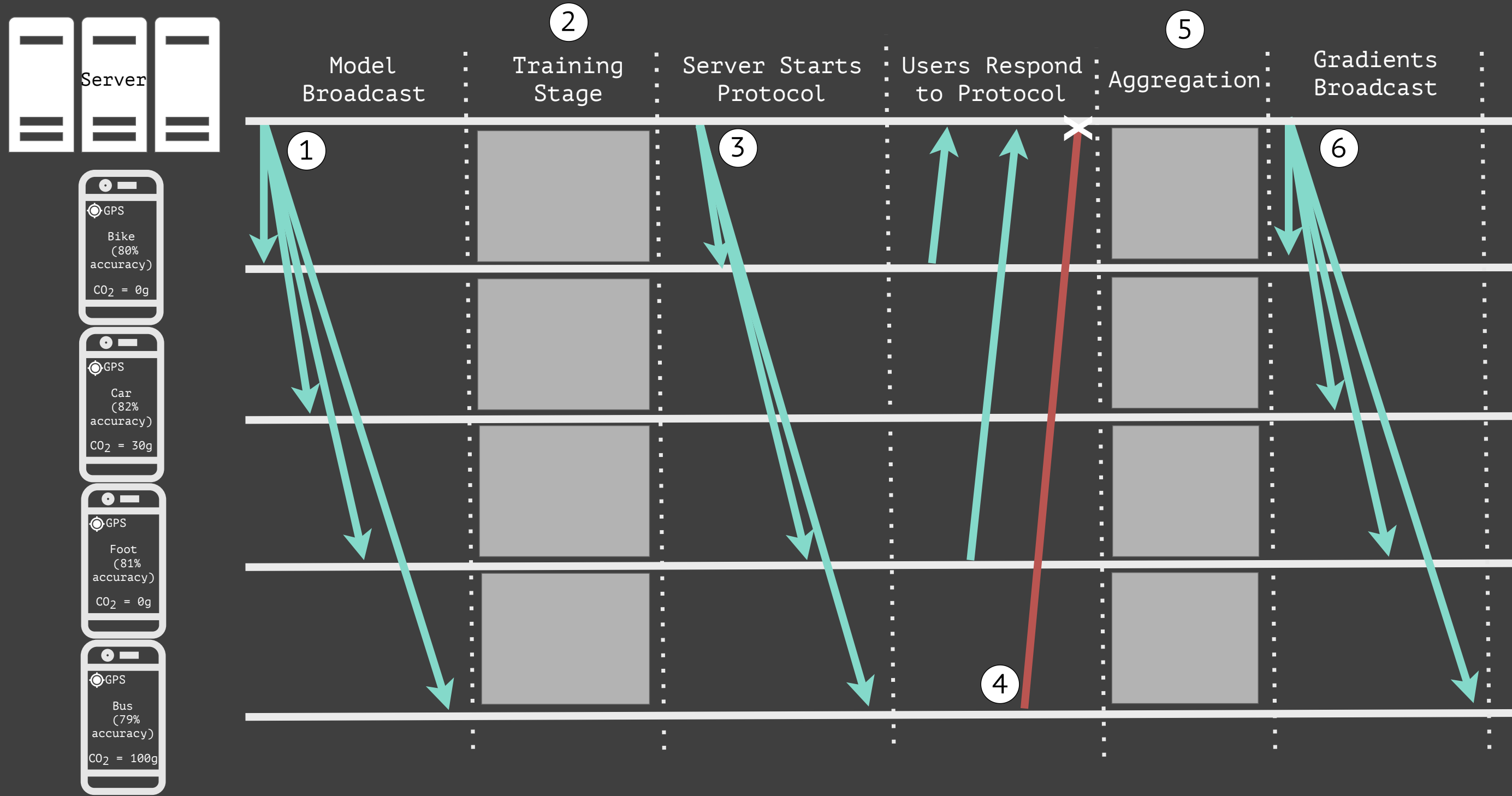


# Emission-Aware Federated Learning: A Case Study on Transportation and Carbon Footprint

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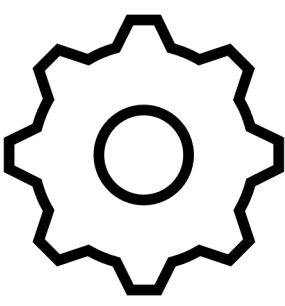
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The addition of Federated Learning to Urban Transportation enables the promotion of sustainable and personalised travel behaviours while preserving data privacy.



