INSTITUT FÜR ENERGIE- UND UMWELTFORSCHUNG HEIDELBERG

Transport Week Berlin 2023
MYC & MRV in Morocco

Transport Data: From MRV to Action

Marie Colson - ifeu

Topics

1. **Ifeu Presentation**
2. MYC emission calculator
3. Project MRV Morocco

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Ifeu: Institut for Energy and the Environment

Ifeu was founded in **1978** as an in**dependent, non-profit environmental research institute**. Around **90 scientists** work in interdisciplinary teams in two offices in Heidelberg and Berlin.

Mobilität
Mobility

ALTERNATIVE DRIVES

- Electricity
- Biofuels
- CNG/LPG
- Hydrogen

EMISSION MODELLING

- Greenhouse gases and pollutants
- Inventories
- Assessment of the effects of measures
- Scenarios

MUNICIPAL/(INTER)NATIONAL CONCEPTS

- Climate protection concept/roadmap
- Individual climate protection measures
- National and sustainable mobility plans

LIFE CYCLE ANALYSIS

- Vehicle construction
- Energy generation and transport
- Waste disposal and recycling

- Ifeu Presentation
- **MYC emission calculator**
- Project MRV Morocco

Mobiliseyourcity: GHG emission calculator

Methodology & system boundary

Developped under the aegis of European and Franco-German cooperation.

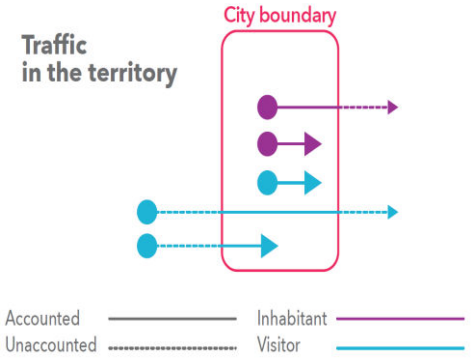
What is the GHG emission calculator made for?

- Provides a **framework and a methodology to follow step-by-step**
- Gives (**inter)national defaults** (e.g. emission factors)
- Enables **fair comparison of the results** for different cities
- **Support on adaptation** to the needs and answer to **questions**

Accompanying methodology

BOTTOM-UP GHG emission quantification

Territorial approach



Also followed by:

