**NAMA Monitoring plan – National Fuel Efficiency Initiative**

1. **NAMA Summary**

**Sector:** Transport

**Objective of NAMA:** The purpose of this Nationally Appropriate Mitigation Action (NAMA) is to reduce greenhouse gas (GHG) emissions and promote sustainable development in the transport sector through the National Fuel Efficiency Initiative. The NAMA includes the design and implementation of policies and measures that will promote the use of more efficient Light Duty Vehicles (LDVs, group of vehicles with a gross weight of less than 3500 kg), the vehicle type whose fleet is demonstrating most growth. The NAMA will help to address the goal of the government of Uganda meeting the energy needs of Uganda’s population for social and economic development in an environmentally sustainable manner.

**Type of NAMA:** TheNAMA seeks support for implementation while recognising that transport policies are subject to continuous evaluation and improvement. In addition to the implementation and monitoring effort, research will continue to support improvements in the design of the NAMA, as part of an ongoing effort to optimise its climate and sustainable development impact. This monitoring plan describes an important part of the data collection in support of that effort.

**Type of support:** Financial support, technical support

**Suggested NAMA proponent:** Ministry of Energy and Mineral Development

**Geographic scope:** Uganda

**2. GHG Monitoring plan**

**Methodology:** The GHG monitoring approach will start at activity level, which allows the Ministry of Energy and Mineral Development to monitor the impact of its individual policies. The two first measures implemented as part of the NAMA are:

1. Development of a fuel efficiency policy and standards, applying a benchmark efficiency for light, medium and heavy duty LDVs being imported into the country.
2. Design of a vehicle inspection and maintenance system, including a certification programme, standards for inspections and establishment of vehicle inspection centres. For this measure, USD 12.5 mln private investment has been attracted to set up 27 testing stations in Uganda. The testing programme will start in March 2016 and aims to have all LDVs in the country tested by September 2016. As part of the testing programme, all LDVs will undergo an emissions test and be registered in the national vehicle registry as maintained by the Ugandan Revenue Authority. LDVs which do not meet minimum emission standards will have to be scrapped.

By 2016 the vehicle inspection programme will collect data on all LDVs. That data will be used to monitor the emission of the LDV fleet in Uganda. Until the vehicle inspection programme is in place, the impact of the fuel efficiency standards for imported LDVs will be monitored separately.

**GHG monitoring of fuel efficiency requirements for imported LDVs**

The Ministry of Energy and Mineral Development will implement minimum requirements on the fuel efficiency of imported LDVs. The GHG emission reductions of this measure stem from increasing the efficiency of LDVs in Uganda.

The emission reductions are the result of the reduction in average CO2 emission factor of the imported fleet of LDVs, compared to the historic CO2 emission factor of the imported fleet. This figure gives the total emission reductions when combined with the average distance travelled per car in the year in which the NAMA is operational (equation 1).

$ER\_{imp,y}=\left(CEF\_{imp,bas,y}-CEF\_{imp,y}\right)×tkm\_{y},$ (1)

|  |  |
| --- | --- |
| Abbreviation | Parameter description |
| *E­Rimp,y* | Emission reductions of the measure: Fuel efficiency requirements for imported LDVs in year y (gCO2/year) |
| *CEFimp,bas,y* | Baseline CO2 emission factor for year y (gCO2/km) |
| *CEFimp,y* | Average CO2 emission factor of the LDV fleet imported in year y (gCO2/km) |
| *tkmy* | Average annual distance travelled by LHVs in Uganda in year y (km/year) |

The average CO2 emission factor of the imported fleet of LDVs can be calculated with equation 2.

