Contested visions and sociotechnical expectations of electric mobility and vehicle-to-grid innovation in five Nordic countries

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Visions, promises, and ideographs in Nordic low-carbon mobility: Contested sociotechnical expectations of electric vehicles and vehicle-to-grid innovation

1. Introduction

The decarbonisation of energy and transport systems is among one of the most important international challenges (Geels *et al*., 2017; Figueres et al. 2017; Rockstrom et al. 2017; Eyre et al. 2018). In this context, due to the transportation sector's dependence on fossil fuel energy sources and the monumental negative consequences for climate change, air pollution and other social impacts, countless researchers, policymakers and other stakeholders view a widespread transition to electric mobility as both feasible and socially desirable (Mitchell et al. 2010; Tran et al. 2012). The International Energy Agency (2017a) even projects in its World Energy Outlook, under the "Sustainable Development Scenario," that 875 million electric vehicles will need to be adopted by 2040.

One potentially fruitful innovation within electric mobility has been vehicle-grid-integration (VGI) and vehicle-to-grid (V2G). VGI and V2G refers to efforts to link the electric power system and the transportation system in ways that can improve the sustainability and security of both (Sovacool et al. 2017a). A V2G configuration means that personal automobiles have the opportunity to become not only vehicles, but mobile, self-contained resources that can help manage power flow and displace the need for electric utility infrastructure. A transition to V2G could enable vehicles simultaneously to improve the efficiency (and profitability) of electricity grids, reduce greenhouse gas emissions from transport, accommodate low-carbon sources of energy, and reap cost savings for vehicle owners, drivers, and other users (Kintner-Meyer et al. 2007; Pasaoglu et al. 2014; Hidrue and Parsons 2015).

The vast majority of studies looking at V2G either simply ignore consumers, or they make troubling assumptions rooted in rational actor models of behavior (Sovacool et al. 2018a). They therefore focus on meaningful techno-economic factors such as battery performance,

range anxiety, or access to charging infrastructure, but neglect broader human and social factors such as user preferences, patterns of incumbency, and public discourses. In this paper, we explore V2G from an unusual perspective: combining an analysis of expectations and visions. We ask: How is V2G and electric mobility being discussed, envisioned, and promoted by experts in the Nordic region? Put another way, what are the dynamics of expectations among prominent Nordic experts? The Nordic region currently includes world leaders in EV adoption Norway and Sweden (International Energy Agency 2017b).

To provide an answer, we interviewed 257 experts across transport, electricity, government and research working on electric mobility across Denmark, Finland, Iceland, Norway, and Sweden. We present and analyze eight distinct visions arising from this data: four positive visions of "the rapid electric society," "ubiquitous and clean automobility," "innovation nirvana," and "energy autarky" are contrasted with four negative visions of "hacked grids," "frozen families," "broken businesses," and "captive consumers." We then discuss tensions and synergies between these visions as well as place them into a typology. We conclude with insights about what such competing visions mean for energy and climate policy as well as sustainability transitions. Our study is the first to focus on utopian and dystopian expectations of low-carbon mobility, based on a novel and original dataset.

In proceeding as such, we hope to make both conceptual and empirical advances. Conceptually, for those familiar with the sociology of expectation, we explore negative promises and visions alongside positive ones. Although some previous work has investigated the specific utopian and dystopian dynamics of climate change discourses (Hjerpe and Linner, 2009), none (to our knowledge) has extended this dichotomy of positive and negative visions to the domain of electric vehicles or household energy transitions more broadly. In addition, we elaborate further on the discussion of ideographs (Van Lente 2010), offering an inventory that goes well beyond that of "technological progress." Finally, drawing on Van Lente (2010),

Berkhout (2006) and Michael (2000) who list varying typologies of expectations centered on distinctions such as fast vs. slow or public vs. private, we offer a typology emphasizing how expectations differ meaningfully in terms of temporality (proximal vs. distant) and pace of change (incremental vs. radical). Empirically, we are the first to examine the rhetorical visions and expectations with V2G alongside electric mobility. Moreover, many of the visions we uncover associated with electric mobility and V2G are novel, having never been identified before.

2. Research concepts, cases and methods

To begin, this section of the paper summarizes our main conceptual framework (the sociology of expectation) and it then justifies our focus on the Nordic region and explicates our research methods.

2.1 The sociology of expectations

As our primary conceptual lens, the authors relied on concepts arising out of the "sociology of expectation." This approach aims to assess how "guiding visions" or "normative expectations" about future benefits affect and structure technology in the present as opposed to predicting the future itself (Berkhout 2006, Van Lente et al. 2013). Bakker et al. (2011: 156) define "technological expectations" as "real-time representations of future technological situations and capabilities. That is, it is a combination of expected progress of the technology at stake, its future markets, and its societal context." Van Lente (2016: 12) is even more precise in offering a definition: "expectations are circulating representations of the future." Such expectations can be individual or collective, and they can involve statements, images, graphs, terms, and stories, within or between firms, research groups, policy, and society. Concepts from the sociology of expectation attempt to reveal the "narrative infrastructure" or "mosaic of stories" surrounding technology (Deuten and Rip 2000: 71).

But how do expectations originate and circulate? A variety of concepts currently ground the approach. One is the notion of a *rhetorical vision*: advocates of a particular technology will often hold shared expectations and narratives about it. These will have specific dramatic elements such as plot lines, stories and characters. Van Lente (2016) terms this "mutual positioning:" actors position themselves, others and future technology in a story (or a plot), and so translate themselves and others into characters. This serves a basic coordinating power that creates a shared agenda and a division of tasks. Many times these characters fall into archetypes such as "the user," "the ally," "the adversary," and the "product to be" (Deuten and Rip 2000). Through politics, the active sharing of information, argumentation and ultimately audience acceptance, these visions become shared, a "collectively held and communicable schemata that represent future objectives and express the means by which these objectives will be realized" (Berkhout 2006). Visions are most powerful when they become part of a "collective repertoire" of ideas and statements shared by large stakeholder groups; in such contexts, the vision cannot be ignored even by those that do not share its ideas, for the vision by that stage is part of social reality (van Rijnsoever et al. 2014).

To be clear, within this body of work, expectations are not synonymous with a narrative or rhetorical vision, nor with a promise. An expectation would be preparing London for electric vehicle charging or that local-level actors would resist electric taxis, whereas a vision would refer to the broader narrative storylines of the electrification of automobility in general, revolving around themes of independence, power, justice, and sense of community (Eames et al. 2006). Specific expectations refer to a particular manifestation of a technology, whereas general expectations refer to the general technological field, and frame expectations at the social level of "hopes and fears that go along with a technology" (Kriechbaum et al. 2017: 2). Promises in turn are the sales pitch of visions and can also take many forms:

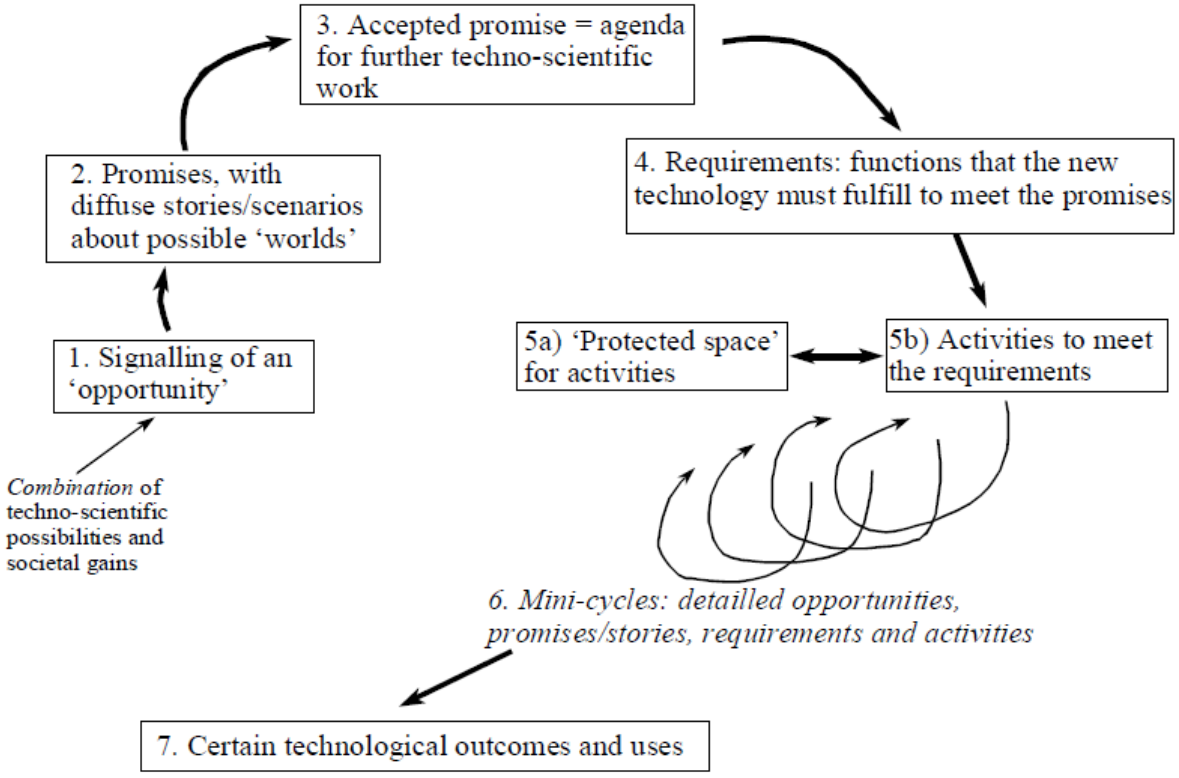
umbrella promises tend to be vague, open-ended, and non-falsifiable; more specific promises can be closed and falsifiable, and thus more prone to disappointment.

One particularly powerful type of collective vision or narrative is an *ideograph*, a sort of meta-vision or super-promise that cuts across visions and recurs. Van Lente (2000) suggests than an ideograph intertwines ideology, power, social control and language—it becomes a "way of understanding what collective conviction means." Ideographs are thus master frames that signify a baseline of public and political commentary, and often relate to common rhetorical tropes such as "freedom," "quality," "prosperity," and "safety." Van Lente (2000) muses that perhaps the most prominent ideograph connected to technology (in the past) has been that of "continual progress," an idea reaching as far back as the Enlightenment and one connected to sociotechnical systems such as electricity, information and communication technology, biotechnology, and nanotechnology.

A related concept is the notion of a "*promise – requirement" cycle*. Van Lente (2016) suggests that most innovation or technical development starts with a promise to solve a problem as well as the promise of profit, which are taken up on politically (groups, firms, policy) and lead to requirements and protection to continue with a next round. Promises and expectations of emerging technologies thus become part of an agenda-setting process that germinates into a requirement for engineers and other actors, justifying a redistribution of resources and giving them a "mandate" to develop "their" technology (Bakker et al., 2011: 557). The steering and coordination of action occurs as expectations are voiced and responded to in a reiterative process. In this way, the functionality of the vision results in a binding promise to developers and advocates: "the freedom to explore and develop combined with a societal obligation to deliver in the end," i.e. of "promissory commitments that become part of a shared agenda and thus require action" (Borup et al. 2006: 291, 289). This dynamism between promises and requirements results in a "nested phenomena" graphically

depicted in Figure 1. As the Figure illustrates, when a promise becomes accepted as part of an agenda, more detailed expectations are proposed, circulated and adopted. A broader promise may thus lead to more specific, achievable promises (Brown et al. 2003; Van Lente and Rip 1998).

Figure 1: Dynamic evolution of promises and requirements



Source: Van Lente and Rip 1998.

A fourth and final related concept describes the two types of actors involved in brokering expectations, termed *enactors* and *selectors* (Bakker et al. 2011). Given that there is rarely a single technological solution to a pressing social (or other type of) problem, different technologies will evoke distinct reactions from stakeholder groups. An *enactor* will stress criteria that favor their particular variation—they will be more steadfast and dogmatic over preferred attributes and performance aspects. Conversely, a *selector* will balance different and at times competing criteria about a technology and will be inherently fluid and dynamic. Enactors focus mostly on maintaining and promoting expectations, whereas

selectors focus more on picking expectations. Enactors and selectors will compete for resources and support in "arenas of expectations" that offer "trials of strength" in an ongoing process of selection and variation. Berkhout (2006: 301) adds that such a competitive environment—which he interprets as "bids about what the future might be like, offered by agents in the context of other expectation bids"—often results in expectations that are both flexible/adaptable as well as contested. This helps explain why many rhetorical visions are strategically vague: visions are malleable, allowing enactors to avoid discussing technical details that may expose the contested nature of their own agenda.

At its core, the sociology of expectation (and its related concepts) offers a semiotic and symbolic understanding of technology development. It thus has similarities to sociotechnical imaginariness (Jasanoff and Kim 2009, Jasanoff 2015), although those are more collective (concerning mass publics) and normative (assessing the morality of innovations). By contrast, expectations are more private (concerning experts and innovations) and approaches more descriptive, not judging the morality of the innovations being examined. Similar to imaginaries, though, expectations approaches underscore how sociotechnical diffusion is a symbolically interactive process as well, with the meanings attached to technology being constantly modified, malleable, and interpretive (Broto 2012). Expectations have "heterogeneous ingredients" and "prospective structures" that are highly iterative: circulating futures exert force because they allocate roles in the actions and reactions, the futures are filled in, modified, and reshuffle, generating a "prospective" structure as opposed to "retrospective" structure (Van Lente 2016). Furthermore, the theory demonstrates how expectations are continually "performative" in defining roles and in building obligations to support a particular technology. Expective statements and promises are descriptive and normative/moralizing, but they are simultaneously performative as they *do* something: they legitimate decisions such as funding projects, guide search activities like

heuristics, they gather support, and coordinate and position an individual in the overall vision (Van Lente 2016).

2.2 Justification of the Nordic region

Empirically, our data collection centered on the five Nordic countries of Denmark, Finland, Iceland, Norway, and Sweden. This was because the Nordic region in particular has aggressive energy, transport and climate policies; high penetration rates for the adoption of low-carbon technologies and practices; and (most relevant for this study) high rates of adoption for EVs.