## 1. Introduction

- Cities worldwide have ambitious goals regarding carbon neutrality.
- Users' lack awareness on their carbon footprint and the motivation to change habits.
- There is still reluctance to use software tools due to possible leakage of users' private data.



## 2. Design

The main goal is to preserve the privacy of users' data while increasing awareness on their carbon footprint.

We propose a methodology that:

- Detects and classifies transportation modes based on ML/DL models.
- Estimates CO<sub>2</sub> emissions for each citizen (through a daily carbon digest).
- Ensures the privacy of citizens data.
- Integrates Explainable AI to make data and models understandable for citizens.

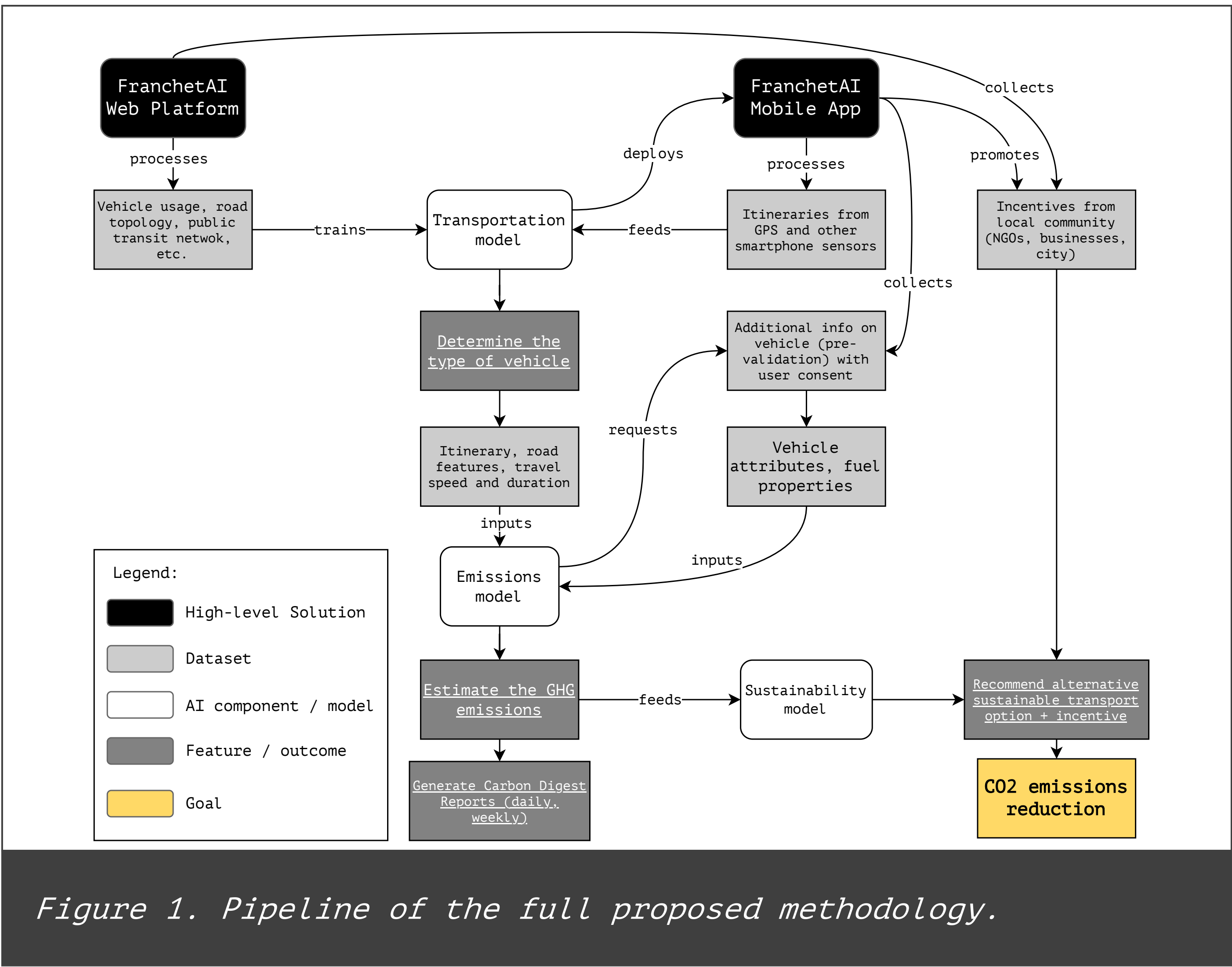


Figure 1. Pipeline of the full proposed methodology.