$CEF\_{imp,y}=\sum\_{x}^{}SEC\_{x,i}×EF\_{CO2,x}×\left(\frac{N\_{i,x}}{N\_{i}}\right),$ (2)

|  |  |
| --- | --- |
| Abbreviation | Parameter description |
| *SECx,i*  | Specific energy consumption of fuel type x in LDV category i (litre/km)  |
| *EFCO2,x* | CO2 emission factor for fuel type x (gCO2/litre) |
| *Ni* | Total number of LDVs in category i |
| *Nx,i* | Number of LDVs using fuel type x in LDV category i |

The baseline carbon emission factor will be the calculated as the average over the years 2011 to 2013 (equation 3). The baseline will be dynamic. The average efficiency of imported vehicles in the baseline years 2011 to 2013, will be corrected for trends observed in vehicle efficiency in the baseline study conducted by Makerere University College of Business and Management Sciences for the years 2005-2013.[[1]](#footnote-1) The results of the study showed a decline in annual average efficiency. Without the NAMA, that decline is likely to continue.

$CEF\_{imp,bas,y}=av(CEF\_{imp,2011},CEF\_{imp,2012},CEF\_{imp,2013})×\left(1+F\_{tr}\right)^{\left(y-2013\right)}$ (3)

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| --- | --- |
| Abbreviation | Parameter description |
| *CEFimp,bas,y* | Baseline CO2 emission factor for the year y (gCO2/km) |
| *CEFimp,2011* | Average CO2 emission factor of the LDV fleet imported in 2011 (gCO2/km) |
| *CEFimp,2012* | Average CO2 emission factor of the LDV fleet imported in 2012 (gCO2/km) |
| *CEFimp,2013* | Average CO2 emission factor of the LDV fleet imported in 2013 (gCO2/km) |
| *Ftr* | Factor describing the trend observed in the average efficiency of imported LDVs (%/year) |

Per imported LDV, the annual emission reductions start counting at the moment of sale, till the end of the technical lifetime of the LDV (equation 4). The moment of sale of the imported LDV is recorded in the national vehicle registry.

$t\_{ER,a}=t\_{tl,a}-t\_{age,a}-t\_{sale,a}$ (4)

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| --- | --- |
| Abbreviation | Parameter description |
| *tER,a* | Total number of years in which emission reductions can be claimed for a specific imported individual LDV a from the date of import (years) |
| *ttl,a* | Manufacturer technical lifetime of individual LDV a (years) |
| *tsale,a* | Average time from import to sale of individual LDV a (years) |
| *Tage,a* | The age of the individual LDV a (years) |

The baseline efficiency of the imported fleet of LDVs is determined based on a standardised vehicle test cycle or, if such data is not available the stated efficiency as provided by the manufacturer and corrected for the age of the LDV (equation 5). This analysis has been conducted already by Makerere University College of Business and Management Sciences.[[2]](#footnote-2)

$SEC\_{i,x}=SEC\_{man,i,x}×\left(1+F\_{eff}\right)^{t\_{av,i}}$ (5)

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| --- | --- |
| Abbreviation | Parameter description |
| *SECi,x* | Specific energy consumption of fuel type x in LDV category i (l/km) |
| *SECman,i,x* | Specific energy consumption of fuel type x in LDV category i when the car was new (l/km) |
| *Feff* | Factor describing the annual decrease of LDV efficiency as a result of aging (%/year) |
| *tav,i* | The average age of the LDVs imported of type i (years) |

**GHG monitoring based on data recorded by the vehicle testing facilities**

The LDV testing facilities are expected to have tested all LDVs in Uganda by the end of 2016. In the process, the testing stations will collect data on the CO2 emission factor, age and type of each LDV and improve the national database of the LDV fleet in Uganda.

At the first round of inspections the no policies and measures as part of the NAMA are new or under development. If the NAMA already has had its impact on the average efficiency of the LDV fleet in Uganda, this impact will be small. As a result, the first round of inspections of all LDVs between March and September 2016 can define the baseline, or rather the efficiency of the LDV fleet before the NAMA starts having its impact.