For example, the International Energy Agency (2018) notes that across the five Nordic countries, the total stock of EVs reached 250,000 cars at the end of 2017 and accounted for 8% of the global total, the third-largest share after China and the United States. The per capita diffusion of EVs across the Nordic region is *highest* in the world at 10.6%; the growth rate the highest in the world (up 57% from the previous year); and Norway in particular features a 39% market share of electric cars sales. The article therefore attempts to document the emerging visions and expectations surrounding this emergent yet ongoing Nordic transition to electric mobility.

2.3 Nordic expert research interviews

Unfortunately, given the newness and limited diffusion so far of V2G, few experts and consumers have knowledge of it. In fact, since V2G is at the earliest stages of testing, even in the Nordic region, only a handful of users have experience with the technology in various pilots and experiments. Instead of talking to this small number of users, we utilized an approach drawing from interviews with V2G and electric mobility experts, asking them what they *thought about* users (and other aspects) as they are the epistemic community setting the market and regulatory conditions for EVs. These experts included inventors, entrepreneurs, researchers, policymakers, planners, corporate managers, intellectuals, and

otherwise influential stakeholders who can likely impact users and mobility pathways across the Nordic region. Therefore, the choice for expert (semi-structured) interviews was intended to match the complexity of the topic of electric mobility and V2G.

As part of a broader project looking at electric mobility and V2G in the Nordic region (Sovacool et al. 2017c; Sovacool et al. 2018b; Sovacool et al. 2018c; Sovacool et al. 2018d; Kester et al. 2018a; Kester et al. 2018b; Noel et al. 2018; Noel et al. 2019), the authors conducted 227 of these semi-structured interviews with 257 experts from over 200 institutions across each of the five Nordic countries (there were more respondents than interviews because some had multiple participants, although we still coded responses by individual). Those interviewed were selected to represent the diverse array of stakeholders involved with electric mobility and V2G, making it a purposive rather than a random sample. The interviews crossed several sectors, including local, regional and national government ministries, agencies, and departments; regulatory authorities and bodies; universities and research institutes; electricity industry players; automobile manufacturers and dealerships; private sector companies working on charging equipment, transport software, alternative transport technologies, and electricity and fuel traders; and industry groups and civil society organizations. Questions were asked about the major energy and transport challenges, about the benefits of EVs as well as their challenges, about potential suggestions to speed up the EV transition, and about V2G (its benefits, challenges and potential incentives). The interviews lasted between 25-90 minutes, with most conducted in person and a few by phone, if personal meetings were impossible. Table 1 offers an overview of our interviews and respondents by country, gender, focus area, and sector.

Table 1: Overview of Research Interviews and Respondents

	Interviews (n=227)	Respondents (n=257)	% of Respondents
Country			
Iceland (Sept-Oct 2016)	29	36	14.0%
Sweden (Nov-Dec 2016)	42	44	17.1%
Denmark (Jan-Mar 2017)	45	53	20.6%

Finland (Mar 2017)	50	57	22.2%
Norway (Apr-May 2017)	61	67	26.1%
Gender			
Male	160	207	80.5%
Female	40	50	19.5%
Groups	27		
Expertise			
Transport or Logistics	73	81	31.5%
Energy or Electricity System	63	75	29.2%
Funding or Investment	10	12	4.7%
Environment or Climate Change	12	16	6.2%
Fuel Consumption and Technology	22	23	8.9%
Other	13	14	5.4%
EVs and Charging Technology	34	36	14.0%
Sector			
Commercial	68	70	27.2%
Public	37	46	17.9%
Semi-Public	40	51	19.8%
Research	37	39	15.2%
Non-Profit and Media	12	13	5.1%
Lobby	23	25	9.7%
Consultancy	10	10	3.9%

Source: Authors. Note: Semi-public refers to commercial companies owned by public authorities, such as distribution service operators.

Participants were guaranteed anonymity and not prompted for responses, except for the follow up questions that were adjusted to the background of the respondent. All but one interview was recorded and then fully transcribed, coded in NVIVO on a statement by statement level and subsequently combined and analyzed inductively in larger themes. As some interviews included multiple respondents, and hence offered slightly different interview dynamics and responses as respondents can establish themes, each participant was given a unique respondent number (e.g., R257). We conducted simple frequency counts of the resulting visions, with more details about that coding presented in Table 2 (below). As we will also see below, because our questions focused on both benefits (leading perhaps to positive expectations) as well as barriers (negative expectations), almost all respondents discussed *both* utopian and dystopian sociotechnical visions.

3. Results: Eight contested sociotechnical visions, promises, and ideographs

As this section of the article demonstrates, our interview material led to no shortage of different visions. Here, we extrapolate the eight that were the most frequently mentioned

across the entire sample. Table 2 offers an overview of how visions differ by type, promises and requirements, and ideographs. Interestingly, many respondents articulated multiple visions—we see 953 distinct instances of a respondent making statements that support a particular vision, or a mean of 3.7 visions per respondent. After positioning visions into two classes—positive and negative—we roughly ordered them by their timeframe (proximal and near-term to distant and far-term). We realize we could have delved deeper into the specific visions resonating within distinct national contexts, but did not pursue that approach given that such visions did not vary significantly based on the country location of a respondent.

Table 2: Summary of Visions, Promises, and Ideographs with Nordic Electric Mobility

Vision	Number of Statements*	Frequency by total statements (N=953)	Frequency interviews (N=257)	Description	Promises and requirements	Ideograph(s)
Rapid electric society	N=216	23%	84%	Electricity will come to meet all passenger transport needs or even all transport needs	Rapid charging, electric highways, adequate vehicle range, electrification	Progress, convenience
Innovation nirvana	N=110	12%	43%	Electric mobility is the first in a cascade of innovations leading to further technical breakthroughs and progress	Bigger batteries, automated vehicles, shared vehicles, mobility as a service, modality of types of vehicles, flying vehicles, robot assisted mobility, hydrogen fuel cells, coupling of innovations	Progress, profit
Ubiquitous and clean automobility	N=167	18%	65%	Automobility will expand to include mobility within buildings	Zero emissions vehicles, avoidance of inclement weather, new production	Environmental sustainability, physical shelter, urbanization

					options, new urbanization options.	
Energy autarky	N=75	8%	29%	A transition to electric mobility will coincide with a transformation to decentralized, local sources of energy	Self-sufficiency, community ownership, independence from energy companies, free energy	Liberty, autonomy
Frozen families	N=180	19%	70%	EVs will runout of power during snowstorms, on mountains, or during emergencies, and lack sex appeal	Range anxiety, stranded vehicles, traffic accidents	Safety, love, status
Broken promises and bankrupt businesses	N=143	15%	56%	EVs are currently an inferior product that on its own will be confined to small niche markets	Bankruptcy of companies, collapse of EV markets	Employment, economic growth
Hacked and vulnerable grids	N=33	3%	13%	A smarter, vehicle-grid-integrated, interconnected economy would raise serious risks of loss of privacy, terrorism, and the collapse of local grids	Monitoring and surveillance, data breaches, terrorist attacks, blackouts	Privacy, security
Captive consumers	N=29	3%	11%	EVs will create or deepen dependencies on electricity suppliers, smart grid operators, charging companies, or battery manufacturers	Unfair tariffs and/or massive profits for companies	Liberty

