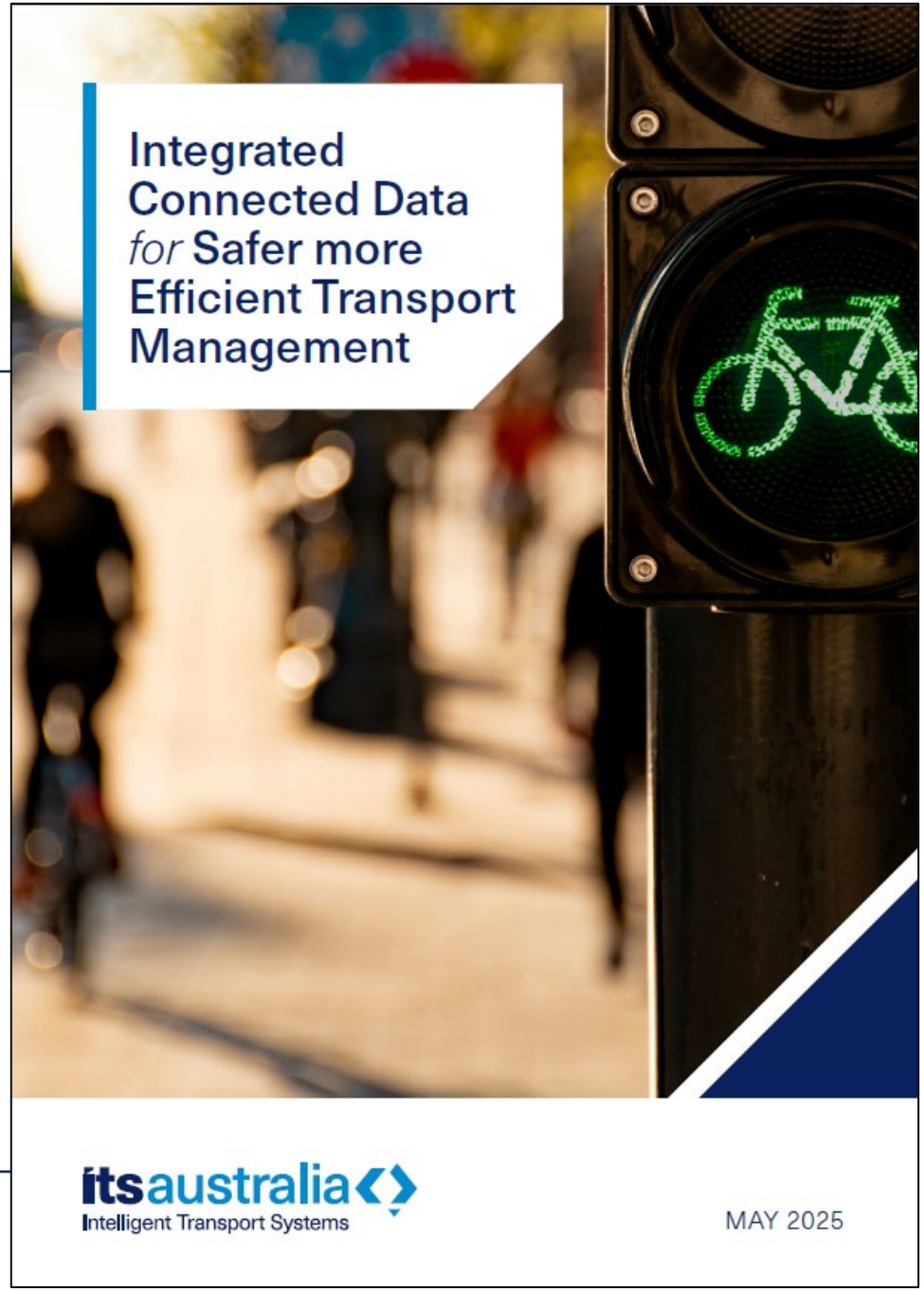
its australia
Intelligent Transport Systems

