is vital to closely monitor and analyze the governance responses to COVID-19, their disruptiveness and consequences from the perspective of transitions.

From the environmental perspective the questions are, what effects of COVID-19 are desirable (e.g. reduced travel and energy demand) and what policies can help support the outcomes worth retaining? These lessons can guide sustainability transition research by addressing the reproduction of new practices arising from a sudden landscape development, by enhancing the understanding of the role of governance in transitions and its ethical and political implications, and the resilience and connections between global and local economies. These and many more trajectories remain to be explored as we in coming years and months begin to come to full terms with the COVID-19 pandemic.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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