Electric Vehicles and Vehicle-to-Grid in the Nordic region

"Innovation and governance of the power sector to enable a high penetration of electric vehicles" Workshop, Chatham House, London, June 12, 2018

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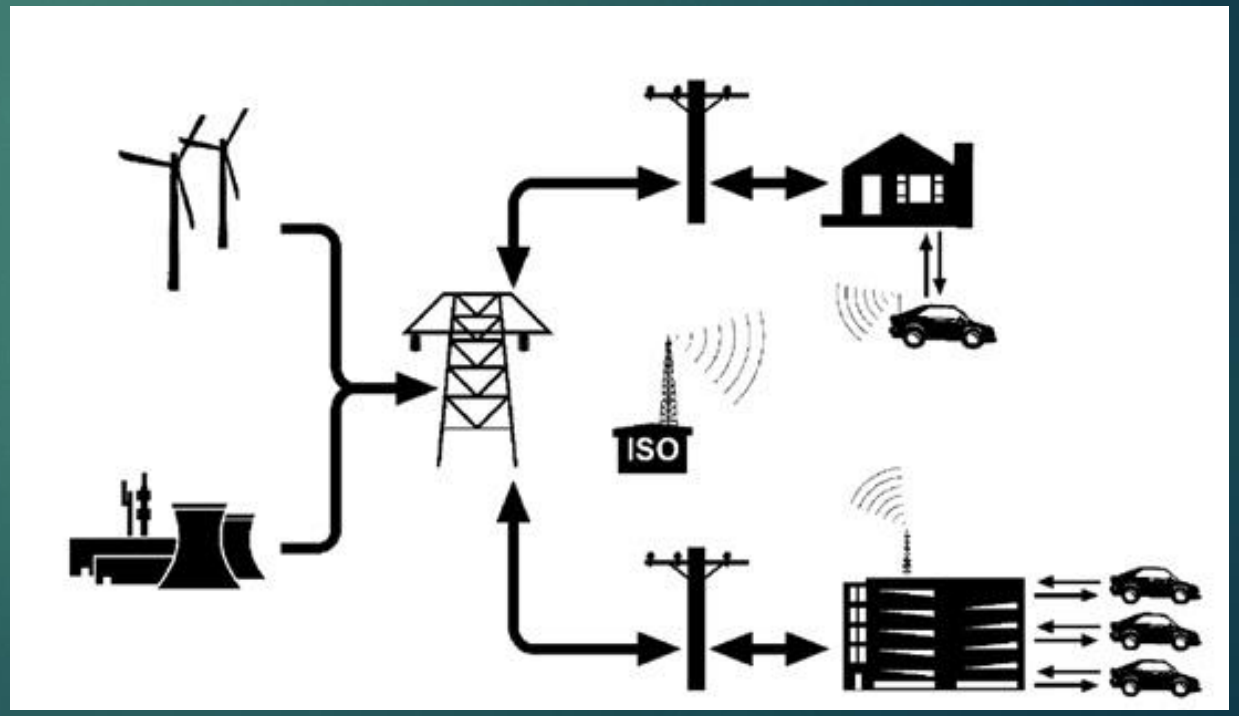
Nordic Vehicle-to-Grid (NV2G) Project

