Petrol Headed: A Critical Examination of the Uneven Consumption of Electric Vehicles in Both Practice and Media Across Select European Nations.

"These cars, then, are not the future. But they did at least bring us to where the future lies."
Top Gear, 2011, S.17 E.6

Introduction:

With climate change and dwindling oil reserves posing increasing risks to society (Whitmarsh & Köhler, 2010), the need to replace carbon-emitting petrol and diesel vehicles with Electric Vehicles *[henceforth: EVs]* is paramount. Currently, traditional forms of road transport are one of the prime contributors to greenhouse gas emissions, with Europe's average CO_2 emissions in 2019 reaching 122.3 g CO_2/km (EEA, 2021). The current academic understanding determines EVs are a potential solution to this problem, as they produce significantly fewer *global warming potentials* when in use, compared to internal combustion engine vehicles[1] (Hawkins, 2012) *[henceforth: ICEVS]*. Therefore, policy makers at local, national, and supra-national levels promote the use of EVs in road transport to reduce net carbon emissions (Knobloch, 2020).

However, the consumption of EVs in uneven within Europe, despite many countries providing similar incentives for purchasing. This led us to formulate our general research question:

What are the causes and motivations behind the uneven uptake of EV ownership across Europe in recent years?

To understand why, we devised 3 research aims/questions to explore this:

i. *Establish a holistic contextual understanding of the uneven nature of EV ownership between different nation states within Europe.*
ii. *Produce a statistical comparison of economic, political/infrastructural factors which account for differing levels of electric car ownership across three selected European nations[2] [United Kingdom, Norway, Slovakia].*
iii. *Examine the portrayal of EVs in UK media: Top Gear, as to formulate social understandings behind EV ownership.*

This report will begin with a literature review, discussing the current academic literature around EV ownership, in addition to situating the paper in a new area of research. The methodology used for each research aim will be explored, with the data presentation and analysis section presenting our findings. These will be collated in my conclusion, stating that uneven EV ownership is a complex topic, based on an amalgamation of social, political, and economic factors; all of which have their own importance.

Literature Review:

Despite being understood as a new automotive phenomenon, EVs have existed from the late 1800s, with popularity lasting until 1918 (Chan, 1993). However, the rise of the ICEVs provided cheaper and faster transport, meaning their popularity dwindled through the 20th century. EVs returned to popularity in recent years, with Ajanovic (2015) noting an increase in

ownership since 2010; largely due to environmental concerns and rising fuel costs (Whitmarsh & Köhler, 2010).

My literature review was conducted using search engines and databases, such as JSTOR and Google Scholar, with search queries focused around *'Electric Vehicles'*, *'EV Ownership'* and *'EV Infrastructure'* [3]. My results returned an understanding that within wider academic debates, the topic of EVs is generally split across three main fields: mechanical/technological understandings (Hawkins, 2012; Sun, 2019; Cox, 2018), political infrastructures (Hardman, 2017; Falchetta & Noussan, 2021, Weldon, 2018), and consumer discussions (Liao, 2017; Egbue & Long, 2012). To gain a full understanding of the literature behind our topic, we drew information from each field respectively:

Technological EV literature revealed the classification criteria for EV status. Currently, *'Electric Vehicles'* includes battery electric vehicles (BEVs) *[AKA: pure electric vehicles (PEVs*)], hybrid EVs (HEVs), and fuel cell EVs (FCEVs) (Sun, 2019). Due to the wide classification of EVs, we decided that our research would focus only on BEVs/PEVs for clarity. Discussions by Cox (2018) and Hawkings (2012) ensured that our project sat within the module guidelines of sustainable consumption, as the majority of EVs are classified as more sustainable than ICEVs, with future EVs projected to have "45-78% lower climate change impacts than current EVs" (Cox, 2018, P. 4989).

Discussions over political infrastructures reference charging points *[henceforth: CP(s)]* and government incentives which promote EV ownership. Papers in this area set out several "barriers to ownership" (Falchetta & Noussan, 2021, P.1; Weldon, 2018) such as CP frequency and comparatively high price of EVs. These concerns are addressed via top-down investment in charging infrastructures; in addition to purchase incentives to reduce consumer costs. Hardman (2017) references the current US incentives ranging from US$2500 to US$20,000 per vehicle. These factors create an automotive infrastructure like conventional ICEVs, via the reduction of start-up costs and regular CPs.

