Republic of Kenya

MINISTRY OF TRANSPORT, INFRASTRUCTURE, HOUSING, URBAN DEVELOPMENT AND PUBLIC WORKS

STATE DEPARTMENT FOR TRANSPORT

Electric Mobility Study

Electric Vehicles registration in Kenya

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List of Acronyms

BEV	Battery electric vehicle
EPA	Environmental Protection Agency
EV	Electric vehicle
FCEV	Fuel Cell Electric Vehicle
GHG	Greenhouse gases
GVW	Gross vehicle weight
HEV	Hybrid Electric Vehicle
ICE	Internal combustion engine
ICCT	International Council on Clean Transportation
KEBS	Kenya Bureau of Standards
KRA	Kenya Revenue Authority
kW	Kilowatts
$MTCO_2e$	Million tonnes of Carbon Dioxide Equivalent
NCCAP	National Climate Change Action Plan
NDC	Nationally Determined Contribution
NTSA	National Transport Safety Authority
PHEV	Plugin hybrid vehicle
SDoT	State Department of Transport
TraCS	Advancing Transport Climate Strategies project

1. Introduction

Electric mobility has been prioritised as a mitigation action that offers immense health and sustainability benefits for the sector and the country at large. SDoT is working on advancing electric mobility in Kenya with support from GIZ and other development partners.

Following consultative meetings on electric mobility hosted by the State Department for Transport, several issues have been identified that need to be addressed to enhance uptake of electric mobility in the country. Key among them include:

a) Update the vehicle registration system to include electric vehicles

b) Assess how electric vehicles are affected by the current CRSP

c) Development of a user guide for the electric vehicle standards

Part of these issues were addressed by a consultancy study supported by GIZ through the Advancing Transport and Climate Strategies (TraCS) Project. This report is a result of this study and is aimed at clarifying the electric vehicle classification system in Kenya and making recommendations on how the process can be improved. The other two components are addressed in two separate reports that were developed within the same study.

1.1 Background

Kenya aims to reduce its greenhouse gas (GHG) emissions by 32% by the year 2030 compared to the business as usual (BAU) scenario. In 2016, the country enacted the Climate Change Act which mandated every state agency to set up a Climate Change Coordination Unit. The role of the unit is to coordinate mainstreaming of all climate change duties in the sector/agency and the Advancing Transport and Climate Strategies (TraCS) project has made significant strides in institutionalizing the Climate Change Coordination Unit at the SDoT.

The Kenyan transport sector accounts for about 12% of Kenya's total GHG emissions, which amounts to 11.25 Million tonnes of Carbon Dioxide Equivalent ($MtCO_2e$) as at 2015 (according to the Transport Sector Climate Change Annual Report, 2018/2019). The emissions are increasing at a faster rate than in other sectors. The sector's emissions reduction target, according to the first Nationally Determined Contribution (NDC)Target, aims to reduce 3.46 $MtCO_2e$ against the Business as Usual (BAU) by adopting a sustainable and low carbon mobility pathway. From an analysis done by TraCS, an increased uptake of electric mobility

has the second highest mitigation potential, contributing to a reduction of about 0.6 MtCO2e against the BAU scenario. This is largely due to a relatively low grid emission factor in the country's electric grid.

Electric mobility is therefore a key area of action to contribute to Kenya's NDC and as a result has been highlighted as a key action in the National Climate Change Action Plan (NCCAP) 2018-2022. To progress this, TraCS has convened various stakeholder consultations involving public and private sector experts, with the objective of identifying barriers that hinder the uptake of electric mobility in Kenya. This report is a result of these efforts and aims at clarifying the electric vehicle classification and registration process in Kenya, as well as what could be done to improve the process' efficiency.

Classification and registration of vehicles are important requirements for transport data collection. Clarity of information on the types of vehicles registered in the country is relevant for transport planning, intelligent transportation systems and in facilitating policy formulation, e.g. to foster uptake of one vehicle type and reduce use of another. This report will look into classification of electric vehicles and the registration process of vehicles in Kenya.

This study was commissioned by the State Department for Transport and conducted by Strathmore University and Knights Energy. It was supported by funding from the TraCS project, a project implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and funded through the International Climate Initiative (IKI) of the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU).

