RÉPUBLIQUE FRANÇAISE Liberté Égalité Fraternité — Cerema CLIMAT & TERRITOIRES DE DEMAIN — Loire Atlantique

ADAPTING PUBLIC POLICY FOR THE MAINTENANCE OF A DEPARTMENTAL ROAD NETWORK TO REDUCE GREENHOUSE GAS EMISSIONS AND IMPROVE SERVICE LEVELS : A DECISION-SUPPORT TOOL FOR THE MANAGER LOIRE-ATLANTIQUE DEPARTMENT (Ref 334)

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Context

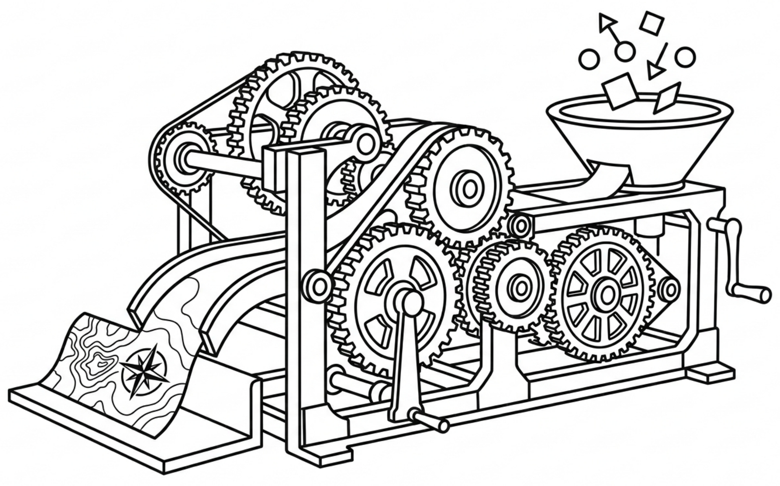
- 4,200 km road network under growing demographic and traffic pressure.
- A vital role in daily mobility, freight transport, and territorial cohesion.
- Accelerated pavement ageing driven by rising heavy vehicle traffic.
- Over a decade of proactive low-carbon maintenance (reclaimed asphalt pavement reuse, warm/cold mix asphalt, innovative techniques).

Challenges

- Achieve a 20% reduction in greenhouse gas (GHG) emissions from road maintenance activities by 2030 compared to 2019, as a milestone on the pathway to carbon neutrality by 2050.
- Maintain the level of service of the road network while limiting financial costs for the local authority.
- Anticipate the end-of-life of a road network predominantly built between 1965 and 1990 by prioritising rehabilitation to prevent maintenance backlog.

1 - Data structuring

Pavement structure database
Road traffic data
History of roadworks
SEVE - GHG database
Road classification by manager
Price list for public road maintenance contracts
Annual GHG reports
Available road records



GID file of the network divided into 100m segments
Segment attributes: traffic class, structure type, year of construction, work history.

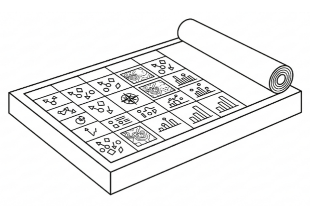
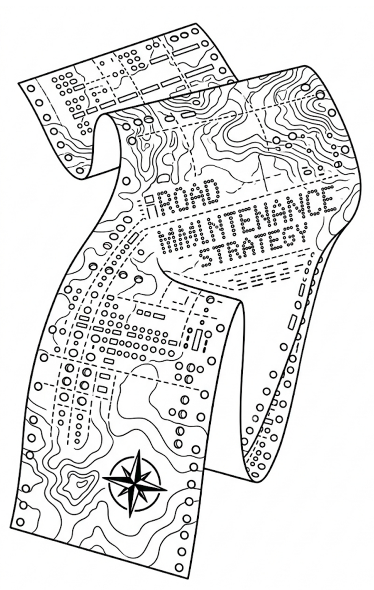


Table of pavement materials, costs and GHG emissions

Maintenance scenario for the period 2024-2073



2 – Apply maintenance models on road segments

A statistical model for flexible pavements

- Built using 50 years of maintenance work history.
- Calibrated using road condition data collected by the network manager.
- Applied to low traffic road classes (A-roads T4–T5 and all B-roads).

Advantages:
Simple gaussian model derived directly from historical data

Limits :
Not explicitly based on the physical degradation mechanisms of the pavement

A mechanistic model for treated-base pavements

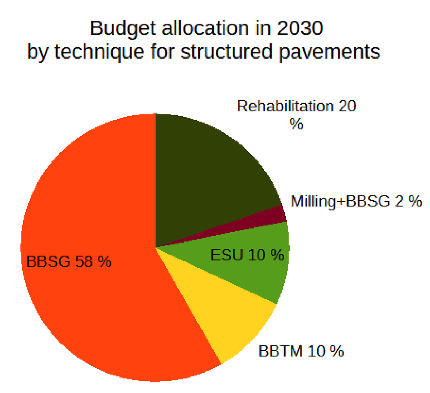
- Developed in accordance with pavement reinforcement guidelines (ALIZE-LCPC).
- Calibrated using selected representative sections with well-documented histories.
- Applied to high traffic road classes (A-roads T0-T3).