Notions of consumer preferences supplement political infrastructures to understand the consumer reasoning for EV's uneven patterns of ownership. Both Liao (2017) and Egbue & Long (2012) reference socio-economic factors such as vehicle price and CP availability. *'Range Anxiety'* refers to the consumer worry that EVs have a smaller range when compared to ICEVS (Rauh, 2015; Neubauer & Wood, 2014); further compounded by the fact that ICEVs can be quickly refuelled with petrol/diesel, while EVs require both access to power outlets and long charging times. This is understood as the largest barrier for consumers, combining both social fear and lack of complete government infrastructure.

Notably, Liao's (2017) focus on *EV Use Behaviour* was highly interesting. The paper explains EV ownership in holistic terms: extending on prior studies by noting the agglomeration of factors which the consumer experiences. This research paper develops this idea by noting the impact of popular media sources on EV ownership; as many consumers can be influenced by wider societal opinions. Deemed the "world's most popular programme" (Bonner, 2010, P.1; Drake & Smith, 2016), our research focuses on the continued anti-environmentalist rhetoric Top Gear used to continually demote EV ownership; with the show achieving 350 million viewers in 2020 (Conlan, 2020). Ensuring a holistically complete understanding, we have first

conducted our own research to understand and visualise the nature of EV ownership across Europe.

Methodology:

For Research Aim i:

We were unable to create our own primary data due to the scale of our proposed research. Therefore, we used secondary data by adapting pre-existing data sets to suit our research aim*[s]* (Tyrrell, 2016). To ensure ethical research, all data sets were adapted from official government/organisational websites; therefore the data is both sourced ethically and likely to be accurate. We collected our data from: EEA (2022), EAFO (2021) and EAMA (2020)[4]. Cloke (2004A) notes how *'official'* data is understood differently in geographical research when compared to other data sources, because of it's perceived authority despite not necessarily being accurate. To ensure accurate data, I cross-referenced both state and privately funded sources. However, the official government data was often the most detailed and easily accessible.

Quantitative data was collated from numerous sources, providing absolute number of EVs in each available country. This was then processed using programmes such as Microsoft Excel and Data Wrapper [5] to create visualisations.

For Research Aim ii:

Once a holistic overview of the number of EVs per country was created, we focused our research onto three European nations to allow for detailed comparison. Using data from all 31 countries[7] used in the map, would simply be impractical given the constraints of our research project. To create a just comparison, countries were compared across *USD $ GDP Per Capita, Population,* Km of *Highway, Total Land Area (Km^2) and Total Passenger Cars.* From the total list of countries, we decided that the UK should be our primary example given the constraint of UK media sources for Research Aim iii. Norway was deemed to be a market leader in the adoption of EVs, meaning it would provide insightful comparisons with the UK. Finally, Slovakia was chosen due to its relative poor utilization of EVs, despite having similar statistics to Norway in our comparison criteria. This provided us with three European nations for comparison, all with different levels of GDP Per Capita and number of EV registrations.

Country:	Population:	GDP Per Capita (USD, 2020):	Total Land Area (km^2):	Highway (km):	Total Passenger Cars:
United Kingdom	66,647,112	41,094.20 USD	244,820	3,803	34,887,915
Norway	5,328,212	67,329.70 USD	323,802	523	2,700,000
Slovakia	5,450,421	19,266.50 USD	49,036	482	2,326,787

Table 1: Comparison between chosen European nations
Sources: EEA (2022), EAFO (2021) and EAMA (2020) and The World Bank (2021).

Data was sourced on infrastructural and economic factors, to try and create understandings of the most important factors which determine EV ownership [10].

For Research Aim iii:

Given our investigation of both economic and infrastructural factors, we wanted to focus our research on social factors experienced by consumers in the UK. This involved viewing one of the UK's most popular car media sources: Top Gear. This allowed for important insight into the consumer mindset, with the show acting as an authority figure within the automotive industry.