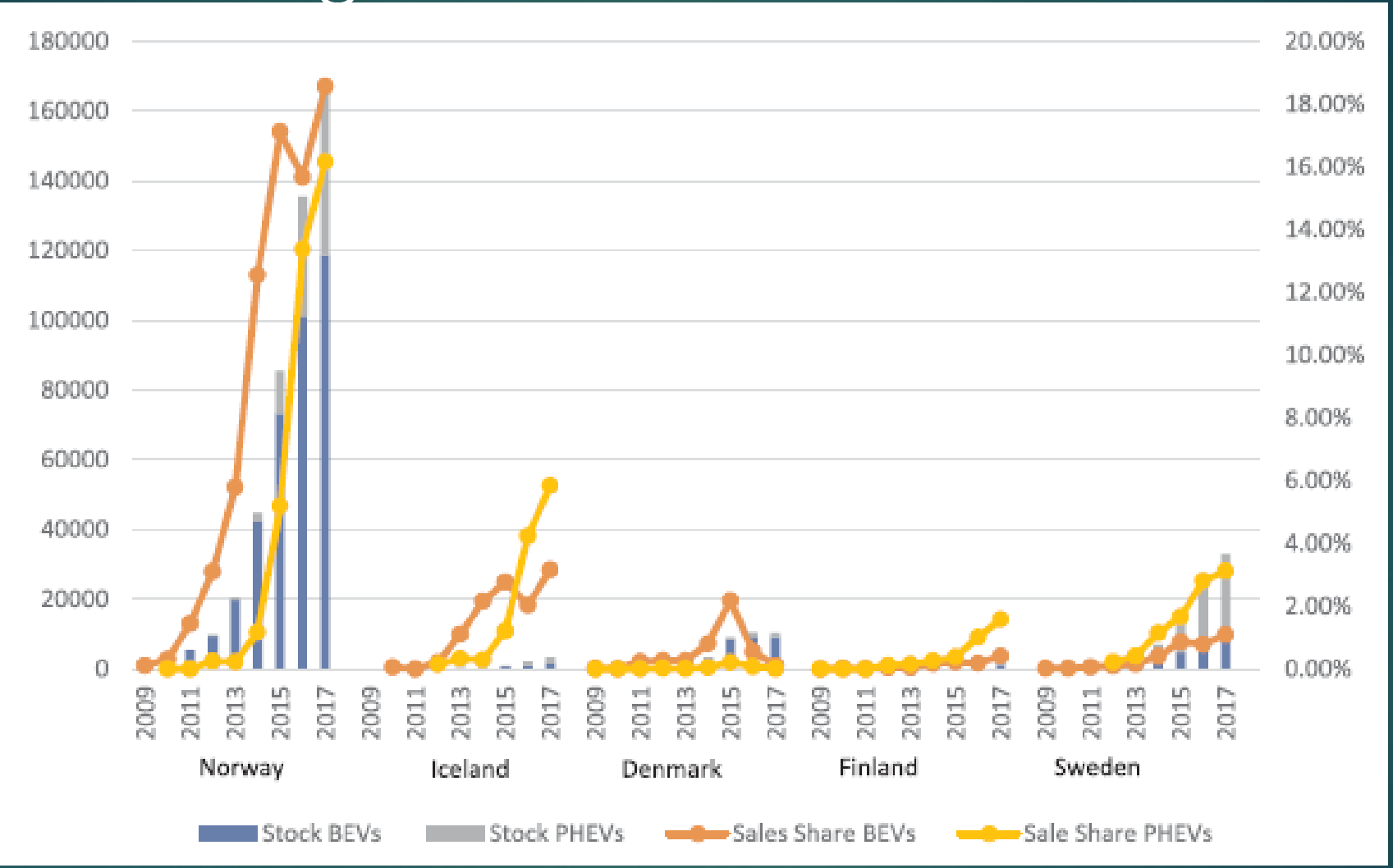
Question: What are the societal and business benefits, barriers, and policies for a vehicle-to-grid (V2G) transition in the Nordic region?

- *Most vehicles are not in use 90% of the time*
- *The equivalent capacity of automobile batteries surpasses that of the grid in all Nordic countries*
- *Electricity is much cheaper than liquid fuel per km driven*
- *Recharging at night wouldn't need significant new power plant infrastructure*

A V2G configuration means that personal Electric Vehicles (EVs) have the opportunity to become mobile, self-contained resources interconnected to homes and power grids



Why the Nordic region?



Source: Kester, J, L Noel, G Zarazua de Rubens, and BK Sovacool, "Promoting Vehicle to Grid (V2G) in the Nordic Region: Expert advice on policy mechanisms for accelerated diffusion," Energy Policy 116 (May, 2018), pp. 422-432.