Source: Authors. *Note: Coding the frequency of particular visions was admittedly difficult, given that they rely on a mix of different terms, phrases, and narratives. We present simple frequency counts to indicate the popularity of these visions among our expert sample. We identified 216 respondents supporting the "rapid electric society" vision by coding among all interviews for the benefits of electric vehicles and/or electricity in

society, including emissions, but excluding innovation elements. We identified 110 instances of "innovation nirvana" inclusive of quotations about technical development, developing new technology, automation, business models, gadgets, interesting technologies, and other future electricity services. We identified 167 instances of "ubiquitous and clean automobility" by coding for either new applications of mobility or the emissions, health, and sustainability benefits of electric mobility. We identified 75 visions of "energy autarky" which mentioned terms such as grid disconnections, energy independence, micro-grids, vehicle-to-home, and vehicle-to-x. We identified 180 visions of "frozen families" based on terms such as fires, long charging times, lack of public charging infrastructure, range anxiety, wear and tear, and suitability to winter weather. We identified 143 instances of "broken promises" or "businesses" based on the terms disinterest, lack of available cars, material constraints, low volumes, lack of affordability, and poor resale values. We identified 22 "hacked and vulnerable grids" based on terms privacy, terrorism, and hacking. We identified 29 instances of "captive consumers" through terms such as increased cost of V2G, complexity of V2G, and dependence. Statements were mutually exclusive—they were only placed in the single category for which they best fit.

3.1 The rapid electric society

By far the most prevalent vision expressed in our interviews—across the entire sample of statements—was that of the rapid electric society. This vision merges together various promises and expectations (rapid charging, electric highways, adequate range) with a vision of a fast transformation to reliance on electricity for mobility. Sometimes, this shift to electricity is framed narrowly for passenger cars, at other times it encompasses the complete penetration of electricity for all transport modes and markets, or even new spaces and applications. Because of its proximal nature, many of its claims are more specific and falsifiable than other visions. This vision connects most frequently to ideographs such as progress and convenience.

In articulating the strength and veracity of this vision, R83 warned that Denmark should not be left behind in the rapid electrification of society:

> *Not so far in the future, we will reach an almost fully electric society … EVs will be on every road, in every parking lot. Taxis, trains, and buses will all be electric. If someone, like a CEO, arrives in two or three years in the airport in Copenhagen, he walks out in the street and sees it's dirty like ten years ago, all the diesel taxis are standing idling and all that. And you fly to Norway, Sweden or Amsterdam or whatever and see everything is electric, it's quiet, and it's nice. He's going turn his heels and walk straight back to the Copenhagen airport and fly somewhere else and start his business. The future of business is electric.*

Other respondents were quick to use sounds, clever anecdotes, and even colorful language. R9 for instance discussed the likelihood of positive social feedback loops accelerating EV

uptake by comparing EVs to lions pushing a herd of calves across the Serengeti and arguing that it only takes a few to move millions.

Furthermore, this vision is framed as "currently underway" or "right around the corner". R1 for instance claimed:

> *Adoption will be so quick, it will be as if they were injected with a virus and like zombies go and buy electrical cars.*

R37 confirmed this point by confidently stating that within five years all manufacturers will offer EVs, or as R4 affirms:

> *It is no question that in Iceland, every car—yes, every single car—will be fueled by electricity in a few years. There is no question about it. It is obvious. We have plenty of everything to create electricity. I say there is no problem to build charging stations to be able to cover all transport needs, everything.*

These statements—and no less than forty others within the sample—all portrayed a shift to the electric society as desirable and fast, occurring in the next two to fifteen years.

In generating more complex and falsifiable expectations, other respondents discussed the sorts of infrastructural shifts that would occur as society itself became fully electric (hence naming the vision "electric society") or vehicle-to-grid capable. R195 emphasized the radical/disruptive nature of the transition and its speed by noting:

> *I foresee the transition to electric mobility as being quick and comprehensive. People like me will change very quickly. I imagine soon that we will cross a tipping point, that the transition to electrification, it will be sort of exponential and all the business models and preferences change. This revolution will really happen overnight ... In three years, you would be stupid to buy a gasoline car. People will think, "Strange people, why did you decide to go petrol?" People will have to change. You'll change or die.*

A final twist on this narrative is bringing electricity through EVs into other areas of society. Creatively, some respondents mused on the potentially fantastic and unusual forms of automobility and customization that such innovation could result in. R85 suggested that:

> *In the future, with electric mobility well established, we will have cars that contain multiple power outlets, where you can not only charge your phone but do crazy things like have a mobile outdoor stereo system, or use it for different equipment such as*

> *motor saws in the woods, or massive torches to light road work, or even to cook food in a mobile kitchen in crisis conditions … I take all of these astronomy photos so I need power all the time I am out, so in the future I will have a big battery in my trunk that will enable vehicle-to-telescope, V2T [laughter] … Just imagine what you can use it for.*

In short, the vision of a rapid electric society was approached positively and confidently seen to develop further in the near future, and it went beyond electric mobility itself to an electrification of society.

3.2 Innovation nirvana

A slightly more distant and ambiguous vision of an "innovation nirvana" (Walsh 2012) describes a world of rapid and sequential innovation processes well beyond electricity and electrification, a nirvana for commercialization, and the continuous improvement of products. When applied specifically to mobility, this vision intertwines automation and self-driving vehicles, robots, flying cars, and hydrogen innovation systems. Many times, it is not developments in EVs or V2G specifically that catalyze such innovation, but improvements in battery technology, computing, processing power, or artificial intelligence. Essentially, innovation occurs within electric vehicles but it also cascades to other segments of society. This vision most strongly connects with the ideograph of progress and profit.

One strand of the innovation nirvana vision focuses on the narrative of improvements to electric mobility technologies. As R117 suggested that EV ownership would evolve to mirror the patterns of cellphone ownership:

> *I am convinced that EV technology is going to be superior both to conventional cars as well as whatever EV technology we have today. We are going to see continuous development and improvement like cellular phones. In five year times people going to change the cars not because they have to get rid of the old car but because they want a new smarter car. And then the new car is going to be much smarter, and innovation will become perpetual.*

Similarly forceful statements emphasized a rapidity of the innovation nirvana. R191 expected that:

> *The issue of batteries will become less and less important. Soon, we will be able to go seven hundred kilometers on a single charge. One charge, and you're halfway around the world.*

Another narrative within the innovation nirvana vision was that innovations in EVs will create knowledge spillovers into other domains, notably automated vehicles and new business models. R107 remarked that:

> *Soon, there will be different technologies that will enable us to spend more time in our car and enhance the driving experience. This may even be not driving—there will be autonomous driving, blind people can drive themselves. Just imagine you put your children in in the car and send them away. The pathway that begins with EVs ends with robot cars and autonomous cars. I see a future for them. In ten years.*

R34 confirmed this timeframe of ten years and added that:

> *By then, you know, probably half of the fleet will be fully autonomous. So, you won't own your car, that's [another] change we are going to see.*

We would emphasize at this point that not everyone was sanguine about automation. Just as environmentalists could argue against the commercial replacement of ever smarter cars, R6 admitted that he was "*shit scared of*" Tesla's autopilot when he and a friend tried it.

