



Middle East  
Centre



# A GREENER KUWAIT

HOW ELECTRIC  
VEHICLES CAN  
LOWER CO<sub>2</sub>  
EMISSIONS



**Andri Ottesen, Sumayya Banna,  
Basil Alzougool and Sadeq Damrah**

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# A Greener Kuwait: How Electric Vehicles Can Lower CO<sub>2</sub> Emissions

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## Abstract

This paper investigates the early adopter market for electric vehicles (EVs) as preamble for mass adoption of EVs as a tool to help Kuwait lower greenhouse gas (GHG) emissions and meet climate policy standards. From interviews and surveys conducted, we found major trends preventing EVs from mass adoption and conclude with a series of recommendations for the Kuwaiti government that would help EV market in Kuwait to develop their mass market appeal, thus lowering current GHG emissions and fulfil international and national commitments towards sustainability. Open-ended interviews were conducted with all automobile dealers in Kuwait selling EVs as well as with 10 current EV owners, in addition to a quantitative 600-participant survey of mostly 18 to 40-year-old drivers of conventional cars. The survey focuses on whether participants were likely to purchase an EV as their next vehicle and under what circumstances. More than half of the participants indicated they were likely to purchase EVs if there were more fast charging stations readily available, if the price of EVs was comparable to conventional vehicles and if gasoline prices increased relative to electricity. Additionally, they would need to have a battery warranty for the duration of the vehicle. Based on the interviews and surveys, the paper presents ten reasons for the current low rate of EV adoption in Kuwait as well as recommendation for improvements.



## Introduction

Kuwait faces many hurdles in reducing its greenhouse gas (GHG) emissions to meet the country's Kyoto Protocol and COP21 commitments<sup>1</sup> as its ambitions for construction and reconstruction, industrial expansion, infrastructural growth, growing population and oil and gas activities continue to expand. Ground transport emits 12% of total GHG in Kuwait and is third among GHG emitters after electricity production 48% (mostly used for indoor air cooling)<sup>2</sup> and manufacturing and industries 27% (mainly oil production).<sup>3</sup> Although the percentage may seem low compared to other sectors, Kuwait's emissions per capita is ranked third in the world after Qatar and Bahrain, approximately three times higher than the EU average.<sup>4</sup> However, Kuwait's GHG emissions per capita have decreased annually since the previously recorded 31.1 tCO<sub>2</sub>e/person in 2005. This study suggests that switching from fossil fuel-based conventional vehicles with internal combustion engines (ICE) to electric vehicles (EVs) could significantly reduce GHG emissions in Kuwait, helping it to meet the standards required by the Kyoto Protocol and COP21.

As the world leader in EV adoption, Norway is frequently mentioned when discussing the possibility of electromobility. Norway has a similar population size to Kuwait and is also an oil-producing nation and, as such, provides an interesting comparison with a country struggling with low EV adoption rates. For example, Norway has replaced 20 percent, or 800,000 vehicles, of its ground transportation with EVs, permanently reducing GHG emissions by 3 percent.<sup>5</sup> In comparison, less than one percent of Kuwait's ground transportation has been replaced with EVs, or about 400 vehicles.<sup>6</sup> This evidence from Norway clearly demonstrates that electromobility could offer a viable solution to fulfil Kuwait's pledge to the United Nations to lower GHG emissions through their Nationally Determined Contributions (NDCs)<sup>7</sup> and Kuwaiti Vision 2035 sustainable goal number 13: 'Take urgent action to combat climate change and its impacts'.<sup>8</sup>

<sup>1</sup> Deen Sharp, Abrar Alshamari and Kanwal Hameed, 'The Quiet Emergency: Experience and Understanding of Climate Change in Kuwait', *LSE Middle East Centre Kuwait Programme Paper Series* 13 (October 2021). Available at: <http://eprints.lse.ac.uk/112491/> (accessed 20 August 2020).

<sup>2</sup> Abraham Leung et al., 'Fuel Price Changes and Their Impacts on Urban Transport—A Literature Review Using Bibliometric and Content Analysis Techniques, 1972–2017', *Transport Reviews* 39/4 (2019), pp. 463–84.

<sup>3</sup> Nawaf H. Aldaihani et al., 'Carbon Footprint of the Kuwaiti Public Road Transport Industry', *American Journal of Applied Sciences* 17/1 (2020), pp. 240–5.

<sup>4</sup> 'Total Greenhouse Gas Emissions (Kt of CO<sub>2</sub> Equivalent) – Kuwait', *World Bank*. Available at: <https://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE?locations=KW> (accessed 18 February 2023).