2. General Electric Vehicle Classification

Electric vehicles are classified based on the hybridization rate[1] which represents the degree of electricity used by the vehicle. The hybridization rate describes how much the powertrain of the vehicle has a mix of technologies and is determined by the role played by the electric motor in the vehicle performance.

The rate ranges from 0 to 1 where 0 is an internal combustion engine (ICE) and 1 is a battery electric-powered vehicle. Between 0 and 1, the hybridization ratio ranges from micro-hybrid, mild/semi hybrid, full hybrid, plugin hybrid and full battery electric vehicles. The hybridization rate also determines the tailpipe emissions caused by the powertrain of the vehicle.

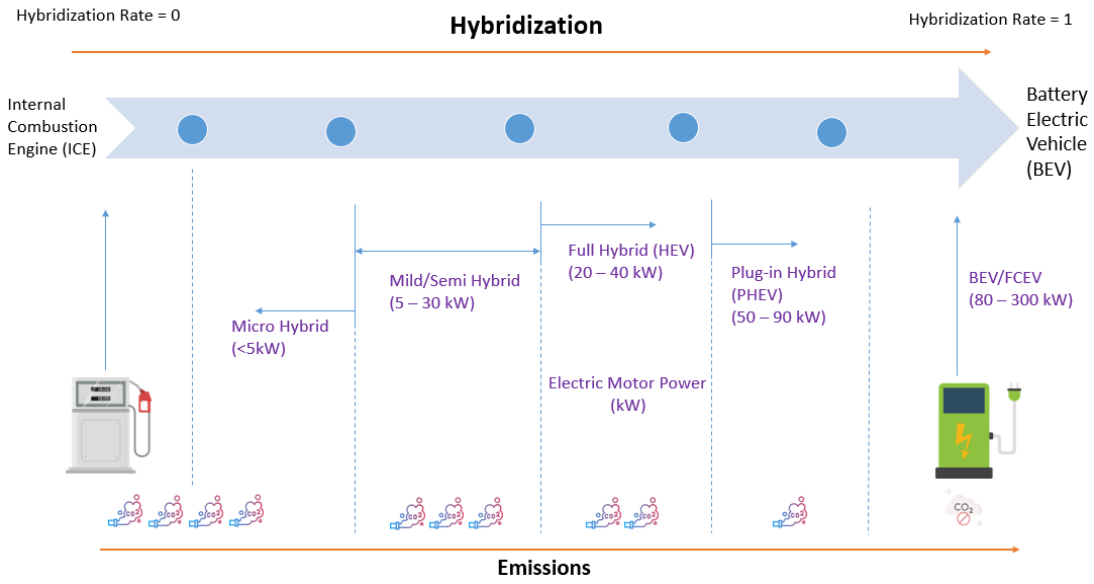


Figure 1: A demonstration of hybridization rate and vehicle classes
Source: Knights Energy, 2020

3.1 Hybrid Electric Vehicle

Hybrid electric vehicles (HEV) are powered by an ICE paired with an electric motor where the electric motor propels the vehicle using energy stored in batteries. The battery is charged by drawing energy from the engine using the electric motor as an electric generator. The following are types of hybrid electric vehicles:

[1] Rate of hybridization is defined as the ratio of power developed by an electric motor in a hybrid vehicle to the total power consumed by the vehicle.

- Parallel hybrid: Both the engine and the motor power the wheels at the same time
- Series hybrid: The ICE is used to drive a generator that provides electrical power for the traction motor and to charge the battery
  - The traction motor is the only power supply unit with a direct connection to the wheels
- Series-parallel or dual-mode hybrid: Operates either in series or parallel mode using a power-split
  - It has a generator to charge the battery as seen in a series hybrid
  - It has an engine and motor simultaneously powering the wheels as seen in a parallel hybrid.

3.2 Plug-in Hybrid Electric Vehicle

Plug-in hybrid electric vehicles (PHEV) are similar to HEV since they have both an engine and motor for propulsion. The main difference is that PHEV batteries have a higher energy capacity and can be externally charged by connecting to a power outlet. In addition, the battery can be charged using the internal combustion engine while driving. This enables the PHEV to use the electric motor for longer periods when driving. A PHEV can drive on electric mode for most of the city commutes and the ICE engine steps in on depletion of battery hence eliminating range anxiety. An example of a PHEV is the Mitsubishi Outlander PHEV[2] which has an electric driving range of 45 kms.