Nordic Vehicle-to-Grid Project (NV2G) – Methods

- 257 expert interview participants across Denmark, Finland, Iceland, Norway and Sweden
- 8 focus groups
- 5,000+ survey responses
- 126 dealer visits in all 5 Nordic countries
- Spinoff articles on
  - Benefits, barriers, and policies
  - Standards (ISO and EVSE)
  - Kids and cars (600 10 year olds in NL and DK)
  - Business models (Better Place)
  - Theories for electric mobility and sociotechnical transitions
  - Plus two V2G reviews (*ARER* and *Nature Energy*)

Central barriers found in the Nordics

- Price of the EV – higher costs, lack of subsidies, tax structure
- Consumer willingness and knowledge of EVs
- OEMs comparatively worse business case (to conventional cars)
- Charging infrastructure chicken and egg problem?
- Fragmentation of policy& development (technological uncertainty)
- Lack of political motivation and will (feedback loop?)
- Feelings & emotions widely discussed as central aspects of personal vehicles
  - "You buy vehicles to get laid"
  - "When buying a car, you don't think with your brain…"

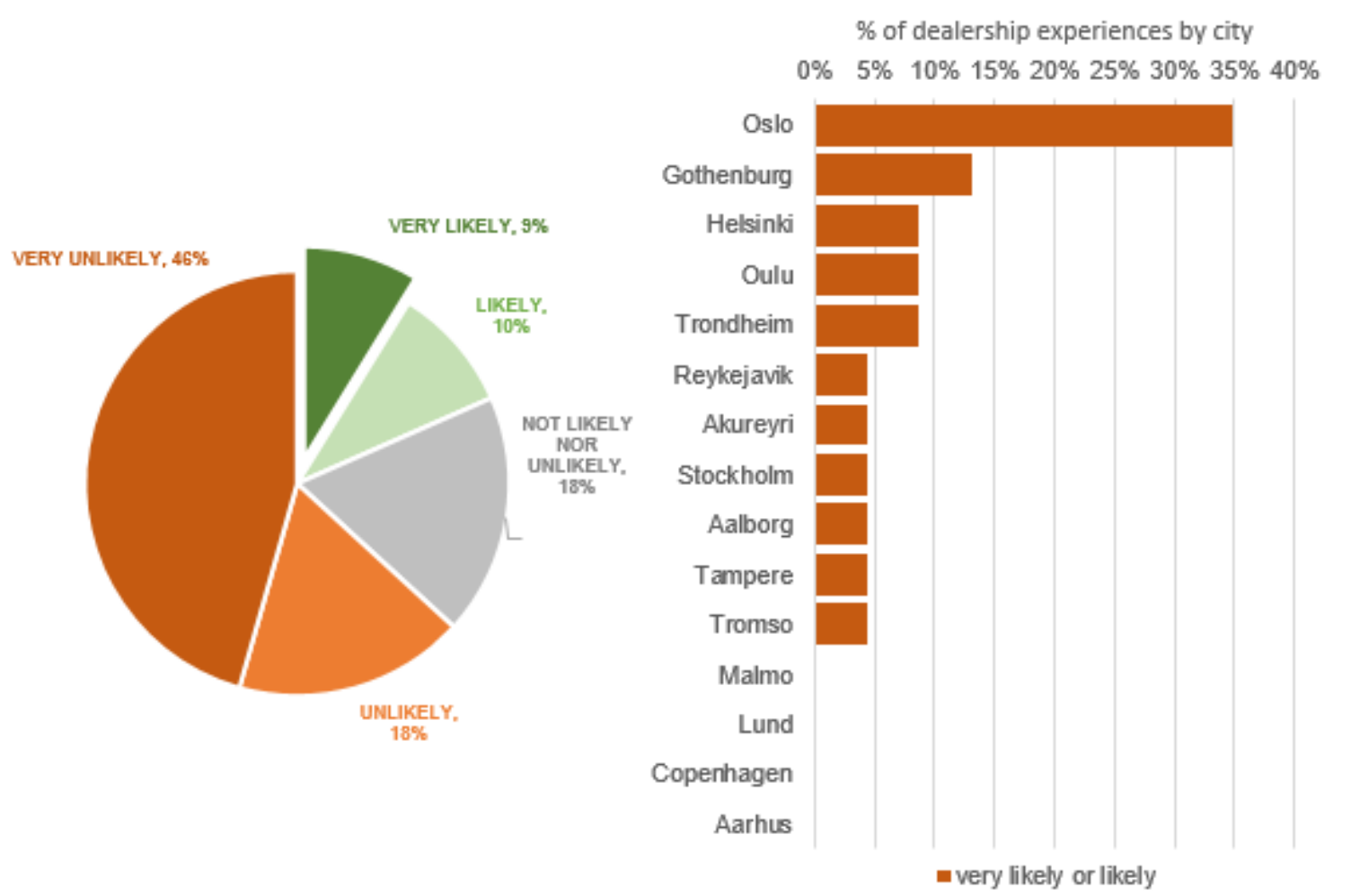
Dealers can be a major barrier at point of sale:

Barrier	Freq.	Example
Dismissive of EVs	28	V86 – "the economics of fuel efficiency doesn't make sense", which was a bit contradictory, because later the dealer said "electricity was very cheap, so you would think that EV drivers would spend less on fuel [/power]".
Misinforming the customer	24	V22 –"we have this electric vehicle". The dealer showed us an EV and said "it only goes 80km".
Neglecting to mention EVs	22	V103 – Dealer said "no we don't have this, you can only get this in petrol and diesel" even though the shopper saw a brochure for EVs on the counter.
Depicting EVs as an inferior option	14	V22 – "do not buy this [EV] it will ruin you, it will ruin you financially".
Lack of EV availability and visibility	12	V64 – The shopper saw a flyer for a Nissan Leaf, but the dealership did not have it in stock.
PHEVs and hybrids are not optimal for decarbonisation	12	V111 – "most people just buy that because of the tax breaks and only use petrol and don't really use the electric part of it".
Stating that the tax system favours conventional vehicles	11	V24 – "if the diesel car is already tax free for 5 years, then means that it should be pretty environmentally friendly…[because] the government is quite strict for diesel and petrol engines, in terms of how much they pollute. So if these ones are below the limits of the government it must mean they are very environmentally friendly".
Stating that the economics work against EVs	11	V99 – "but I'm not sure if an EV would equate to financial savings, if you get more capital cost upfront with less tax would eventually mean less money overall. Because…you're giving the money now, but the savings are in the future, you don't know what's going to happen, what if you change car or in 10 years it's not really there".
Lack of models for segments	10	V124 – "if you do need the 4-wheel drive or interior space, go with the station wagon or SUV, not the EV".

Source: Zarazua de Rubens, Gerardo, L Noel, and BK Sovacool. ""Dismissive and deceptive car dealerships create barriers to electric vehicle adoption at the point of sale," *Nature Energy* (in press, 2018)

Dealers can be a major barrier at point of sale:

Likelihood of EV purchases across the Nordic region and selected cities



Source: Zarazua de Rubens, Gerardo, L Noel, and BK Sovacool. ""Dismissive and deceptive car dealerships create barriers to electric vehicle adoption at the point of sale," *Nature Energy* (in press, 2018)

Barriers (and benefits) are socio-technical:

Dimension	Inclusive of	Example(s)
Technical	Technology, infrastructure, and hardware	Vehicle performance, grid interconnection, communication, battery degradation
Financial	Price signals, economics, regulatory tariffs	Capital cost of VGI charging stations, vehicles, batteries and interconnectors, revenues, cost savings
Socioenvironmental	Broad social costs and benefits	Mitigated greenhouse gas emissions, air pollution, integration with renewable sources of energy, externalities
Behavioral	Consumer and user perceptions, attitudes, and behavior	Consumer perceptions of all of the above, including benefits, inconvenience, distrust, confusion, range anxiety

Source: Sovacool, BK, J Axsen, and W Kempton. "The Future Promise of Vehicle-to-Grid (V2G) Integration: A Sociotechnical Review and Research Agenda," *Annual Review of Environment and Resources* 42 (October, 2017), pp. 377-406.