<sup>5</sup> 'How Norway's EVs Have Cut Emission Globally', *DNV Report*. Available at: <https://www.dnv.com/energy-transition/how-norway-evs-have-cut-emissions-globally.html> (accessed 20 August 2022).

<sup>6</sup> Andri Ottesen et al., 'How to Sell Zero Emission Vehicles When the Petrol is Almost for Free: Case of Kuwait', *Journal of Management Sciences* 9/2 (2022).

<sup>7</sup> Salpie S. Djoundourian, 'Response to the Arab World to Climate Change Challenges and the Paris Agreement', *International Environmental Agreements: Politics, Law and Economics* 21/3 (2021), pp. 469–91.

<sup>8</sup> 'Kuwait Voluntary National Review 2019: Report on the Implementation of 2030 High Level Political Forum on Sustainable Development', *Central Statistical Bureau*. Available at: <https://www.arabdevelopmentportal.com/publication/kuwait-voluntary-national-review> (accessed 20 August 2022).

## Ten Reasons for Low EV Adoption In Kuwait

To better understand the car market in Kuwait and the apparent resistance to adoption of EVs, we interviewed all automobile dealers in Kuwait selling these vehicles, as well as conducting 10 in-depth interviews with EV owners in Kuwait, in cooperation with the Kuwait National Laboratory at the Kuwait Institute for Scientific Research (KISR). In our recently published article,<sup>9</sup> as well as research<sup>10</sup> by KISR on EV battery performance in high-temperature environments,<sup>11</sup> we concluded that the following causes for low adoption in Kuwait were most evident, presented in order of importance.

1. A lack of fast-charging 300 kW direct current (DC to DC) public charging stations that can charge Kuwait's most popular large-battery EVs up to 80 percent in about 20 minutes.<sup>12</sup> At present, there are only 38 alternating current (AC) charging stations installed around shopping centres, which can take around five hours to charge a large-battery EV.
2. Reluctance of Kuwaiti landlords to allow EV owners to install 380V fast-charging EV amplifier wall-boxes in or around their rental flats that drastically reduce charging time.
3. Kuwait has one of the world's lowest retail gasoline prices at £0.27 per litre. Meanwhile, European Union retail gas prices are nearly six times the price.<sup>13</sup> Although electricity is subsidised in Kuwait and the cost to charge an EV is only about one quarter the difference (monthly costs are about £50 for fuel vs £12 for charging), it is still too low to offer any real saving incentives given that EV owners still have to purchase a £1,500 wall box.
4. Neither Kuwait nor any of its municipalities give financial incentives to acquire or own EVs. In Norway – the world EV adoption leader – the government offers incentives including:
  - a) import and value-added tax exemptions from the purchasing price;
  - b) road tax exemptions;
  - c) ferry and toll-road fee exemptions;
  - d) permission to drive EVs on designated fast lanes for buses;
  - e) free municipal parking.

Without these subsidies and the largely tax-free import of ICE cars in Kuwait, the car owners do not see the economic incentives to switch to EVs given the 20–30 percent higher purchasing cost in comparison to ICE cars (due to the extra production cost of the battery), even though maintenance costs are considerably lower.<sup>14</sup>

<sup>9</sup> Andri Ottesen, Sumayya Banna and Basil Alzougool, 'How to Cross the Chasm for the Electric Vehicle World's Laggards—A Case Study in Kuwait', *World Electric Vehicle Journal* 14/2 (2023), pp. 2–22.

<sup>10</sup> Hidab Hamwi et al., 'Effect of High Ambient Temperature on Electric Vehicle Efficiency and Range: Case Study of Kuwait', *Energies* 15/9 (2022).

<sup>11</sup> Ibid.

<sup>12</sup> 'Charging Station Locations, Charged Kuwait', *Charged*. Available at: <https://www.chargedkw.com/where-to-charge> (accessed 28 January 2023).

<sup>13</sup> 'Gasoline Prices, Litre (19th of December 2022)', *GlobalPetrolPrices.com*. Available at: [https://www.globalpetrolprices.com/gasoline\\_prices/](https://www.globalpetrolprices.com/gasoline_prices/) (accessed 22 December 2022).

<sup>14</sup> Ottesen et al., 'How to Sell Zero Emission Vehicles'.