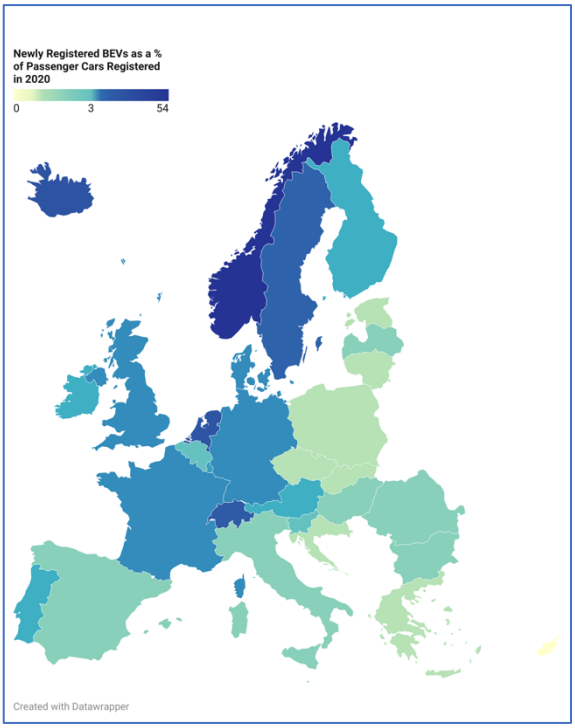
Audio transcripts were sourced for the episodes: with some found online *[at sublikescript.com]* and others individually copied from provided subtitles[8]. This allowed me to conduct textual, qualitative analysis (Aitken, 2005; Crang, 2005) on the episodes in question. Further analysis was undertaken via the use of word frequency analysis, to extract the main themes. Human names were removed from the text, as they were the most frequent terms but provided no use to our analysis. The extracted word frequency data was visualised using word clouds[9].

Non-verbal emotions were also noted following the Top Gear episodes, accounting for feelings of irony, satire and comedy which may have been lost in conversion to plain text.

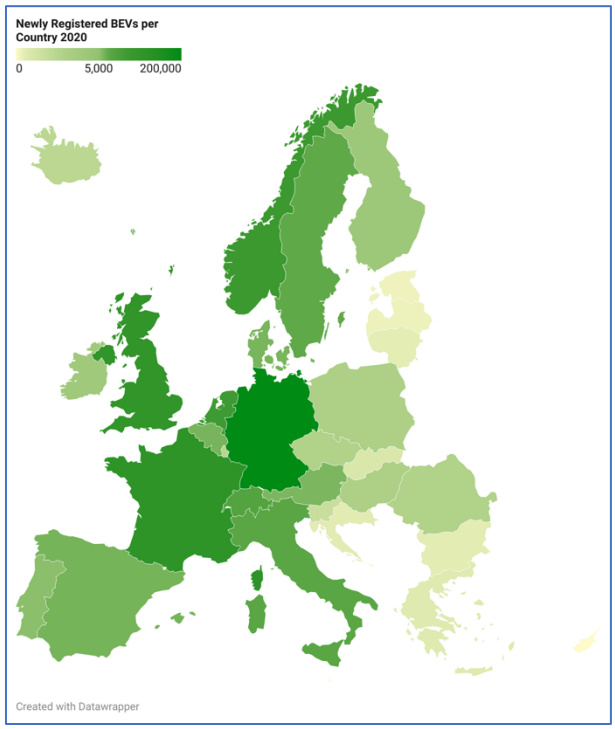
Data Presentation & Analysis:

Research Aim i:

Opening our data presentation is a holistic overview of EV ownership across Europe:



Map 1: Newly Registered EVs[6] as a %, Per Country, 2020



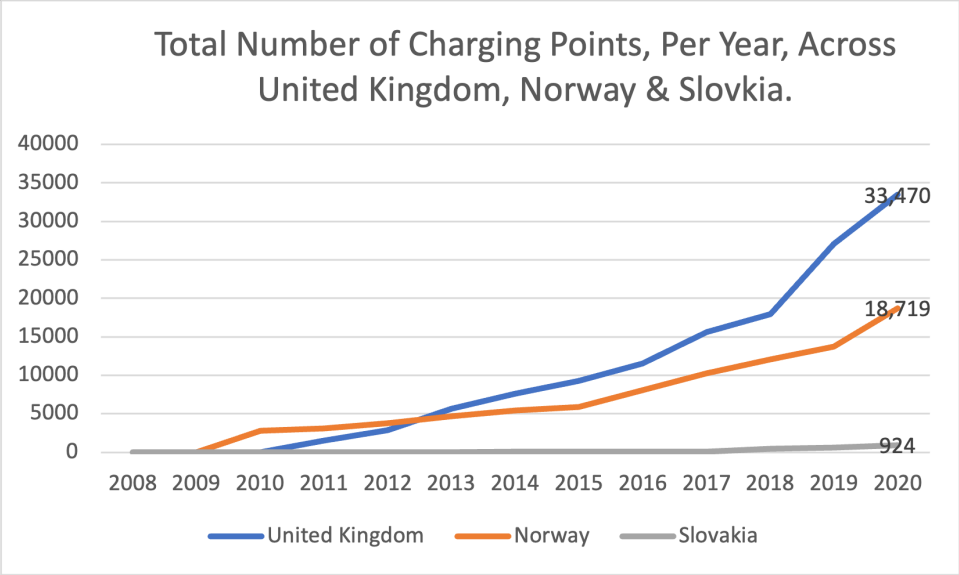
Map 2: Newly Registered EVs[6], Per Country, 2020
Sources: EEA, 2022; EAFO, 2021; EAMA, 2020

Both Map 1 & 2 demonstrate the geographical nature of the uneven uptake of EVs across both new registrations and EVs as a percentage of

total cars. Scandinavian countries *[Norway, Finland & Sweden]* are the European leaders in EV ownership, with EVs in Norway reaching 54% of total registrations in 2020 *[absolute total: 76,598 cars]*. Aside from Scandinavia, there is a clear Western bias, as the UK, Switzerland and France all have ≥7% of total cars registered as EVs. *[absolute totals: 107478 (UK), 43396 (CH) & 114604 (FR)]*. Comparatively, there are far fewer registrations in Eastern Europe, with some data sets missing as they were deemed *'negligible'*. Slovakia and Lithuania both only have ≤1% of total registrations classified as EVs, totalling 1381 cars in both countries combined. Therefore, the uptake of EVs is an inherently geographical and uneven process.

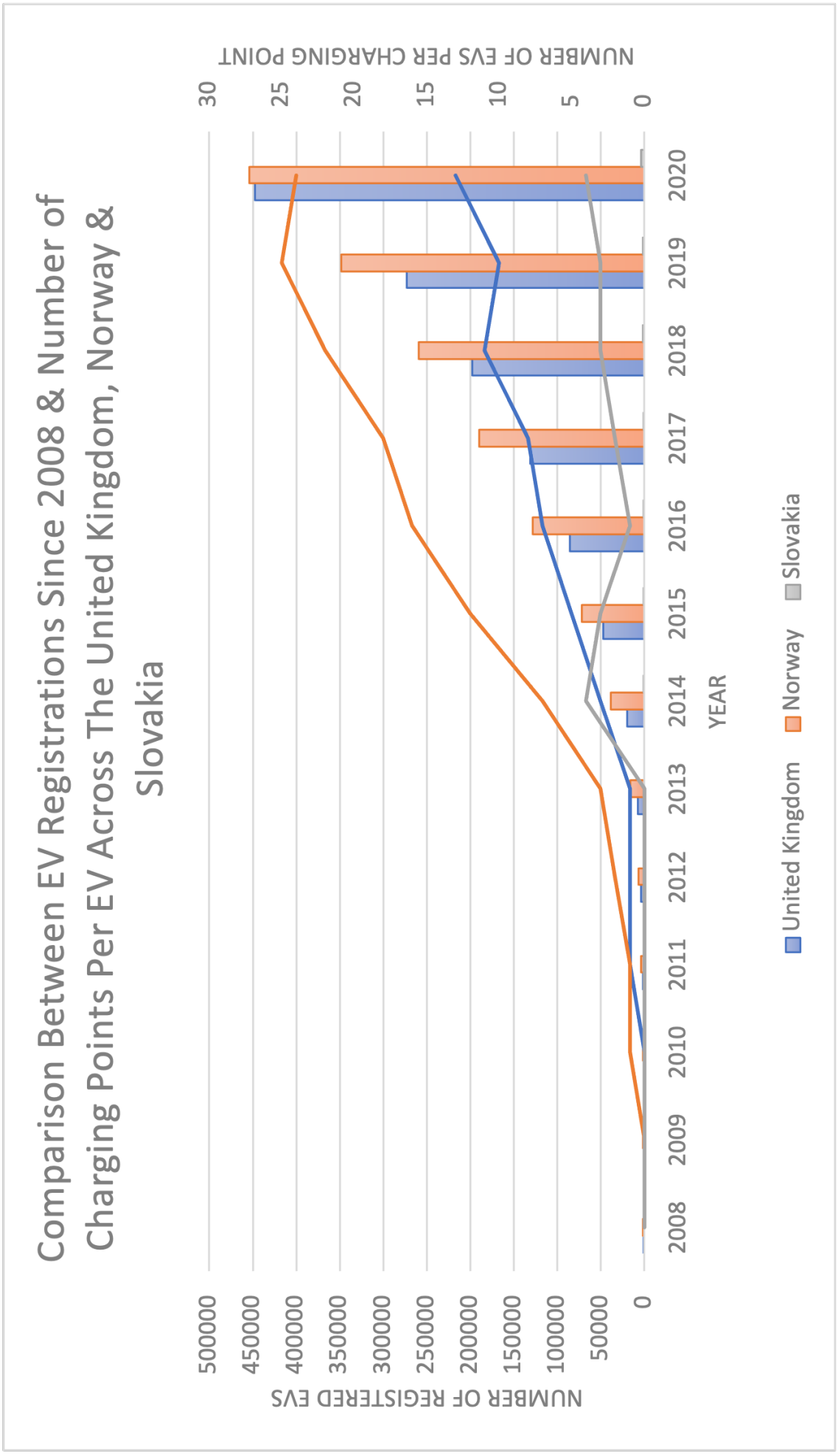
Research Aim ii:

Infrastructural Data:



Graph 1: Growth of Charging Points
Sources: EEA, 2022; EAFO, 2021; EAMA, 2020

From Graph 1, Slovakia presents a significantly lower number of CPs than the other two chosen countries, with 924 total and a maximum growth of 412 new CPs in 2018. Despite this, all three countries do have a positive trend, indicating that investment is being made across all countries to promote EVs. However, the UK has a maximum increase of 9,140 CPs in 2019, a 2118.45% *[2 dp]* increase when compared to Slovakia, showing a much higher level of investment. The UK also had a markedly steep increase from 2018-2020, totalling 17,833 new CPs across three years. Norway remains in the centre, despite having 14,751 fewer CPs than the UK: given Research Aim i showing that the two countries have similar number of EVs *[447,359 UK, 453,960 Norway]*. Therefore, by comparing the number of EVs per CP, a relative understanding can be created.



Graph 2: Number of Charging Points Per EV, Compared Against Absolute Total Numbers of EV Registrations
Sources: EEA, 2022; EAFO, 2021; EAMA, 2020

Graph 2 shows us a comparison between absolute total number of EVs and the number of EVs per CP. This allows us to visualise the adoption of EVs by consumers, in relation to public infrastructure investment in CPs. All three countries have positive trends, indicating that public investment in CPs may be falling behind the number of EVs purchased. Despite having very similar numbers of EVS, comparing the UK and Norway reveals a disparity between the number of EVs per CP. Norway has consistently had more EVs per CP since 2012, achieving a total of 24 EVs per CP in 2020, 11 more than the UK. However, both countries do retain similar levels of EV ownership. Comparatively, Slovakia has far fewer EVs per CP, with only a maximum of 4 achieved in 2014 and 2020. This includes a period of investment between 2014 and 2016, where the number of EVs per CP declined due to an increase in total CPs. Despite this, the low numbers of EVs registered limits the problems caused by underinvestment in EV infrastructure. Holistically, investment in EV infrastructure is important to promote consumer ownership but it cannot be classified as a silver bullet factor; as both Norway and the UK retain similar number of registrations, despite disparities in the relative number of CPs. Therefore, it is important to view other economic factors, such as government incentives, which promote EV ownership.