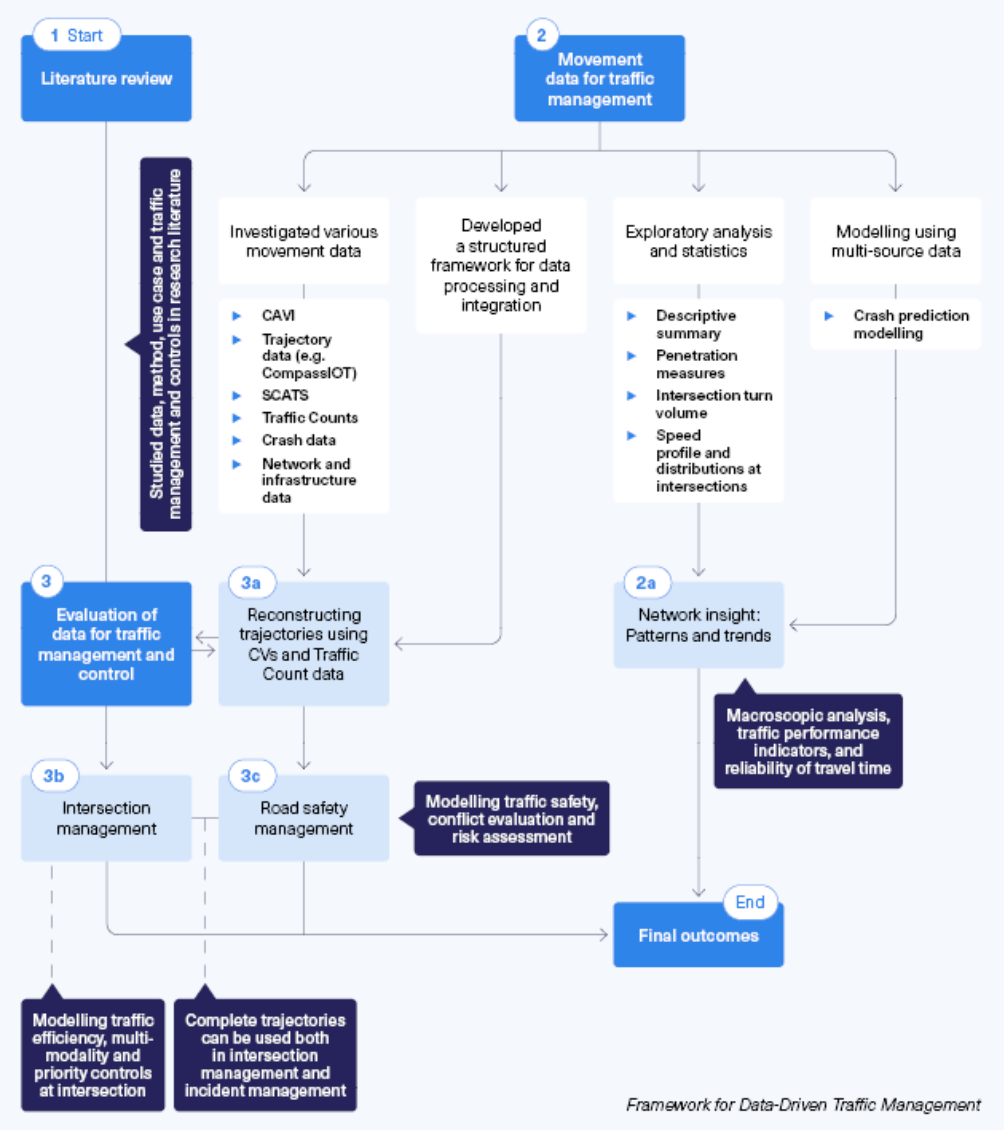
Integrated Connected Data: Safer, Smarter, Cleaner Transport

Insights from a National Collaborative iMOVE Research Project

ITS Australia & University of Melbourne



Methodology



Framework for Data-Driven Traffic Management

Multi-source data for traffic control

- Intersection signal control and multi-modal traffic operations
- Micromobility management, enhancing bicycle safety and efficiency
- Computer vision for traffic safety
- Network and freeway management
- Emission estimation

Probe data—real-time vehicle position tracking—emerged as a valuable tool for predicting traffic patterns and informing decision-making. There is also growing interest in using this data for long-term infrastructure planning.

Understanding traffic and emissions: what real vehicle movements can teach us

Imagine being able to watch how every car moves through a city – where it slows down, stops, and speeds up. Now imagine using that information to understand how much pollution those cars create. That's exactly what our study did.

What we looked at

Our study focused on three big questions:

1. How do different traffic conditions affect emissions?
2. How do emissions vary by time and location
3. What difference does replacing ICE vehicles with Electric Vehicles make?