Others connected EV innovation with flying cars. R34 shared with us an anecdote of how he had some insight into what NASA was working on and mentioned in relation to "*flying cars"* that *"they are thinking really outside of the box … The future is going to be full of exciting, unforeseen surprises."* Similarly, R230 supposed that:

> *I'm more excited about electric planes than cars. Your children will fly, not drive, or drive something that will fly too, to their houses. So transport right there in the air. There's a lot of space. More roads will appear in the sky.*

Importantly, these latter claims about innovation were more distant, less falsifiable and more general. Nevertheless, these notions of perpetual innovation, while part of a rapid electric society, stand on their own as it points to a constant development and automation beyond just EVs.

3.3 Ubiquitous and clean automobility

This vision depicts EVs and V2G systems as both clean and emissions free, as well as a necessary step towards an expansion of automobility to encompass new services and business opportunities. Because EVs do not combust fuel and have no direct tailpipe emissions, they are suitable for use indoors—within apartment buildings, schools, libraries, offices, and so on. The timing of this vision varies from proximal to distant. This vision connects most prominently to the ideograph of environmental sustainability but also links up to ideographs of physical shelter and urbanization (see below).

The first strand of this vision emphasizes the cleanliness of electric vehicles, the imperative of climate targets, and the perils of fossil fuels. R52, in relation to an electric bus, commented that:

> *Thanks to the high shares of renewable energy in the Nordic electricity mix, we know that this bus is being fueled with wind power. We know that it is part of climate neutral transportation and we like it because of that. Knowing that gives me a green feeling. It's as clean as it can be.*

R239 also recognized the trend of decarbonisation and the "green feeling":

> *EVs are a remarkable technology when you think of it. When you get into an electric car, the technology itself is very good, it is comfortable, it is cutting emissions, you have a better consciousness when driving. So, it feels better. I think if you have these cars that go longer distances you can also cut some emissions from flying. So we are heading towards a carbon neutral society.*

In contrast, others highlighted the perils of fossil fuels, with some predicting their end when stating, like R68, that "*I'm absolutely convinced that we are seeing the death of chemical fuels as a carrier of energy, and I hope to live long enough for all electric airplanes.*"

The substitution of electricity would not only enable a carbon neutral society; it could also lead to an expansion of automobility into previously unthinkable dimensions, namely the domestication of automobility by bringing electric vehicles indoors, and not just cars and buses and cars, but also forklifts, indoor golf cars, scooters, even electric lawn mowers, vacuum cleaners, and robots. R43 argued that for these innovations, "*The environmental*

footprint on the climate it would be hardly measurable." Others discussed (hybrid) electric ferries and boats. R155, in this respect remarked more generally how in certain commercial sectors like mining and harbors electric power trains for ferries and boats hold great potential:

> *At ports and harbors, the payback time for fully electric cranes or one of these shuttle carriers could be two years. Electric mining underground would be valuable as you don't have to vent diesel fumes. E-mobility could revolutionize the safety and durability of these sectors.*

R248 expanded this idea to larger vehicles:

> *In 2025 there will only be electric busses in Tromso, and they will go everywhere—outdoors and indoors. Entirely new blocks of flats and buildings will be erected with this in mind. We will have bus stations in the garage, like indoors. So it's just as easy to use the bus as your own car in the garage. Difficult to go driving when its snows, but you won't have to worry about that. Since it doesn't have emissions you have the possibilities to drive literally from desk to desk. You can park it inside, no need to search for a parking space in the ice. Just think—catching a bus without having to worry about the weather.*

And although such a complete shift urban environmental planning sounds drastic, most of the experts around Gothenburg (Sweden) and a few beyond that reflected on the fact that this already exists. Like R154, who added that: "*Volvo is talking about bus stations inside houses. Already they have built a café where one can take a coffee and go on and off the bus inside."*

In other words, the absence of exhaust fumes allows for a radical transformation in mobility, as well as changes to industry and urban form: increasing the urbanization of cities by covering roads, shifting transport to indoor environments, and thereby also allowing for more indoor production options.

3.4 Energy autarky

A more distant energy autarky vision is meant to convey an energy (and mobility) future dominated by local, self-sufficient sustainable energy production free from the forces of corporate capitalism, where individuals come to enhance their autonomy and ownership via decentralized community sources of energy (Müller et al. 2011; Wentland 2016; Moss

and Francesch-Huidobro 2016). This vision thus connects with ideographs of liberty and autonomy.

R144 astutely captured the essence of this vision when noting that:

> *In the long-term, the vision is to create a local energy and mobility economy free from outside interference, independent from energy conglomerates. Now you can call it a nightmare or a dream, depending on who's looking at the picture. For instance, I think the grid companies are really scared about that. They have a lot of money invested into the grid and if you're starting to produce locally and store electricity locally that will reduce the transmissions in the grid. You're eroding their sunk investments and operating against their natural monopolies. You're rejecting both their control and their entire business mentality, which is to make money from you.*

Where R144 discusses the impact on grid companies, R191 went so far as to frame a V2G society as one resulting in the "death" of traditional energy companies:

> *There's high probability that Europe is going renewable and when coupled with grid-integrated vehicles, energy will become so easy to produce it will have very little value. There is a point where energy or electricity could even be free, or almost free, like the internet. A V2G society's essentially spelling the death of traditional fossil fuel and energy companies … For the vast majority of the lifetime of a solar plant, your marginal cost is almost zero. You need some goats to take the grass, and you need a dude with a hose to clean it every now and then, and that's it. … V2G turns upside down the whole business model of the industry, because it's democratic and decentralized.*

Electric mobility and V2G may prove to be radical and disruptive technologies in the energy autarky vision that being the end of the electricity grid structure as we know it. Indeed, the comments above imply a radical democratization of the cost of electricity shifting the power from voracious energy companies to a future of cheap individually produced energy.

3.5 Frozen families

The next four visions articulate negative expectations. The first proximal vision of frozen families—the second most frequent across the interviews—centers on two negative rhetorical tropes with ideographs of family safety and love, which emphasize the expectation that EVs could breakdown during cold weather or during emergencies. R1 summarized this

issue with the remark that people, "*when the temperature is cold and the battery is depleted, I worry that they cannot go pick up the baby downtown without waiting hours for a charge.*" R225 in Norway framed this reliability issue in terms of being stranded on a snowy mountaintop:

> *When I first learned about Tesla, my reaction was that its vehicles should be banned from mountains. When the weather is bad and you're driving up a queue in a mountain, with 20 cars in a row and your blinkers on, a Tesla might just stop in the middle of the road. It would be stranded there on the mountain, and it would be very hard to save the people inside.*

Even more starkly, R18 in Iceland framed this as life-threatening:

> *Imagine that you're sitting at your house, and you've just gotten in for the evening, and you're EV is not charged. It's cold outside, and you have maybe 20 kilometers of range left. All of a sudden, a volcano erupts and you have to evacuate. What do you do? You're stranded, and likely dead [laughs].*

Clearly, rhetoric tropes like these that sketch negative impacts of a potential transition are used to steer, if not counter, the visions about a rapid electric society and ubiquitous and clean automobility. They highlight the uncertainty that comes with a new technology and the minimal expectations of automobiles in general – e.g., to be able to pick up the baby, drive in the snow on a mountaintop or escape from a volcano – that EVs need to adhere to.

3.6 Broken promises and bankrupt businesses

Other experts question the pragmatic nature of the transition and thus the achievability of the promise of electric mobility itself. These proximal to distant visions frame advocates of electric mobility as charlatans pushing an inferior product doomed to fail, something that will result in failed investments and broken and bankrupt businesses. Ideographs here revolve around employment and economic growth.