GREENHOUSE GAS PROTOCOL

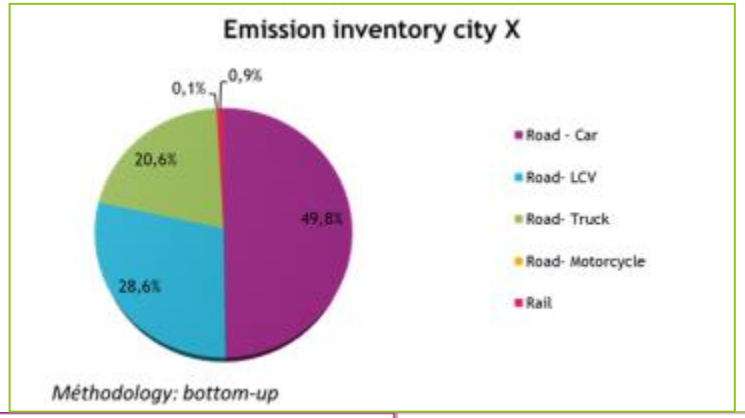
C40 CITIES

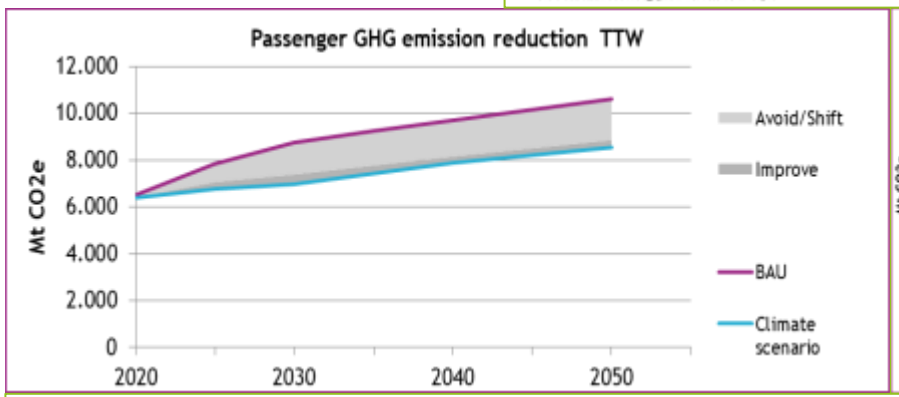
Klimaschutz-Planer

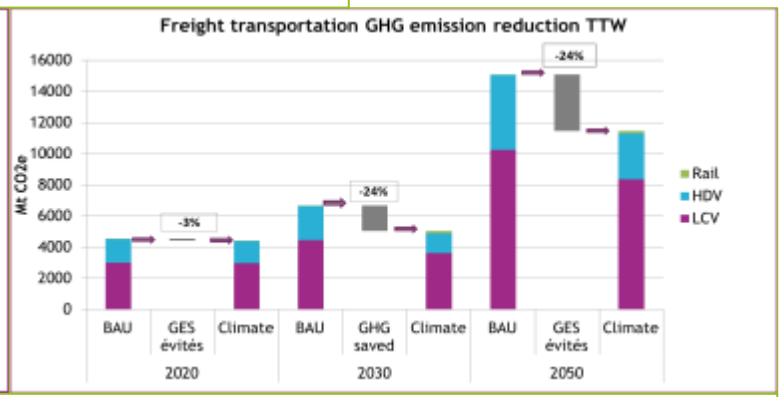
Source: ifeu

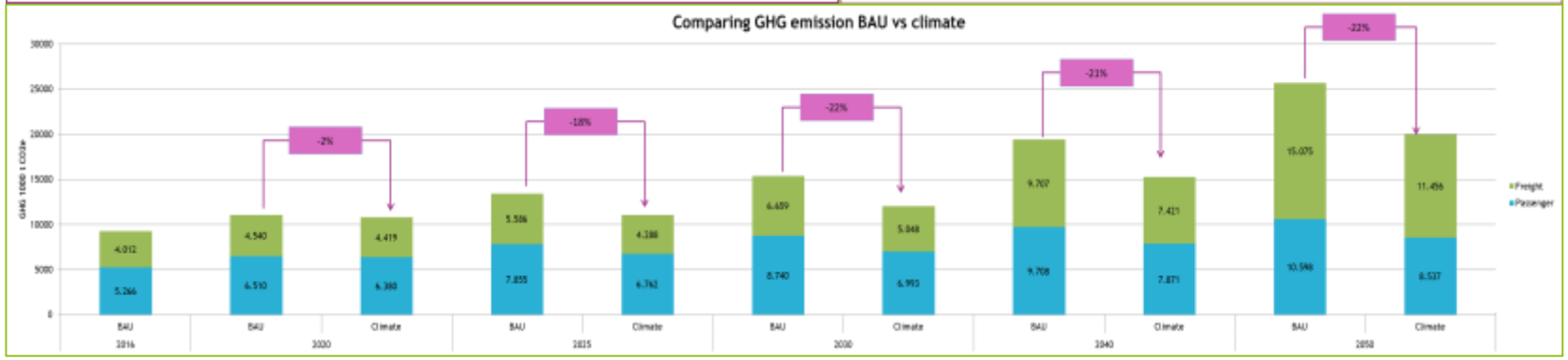
Download under: https://www.mobiliseyourcity.net/emissions-calculator-and-mrv-toolkit

Example fo results inventory and scenario









- Ifeu Presentation
- MYC emission calculator
- **Project MRV Morocco**

Data collection
Road and rail transport

NARSA

- File of periodic technical inspections over the last 5 years (2018-2022) for all vehicles
- Number of vehicles registered at the end of 2022
- Database of transfer roadworthiness tests for motorbikes over the last 5 years (format: excel)

SNTL

- Number of state vehicles 2022 by vehicle category

Fondation Mohammed VI

- Carbon footprint tool and report

ONCF

- Activity data and carbon footprint

DTR

- Cost study*

CNER

- Road traffic counts 2021

+ varied literature

*carrying out a study to calculate, update and monitor the reference cost structure for road transport and setting up an it application.