5. Battery durability fears are one of the biggest obstacles to mass adoption of EVs as consumers tend to equate lithium batteries in phones with lithium batteries in EVs. Cell phones in countries like Kuwait often automatically shut off because of overheating, especially if left in the car over the summertime. Similarly, Kuwaitis change phones every one or two years because the battery life per charge starts deteriorating. For EVs, battery warranties are typically only for eight years (or about 150,000 km), although some manufacturers give up to ten years. Ten years is still considerably lower than the average lifespan of ICE vehicles which is about 13 years. Without an EV battery warranty duration for these otherwise durable vehicles, the fear of the battery replacement cost (which could surpass the value of the EV at the time of replacement) stands as one of the main reasons customers might avoid purchasing EVs. Rapid depreciation costs represented in the EV's resale value due to fear of early battery replacement may well be the largest operational cost (OPEX) of owning an EV. On the positive side, KISR has examined this issue and continues to provide data to allay EV customers' fears.
6. No EV community has formed as a result of Kuwait's low EV adoption rate. That is, EVs have not transitioned from being a niche product to a normal mass market item. This development indicates that Kuwait's customers have not 'crossed the chasm' – a term for a disruptive invention that will in the end replace existing technology.<sup>15</sup> The biggest challenge is when the market is dominated by an early niche market of innovators and techies, also called early adopters. The majority of potential users, or those who take a more pragmatic approach, have not yet entered the market because of 'the lack of perceived usefulness' and 'the uneasiness of use' as explained by the Technological Acceptance Model.<sup>16</sup> An example of 'Innovators' or 'Early Adopters' in the Kuwaiti market can be seen in the most sold EV in Kuwait in 2021 and 2022, the top-of-the-line Porsche Taycan. According to the Porsche dealership, affluent Kuwaiti men in their 50s–60s exclusively bought this vehicle as a status symbol due to its unique selling point – the gearless EV drivetrain that allows for acceleration unmatched by ICE cars including Ferrari and Lamborghini. Furthermore, these vehicles were not the buyers' primary cars, but often their third or fourth vehicle.<sup>17</sup>
7. Dealerships are reluctant to build technical capacity or parts inventories because EVs require next to no maintenance. EVs only have 20 moving parts compared to ICE cars' 2000 moving parts. For example, Tesla updates and inspects its parts online, hence, Kuwait has no Tesla dealership, which makes accidents and other mishaps more complicated due to the lack of spare parts or repair facilities.<sup>18</sup>
8. EV owners have pointed out that the ground clearance of the car is especially important for EVs in Kuwait. High speedbumps in residential areas aiming to keep out low-riding power cars are a problem for EVs as they may damage the battery at the bottom of the car. The same applies for potholes that are formed when the baked, dry asphalt is washed away when rains finally come.

<sup>15</sup> Clayton Christensen, Michael B. Horn and Curtis Johnson, *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns*, 2nd ed. (New York, NY: MacGraw Hill, 2011), pp. 179–96

<sup>16</sup> Julian M. Muller, 'Comparing Technology Acceptance for Autonomous Vehicles, Battery Electric Vehicles, and Car Sharing—A Study across Europe, China and North America', *Sustainability* 11/16 (2019).

<sup>17</sup> Ottesen et al., 'How to Sell Zero Emission Vehicles'.

<sup>18</sup> Ibid.

9. A lack of available EV parking spots. Some municipalities, shopping centres and transportation authorities have designated EV parking spaces both with and without charging facilities. However, since no penalty is typically levied on ICE cars parking in designated EV parking spots, all the EV owners we interviewed complained that drivers did not respect these spots designation as exclusively for EVs and were seldom vacant for EVs to use.
10. Although farfetched, there seems to be a possible correlation between the percentage of women in national congresses and EV sales of that year. About 46 percent of Norway's parliament and 9 of 19 ministers are women for example. Contrastingly, the Kuwait parliament had only 2 women out of 50 lawmakers and 1 out of 12 ministers. Several studies demonstrate that women in leadership are more environmentally conscious than men. Therefore, this ratio may explain in some remote way why Kuwait has been slower than Norway in their EV adoption.