3.3 Battery Electric Vehicle

Battery electric vehicles (BEV) have only an electric motor and no internal combustion engine. The vehicle uses a large traction battery pack to power the electric motor and the battery must be charged from a power outlet. The driving range of BEVs starts from 95km for the **Smart EQ forfour** to 500 km for the **Tesla Model S Long Range**.[3] Other BEV concepts are promising up to 900 kms.

3.4 Fuel Cell Electric Vehicle

A fuel cell electric vehicle (FCEV) substitutes the battery of a BEV with a fuel cell to generate electricity from hydrogen fuel. The main difference between fuel cell and battery is that a fuel cell is not a storage device but a component that produces direct current from a chemical reaction. A small battery is still used as an energy buffer and to power the electric motor using the motor drive. A fuel cell vehicle has the

[2] https://www.mitsubishi-motors.co.uk/cars/outlander-phev/range
[3] https://ev-database.org/

advantage of short refuelling times and extended driving range when compared with BEV. An example of a FCEV is the Toyota Mirai[4] that has a range of 502 km.

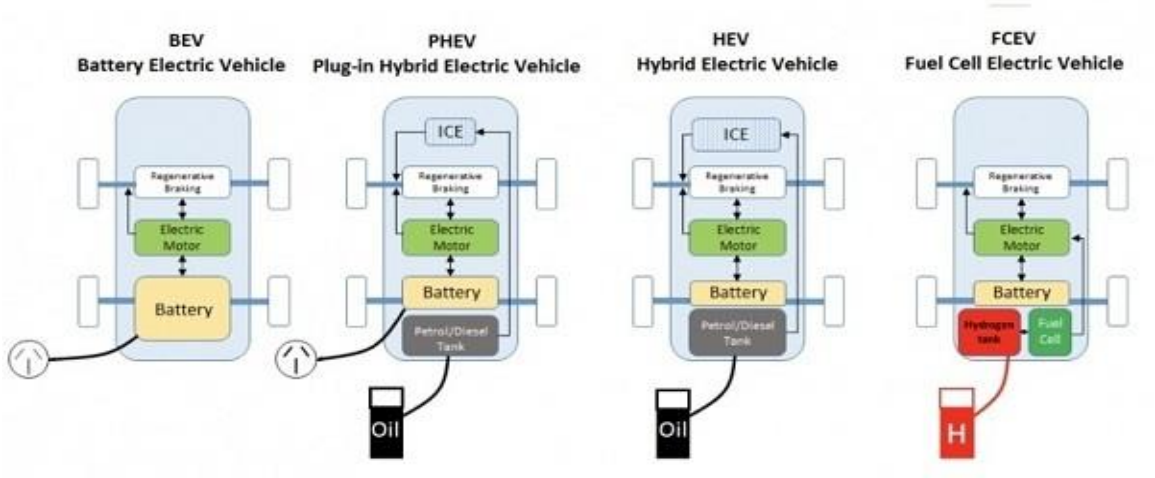


Figure 2: Types of electric vehicles
Source: PT. Omazaki, 2019

[4] https://www.toyota.com/mirai/fcv.html

3. Case Studies

Historically, governments and private organizations have developed vehicle classification schemes that are used for various purposes such as regulation, description and categorization of cars. The terms of classifying the vehicles can be found in the International Standard ISO 3833-1977 Road vehicles - Types - Terms and definitions.

The classification system is mostly based on vehicle size and weight while the actual size and names of individual classes vary from region to region. These classification systems were developed for traditional fossil fuel vehicles and most electric cars are classified according to these classes to date. Differentiation from their fossil fuel counterparts usually comes up in fuel type/source and in vehicle registration which varies from one country to another.

With the introduction of electric vehicles, other registration parameters have been introduced in vehicle registration forms to cater for the unique characteristics of electric vehicles. The study reviewed the vehicle registration process in countries that have great developments in electric vehicles. The countries whose vehicle registration systems were studied are UK, Germany, Hong Kong, Japan and China. There are two common parameters that were observed in all the registration systems of these countries – the carbon emissions from the vehicles and the fuel type of the vehicles that include the different classification of electric vehicles.