This narrative begins by pointing to the inferior attributes of electric vehicles compared to their conventional counterparts. R143 remarks that "*people fear EVs*" and that

"*they are stuck with the idea that EVs are somehow … improper, lighter semi-cars*" or as R8 cynically reflects:

> *People here in Iceland really like their big jeeps and the idea of freedom that they represent, that you can go up to the glacier whenever you want to, even though what you end up doing is going to the bakery. I don't see EVs substituting for this image anytime soon.*

The seriousness of such perceived inferiority was prevalent in some statements about safety, in particular claims that EVs would (rather spontaneously) catch fire. R19, working in the energy sector, for instance, confessed that EVs scared him given "*the sheer amount of power in the back of the car",* stating that the batteries *"could explode with much more force than gasoline."* This was not an isolated remark, and also came up with R212 who admitted to know "*many people who are afraid that EVs in the garage will simply catch fire, because they have read somewhere that if you don't charge correctly it can overheat and combust."* In particularly, R212 connected this to consumer's making the analogy between EV batteries and exploding lithium ion batteries on airplanes and in mobile phones.

For reasons such as these, as well as high purchase prices, some respondents constructed a narrative around EV promotion only leading to disappointment and (eventually) broken companies and stranded assets. As R32 articulated:

> *EVs just don't make business sense. If somebody told me they were starting a business to sell only EVs in the near-future, I would close it down immediately [laughs]. Because it would be wiser for me to close than to suffer for 2 years. An EV pathway is the same as misery.*

R13 added that:

> *The sales of battery electric cars is a huge disappointment in the world. Only Iceland and Norway are great markets percentage wise. California is not doing as expected, the same for Japan and Germany. Sales are dropping in Demark as they took out some of the tax incentives. So, in general, battery electric cars are not selling, and that is a very sad story because it is a good technology. But the market is doomed to low volumes and eventual collapse.*

Tellingly, others were convinced that the addition of V2G capability does not overcome the business case against EVs, nor that it looks like a promising business case itself. R49 noted how V2G "*is nothing more than an unreachable dream"* and would not change the general public's desire for "*a normal car with a towing hitch or a big truck."* R113 also believed that V2G does not make sense businesswise, but put it even stronger when stating that "*V2G is a wet dream in someone's silly mind when they saw a lot of batteries out there."* In these expectations, in other words, the promise is one of failure of the proponents of electric mobility to deliver on their promises.

3.7 Hacked and vulnerable grids

Rather than underscoring the positive value of interconnected and potentially autonomies and ubiquitous electric vehicles, this proximal vision—admittedly one of the least frequent—sees them as a threat to secrecy and cyber security, similarly touching in ideographs of privacy and security.

R57 captured the thrust of this vision by noting that the linking of ICT and vehicles enabled by a V2G transition could completely transform how people are connected to the web:

> *I have major concerns over privacy and how future digital citizens will interact in a V2G society. I imagine a world where companies can monitor and track your every move. Everyone could see where you are and stuff like that. If you're a one-person household, people could see that the car is away and could come into your house. It's a problem—and it opens up intimately private lives, not only to companies but to others who could use or misuse the system as mass surveillance.*

R62 emphasized such a system could have major security risks such as terrorism:

> *To me the connection between V2G and the increased potential for terrorism is not that far off. Tomorrow's terrorism is probably completely different form yesterdays and we need to think about that when we working with these systems. Imagine a terrorist taking control of people's vehicles or trucks. Would it be possible to get into these computers and make the cars do things they shouldn't do? Yeah. How will cybersecurity be protected or maintained in a world full of future terrorists and hackers? If anyone can hack the computers and find out which car I'm driving and what stores I'm shopping at and what kind of products I'm shopping for, and what*

> *kind of advertisement should be sent to my home, whether I like it or not, then the privacy of people is severely infringed … Such a system may give many the opportunity to do the evil things.*

Undesired and unauthorized access to the car and the car's location clearly coalesce into negative visions related to a future (automated) electric mobility.

A related narrative stressed the unintentional side effects of increased electrification straining local grids. R119 in Denmark remarked how even Better Place, the battery swapping company in Denmark (Noel and Sovacool 2006; Sovacool et al. 2017b), had to install intelligent solutions to charge the "*20 or 30*" cars on its parking lot so as not to overload the local grid. R149 in Finland characterized it this way:

> *It's the last five meter challenge. We've been focusing so much on decarbonizing electricity supply, and large grids and power pools, less attention has been paid to local grids and distribution networks. There are stories circulating about people disrupting the entire village or town grid because they tried to charge an electric vehicle. That is a monumental challenge for local networks.*

R181 similarly highlighted the "*risk of collapsing local grids*" at certain transmission and distribution hotspots due to big consumption peaks from EVs. Furthermore, R181 linked this back to transportation itself when reflecting how:

> *EVs also illustrate the single point of failure issue. If I have a problem with the electricity system, then even the transportation system becomes frozen. [In some cases] interconnection becomes a liability, not an asset.*

In short, these expectations look beyond the initial promise of a rapid electric society and clean automobility to the impacts that such a shift could have.

3.8 Captive consumers

A last negative vision, also less frequent, is more distant and radical on a societal level, as it sees an EV and V2G society, counter to the energy autarky vision, as one that has merely swapped one set of corporate overlords (big automakers, oil providers) with another (energy companies, digital and ICT companies). The central ideograph here is again one of liberty.

R188 for example noticed a reluctance among consumers to "*become dependent on some distant infrastructure for their daily travel",* thus pointing to a dependence on charging stations. R29 illustrated another part of the logic of this vision when pointing to battery ownership and noting:

> *An electric mobility future all sounds great until you ask the question of who will control the batteries. Because people are afraid that the batteries will not last long enough and it is very costly to get new ones. You become dependent on battery providers. And once that happens, they can charge extreme prices and reap extreme profits.*

R20 even framed the vision, especially the materials for batteries, in terms of substituting oil companies and a country like Saudi Arabia with lithium companies and the politics of countries like Bolivia or Columbia, asking rhetorically "*So, what is the difference?"* especially as environmentally *"you have to destroy many things to get either one."*

On the electricity side, R186 in turn questioned how a decentralized energy production and consumption system would actually be organized in terms of its information structure, and in doing so touched upon themes also present in the hacked and vulnerable grids vision:

> *If I have a very nicely physically distributed energy system and that system relies on an information system that is highly centralized, is it still decentralized? Because they always say the end-user should be able to participate in the spot markets. Let's assume that we do that. But then, if I have some big players and I know the system well enough, ideally, I can actually bring down the whole system without actually doing anything. This is similar to the 2010-2011 flash crash of the stock market caused by improper bits of information. We don't touch a power plant, we don't do anything. There is not even a virus. I don't cut cables, I just press buttons.*

With these visions and expectations, respondents question the vision of clean and free automobility and a rapid electric society brimming with innovation and the potential for autarky, and force them to reflect on themselves and better explicate their promises and the requirements necessary to reach them.

4. Discussion: Tensions, synergies, and agency in sociotechnical visions

The sections below offer, respectively, a content based and temporal reflection on the relationships between the eight identified visions.