Tools for calculating the GEs inventory for Morocco 2022

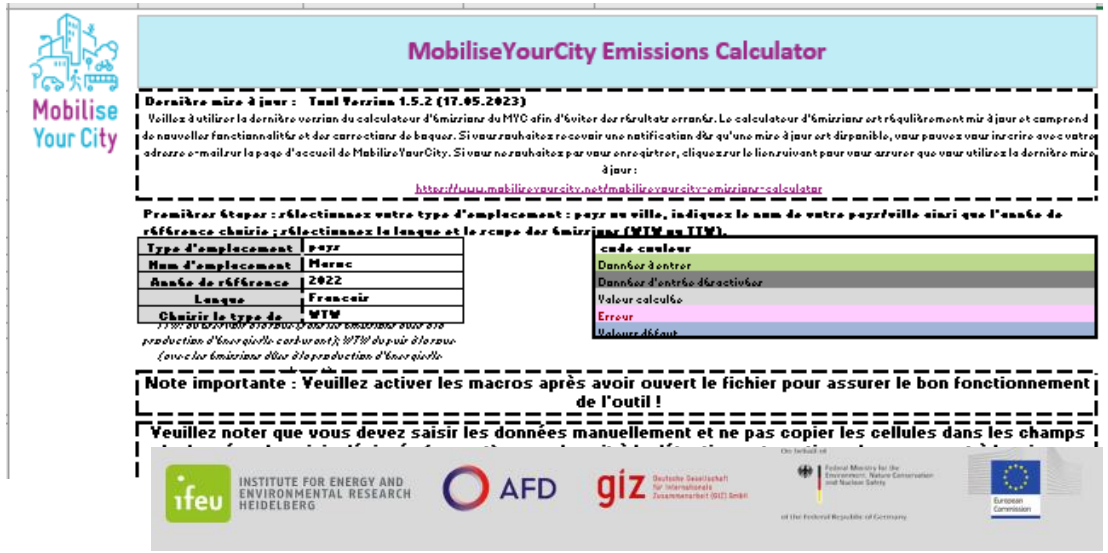
First bottom-up inventory

- Python code developed by the DTR/NARSA/ifeu team processing several million items of data from the NARSA databases

```python
#create figure that shows registered and controlled vehicles vs. MeC year (contains only NARSA data, not state vehicles)
nonControlledVehicles = np.delete(dataRegistrations, indicesRecentlyControlledVehicles)
motorcycles = nonControlledVehicles[nonControlledVehicles['vehicleCategory'] == 'moto']
agri = nonControlledVehicles[nonControlledVehicles['vehicleCategory'] == 'agri']
nrmm = nonControlledVehicles[nonControlledVehicles['vehicleCategory'] == 'NRMM']
ncM1 = nonControlledVehicles[np.isin(nonControlledVehicles['vehicleCategory'], vehicleCategories5Years)]

binArray = np.arange('1970', str(targetYear + 2), dtype='datetime64[Y]')
histUsed = np.histogram(dataRegistrations['meCDate'][dataRegistrations['useRow']], bins=binArray)[0]
histControlled = np.histogram(dataRegistrations['meCDate'][indicesRecentlyControlledVehicles], bins=binArray)[0]
histMoto = np.histogram(motorcycles['meCDate'], bins=binArray)[0]
histAgri = np.histogram(agri['meCDate'], bins=binArray)[0]
histNRMM = np.histogram(nrmm['meCDate'], bins=binArray)[0]
histNcM1 = np.histogram(ncM1['meCDate'], bins=binArray)[0]
histAll = np.histogram(dataR
plt.figure(dpi=300.0)
b6 = plt.bar(np.arange(1970,
b0 = plt.bar(np.arange(1970,
b1 = plt.bar(np.arange(1970,
b2 = plt.bar(np.arange(1970,
b3 = plt.bar(np.arange(1970,
b4 = plt.bar(np.arange(1970,
b5 = plt.bar(np.arange(1970,
plt.xlim(1969, int(str(targe
plt.title('Répartition de la
plt.legend([b6, b5, b4, b3,
plt.xlabel('Année de mise en
```