Government Incentives:

	United Kingdom:	*Norway:*	*Slovakia:*
Acquisition:	Exemption for zero-emission vehicles.	N/A	BEVs combined with other fuel types or energy sources.
Tax Benefits:	Exemption for zero-emission vehicles.	Exempt from vehicle tax rate.	Exemption for BEVs.
Company Cars:	Minimum rate for zero-emission vehicles: • 0% 2020-2021. • 1% 2021-2022. • 2% 2022-2025.	N/A	N/A
Purchase Incentives:	Government dealership grants: • Zero-emission cars up to £3,000, on vehicles priced <£50,000. • Vans, taxis, and trucks	Reduced parking fees, road, and ferry tolls.	• €8,000 for BEVs. • €5,000 for PHEVs.

Table 2: Government Incentives
Sources: EEA (2022), EAFO (2021) and EAMA (2020)

Table 2 presents an amalgamation of all current *[2020]* government incentives provided by our three select countries. Despite all three countries providing some taxation benefits and purchase incentives, both the UK and Slovakia implement comparatively large-scale incentive schemes, notably offering money back as a purchase incentive. The UK especially provides some form of incentive across all four categories. Whilst this clearly has worked in the UK to drive consumer purchases, Norway comparatively has very few benefits, yet similar levels of EV ownership. Norway provides no grants upon purchase, with only exemption from vehicle tax and reduced parking, road, and ferry tolls as their main forms of incentives. Thus, while it is clear to see providing some form of government incentive can drive consumer purchases of EVs, it again is not the sole reason as to why Norway achieves high EV registrations.

Consequently, if infrastructural and economic factors do not fully satisfy the question of explaining uneven EV ownership, current solutions employed by governments of top-down investment are insufficient in achieving widespread, sustainable EV growth. To achieve

holistic growth, there must be additional focus on social facets of EV ownership, with this paper specifically viewing TV media as a medium for consumer influence.

Research Aim iii:

Top Gear episodes featuring the use of EVs generally promote negative themes, focusing on the disadvantages of the cars when compared to traditional ICEVs. Such negative comments were focused on areas such as *range anxiety and price.*

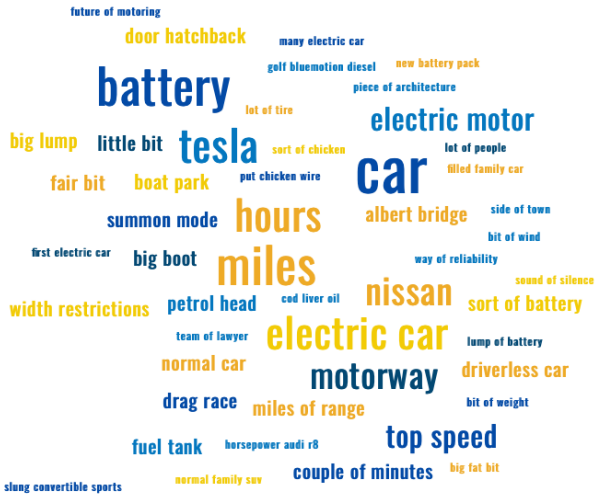
Both Series 5, Episode 7 (2004) and Series 17, Episode 6 (2011) show reviews of EVs with very limited range despite the presenters' just beginning their journey. There are multiple comments made on this issue:

"What range do you have left? I have 19 miles. I was down to 14 miles" (Top Gear, 2011)

This negative focus was further impacted by the lack of CPs available in their chosen town, Lincoln, representing a planned decision to demonstrate the lack of universal CP infrastructure. This is coupled by satirical sketches during time where the cars were charging, lasting for 5 mins 21 seconds, approximately 1/3 of the whole review. Furthermore, Top Gear (2004) claims that a Volkswagen Lupo driving the same distance as an EV received 20 more miles to the gallon, thus making the conventional ICEV a cheaper and *"greener"* alternative. These factors work to mock EVs for their potential shortcomings when compared to traditional ICEVs, and promote consumer barriers to ownership.

Top Gear states that EVs are *"not what you'd call cheap" (Top Gear, 2011)*, despite failing to mention the government incentives and fuel saving costs within their extensive review which help to lower consumer costs. Notably, they reference that the cars *"very expensive… cheaply made and pointless" (Top Gear, 2008)*. The consumer here, is focused on the large start-up cost which current EVs do currently require, but key information surrounding the government incentives and long-term cost saving features are omitted.