Non-rational and symbolic factors can play a strong influence alongside utilitarian dimensions

Functional-Symbolic and Private-Societal Dimensions of Driver Behavior

	Functional	Symbolic
Private	What it does for you, e.g. • save money • reliable • fun to drive (experiential)	**What it represents, e.g.** • **Expression of self-identity** • **Convey personal status** • **Attain group membership**
Societal	**What it does for society, e.g.** • **Reduce air pollution** • **Reduce global warming** • **Reduce oil use**	**What it says to society, e.g.** • **Inspire other consumers** • **Send message to automakers, government, oil companies**

Source: Sovacool, BK, J Axsen, and W Kempton. "The Future Promise of Vehicle-to-Grid (V2G) Integration: A Sociotechnical Review and Research Agenda," *Annual Review of Environment and Resources* 42 (October, 2017), pp. 377-406.

Such socio-technical and symbolic factors can block innovations:

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Why Did Better Place Fail?: Range anxiety, interpretive flexibility, and electric vehicle promotion in Denmark and Israel

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- A confluence of social factors (anxiety), contestation (interpretive flexibility), and poor policy coordination (promotion) explain its "failure"

The academy remains unsure about the ostensible benefits of EVs

Socio-material system-effects of electric mobility.

Interacting developments	Dimension	Positive impacts	Negative impacts
Transport-related	Intermodality	Use of EV within systems of intermodality, in combination with measures to discourage car use	Use of EV in systems that encourage excessive driving and EVs as second or third (luxury) cars
	Desire for motorized transport	Substitution of cars and scooters	Increase in car-based mobility
	Organized car sharing	Use of EVs in car sharing/ride sharing schemes	Increase in preferences for private, single-occupancy driving practices
	Increases in mobility	Implemented in tandem with active transport planning (walking, cycling)	Extra car trips, multiple car ownership, displaces enthusiasm for cycling
Non-transport related	Zero-carbon & low carbon electricity	Use of EV in countries with de-carbonized electricity grids	Use of EV in countries with coal-based electricity
	Smart grids	Charging at off-peak times and storage for peak demand	Charging at peak times with no storage
	Critical materials scarcity	Efficient manufacturing techniques with an appreciation for externalities and battery recycling	Inefficient and polluting manufacturing techniques with no battery recycling
	Employment, competitiveness, and growth	Designed and promoted by sustainable firms with a focus on innovation and entrepreneurship	Coopted and marginalized by transnational conglomerates with little desire for social change