Table 1: Vehicle registration systems in other countries

Parameter / Country	Carbon Emission	Fuel Type with options for electric vehicles – PHEV, FCEV, HEV, BEV	Seating Capacity – Mopeds, Motorcycles, Cars, Buses, Trucks	Electrical Motor Power (kW)
UK	x	x	x	x
Germany	x	x	x	x
Hong Kong	x		x	x
Japan	x	x	x	x
China	x	x	x	x

4. Electric Vehicle Classification in Kenya

Classification of motor vehicles according to the Traffic Act is divided into the following classes:

- Motor omnibuses
- Heavy commercial vehicles
- Commercial vehicles
- Tractors
- Motorcars
- Motorcycles not exceeding fifty cubic centimeters engine capacity
- Motorcycles exceeding fifty cubic centimeters engine capacity
- Invalid carriages
- Special types of motor vehicles for which special authorization is required from the authority before such vehicles can be registered or used on a road. (e.g. Breakdown lorries, Crane lorries, Fire fighting vehicles e.t.c)
- Matatus.

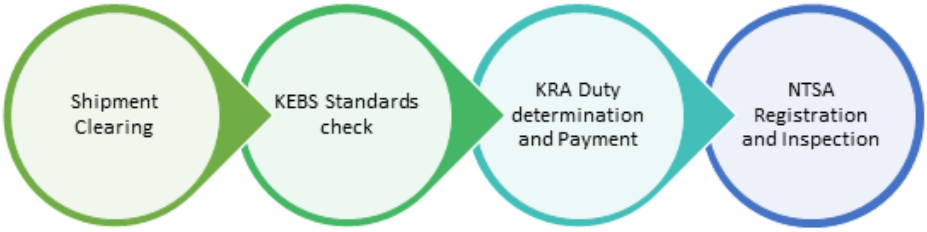
The vehicle classes guide the tariffs set on importation to calculate total importation duty or on sales tax for locally assembled vehicles. The vehicle characteristics that guide the set tariffs are:

- Vehicle function (carrying passengers, prime movers, heavy machinery, special purpose)
- Engine capacity
- Fuel type (petrol, diesel, electric)
- Gross vehicle weight

Electric vehicle classification in Kenya is done during the vehicles registration process by the National Transport and Safety Authority (NTSA). The fuel type entry in the registration database records whether a vehicle is powered by fossil fuel or electricity.

The Process of Vehicle Registration

The process of clearing an imported vehicle for use is as shown below and the outcome of this process is a vehicle registration certificate (known as a logbook):



Source: Knights Energy, 2020

The logbook captures the vehicle particulars and the registered owners. The image below shows a vehicle registration certificate/ logbook of an electric vehicle (a Nissan Leaf) owned by Knights & Apps Ltd.

The engine size entry also differentiates the internal combustion engines (ICE) from electric-powered vehicles since the engine power of internal combustion engines is recorded in CC while that of electric vehicles (as per current practice) is recorded in kilowatts (kW).