When viewing the word cloud, notions of *miles, range, and motorway driving* are some of the most prominent negative factors which the reviews explore. This works to increase consumer fear, instead of promoting environmentally sustainable benefits which EV use provides. Tokenistic positives are provided across all reviews, with some acknowledgement given to the quiet nature of the vehicles, and their increased internal space.



Word Cloud: Top Gear

Sources: Top Gear (2004, 208, 2009, 2011)

Therefore, popular automotive media source Top Gear has consistently used anti-environmental rhetorics to highlight the negative aspects of EV use, thus having a significant impact on consumer mindsets. Again, this factor cannot be said to be the sole reason that EV use is uneven, but provides insight into consumer fears and understandings around EVs. Top Gear specifically presents an outdated, '*petrol headed*' approach, one which is not found as prominently in other leading countries, such as Norway.

Conclusion:

This report has both outlined the nature of EV ownership in Europe as uneven, in addition to giving insight into the economic, political, and social reasons which account for differences in consumer behaviour. Research Aim i worked to show the geographical nature of EV ownership, with a clear Western and Scandinavian bias within Europe. This was examined further, through the selection of our three European nations *[United Kingdom, Norway, Slovakia].* This allowed for detailed comparisons to be made across economic and infrastructural/political factors, resulting in conclusions that neither EV infrastructure, nor economic purchase incentives are the primary cause of uneven ownership. Current government strategies of top-down investment is both insufficient and uneconomical.

Research Aim iii worked in further detail to discuss the social factors behind EV ownership within the UK through the lens of Top Gear. Their use of satire and overwhelming focus on negative aspects of EVs worked to play on consumer fears, rather than promoting the ample environmental and economic benefits which EVs provide. Governments should work to promote pro-environmentalist media to produce societal understandings of the benefits of EV use. Therefore, to promote more sustainable consumption of EVs all factors must be addressed, with this paper promoting the importance of social factors such as media in addition to economic and infrastructural/political development.

Appendix:

1. Some high efficiency internal combustion engines *can* "perform better" (P.1010) when compared to EVs powered via coal (Hawkins, 2012). However, with increasing decarbonisation in electricity production services, the long-term effects are understood to be positive in reducing total carbon emissions (Knobloch, 2020).
2. Justification for our three select European nations discussed in methodology, as informed by initial data collection.
3. Last date of literature searching: 13/3/2021.
4. Non-abbreviated names are as follows: European Environment Agency (EEA), European Alternative Fuels Observatory (EAFO) & European Automobile Manufacturers Association (EAMA).
5. See: https://www.datawrapper.de
6. As mentioned in literature review, BEVs are the same as EVs, accounting for difference in legend on the map.
7. Only 31 countries had available data on EVs *[out of the 44 countries in Europe]*.
8. *The Grand* Tour also classified under Top Gear. Full list of episodes as follows:
    a. Series 5, Episode 7
    b. Series 12, Episode 7
    c. Series 14, Episode 2
    d. Series 17, Episode 6
    e. Series 2, Oh Canada *[The Grand Tour]*
9. Word clouds created using https://monkeylearn.com/word-cloud/
10. Data was compiled from numerous different pages on the referenced websites.

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Group Project Review:

1) Describe the Process of Forming the Focus for Your Project and Whether and How the Focus Has Changed Through the Project? You Should Comment on Your Research Question and How It Has Evolved.

The initial focus for our research project was formulated in the first week, drawing on material covered in other modules which covered the use of electric vehicles. Not only did this allow us to put forward a research project which we had some prior experience, knowledge and materials in; but also was an area of study which we all thoroughly enjoyed as a group. With relation to the brief and learning objectives set out by the module, academic discussions of sustainable consumption often involve the promotion of electric vehicles, as the produce far fewer global warming potentials when compared to regular combustion engines. A combination of all of these factors allowed us to begin exploring the topic. This initially provided us with the research question of: *"What are the causes behind the uneven uptake of Electric Vehicle ownership across Europe in recent years?"*

As the module continued, topics discussed in the week 3 lecture provided understandings of alternate data sources. We felt that such a focus on alternate data sources was important, and we should mould both our research and subsequent research question to allow for the input of alternate data sources. In conversation with module convenor Dr Matt Finn, we spoke about the input that popular media sources has on the uptake of electric vehicles: marked by Top Gear consistently slandering the topic. Therefore, we adapted our research question to include a focus on media sources, thus providing us with *"What are the causes and motivations behind the uneven uptake of Electric Vehicle ownership across Europe in recent years?"*.