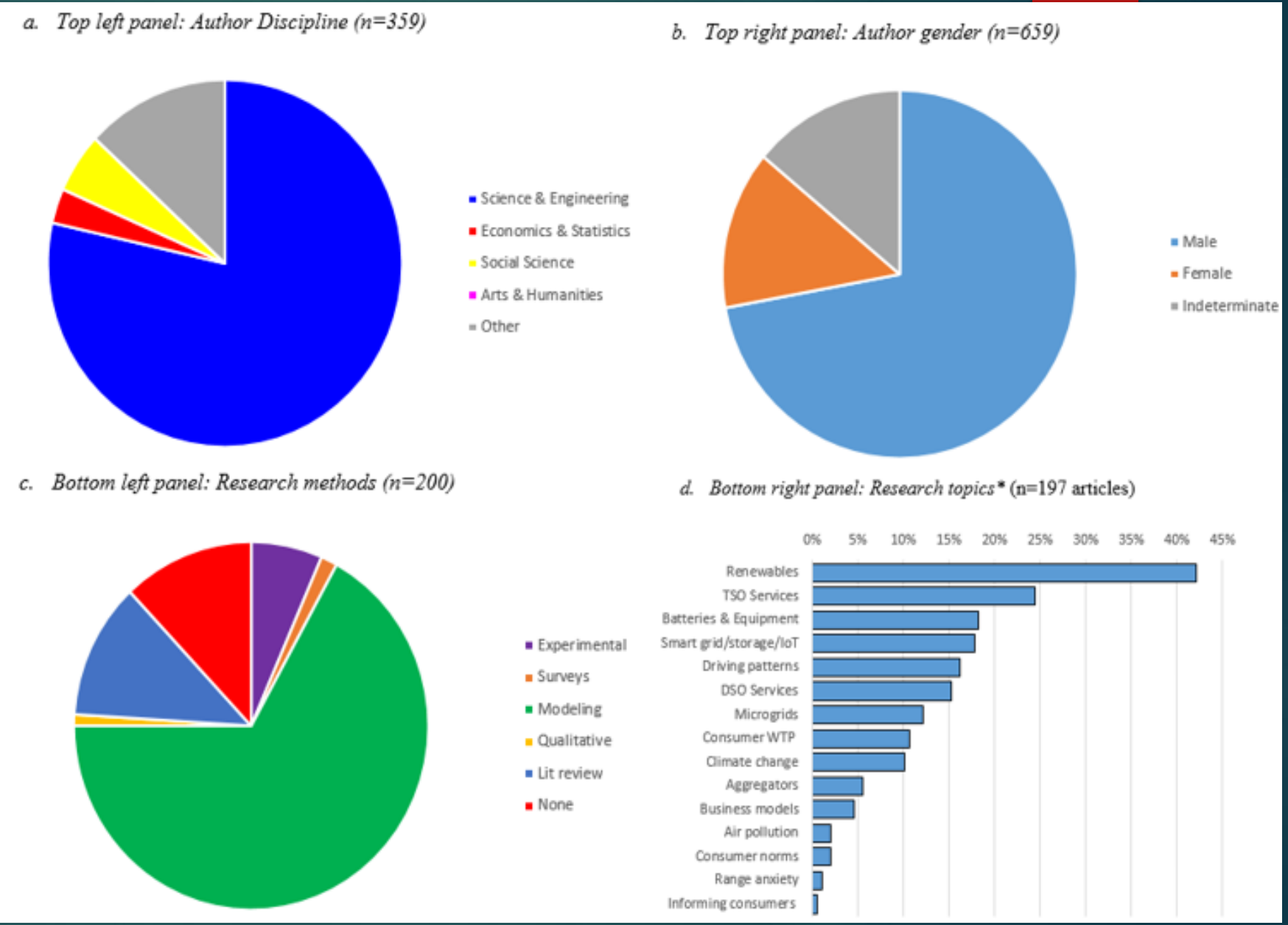
- Also confirmed that EVs remain **contested** within the expert community

Source: Sovacool, BK. "Experts, theories, and electric mobility transitions: Toward an integrated conceptual framework for the adoption of electric vehicles," *Energy Research & Social Science* 27 (May, 2017), pp. 78-95

Major research gaps exist:

Publishing trends in Vehicle-to-Grid (V2G) Research, 2015-2017 (n=197 peer-reviewed articles)

Source: Sovacool, BK, L Noel, J Axsen, and W Kempton. "The neglected social dimensions to a vehicle-to-grid (V2G) transition: A critical and systematic review," *Environmental Research Letters* 13(1) (January, 2018), 013001, pp. 1-18.