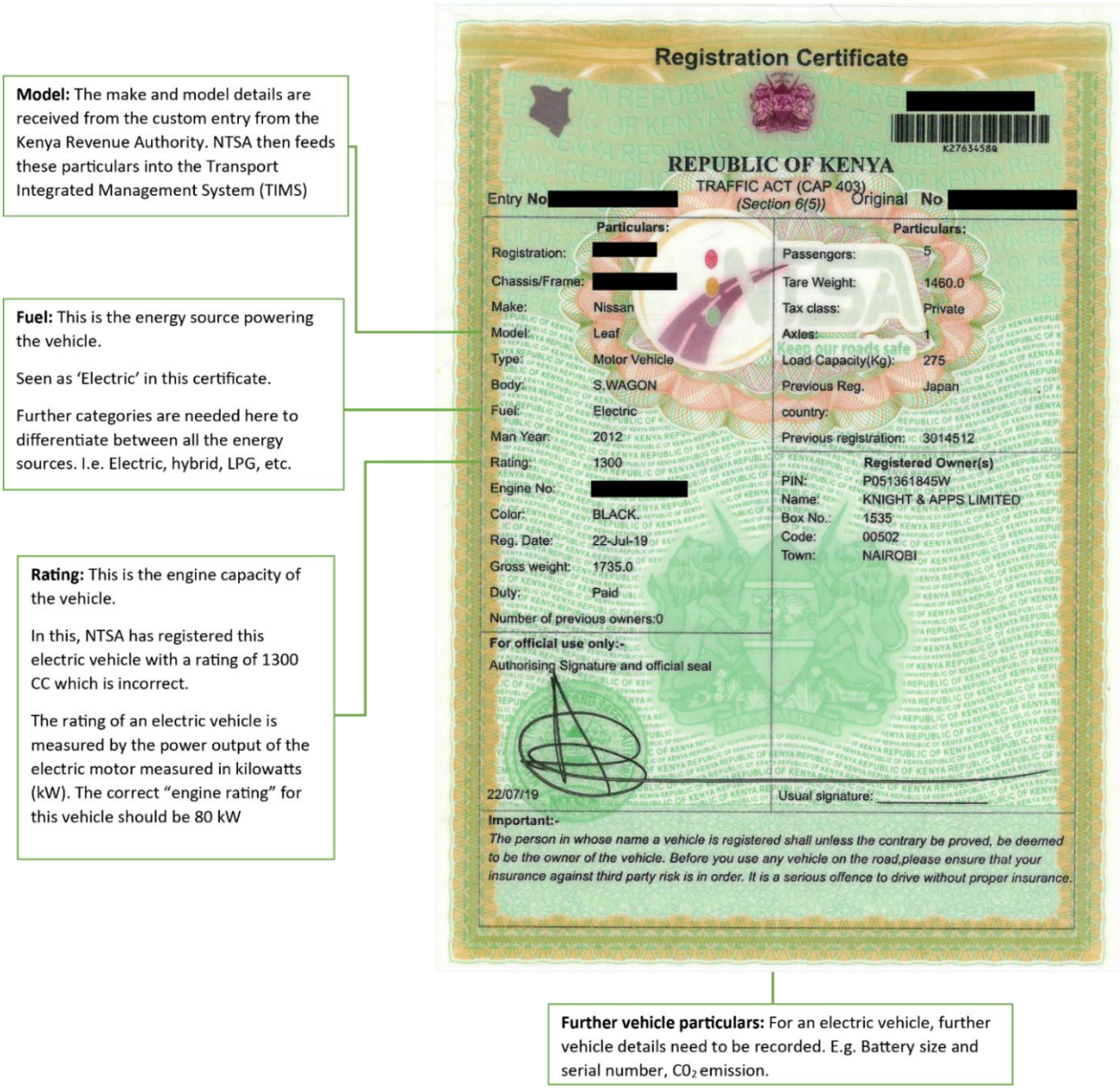


Figure 4: Registration Certificate of Kenya

4. Recommendations

NTSA should develop a registration template that captures the details of electric vehicles that is similar to registration systems in countries that have a high number of electric vehicles. The details that should be included in the registration form are:

- Electric motor power rating (in kilowatts) – This specifies the electric power capacity that the vehicle requires. It is useful to identify the amount of electric power one requires for the vehicle.
- Seating Capacity – This specifies the type of vehicle and outlines a clear classification for bicycles, mopeds, cars, trucks and buses.
- Size of battery (kWh)– This specifies the electrical energy storage capacity of the vehicle. Based on the power consumption, this parameter will tell the vehicle's range on a full charge. As well to be considered is Energy Consumption in kWh per km as an additional field. Such information would be available from manufacturers.
- Battery identifier (Serial No.) – This is useful in identifying the battery and its characteristics that are important during maintenance and replacement of the battery.
- Power source – This specifies the main source of power for the vehicle. It is useful in identifying the energy source of the vehicle.

  The power source entry can be customized to capture all types of energy sources used in the propulsion of all vehicles. Considerations for the power source entry template can be observed in figure 5.