Table 1: Proportional Seats Held by Women in National Congress and Electrical Plug-in Vehicles Sold in 2021<sup>19</sup>

Countries	Women in Congress	New Plug-in Vehicles Sold
Norway	45%	86.2%
Iceland	48%	71.7%
Sweden	47%	43.3%
Denmark	40%	35.2%
Finland	46%	30.8%
Netherlands	39%	29.8%
Germany	35%	26%
Switzerland	43%	22.5%
Portugal	40%	20%
United Kingdom	34%	18.6%
Belgium	42%	18.4%
France	40%	18.3%
Ireland	23%	15.7%
Romania	19%	15.5%
China	25%	15%
Italy	36%	9.3%
Spain	43%	7.8%
Canada	30%	6.6%
New Zealand	49%	5.5%
United States	28%	4%
Australia	31%	2.4%
Japan	10%	1%

<sup>19</sup> Andri Ottesen et al., 'Driving Factors for Women's Switch to Electric Vehicles in Conservative Kuwait', *Journal of Women's Entrepreneurship and Education* 3/4 (2022), pp. 46–67.

Regression between 22 countries' 2021 plug-in vehicle sales figures as a percentage of new cars sold and the percentage of women's representation in congress revealed a 52% correlation (Table 1). A regression relationship does not, however, indicate causation. We cannot assert that increasing the number of women in congress will increase sales of zero-emission vehicles. However, previous research has shown that women prefer EVs because they are more environmentally conscious than males. In Iceland, another leader in EV adoption, women's purchasing decisions were influenced by environmental concerns, whereas men were motivated to purchase EVs by their rapid acceleration.<sup>20,21</sup> According to the International Transport Forum and FIA Foundation, women leaders at the public, private, and policy levels consider the social and environmental consequences of their decision-making more frequently than male leaders. This raises two questions: What would it take for Kuwaiti women to abandon their gasoline-powered vehicles for electric vehicles? How would they alter the Kuwaiti transportation system if they had more influence over zero-emission technology such as electric vehicles? This study aims to address these issues.

From the point of view of EV owners, safety was not one of the concerns or reasons for low implementation. On the contrary, EVs owners thought EVs safer than ICE cars, which is a viewpoint congruent with the 2021 American safety data that EVs are 60 times less likely to catch fire than combustion engine cars.<sup>22</sup> Similarly, charging cost was not viewed as a problem either. In Kuwait electricity is subsidised and costs roughly KWD 0.009 (or about £0.023) per kWh, making the monthly charging cost about KWD 5 or £13.<sup>23</sup> Finally, our interviewees were aware that, despite Kuwait's use of natural gas to generate electricity and that they generally drive EVs with larger batteries that consume more CO<sub>2</sub> to produce than ICE cars, their EVs are still considerably more environmentally friendly as they have about 3-fold higher efficiency in transferring energy from well-to-tank and tank/battery-to-wheels than petrol, diesel and even hydrogen-driven vehicles.<sup>24</sup>

<sup>20</sup> Andri Ottesen and Tinna Kjartansdottir, 'The Future of Electric Cars in Iceland: Market Readiness and Growth Opportunities', *Asia Pacific Journal of Advanced Business and Social Studies* 1/1 (2015).

<sup>21</sup> Andri Ottesen and Summayya Banna, 'Early Adapter National for Electric Cares: Case of Iceland', in A. Bumajdad et al. (eds), *Gulf Conference on Sustainable Built Environment* (Cham, Springer), pp. 401–17.

<sup>22</sup> 'How Many Electric Cars Are on the Road in the United States?', *USA Facts*. Available at: <https://usafacts.org/articles/how-many-electric-cars-in-united-states/> (accessed 28 January 2023).

<sup>23</sup> 'Kuwait Electricity Prices', *GlobalPetrolPrices.com*. Available at: [https://www.globalpetrolprices.com/Kuwait/electricity\\_prices](https://www.globalpetrolprices.com/Kuwait/electricity_prices) (accessed 28 January 2023).

<sup>24</sup> 'Electric Vehicle Myths', *United State Environmental Protection Agency*. Available at: <https://www.epa.gov/greenvehicles/electric-vehicle-myths#Myth1> (accessed 28 January 2023).