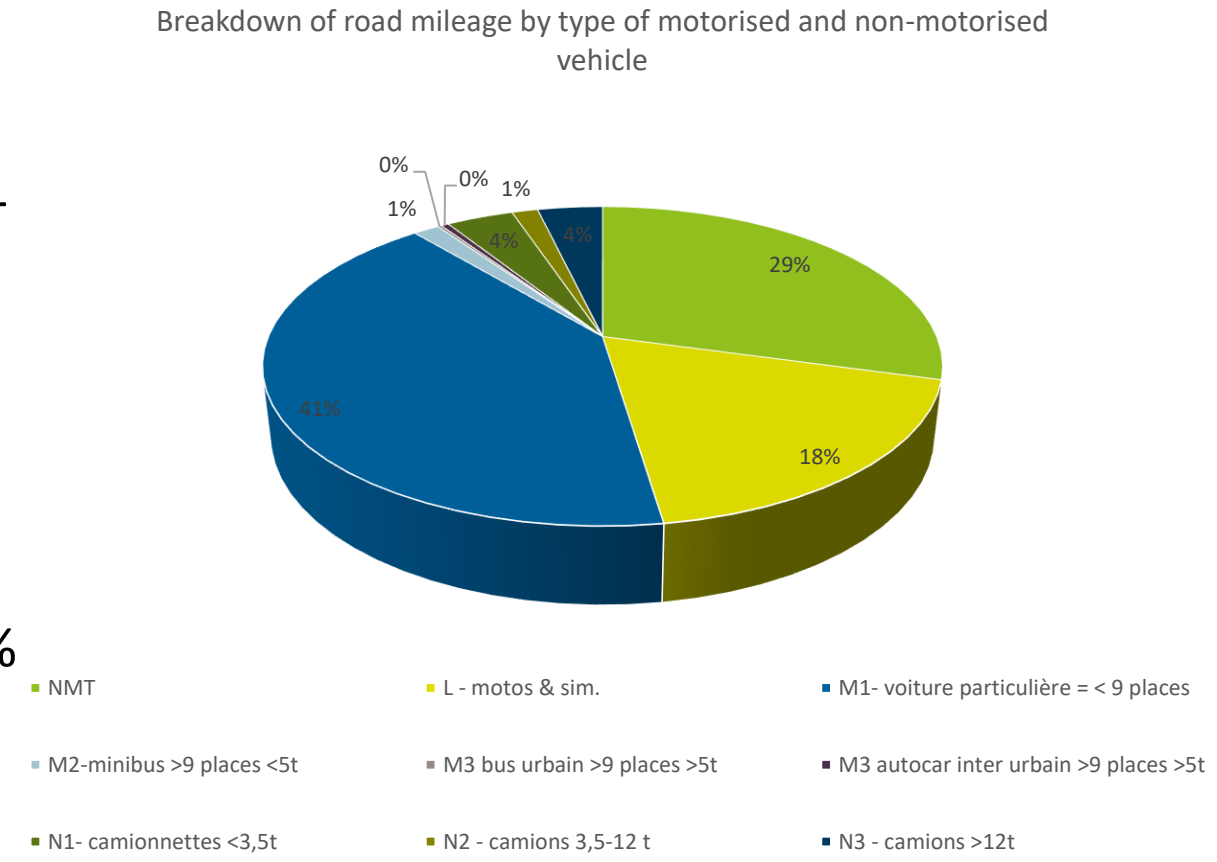
```python
#sort both arrays by license plate
dataRegistrations = np.sort(dataRegistrations, order=['matZone','matSerial','matLetter','matDate','meCDate'])
dataControls = np.sort(dataControls, order=['matZone','matSerial','matLetter','matDate','meCDate'])

#assign integer IDs to controls that did not get an ID in the previous step
#control corresponds to vehicle if license plate and one of the folloeing are identical: matDate, meCDate
j, k = 0, 1                    #j: index of line in dataRegistrations to be analysed, k: introduced to avoid problems with license plates app

for i in np.arange(dataControls.size):                    #loop over controls
    if dataControls['ID'][i] != -1:                       #go to next control if control already has an ID
        continue
    plateCo = plate(dataControls, i)                      #license plate of current control
    try:
        while plateCo > plate(dataRegistrations, j):
            j += k                                        #go to license plate number in registration data
    except IndexError:
        j = dataRegistrations.size - 1
    if plateCo == plate(dataRegistrations, j):
        k = 0
        while plateCo == plate(dataRegistrations, j + k):       #loop over all vehicles with the same license plate
            if (dataControls['matDate'][i] == dataRegistrations['matDate'][j+k]) or (dataControls['meCDate'][i] == dataRegistrations['meCD
                dataControls['ID'][i] = dataRegistrations['ID'][j+k]
            k += 1
    else:
        k = 1

#sort arrays by IDs (and control date)
```