Future improvements in the CO2 emission factor of the LDV fleet can be attributed to the NAMA. This includes the impact which the minimum requirements on the fuel efficiency of imported LDVs will have on the efficiency of the LDV fleet in Uganda. Although the two monitoring approaches can exist in parallel, the results can not be aggregated to avoid double counting.

Information on the annual distance travelled per LDV per year can be obtained by recording the mileage of each LDV. By noting the difference in mileage between two inspections and the number of days between inspections, the average annual distance covered can be recorded.

This approach will be based on data at the level of individual vehicle owners, as shown in equation 6. This approach quantifies emission reductions based on the improvement of LDV efficiency, and a reduction in the distance travelled per LDV per year.

$ER\_{y}=\sum\_{a}^{}\left(\left(CEF\_{test1,a}-CEF\_{test,a,y}\right)×tkm\_{y,a}\right)$ (6)

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| --- | --- |
| Abbreviation | Parameter description |
| *ERy* | Emission reductions in year y as a result of car efficiency improvements in year y (gCO2/year) |
| *CEFtest1,a* | CO2 emission factor of the LDV owned by a at its first testing in 2016 (gCO2/km) |
| *CEFtest,a,y* | CO2 emission factor of the LDV owned by a at its test in year y (gCO2/km) |
| *tkmy,a* | Distance travelled by LDV owner a in year y (km/year) |

All this information combined allows for estimating the total emissions from LDVs in Uganda. It also allows the Ministry to monitor the average CO2 emission factor of LDVs in Uganda, the size of the LDV fleet and the average distance covered annually per LDV. These indicators can be used to monitor the performance of different NAMAs targeting the transport sector, including those that aim at modal shift.

**Parameters**

This section lists the main parameters on which data will be collected for the monitoring of the GHG impact of the NAMA.

**GHG monitoring of fuel efficiency requirements for imported LDVs**

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| --- | --- |
| Data / Parameter | *E­Rimp,y* |
| Unit | gCO2/year |
| Description | Emission reductions of the measure: Fuel efficiency requirements for imported LDVs in year y  |
| Source of data | Calculated |
| Measurement frequency | Annually |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | The calculations will be performed annually by the Ministry of Energy and Mineral Development. |

|  |  |
| --- | --- |
| Data / Parameter | *CEFimp,bas,y* |
| Unit | gCO2/km |
| Description | Baseline CO2 emission factor  |
| Source of data | Calculated |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | The data for the years 2011-2013 will be used to calculate the baseline average efficiency of the imported LDV fleet. These are the last three years covered in the analysis by Makerere University and before any policies and measures under the NAMA were implemented.The baseline efficiency of imported LDVs has been determined by the research undertaken by Makerere University,[[3]](#footnote-3) funded by the United Nations Environment Programme (UNEP). Makerere University collected data on the type and age of LDVs imported between 2005 and 2013.  |

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| --- | --- |
| Data / Parameter | *CEFimp,y* |
| Unit | gCO2/km |
| Description | Average CO2 emission factor of the LDV fleet imported in year y  |
| Source of data | Calculated |
| Measurement frequency | Annually |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | The calculations will be performed annually by the Ministry of Energy and Mineral Development. |

|  |  |
| --- | --- |
| Data / Parameter | *tkmy* |
| Unit | km/year |
| Description | Average annual distance travelled by LHVs in Uganda in year y |
| Source of data | Kampala Capital City Authority (KCCA) |
| Measurement frequency | Annually |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | The Kampala Capital City Authority (KCCA) undertakes regular transport surveys. With 70-80% of the LDVs registered in Kampala, these give a good indication of the average distance travelled per year per LDV in Uganda. A question on the average distance covered per vehicle will be included in the transport surveys. The results will be annually reported to the Ministry of Energy and Mineral Development to perform the calculations. |