4.1 Tensions, synergies and agency

As predicted by the sociology of expectations approach, we see considerable contestation and tensions within our sample of visions. Proximal visions such as the rapid electric society and frozen families are presented as inevitable and fast, yet ostensibly would still need policy and financial support to occur. As Table 2 (above) summarized, ubiquitous automobility sees automobility go inward, inside buildings, whereas innovation nirvana sees it go outward, to flying cars and automated long distance mobility. The innovation nirvana sees electric mobility as a lucrative source of knowledge and profits, whereas the energy autarky vision sees the collapse of the corporate entities that would be reaping those profits. Energy autarky and captive consumers are literally opposite visions. The ubiquitous automobility vision includes narratives about how healthy and happy EV drivers are, contrasted with the insecure, hacked, frozen and broken people depicted in all four of the negative visions. Some visions even internally contradict: the energy autarky vision still needs centralized control and decentralized production is not always an option in urbanized environments.

The synergies between visions are not entirely negative. Table 2 (above) also demonstrates that positive synergies exist as well. For instance, an innovation nirvana would only further the cleanliness and ubiquity of mobility, and also likely increase demand for a rapid electric society. The inverse holds true as well: rapid electrification of society would likely lead invariably to new innovations and breakthroughs. The vulnerability portrayed in a hacked and vulnerable grid would only hasten the drivers behind the vision of broken and bankrupt businesses, but could just as well spur the innovation nirvana and by extension an

electric society and clean automobility. Similarly, the vision of frozen families leads to business opportunities, just as captive consumers could either hinder the autarky completely, or, more likely, hasten innovations in business and technology as well as in judicial and regulatory spheres.

Furthermore, each of these visions has implicit interpretations of agency and performativity. For most of the utopian visions the referent object is a broader society and the vision is pushed by enactors – the only exception is energy autarky where the referent object details consumers. However for the dystopian expectations the referent objects are consumers, businesses, individuals and other specific elements of society that selectors expect to remain as they are or become vulnerable to specific threats. Also, the visions that lean on and support the initial promise of electric mobility, like the ubiquitous and clean automobility or energy autarky, are used to define the requirements of electric mobility (interconnectivity, automation, smart metering systems, and so on). Yet, they are also promises in need of acceptance themselves. Likewise, the dystopian visions often simultaneously question the actual acceptance of the promise (captive consumers), its temporal viability (broken business and frozen families) or draw attention to one of its aspects with the intent to request certain additional requirements (hacked grids).

4.2 A temporal and radical typology of visions

Moreover, the visions differ meaningfully in terms of some of their constitutive elements. Here, two sets of factors seem especially meaningful. The first set refers to whether the scope of sociotechnical change brought about by the vision is incremental, pragmatic or conventional, or instead is radical, substantive, and utopian (Michael 2000). These aspects cut to the core of the scale and scope of each vision. Incremental visions essentially see the future pretty much as similar to the present, taking fundamental or foundational conditions of now as the basis of their foresight. This contrasts with radical

visions that are more progressive, substantive, or ends-oriented, in which society may differ in fundamental ways from how it exists now.

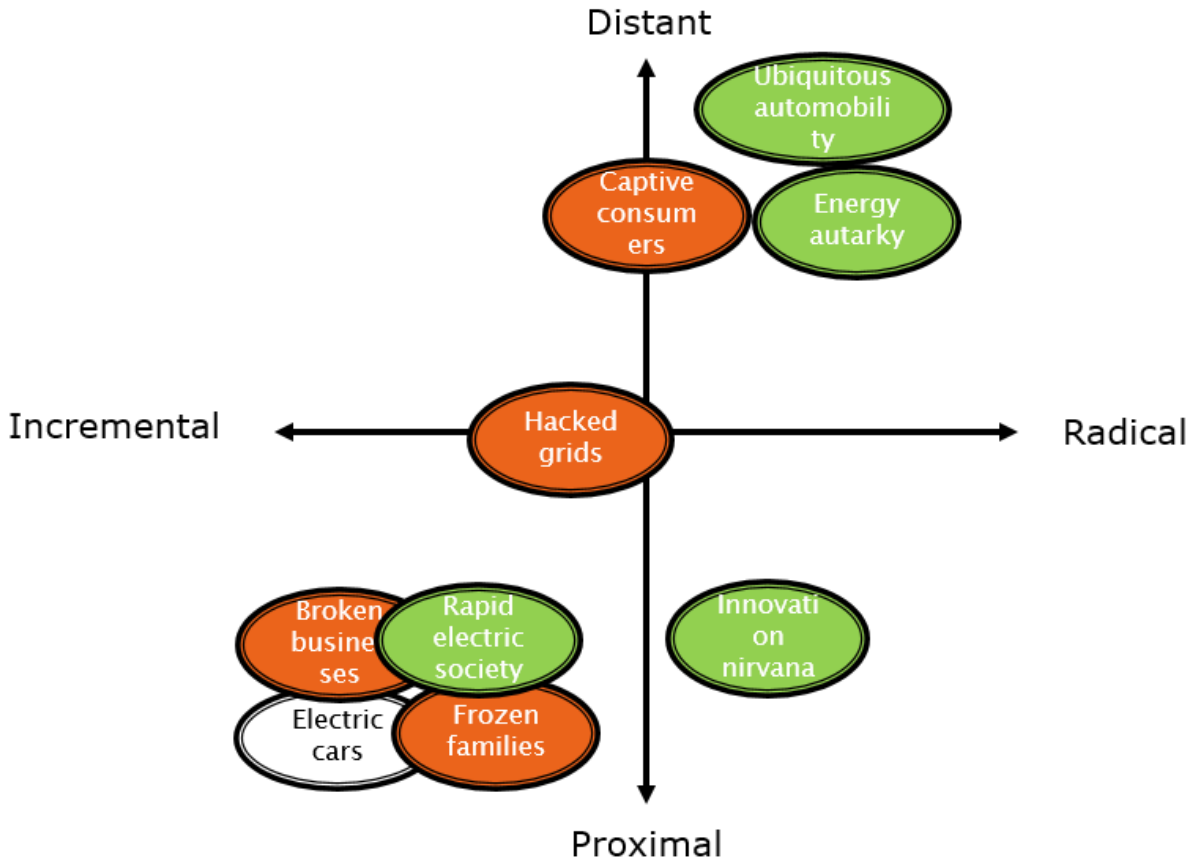
When applied to EVs and V2G specifically, a radical vision would be one that depicts completely new forms of mobility such as robots, or flying cars, whereas an incremental vision portrays an electrification of current mobility forms, much as we know it today with human drivers and normal vehicles. Radical visions are about transforming all of automobility, incremental ones more about specific components or parts. In this light, the rapid electric society, frozen families, broken businesses, and hacked and vulnerable grids (with new forms of terrorism) are all incremental visions; while ubiquitous automobility, energy autarky with captive consumers, and innovation nirvana are more radical.

The second set refers to whether visions are proximal versus distant. More immediate or proximal visions would occur in a few weeks to a few years' time, they have a sense of urgency. Distant visions are far into the future—usually at least a decade away, possibly a century away, and they may even lack urgency to the point of being framed as inevitable. Here, frozen families, rapid electric society, broken businesses and innovation nirvana would be most immediate; hacked grids more intermediate; and ubiquitous automobility, captive consumers and energy autarky more distant.