Advantages :
Enables calculation-based estimation of segment end-of-life

Limits :
Requires extensive historical data to calibrate sub-models

3 - Results of modelling

Map and table of service levels by year over the period 2024-2073



Map and table of pavement materials used per year over the period 2024-2073

Table of annual financial budgets

	Budget 2030 (€ 2024 values)	GHG Emissions 2030 ***(tCO₂eq, June 2025 baseline)***	**Budget 2050 (€ 2024 values)**	GHG Emissions 2050 ***(tCO₂eq, June 2025 baseline)***
A-Roads	€5,464,851.00	2477	€5,710,312.00	2459
B-roads	€5,371,521.00	757	€5,371,435.00	763
Roundabouts and Slip roads	€666,413.00	343	€666,413.00	343
Total	**€11,502,785.00**	3577	**€11,748,160.00**	3565
Difference compared with the 2019 Greenhouse Gas Emissions Report ***(4,815 tCO_2eq - SEVE baseline, June 2025)***		**-26%**		**-26%**

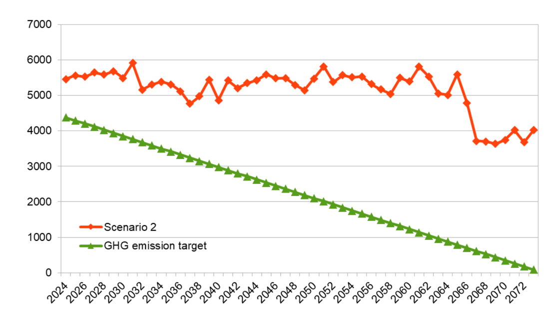
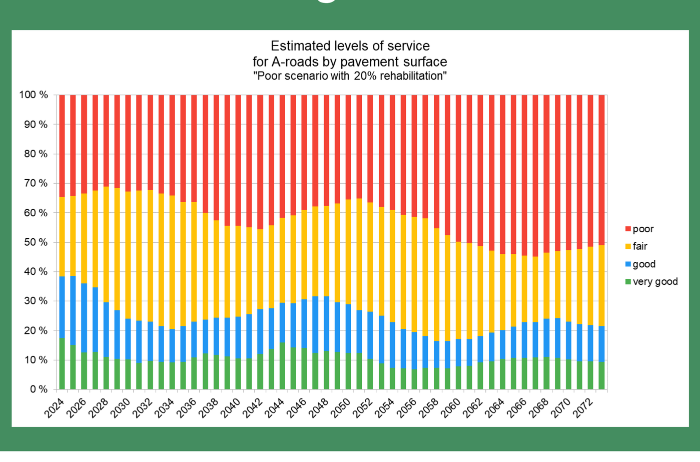


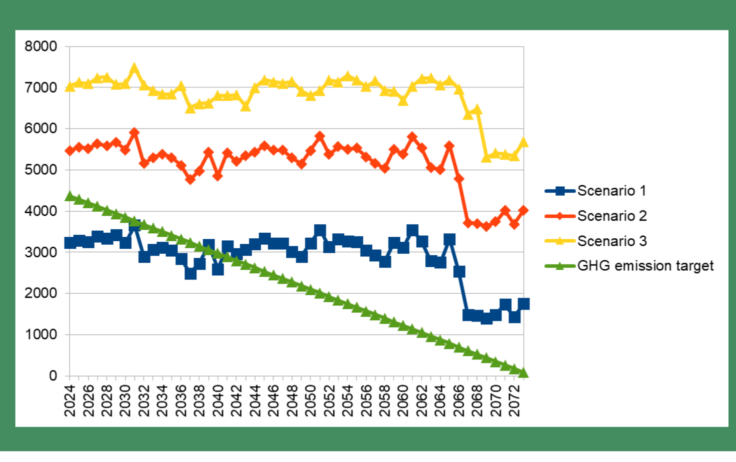
Table of annual greenhouse gas emissions

Comparative analysis and decision-support tool

- Comparative analysis of maintenance scenarios (service levels, GHG emissions, financial costs).
- Assessment of key GHG reduction levers.
- Recommendations for revising the maintenance policy

The initial results highlight the difficulties of achieving the GHG reduction target while maintaining service levels over the long term.





Outlook following this study

To continue this study

- Estimate the effort required on the main decarbonization levers (increasing RAP content, lowering asphalt mix production temperature, and increasing the use of emulsion-treated bases, emulsion asphalt mixes, or surface dressing) to achieve the GHG reduction target.
- Increase the number of representative sections modeled for better estimation of structural pavement condition beyond 2050.
- Update the materials database with representative materials (RAP ratio average, hot/warm mix, average transport distance) and low-GHG alternatives.