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| --- | --- |
| Data / Parameter | *SECx,i* |
| Unit | litre/km |
| Description | Specific energy consumption of fuel type x in LDV category i  |
| Source of data | Calculated |
| Measurement frequency | Annually |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Makerere University has collected this data for the baseline study. In future, the Ministry of Energy and Mineral Development will be responsible for updating these figures. |

|  |  |
| --- | --- |
| Data / Parameter | *EFCO2,x* |
| Unit | gCO2/litre |
| Description | CO2 emission factor for fuel type x |
| Source of data | Calculated based on IPCC default factors: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2 Energy, Chapter 1, introduction |
| Measurement frequency | *-* |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | The IPCC guidelines provide information on the carbon emission factor of different fuels per GJ. Based on information on the calorific value of specific fuels used in Uganda and data on their weight, the emissions per litre can be calculated. If national statistics on fuel density (g/litre) and/or the calorific value (GJ/gCO2) are available per fuel type x, these figures can be used. |

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| --- | --- |
| Data / Parameter | *Ni* |
| Unit | # |
| Description | Total number of LDVs in category i |
| Source of data | The Uganda vehicle registry maintained by the Uganda Revenue Authority |
| Measurement frequency | Continuous |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Makerere University has collected this data for the baseline study. In future, the Ministry of Energy and Mineral Development will be responsible for updating these figures. |

|  |  |
| --- | --- |
| Data / Parameter | *Nx,i* |
| Unit | # |
| Description | Number of LDVs in LDV category i using fuel type x |
| Source of data | The Uganda vehicle registry maintained by the Uganda Revenue Authority |
| Measurement frequency | Continuous |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Makerere University has collected this data for the baseline study. In future, the Ministry of Energy and Mineral Development will be responsible for updating these figures. |

|  |  |
| --- | --- |
| Data / Parameter | *Ftr* |
| Unit | %/year |
| Description | Factor describing the trend observed in the average efficiency of imported LDVs |
| Source of data | Calculations |
| Measurement frequency | - |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Makerere University has collected this data for the baseline study. In future, the Ministry of Energy and Mineral Development will be responsible for updating these figures. |

|  |  |
| --- | --- |
| Data / Parameter | *TER,a* |
| Unit | Years |
| Description | Total number of years in which emission reductions can be claimed for a specific imported individual LDV a |
| Source of data | Calculated |
| Measurement frequency | - |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Makerere University has collected this data for the baseline study. In future, the Ministry of Energy and Mineral Development will be responsible for updating these figures. |

|  |  |
| --- | --- |
| Data / Parameter | *ttl,a* |
| Unit | Years |
| Description | Manufacturer technical lifetime of the imported LDV a |
| Source of data | Manufacturers data. |
| Measurement frequency | - |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Makerere University has collected this data for the baseline study. In future, the Ministry of Energy and Mineral Development will be responsible for updating these figures. |

|  |  |
| --- | --- |
| Data / Parameter | *tsale,a* |
| Unit | Years |
| Description | Average time from import to sale of individual LDV a |
| Source of data | The Uganda vehicle registry maintained by the Uganda Revenue Authority |
| Measurement frequency | Continuous |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | The Uganda vehicle registry records changes in ownership and the date of import. From that the time between import and sale can be determined.The Uganda Revenue Authority will collect and aggregate the data annually and provide the database to Ministry of Energy and Mineral Development based on a pre-defined template. |

|  |  |
| --- | --- |
| Data / Parameter | *Tage,a* |
| Unit | Years |
| Description | The age of the individual LDV a |
| Source of data | Uganda Revenue Authority |
| Measurement frequency | Continuous |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Reading from the car forms or calculated based on the date of manufacturing. The Uganda Revenue Authority will collect and aggregate the data annually and provide the database to Ministry of Energy and Mineral Development based on a pre-defined template. |

|  |  |
| --- | --- |
| Data / Parameter | *SECi,x* |
| Unit | litre/km |
| Description | Specific energy consumption of fuel type x in LDV category i  |
| Source of data | Calculated |
| Measurement frequency | - |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | The Ministry of Energy and Mineral Development will use this figure to calculate the emission reductions from efficiency restrictions on imported cars. |