## 3. Results

- GeoLife dataset was used to train and create **general labels** for the transportation modes (e.g., car, foot, bus).
- The system was tested with **10 clients**, achieving around **75%** accuracy.

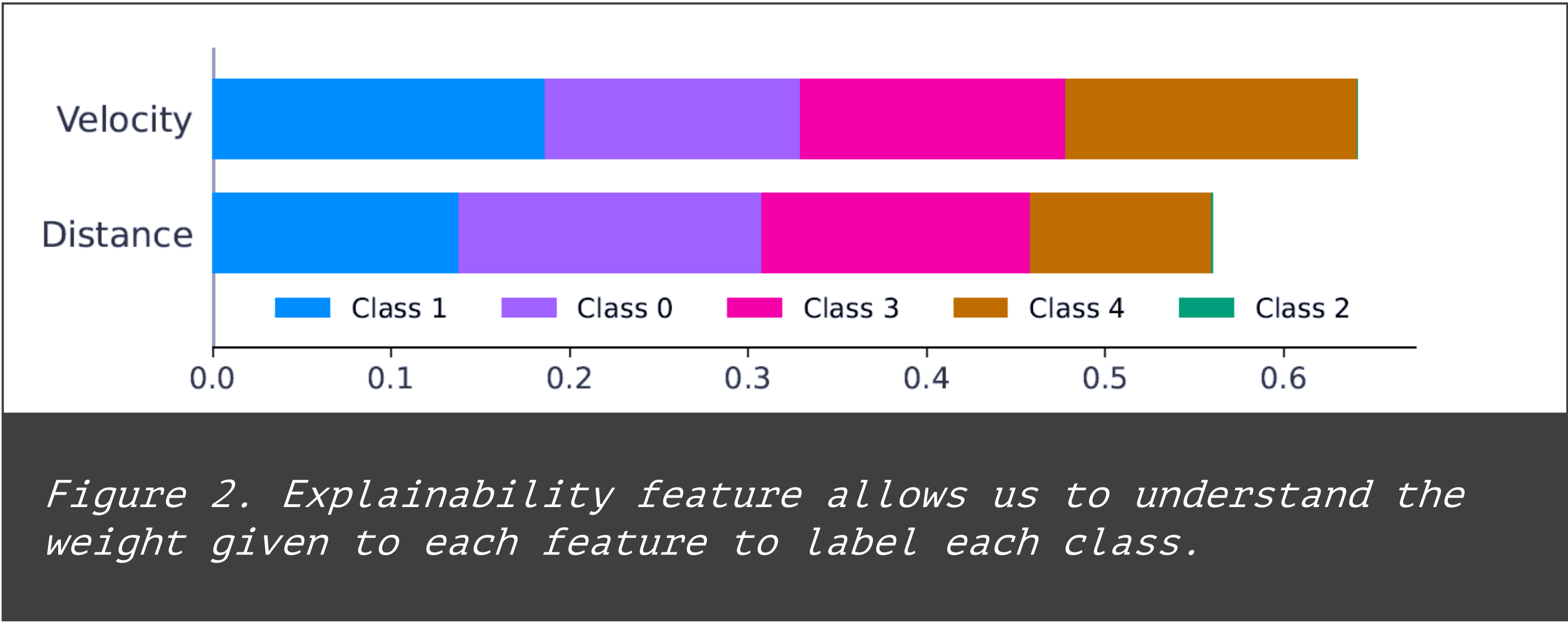
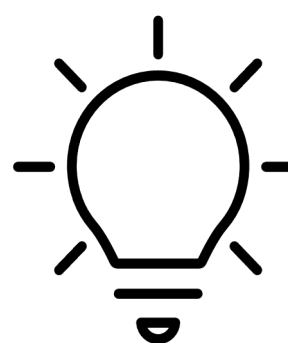


Figure 2. Explainability feature allows us to understand the weight given to each feature to label each class.