## The Early Adaptors and the Early Majority (Pragmatists)

Kuwait market has clearly not ‘crossed the chasm’, in that a mass market for EVs has not been developed due to the reasons for low adoption outlined earlier. Thus, EV technology in Kuwait is currently limited to early adopters. Our mission for this study was to gather information on how to establish a mass market for EVs and ascertain who would constitute the early majority that would buy EVs and under what conditions. Through mixed methods such as qualitative interviews with EV owners and EV car dealers, factor analysis using Q methodology (prioritising 30 statements with which they most agree and most disagree related to this topic) as well as surveys of 600 drivers in Kuwait aged 18–40, we concluded that the early adopters were primarily three kinds of drivers. The first group is the torque and luxury enthusiasts – mainly 60+ years old affluent males who buy full option sport versions of EVs as a third or fourth car (Porsche Taycan, Tesla S and Jaguar I-Pace and BMW i3S). The second group is 50+ years old executives and senior specialist males who buy a luxury EV as their second car (Audi e-tron, Mercedes EQS, Tesla X and Volvo XC40). The third group is overwhelmingly women of 30–40 years old who are usually junior or middle managers, married with small children and have another ICE car in their family (Mercedes EQC, Renault Twizy, Smart, Volkswagen ID.4, Chevrolet Bolt, Hyundai Ioniq 5, Mazda MX-30 and Polestar 2). This group were environmentally friendly and favoured the soundless engine and lack of maintenance. Tesla drivers of model Y and model 3 were primarily male, as women generally did not risk buying a car that did not have a dealership in Kuwait.

We concluded that one of these groups was likely to become the early majority/pragmatist component, given that certain conditions were met such as installations of fast charging stations and battery warranties that last the lifetime of the car. To determine which group would prevail and become the early majority, we analysed the current demographic shifts in Kuwaiti society in the 2020s. In doing so, we could not help noticing three main parallels to the US in the 1960s and 1970s. The first demographic shift is the declining birth rate to just two children per woman. The second shift is the increase in the number of women graduating from university – now approximately two-thirds of university graduates are women, meaning the situation during 1960–1980 in the US is comparable to 2000–2023 in Kuwait.<sup>25</sup> The third demographic shift is an increasing number of women in the workplace as well as delayed childbirth and marriages where women rely on their own incomes. Capitalising on similar conditions, Japanese car manufacturers managed to penetrate the US market with their promise of environmentally friendly and low maintenance cars with advanced safety features and sleek car interiors specially catered to the taste of women. Based on our findings, we believe that EV manufacturers in China will use the same playbook to penetrate the Middle East market.

<sup>25</sup> Andri Ottesen et al., ‘Learning from the Future of Kuwait: Scenarios as a Learning Tool to Build Consensus to Action Needed to Realize Vision 2035’, *Sustainability* 15/9 (2023).

## Empirical Investigation

Our prediction that educated women under 40 would be early majority buyers of EVs in Kuwait is based on sales figures of vehicles deemed appealing to early adopters, and on how Japanese car manufacturers similarly penetrated the US market in the 1970s via targeting a comparable demographic. Our prediction was furthermore validated as it cohered with research EV specialist Mohammed Navfal conducted for the Kuwaiti Auto Dealer which yielded similar results.<sup>26</sup> Given these predictions, we asked 234 women of ages 18–40, all of whom had some level of university education and who we believed represented the early majority/pragmatists, what they wanted in an EV.<sup>27</sup> The first section of the questionnaire contained 11 questions regarding the respondents' demographics, including their gender, age, education, household income, employment, nationality and number of vehicles owned by their households. The second section contained 18 Likert-scaled perspectives/statements on electric vehicles (spanning from 0 -strongly disagree to 3 -strongly agree).<sup>28</sup> The statements were collected from interviews and literature evaluations conducted in the past two years. Over a third of the participants were between the ages of 18 and 25. More than half of the respondents were single, unmarried women, while less than 20 percent were married with three or more children. Nearly two-thirds of the participants were Kuwaitis, while the other third were Middle Eastern Arabs. At least 58% of respondents hold a Bachelor's degree and 35% own two vehicles while 27.4% own five or more. More than a third of participants (36.3%) were employed in the public sector, while about a third (30.8%) worked in the private sector. More than 60.3% of participants have monthly incomes of less than KWD 1,000 or £2500.

The survey participants, when asked about the most desired EV feature, strongly agreed on only one feature – eco-friendliness, which improves air quality (M=2.39). Other features garnered moderate agreement, including significantly reduced electric charging costs compared to petroleum costs for the same mileage (M=2.28). Other features that received moderate agreement include improved fire safety records and increased safety during collision tests (M=2.27). The soundless engine (M=2.26), quicker and more potent air conditioning (M=2.26), much faster acceleration (from 0–100 km) (M=2.15) and significantly reduced maintenance and associated costs (M=2.07) also received moderate agreement from the participants.

<sup>26</sup> Authors interview with Mohammed Naval, research EV specialist.

<sup>27</sup> Andri Ottesen, Sumayya Banna and Basil Alzougool, 'Women Will Drive the Demand for EVs in the Middle East over the Next 10 Years—Lessons from Today's Kuwait and 1960s USA', *Energies*, 16/0 (2023).