2) Describe the Different and Changing Roles That Reading Has Played During Your Project.

Initially, I felt that reading the example papers from last year was a strong area to start in, noting areas which I believed were strong and some which were weak. A common theme found through this process was the breaking down of a wider holistic research question into smaller research aims, to allow for a report with greater structure and depth.

From this initial understanding of the brief, I moved onto focusing on principals of teamwork. This allowed for our group to work in a more cohesive way, given base understandings of respect and leadership. This was supplemented by readings on the use of both quantitative data and textual analysis, giving a foundational understanding of how to best use the sources we were discovering.

Finally, as our research project involved the use of textual analysis, there was a lot of reading of data sources in The Guardian in order to best identify which suited our research project best.

3) Describe the Process of Sourcing Your Data (In Terms of Searching, Selecting, Generating, Preparing Your Data as Appropriate to Your Project)

The method of sourcing of our data was tailored to each one of our specific research aims. For research aims i and ii, we sourced solely quantitative data from relevant Government

websites. Not only was the data presented clearly and readily available, but this also allowed us to overcome any ethical issues with generating our own primary data. Select categories of data were chosen, covering economic and infrastructural issues. Much of our data collection for i & ii was the collation of pre-existing numerical data sets, before presenting new comparisons in tailored graphs, among other data presentation techniques.

The sourcing of the quantative data began with an agreement over which sources we would focus on, namely Top Gear and The Guardian in the UK. The relevant articles and episodes were discussed, before notes we're taken over the content of each. For the TV episodes of Top Gear, transcriptions were created from both the subtilties and online archives.

4) Describe the Steps You Have Taken to Ensure That the Research Was Ethical and Any Challenges You Found in Doing So.

Given the data used in research aims i and ii of our project being directly Government data, sourced directly from the relevant websites, there were minimal ethical concerns which we had to address; yet we still were aware of promoting ethical research at all stages in our project.

With respect to concerns over research aim iii, we ensured that all data used was in the public domain, and was both analysed and collected without bias.

5) Describe the Process of Initial Analysis of your Data.

Once our data was collated for research aims i & ii, some further reading was undertaken to understand the relevant analysis we could apply. This involved the learning of data presentation and analysis techniques via Excel. As we had no prior experience in any other software (for example: SPSS), we decided that due to its readily available nature and some powerful processing techniques, it was a relevant tool. One the data was presented, each graph and table was analysed individually, drawing relevant conclusions.

Research aim iii provided an area of textual analysis, where themes and understandings were drawn out from each article and TV episode respectively.

6) Describe Your Working Practices, and the Roles Played, by Members of the Team

Given we were only a group of four boys, there was no need for a direct leader to co-ordinate work flow. Initially I drew out research project flow diagram [also attached in appendix], which the team mostly adhered to. This allowed for us to segregate the work in an even and clear manner, as each individual task was clearly labelled with its relevance to other aspects of the project.

We decided to work through the project in a chronological manner, with all members playing a part in each task at a time. This worked well for our group, but did require constant clarity and communication.

We held regular meetings, and often spoke on WhatsApp in order to update each other of our progress.

7) Describe Any Barriers You Faced in Doing Your Research and How You Sought to Overcome Them.

We holistically had very few barriers to work: most of the group members abided by self-imposed deadlines and held themselves accountable if they failed to do so. There was an ongoing balance between module work and the competition of other essays and relevant work, which the group largely adhered to. It was overall a pleasant and fun working experience.

8) Describe Anything You Would Have Done Differently With the Knowledge You Have at This Point.

As our group communicated well; provided clear information; and adhered to the research project flow diagram, there is not much which we would have done differently with our current knowledge. Some areas of our data, however, have become unreferenced. This will be rectified in our report by retracing our steps and finding the relevant online source to ensure our research is fully referenced, yet this remains an arduous process. I believe now, after becoming more skilled with the use of data sets, I would ensure that previously all references are clear and orderly, to ensure the writing of the report becomes much smoother.