- The Mobilise your City GHG emissions calculator, freely accessible and adapted to the first inventories



Breakdown of road mileage by type of motorised and non-motorized vehicles

- According to our study, motorised road vehicles will have travelled 79.5 billion kilometres in Morocco in 2022.
- Pedestrian and cycle kilometres (NMT: non-motorised transport) have been estimated at 33 billion kilometres*.
- Cars therefore account for 41% of mileage, equivalent to 58% of motorised vehicle mileage.
- Motorbikes account for the second largest number of vehicles: 18% of kilometres (26% of motorised vehicles)
- Freight (N1, N2, N3) represents only 9% of kilometres (13% of motorised), buses (all types) only 2% of kilometres.



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Thanks for you attention

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BACK UP

Content of the current MYC emission calculator

Inventory	BAU scenario	Climate scenario
Inputs: ➢ **Road**: kilometers per vehicle type & fuel, vehicle fuel consumption; occupancy rate; load ➢ **Rail:** total kilometer, total fuel consumption, occupancy rate and load	**Inputs**: ➢ **Road & Rail**: Growth rate of kilometers per vehicle type; growth rate of fuel consumption, Population;	**Inputs**: ➢ **Road & Rail**: share of km avoided, shifted or rate of improvement of vehicle fuel consumption (incl. Use of renewable energy) compared to BAU

Outputs

- **Transport performances (pkm)**
- **Total mileage (km)**
- **Modal split (%)**
- **GHG emissions (CO2eq)**

Emission savings BAU vs climate scenario (2016;2020;2025;2030;2040;2050)

BAU: Business-as-usual

Levers for climate friendly transportation

Avoid

- Using ICT (i.e. home office)
- City planning: short trips
- Regional and local economy
- Future transport infrastructure (based on needs – no traffic induced)

Shift

- Shifting towards sustainables passenger modes (PT, bike etc)
- Shifting towards sustainable freight modes (rail, navigation)