<sup>28</sup> Jacob Cohen, *Statistical Power Analysis for the Behavioural Sciences* (Cambridge, MA: Academic Press, 2013), pp. 56–70

Regarding the perceived conditions or requirements to purchase an EV, participants strongly agreed on three requirements: a fast-charging station within 5 km radius anywhere in Kuwait, similar to petrol stations ( $M=2.37$ ), a discernible change in air quality as a result of people driving electric cars ( $M=2.35$ ) and a battery warranty of at least ten years or 150,000 km ( $M=2.34$ ). Other requirements had medium agreement, including if the range (how far they can drive) per full charge was at least 400 km ( $M=2.30$ ), if they had a cool and unique design ( $M=2.30$ ), if the reselling value was equal to or greater than a gasoline car ( $M=2.30$ ), if there was a special electric car lane on major highways ( $M=2.27$ ) and if the price was the same or less than an equivalent gasoline car ( $M=2.24$ ).

## Discussion

This study examines the EV choices, preferences and attitudes of women drivers in Kuwait in relation to their demographic characteristics. We discovered that women who drive conventional vehicles prefer EVs due to their pro-environmental societal attributes such as lower CO<sub>2</sub> emissions that result in improved air quality. This result is consistent with previous analyses of work performed in the European Union, and Spain in particular.<sup>29</sup> Curiously, none of the seven background variables – age, education, household income, occupation, nationality and number of vehicles possessed by respondents' households – are substantially associated with desired attributes for EVs. This indicates that women drivers in Kuwait, regardless of their demographic background, favour EVs for their environmental benefits and suggests that, in the future, they will choose EVs solely based on environmental considerations. In addition, we found that women are highly likely to purchase EVs in the future given improvement in infrastructure (charging facilities, parking and use of fast lanes), environmental (improved air quality and less sound from cars), financial and economic factors (cost of purchase and ownership) as well as specific circumstances associated with each factor. These specific circumstances include establishment of a fast-recharging station within five kilometres of any major road in Kuwait and the guaranties and warranties of the battery to last at least ten years or 150,000 km or, more preferably, to last 12 years, which is considered the lifetime of the vehicle.<sup>30</sup> If these requirements are fulfilled we believe that it will pave the way for the mass market adoption of EV and moves towards e-mobility to start decreasing the country's CO<sub>2</sub> footprint and GHG emissions. Thus, we put forward here five recommendations for the Kuwaiti authorities to implement.

<sup>29</sup> Ruben Cordera et al., 'Demand for Environmentally Friendly Vehicles: A Review and New Evidence', *International Journal of Sustainable Transportation* 13/3 (2019), pp. 210–23.

<sup>30</sup> Boqiang Lin and Wei Wu, 'Why People Want to Buy Electric Vehicle: An Empirical Study in First-Tier Cities of China', *Energy Policy* 112 (2018), pp. 233–41.



## Recommendations

### Install 150 fast charging stations, one at every petrol station

We found that charging issues were the greatest barrier for the early majority/pragmatist to acquire EVs, specifically public charging stations. The EV service provider ChargedKw reports 38 AC public charging stations in Kuwait, all in urban areas. Shopping centres generally have these charging stations. The AC charging stations (80 kW) can charge an EV battery from five percent charge to 80% charge in about five hours. In comparison, a 300–400 kW DC charger takes 20 minutes to charge most modern EVs. As of May 2023, there is only one small DC to DC (25 kW) demonstration unit installed. Co-Founder and CTO of ChargedKw, Oliver von der Brueggen, says Kuwait needs one EV charging station at each of its 150 gas stations to create a working EV charging grid. Without municipal or transportation authority revision, such an order is improbable. Establishing such stations would take two years due to backlogs in orders, not including the time to administrate the bidding process. Installing charging stations and cooling units at each of the 150 stations would cost KWD 15,000 (£40,000) or KWD 2.3 million (£6 million) and could take up to a year. If the decision is taken early in 2023, the network might be complete by the year 2026 and local government and traffic authorities could plan electrical current delivery in the meantime. Van Den Brueggen believes that every two years another such order would have to be made and ramp up to four charging facilities per station over the following 15 years to meet the projected demand for EVs.