## 4. Future Directions

- Study the **trade-offs** between **data privacy** and **models accuracy** when applying differential privacy.
- Assess with **realistic scenarios** and **datasets**.

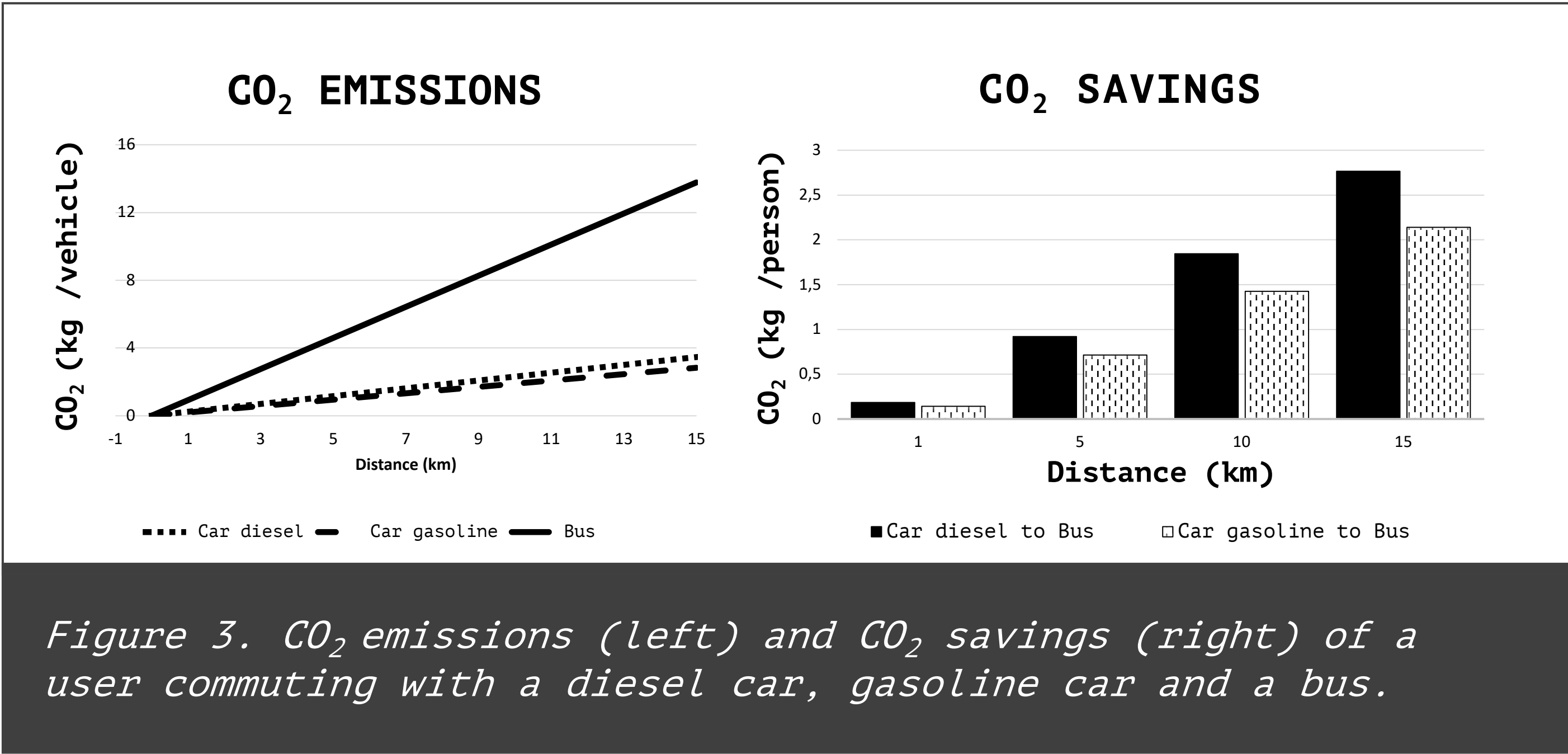


Figure 3. CO<sub>2</sub> emissions (left) and CO<sub>2</sub> savings (right) of a user commuting with a diesel car, gasoline car and a bus.

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