Improve

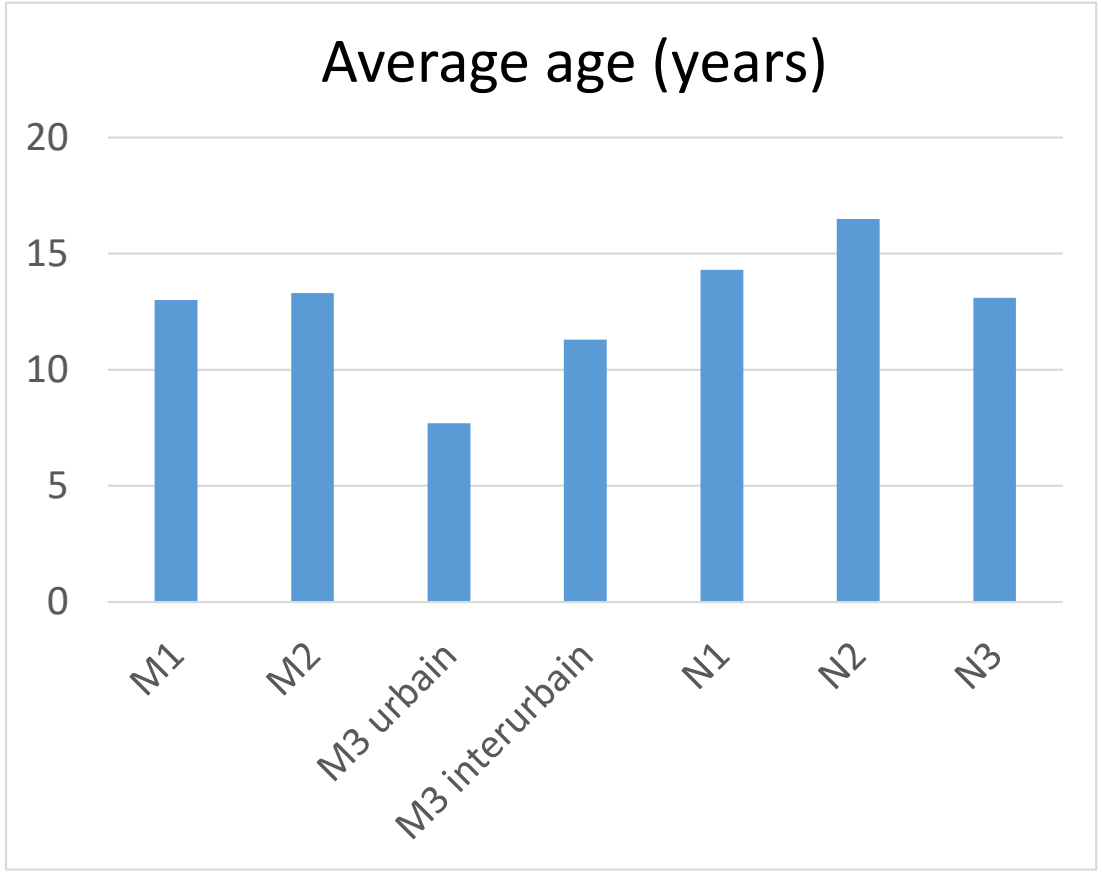
- Improving vehicle use
- Improving vehicles energy efficiency
- Increasing the use of low carbon vehicles i.e. e-mobility, biofuels etc
- Improving traffic control