### Prohibit Kuwaiti landlords from banning home-charging amplifiers

During our interviews with EV owners, we discovered that landlords were completely unwilling to rent to EV owners if they wanted to install an EV amplifier charging box, which allows five-hour charging instead of 48 hours if the EV is plugged into a 220v socket. As only Kuwaitis can own real estate and rent it to expatriates, who make up 75 percent of the population, this absolute unwillingness prevents foreigners from owning EVs. One of our expat interviewees stated that he visited over 20 Kuwaiti landlords who told him he could not charge his Tesla X at their apartment complex or private house. Two other interviewees conveyed similar stories. The government should educate landlords that wall box/380v amplifier EV charger is no more hazardous or inconvenient than installing a washing machine. The local government should also prohibit landlords from banning renters from installing charging boxes. Furthermore, since residential electricity is subsidised by the government, monthly vehicle payments never exceed 10 KWD (£26) and this could be simply considered as an added cost to the rent.<sup>31,32</sup>

<sup>31</sup> Ottesen et al., 'How to Sell Zero Emission Vehicles'.

<sup>32</sup> Ottesen, et al., 'How to Cross the Chasm'.

## Enforce designated EV parking

Virtually all of the EV-owners interviewed had experienced an ICE car parked in a designated EV parking spot or charging facility at a shopping centre. As no fines are levied for ICE cars parked in EV spots, this will inevitably happen. Solutions proposed from the EV owners was to install small cameras at every charging station that would sense if an ICE car was parked in an EV spot and send that picture to the police who would issue a parking ticket equivalent to blocking traffic. Another complaint EV owners have about these charging facilities was that drivers who charge their EVs would leave them much longer than needed, effectively blocking other EV drivers from being able to charge their vehicles. For the EV owners who overstay and effectively block other EV owners from charging, they should be connected by an app to tell them to move their vehicle when the charging is done or face similar fines to after an appropriate grace period.

## Give 12 years to lifetime EV battery warranties

The average lifetime of an ICE car is about 13 years.<sup>33</sup> US federal regulation mandates that EV batteries should have at least years or 100,000 km driven, which is five years less than the average lifetime of an ICE car or about 40 percent less lifetime assuming that the battery will only last the warranty period and it would be too expensive to exchange the battery after 8 years in comparison with the value of the car at that time.<sup>34,35</sup> Everyday EVs driving in extreme heat condition (about 50°C) is a relatively recent phenomenon. Thus, data that extend further than 8 years is not available. Extensive research has been conducted about energy intensity and range in a variety of temperatures with and without use of air conditions.<sup>36</sup> According to EV user manuals, drivers should expect up to 15 percent degradation and range reduction at the end of the warranty period, usually after 8 years. If the degradation has been more than 70–75 percent, the terms of the warranty will usually kick in and the battery will be repaired (cells replaced) or replaced as a whole. The Genesis, Hyundai and Kia cover their batteries for ten years while Mercedes gives the best warranty with ten years or 155,000 km driven.<sup>37</sup> In Kuwait, Chinese ICE dealerships have overcome some credibility problems of their vehicles by offering up to 10 year overall warranties vs 5 years for most Japanese, US and European models. We feel that same must apply to all EV batteries and would expect to see up to 12 year warranty against battery degradation beyond 70 percent of the original value to appease the mass market early majority.

<sup>33</sup> Wojciech Rabię et al., 'How Long Will Combustion Vehicles Be Used? Polish Transport Sector on the Pathway to Climate Neutrality', *Energies* 14/23 (2021).

<sup>34</sup> 'EV Battery Warranties and Exclusions', *GreenCars*. Available at: <https://www.greencars.com/greencars-101/ev-battery-warranties-and-exclusions> (accessed 14 February 2023).

<sup>35</sup> Hidab Hamwi et al., 'A Pilot Study of Electric Vehicle Performance, Efficiency, and Limitation in Kuwait's Harsh Weather and Environment', *Energies* 15/20 (2022).

<sup>36</sup> Hidab Hamwi et al., 'Effect of High Ambient Temperature on Electric Vehicle Efficiency and Range: Case Study of Kuwait', *Energies* 15/9 (2022).

<sup>37</sup> 'By the Numbers: Comparing Electric Car Warranties', *Forbes*. Available at: <https://www.forbes.com/sites/jimgorzalany/2022/10/31/by-the-numbers-comparing-electric-car-warranties/?sh=4c832c553fd7> (accessed 14 February 2023).