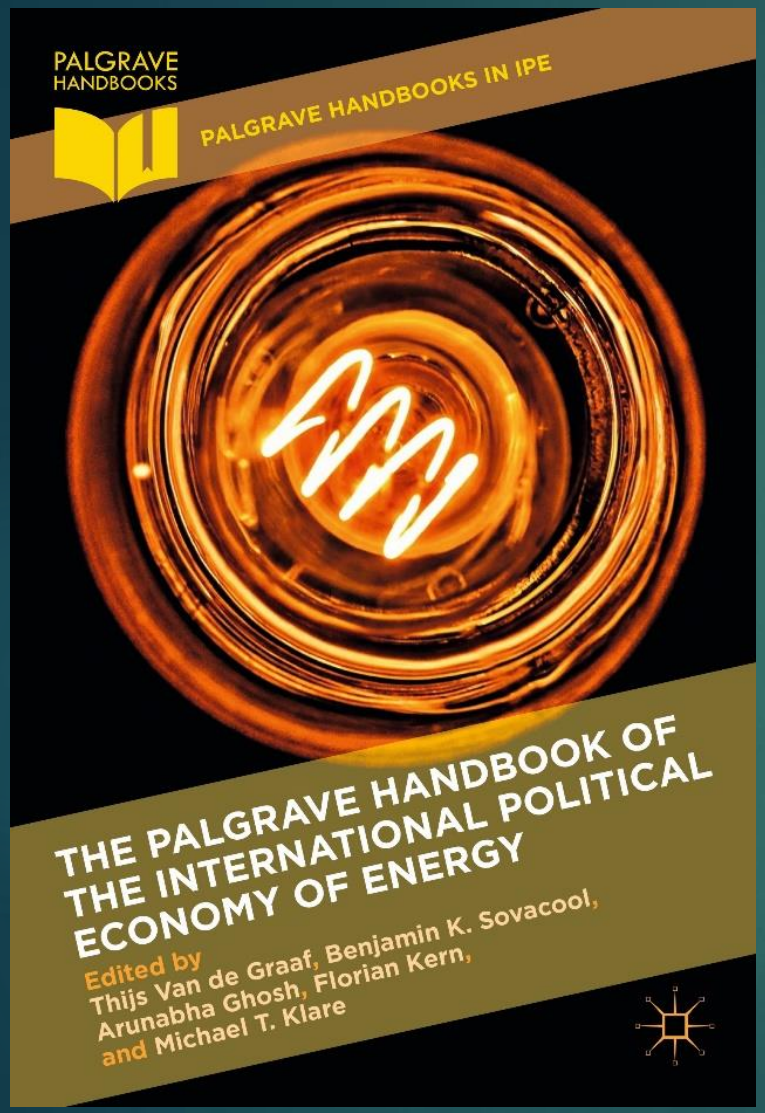


Summary of underexamined topics in V2G research

Dimension	Proportion of selection of articles (n=197)	Example(s)
Environmental performance	10% (carbon emissions) and 2.5% (air pollution)	Assessing the V2G specific benefits of climate change mitigation or the displacement of noxious air pollution such as PM or acid rain
Financing and business models	4.6%	Monetizing the market value of V2G services, mechanisms by which businesses can capture those services, and identifying market segments
User behavior	2.1% (consumer attitudes), 1.1% (range anxiety), 0.5% (information and education)	Examining the social acceptance of V2G technologies, driver concerns over battery range or degradation, and recommendations for better informing or educating users
Natural resource use	1.0%	Studying the natural resource inputs (materials, minerals) with V2G, lifecycle assessments of externalities
Visions and narratives	0.5%	Investigating the stories and imaginaries surrounding V2G, as well as hype cycles and expectations
Social justice concerns	0%	Considering the equity in the distribution of V2G costs and benefits, or displacement and exclusion in adoption patterns
Gender norms	0%	Exploring the ways that gender norms, values, and routines affect V2G purchasing and driving
Urban resilience	0%	Identifying V2G pathways on adaptive capacity and community resilience

Source: Sovacool, BK, L Noel, J Axsen, and W Kempton. "The neglected social dimensions to a vehicle-to-grid (V2G) transition: A critical and systematic review," Environmental Research Letters 13(1) (January, 2018), 013001, pp. 1-18.

Contact Information



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