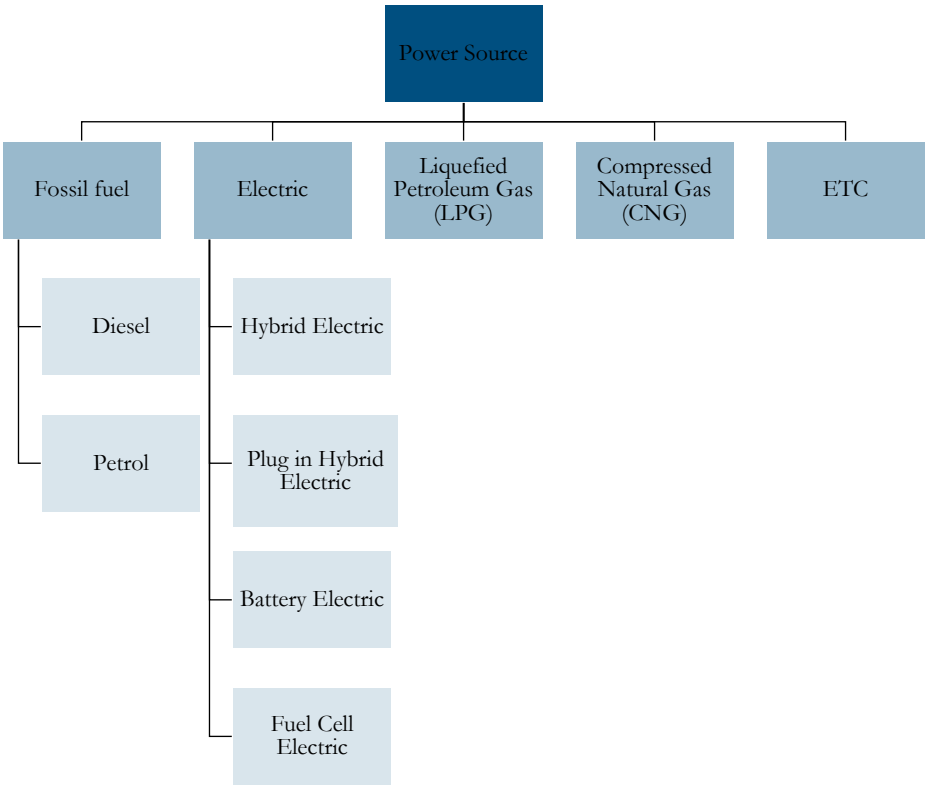


Figure 5: Power source entry categories for vehicle classifications
Source: Knights Energy, 2020

- Tailpipe emissions – This is useful in quantifying the amount of carbon emissions generated by vehicles. Tax waivers can also be applied based on the carbon emission that a vehicle produces as an incentive to promote electric vehicles and protect the environment.

The WLTP (World harmonized Light-duty vehicles Test Procedure) is recommended for use in the registration template. It is a global harmonized standard for determining emissions, pollutants and fuel consumption. It is replacing the New European Driving Cycle (NEDC) procedure and European countries including Japan are using this standard. The assumption here is all vehicles undergo emission test cycles and the results of these tests are publicly available. This can become the basis for a Fuel Economy label program, a CO2 taxation program and future fuel economy or CO2 emission standards.

A sample template that includes these parameters is proposed below (see figure 6 and 7). This registration template will help clarify the different types and technologies used in electric vehicles. The information captured can be used to quantify the different classes of electric vehicles in the country and the contribution of new vehicles to carbon emissions.

- ICEs, motorbikes and bicycles that have been retrofitted to EVs should be registered afresh using the proposed template. This will cater for electric vehicles that are being converted locally. It may also be necessary to consider adding a corresponding field in the template to show that a vehicle is retrofitted and not an original equipment.
- The government should adopt special number plates for electric vehicles to make them easily identifiable. This will enable authorities to easily identify the cars when offering use incentives such as:
  - Subsidized parking fees
  - Entry to noise level-controlled areas.

  The proposal is to have the letter 'e' after the first three letters of the number plate e.g. "KCFe XXXX" to indicate that it is an electric vehicle.
- To encourage the adoption of electric vehicles, NTSA should subsidize/exempt vehicle registration fees for electric vehicles.