## Introduce additional incentives to elevate EV adoption rate in Kuwait

Most countries give tax concessions for EVs due to their environmental impact. Such concessions are generally the omission of import taxes and value added taxes (VAT) or sales taxes. No such concession is in place as of mid-2023 in Kuwait. The country levies a five percent general import tax that applies to all cars including EVs.<sup>38</sup> There are no sales taxes or VAT levied yet in Kuwait. However, as the unfunded budget deficit continues to increase faster than the increase of oil prices, taxation such as VAT appears very likely in the near future.<sup>39</sup> How many percentage points will be levied remains to be seen. Our prediction is that Kuwait will follow suit with Saudi Arabia and raise the VAT in increments to 15%.<sup>40</sup> If the VAT is capped at 15% and Kuwait omits VAT and import tariffs for EV imports, the price of EVs will be close to that of ICEs. EV cars are now between 20–30% more expensive, reflecting the extra cost of manufacturing the EV battery. We feel that introducing tax concessions for EVs and the resulting price equilibrium between ICE and EV would greatly increase the likelihood of mainstream buyers purchasing an EV.

Norway is the country with the highest EV adoption rate. They have already replaced over 20 percent of passenger cars (up to 7 seaters) with EVs and about 80 percent of new cars sold in 2022 were EVs.<sup>41</sup> According to Norwegian transportation authorities, one of the pivotal policies and practices that helped speed up the EV transitions was allowing EV drivers to use bus and taxis fast lanes for free, especially in and out of downtown areas. This considerably shortened the morning and afternoon rush hour commutes for those who live in the suburbs of Oslo, the capital of Norway.<sup>42</sup> When Kuwait transport authorities are designing and constructing freeways in and out of downtown areas where residents drive in to work from the suburbs, they might think about similar policies as incentives the use public transport as well as zero emission vehicles such as EVs.

<sup>38</sup> 'Kuwait – Country Commercial Guide', *International Trade Administration*. Available at: <https://www.trade.gov/country-commercial-guides/kuwait-import-tariffs#:~:text=The%20GCC%20established%20a%20customs,5%25%20for%20most%20imported%20goods> (accessed 14 February 2023).

<sup>39</sup> 'Kuwait Likely to Implement VAT', *Arab Times*. Available at: <https://www.arabtimesonline.com/news/kuwait-likely-to-implement-vat/> (accessed 14 February 2023).

<sup>40</sup> 'Saudi Arabia: Corporate Taxes and Other Taxes', PWC. Available at: <https://taxsummaries.pwc.com/saudi-arabia/corporate/other-taxes> (accessed 14 February 2023).

<sup>41</sup> '79% of Cars Bought in Norway in 2022 are Electric. But the Trend May Change', *Mezha*. Available at: <https://mezha.media/en/2023/01/05/79-of-cars-bought-in-norway-in-2022-are-electric-but-the-trend-may-change/#:~:text=According%20to%20the%20Norwegian%20Road,%2C%20diesel%20cars%20%E2%80%93%202.9%25> (accessed 15 February 2023).

<sup>42</sup> 'How Norway's EVs Have Cut Emission Globally', *DNV*. Available at: <https://www.dnv.com/energy-transition/how-norway-evs-have-cut-emissions-globally.html#:~:text=By%20replacing%20a%20sizeable%20number,tonne%20of%20CO2%20reduced> (accessed 20 January 2023).

## Conclusion

Per capita, Kuwait is the third largest emitter of greenhouse gases in the globe. The average air quality in Kuwait in 2022 was deemed hazardous due to the presence of 11.2 times more PM<sub>2.5</sub> particles than the World Health Organization standard, which ranked Kuwait as the seventh worst among the 130 nations measured for air quality. (The term fine particles, or particulate matter 2.5 -PM<sub>2.5</sub>, that refers to tiny particles or droplets in the air that are two- and one-half microns or less in width). It is evident that the government of Kuwait must implement programmes to reduce carbon combustion practices for the welfare of its residents and to fulfil its international obligations.

As a significant portion of Kuwait's GHG emissions and sources of air pollution stem from ground transportation, replacing ICE engine vehicles with EVs has proven to be an effective instrument for reducing GHG emissions and enhancing air quality. As one of the world's EV implementation laggards, Kuwait has recently shown little enthusiasm for this option. We narrowed down the causes of low EV adoption by comparing the implementation programmes of countries with high EV adoption, interviews with EV owners and car dealers in Kuwait and surveys of a large sample of potential EV purchasers. The lack of public rapid charging stations, landlords' reluctance to permit the installation of home charging stations, and the absence of government programmes that equalise the price of EVs and ICEs are the primary causes of low adoption. Evidence from other nations suggests that widespread adoption of electric vehicles will not occur without a strong political will from the national government and rapid and effective implementation procedures, which will require cooperation between various governmental bodies, as well as municipal involvement and public-private partnership.

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