Figure 2 offers a typology of visions across the two dimensions of temporality (distant/proximal) and change (incremental/radical), both to map visually how the visions relate to each other and to indicate more graphically which ones serve incremental and immediate versus more distant and radical ends. The rapid electric society (as its name implies) is proximate even though it encompasses more distant shifts (airplanes), but in all cases only replaces the drivetrain, so it is incremental. Frozen families and broken businesses both question the current status of the personal EV transition— hence, they are also incremental and immediate. Both the hacked grid and innovation nirvana capture multiple

technological innovations, some distant other proximate, some radical others incremental. Ubiquitous and clean automobility is distant and radical as it will change society in ways we cannot foresee, similar to energy autarky and captive consumers, making them more radical.

Figure 2: A typology of sociotechnical expectations for Nordic electric mobility



As Figure 2 also indicates, some visions are even twinned or interconnected. The extent that one sees more rapid electrification and the pursuit of the electrical society, the more that concerns about grid ability and hacking arise. The more that families resist EVs for the costs or fear of being stranded, the more the broken business vision resonates. The more people come to adopt batteries as a means of energy autarky, the more they come to depend on charging companies, electricity suppliers, and battery manufacturers, becoming captive in another way. Additionally, we observe that all the dystopian visions in our sample are more incremental/proximate than the utopian visions that they question. In a way, they actually question the radical and distant nature of the utopian visions, by highlighting more practical

problems. People envision such alternative realities filled with failure, danger and challenges, not just because they do not believe in the promise or vision of electric mobility, but also to strengthen the initial promise proactively.

5. Conclusion

We offer six conclusions about the expectations and expert visions circulating around EVs and V2G in the Nordic region.

First, the imagined futures are emotive and sometimes transformative. A host of positive visions frame electric mobility or V2G systems as preludes to a fully electrified society, a nirvana for innovation and technical development, a platform for automobility ubiquity, or a pathway towards energy decentralization, community control, and autarky. These starkly contrast with negative visions of families literally freezing to death, small businesses declaring bankruptcy, terrorists and hackers launching new sophisticated attacks on grids, and consumers held hostage to the whims of unsentimental corporate firms. This belies that the low-carbon transport future itself is simultaneously pregnant with opportunity and full of promise, but has some dark, despairing, and despondent elements. It evokes strong emotions and ties into tense and compelling plotlines. Ubiquitous and clean automobility, energy autarky, and captive consumers in particular were sweeping, transformative and radical, underscoring how fairly incremental changes to technology (electric motor, grid interconnectivity) can lead to visionary storylines. Also, visions are technologically differentiated: some visions seemed rooted in V2G in particular (hacked grids, captive consumers) whereas others were more about electric mobility generally (electric society, broken businesses).

Second, the imagined futures are unexpected, creative and collective. This paper introduces a number of surprising visions which we would have never predicted before undertaking our research, nor encountered anywhere else. Nevertheless, some visions were

mentioned by dozens and dozens of respondents (e.g. rapid electric society, innovation nirvana, ubiquitous automobility, frozen families), although others were mentioned by only a handful (energy autarky, hacked and vulnerable grids, captive consumers). The popular and recurrent visions do suggest that the broader low-carbon transport future remains an open ended idea, as well as one subject to mass appeal, capable of sustaining the public imagination.

Third, the imagined futures are contested and contradictory. Within our sample of Nordic experts, there remains no consensus, no master vision or ideograph, about electric mobility or V2G, what it can do, whether it is positive or negative, or how quickly it will occur. Indeed, the 257 respondents articulated 953 instances of a vision, in some cases noting visions later in the interview that internally contradicted visions discussed earlier in the interview. To be fair, this duality of visions was shaped by our approach of asking experts to reflect both on their own and on consumer expectations around electric mobility, which enabled them to list positive and negative aspects (and thus not only act as an enactor of electric mobility, but partly act as a selector of the counter visions present among the wider population). Nevertheless, it also underscores the mixed emotive forces at play behind the visions: people may simultaneously feel excited and anxious about for instanceV2G technology. Because of such contestation, the more specific future of electric mobility and V2G/VGI remains uncertain. Consensus at this stage across enactors and selectors should neither be expected nor sought. One person's utopia is another's dystopia. The arena of expectations reflects competing visions underpinned by competing interests and clashing values, creating intense selection pressures which perhaps lead to more pronounced variation among the visions. Put another way, a "master vision" does not exist but is shaped, and might be emerging. Or, to borrow from Bijker and Law (1992: 110), electric mobility and V2G in particular has not yet attained "closure."

Fourth, while the visions and expectations are open, the ideographs remain constant and recurrent. To be sure, there may be a distinctly Nordic or at least European flavor to some of our visions. Families freezing to death and the desirability of catching buses inside a building may not be germane to contexts in warmer climates. Traveling on top of mountains, taking picnics and visiting glaciers all reflect a fairly unique outdoorsy attitude and strong environmental ethic. This may make our findings less generalizable to other regions, although the work of Tyfield et al. (2016) hints at similar themes present in China. Nonetheless, the study highlights how these visions at a narrow level about EVs and V2G end up borrowing from and connecting with deeper ideographs of progress, convenience, environmental sustainability, physical shelter, liberty, autonomy, privacy, security, safety, love, employment, and economic growth. In this way, expectations and promises fulfil a general social need, and as such will likely continue to exist and evolve even as the specific sociotechnical systems behind electricity and mobility change.

Fifth, all of this leads us to argue that the sociology of expectations literature has strong albeit incomplete explanatory power. Theoretically, although we confirm the utility of concepts such as rhetorical visions, ideographs, promise-requirement cycles, and enactors/selectors, the four dystopian futures seem to go against the core point of the sociology of expectations, namely this focus on the promise (instead of the problem). Instead, all the dystopian futures start from the problem and they stay there - they do not offer the relief of a promise or salvation, and in some cases sit diametrically opposed to a particular expectation or promise—i.e. vehicles breaking down, grids being hacked, businesses going bankrupt, families falling apart.

Yet, an analysis of visions and expectations would not be complete without the performative effects of such dystopian visions. Future qualitative work, among experts and consumers, could take into account these ascribed negative expectations, not only as

resistance to the hypes and desired innovations, but as performative of their own futures – in line with for example critical security studies (Patomäki 2015; Buzan et al. 1998). Negative visions (as well as competitive visions of other clean transport technologies), through their implicit take on the positive vision, may narrow the interpretative flexibility of the latter.

Sixth, and more practically bringing this back to the topic of transitions, our typology highlights that the more proximate negative visions not only originate from a level of inexperience with a new technology, but also arise from the expectations that derive from existing technologies. The innovation nirvana vision in particular suggests that improvements and future designs are expected to match, if not improve, existing technologies. And yet, putting these negative visions aside as simply originating out of "ignorance" ignores itself the political and social effect of negative visions, as these, through their shock-factor, may more quickly generate affirmation and thereby support consumers in their passivity. Negative visions, or "broken promises," can also justifiably highlight shortcomings that advocates strategically brush away. In doing so, negative visions may do just as much as positive ones in actively shaping the directionality of an environmental innovation. A proper and balanced reflection of positive and negative visions—utopian and dystopian dynamics—could thus proactively guide transition pathways.

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