The figure below shows the proposed vehicle registration template to be considered by the NTSA:

Vehicle Registration Template

Owners Information

Name		Business Name (For company car)	
Phone Number		Company Registration No.	
Email Address		Contact Person of Company (if using company as registered vehicle owner)	
ID/Passport No.		Name of Building / Estate	
P.O. Box No.		Street	
		Town	
		County	

Vehicle Information

Vehicle Registration No.		Color(s)	
Vehicle registration date		Year of Manufacture	
Vehicle Type		Number of Previous owners	
Make		Seating Capacity (excluding driver)	
Model		CO 2 in g/km combined value	
Body Type		Traction battery size in kWh (For Electric vehicles)	
Country of Origin		Volume of the tank for tank vehicles in m^3	
Engine No.		Permitted Gross Vehicle Weight:	
Chassis No.		Permitted Gross Combined Weight:	
Battery Serial No. (For Electric Vehicles)		Number of axles	
Cylinder Capacity (c.c)		Number of drive axles	
Rated electric motor power (k.w) (For Electric Vehicles)		Odometer Reading	

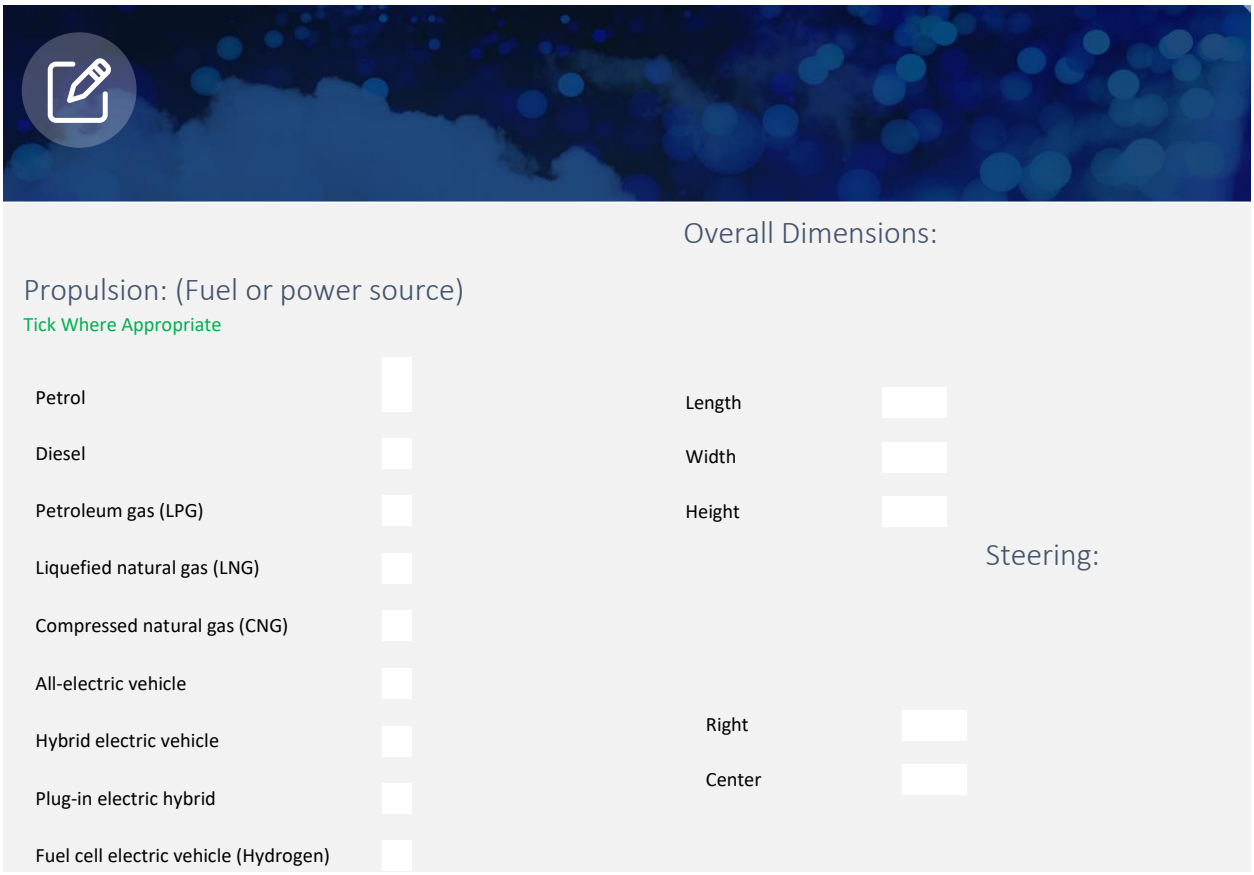


Figure 6 Sample vehicle registration template

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