ICT: Information and communication technology

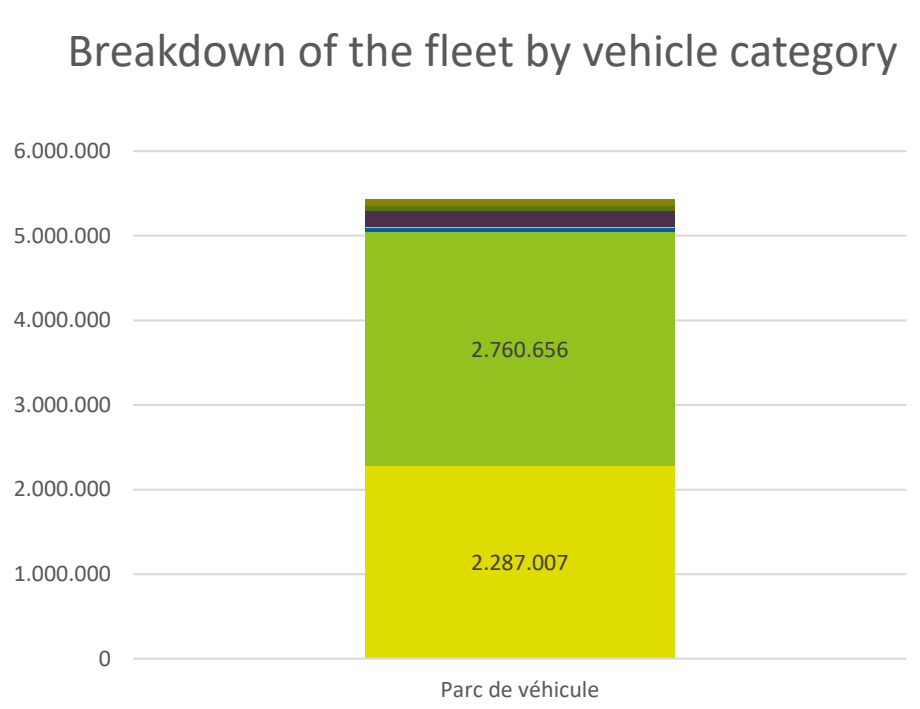
Analysis of the Moroccan road fleet

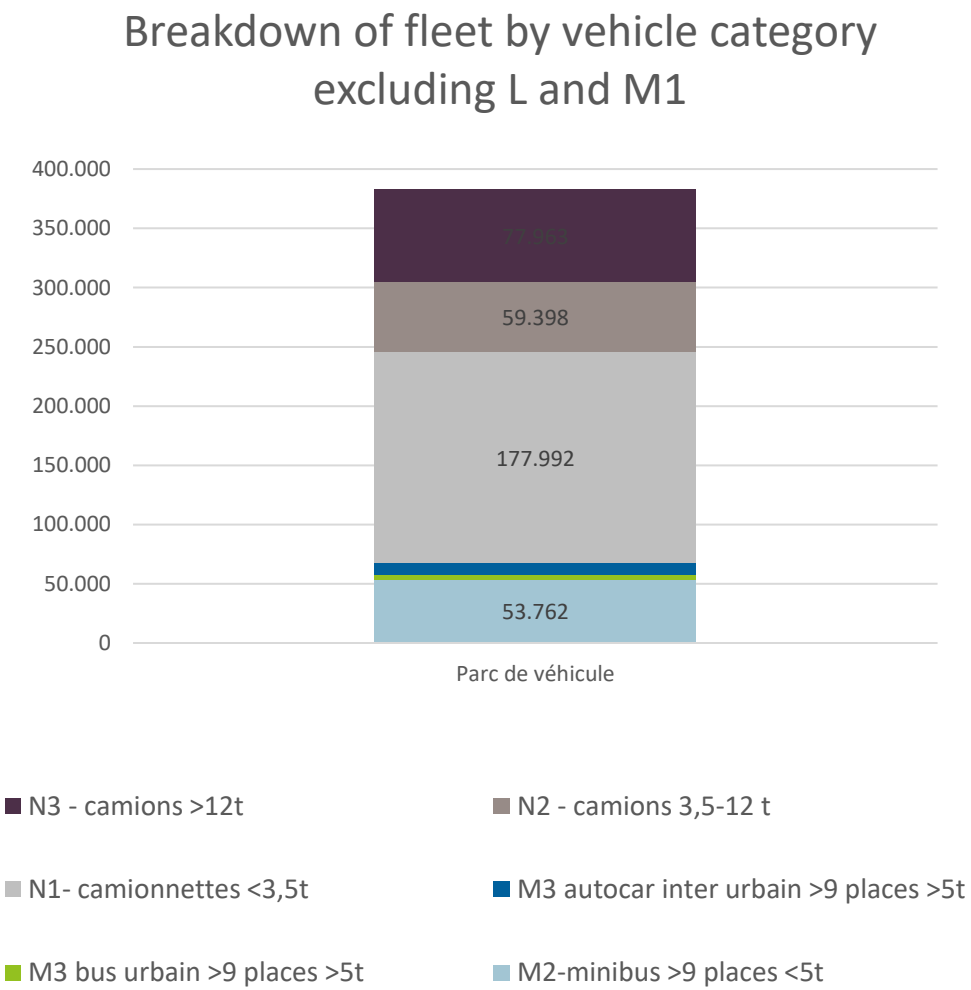
Average age of the vehicles

Vehicle categories	Average age
M1	13 years
M2	13,3 years
M3 urbain	7,7 years
M3 interurbain	11,3 years
N1	14,3 years
N2	16,5 years
N3	13,1 years



The road fleet in Marocco: results by category





Breakdown of annual mileage by vehicle category