|  |  |
| --- | --- |
| Data / Parameter | *SECman,i,x* |
| Unit | litre/km |
| Description | Specific energy consumption of fuel type x in LDV category i when the car was new |
| Source of data | Data from standardised test cycles if available. Otherwise manufacturers data can be used. |
| Measurement frequency | - |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | Makerere University has collected this data for the baseline study. In future, the Ministry of Energy and Mineral Development will be responsible for updating these figures.  |

|  |  |
| --- | --- |
| Data / Parameter | *Feff* |
| Unit | %/year |
| Description | The annual decrease of LDV efficiency as a result of aging |
| Source of data | Rajbahak. H. L, Joshi K. M and Ale. B. B.,(2011); Report On Vehicular Exhaust Emission With Reference To Age of Vehicles, Road Conditions and Fuel Quality Aspects, Society of Mechanical Engineers Nepal (SOMEN). Page 16, Rajbahak, et al 2011), as provided by Makerere University. |
| Measurement frequency | - |
| Purpose of data | Calculating the emission reductions as a result of the import restrictions. |
| Measurement methods and Responsibilities | This figure shall be used in the calculations by the Ministry of Energy and Mineral Development and in the baseline calculations by Makerere University. |

|  |  |
| --- | --- |
| Data / Parameter | *tav,i* |
| Unit | years |
| Description | The average age of the LDVs imported of type i  |
| Source of data | Calculated |
| Measurement frequency | - |
| Purpose of data | - |
| Measurement methods and Responsibilities | The Uganda Revenue Authority will collect and aggregate the data annually and provide the database to Ministry of Energy and Mineral Development based on a pre-defined template. |

**GHG monitoring based on data recorded by the vehicle testing facilities**

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| --- | --- |
| Data / Parameter | *ERy* |
| Unit | gCO2/year |
| Description | Emission reductions in year y as a result of car efficiency improvements in year y |
| Source of data | calculated |
| Measurement frequency | - |
| Purpose of data | Calculating the annual CO2 emissions of the Ugandan LDV fleet. |
| Measurement methods and Responsibilities | The calculations will be undertaken by the Ministry of Energy and Mineral Development.  |

|  |  |
| --- | --- |
| Data / Parameter | *CEFtest1,a* |
| Unit | gCO2/km |
| Description | CO2 emission factor of the LDV owned by a at its first testing in 2016  |
| Source of data | Vehicle inspections, SGS |
| Measurement frequency | At every inspection |
| Purpose of data | Calculating the annual CO2 emissions of the Ugandan LDV fleet. |
| Measurement methods and Responsibilities | Metering of the emission factor during the emissions test at the car inspection. The approach of the emissions test should aim to reflect normal usage of the car.The Ministry of Works and Transport will collect the data from SGS and provide the database of information to the Ministry of Energy and Mineral Development on an annual basis, based on a pre-defined template. |

|  |  |
| --- | --- |
| Data / Parameter | *CEFtest,a,y* |
| Unit | gCO2/km |
| Description | CO2 emission factor of the LDV owned by a at its test in year y  |
| Source of data | Vehicle inspections, SGS |
| Measurement frequency | At every inspection |
| Purpose of data | Calculating the annual CO2 emissions of the Ugandan LDV fleet. |
| Measurement methods and Responsibilities | Metering of the emission factor during the emissions test at the car inspection. The approach of the emissions test should aim to reflect normal usage of the car.The Ministry of Works and Transport will collect the data from SGS and provide the full database of information to the Ministry of Energy and Mineral Development on an annual basis, based on a pre-defined template |

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| --- | --- |
| Data / Parameter | *tkmy,a* |
| Unit | km/year |
| Description | Distance travelled by LDV owner a in year y  |
| Source of data | Vehicle inspections, SGS |
| Measurement frequency | At every inspection. Sometimes the car mileage is changed to make the car more attractive for sale. That is made more difficult with the periodic vehicle inspections. |
| Purpose of data | Calculating the annual CO2 emissions of the Ugandan LDV fleet. |
| Measurement methods and Responsibilities | Reading the mileage and correcting for the number of days between inspections.The Ministry of Works and Transport will collect the data from SGS and provide the full database of information to the Ministry of Energy and Mineral Development on an annual basis, based on a pre-defined template |

**3. Performance Indicators**

In addition to the GHG monitoring, a number of performance parameters are proposed which track the implementation progress of the different activities under the NAMA.

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| Indicator | Description | Responsible authority |
| Gasoline and gas oil consumption | The total annual consumption of transport fuels in Uganda (m3/year).  | Ministry of Energy and Mineral Development  |
| Database progress | The number of LDVs recorded in the database by the LDV inspection programme.  | Uganda Revenue Authority |
| Average age of LDVs | Average age of the LDV stock in Uganda. The LDV inspection programme will collect the age of the LDVs inspected. From this, information on the average age of the LDV stock in Uganda can be extracted. | Uganda Revenue Authority |
| Sulphur content of gasoline and gas oil | Samples of fuels sold in Uganda will be tested in a laboratory to determine the sulphur content. The regulatory standard dictates that the sulphur content can not exceed 50ppm. | Ministry of Energy and Mineral Development |
| Usage of the incentive scheme | The replacement of inefficient LDVs will be encouraged with financial incentives. This indicator records the number of LDV owners per year which make use of the financial incentives scheme for LDV replacement | Uganda Revenue Authority |

**4. Monitoring co-benefits**

The NAMA has a number of Economic, Social and Environmental co-benefits, some of which will be monitored as well. Where direct monitoring is challenging, specific indicators are proposed.

|  | Co-benefit | Monitoring approach | Responsible authority |
| --- | --- | --- | --- |
| Economic | Foreign exchange savings and lower oil import bills | The total annual consumption of transport fuels in Uganda (m3/year).This value can be multiplied with sales price of these fuels at the pump to estimate the impact of the NAMA on household expenditures in Uganda. | Ministry of Energy and Mineral Development |
| Improves energy security | For this SD benefit, the performance parameter: total annual consumption of transport fuels imported into Uganda (m3/year) can be used. | Ministry of Energy and Mineral Development |
| Household/Business fuel savings | Annual household surveys includes questions on annual expenditures on fuel savings.  | Uganda Bureau of Statistics |
| Direct employment creation | Inquiring with the ministries, agencies, and companied involved how many staff they employ for the NAMA activities. | Ministry of Energy and Mineral Development |
| Social | Improved health | The annual number of patients seeking medical assistance at the main hospital in Kampala with respiratory diseases per year. | Mulago Hospital/Ministry of Health |
| Reduced number of accidents | Record total number of accidents recorded in the database of police reports. | Ministry of Works and transport |
| Environmental | Improved local air quality | Fixing NO2 diffusion tubes near major traffic junctions. Quantitatively determine the concentrations of Nitrite ions absorbed are by UV/Visible Spectrophotometry. This is then referenced to a calibration curve derived from the analysis of standard nitrite solutions.Traffic is a major source of NO2 emissions and gives an indication of changes in air emissions from transport. | KCCA |

1. Baseline survey on Uganda’s national average automotive fuel economy (baseline setting), First draft report, 28th April, 2015, and the underlying database. [↑](#footnote-ref-1)
2. Baseline survey on Uganda’s national average automotive fuel economy (baseline setting), First draft report, 28th April, 2015, and the underlying database. [↑](#footnote-ref-2)
3. Baseline survey on Uganda’s national average automotive fuel economy (baseline setting), First draft report, 28th April, 2015, and the underlying database. [↑](#footnote-ref-3)