What this means for cities

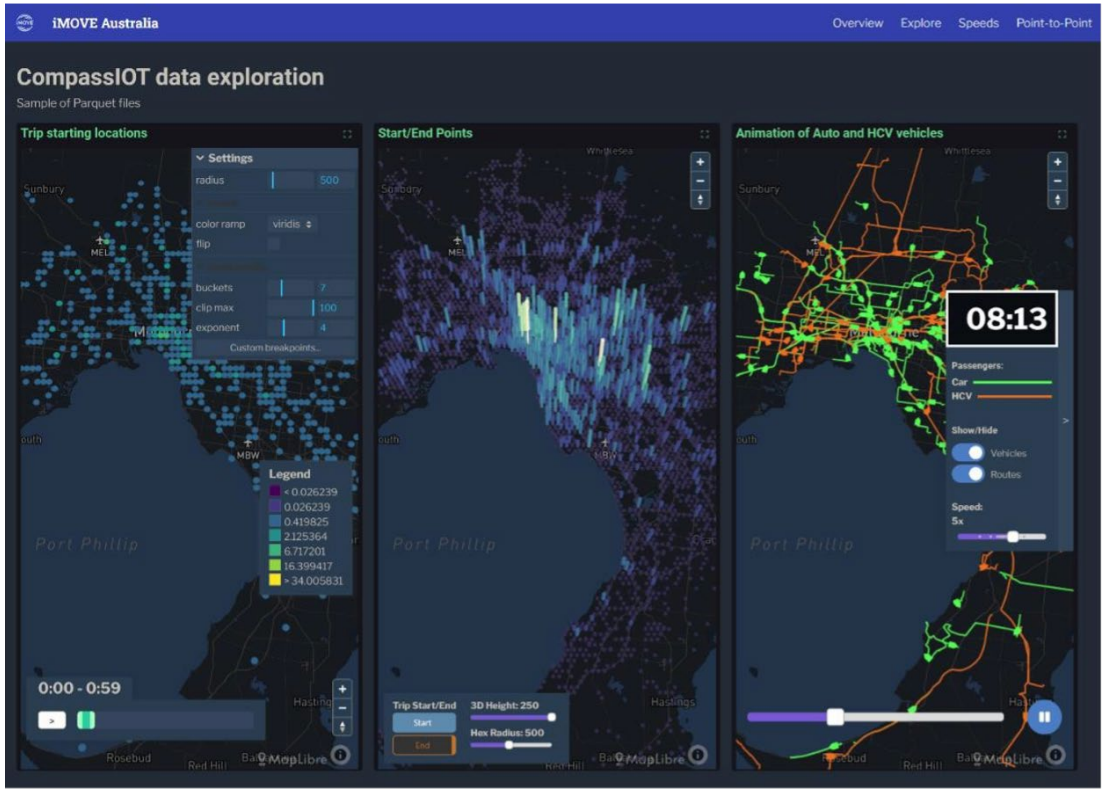
Our study shows that small changes can make a big difference:

- **Improving traffic flow**—especially before intersections—can reduce emissions.
- **Encouraging travel during off-peak hours** helps spread out traffic and pollution.
- **Switching even a small percentage of vehicles to electric** can dramatically cut emissions.
- **Managing vehicle speeds**, especially preventing unnecessary acceleration, can reduce pollution.

By using real-world data from actual vehicle movements, we're now better equipped to design cities that are cleaner, healthier, and smarter about traffic.

Driver behaviour and safer streets

Road intersections play a critical role in urban transportation systems, where frequent fluctuations in vehicle acceleration, deceleration, and queuing contribute to higher safety risks, emissions, and fuel consumption.



1

Distinct Driving Styles: The study identified 16 distinct driving scenarios based on vehicle type, time of day, and traffic signal status.

2

Green Signal Phases: Most vehicles maintained speeds between 50% and 70% of the speed limit, while a small percentage of drivers exceeded speed limits, particularly among passenger cars.

3

Red Signal Phases: A small but notable number of passenger cars crossed intersections illegally during red signals, while commercial vehicle drivers followed traffic rules more consistently.

4

Yellow Signal Phases: Most drivers stopped at yellow signals, but a subset, mainly passenger car drivers during rush hours, crossed at high speeds.

5

Driving Style Variability: Commercial vehicle drivers exhibited greater caution, while passenger car drivers displayed a wider range of behaviours.

6

Rush Hour and Vehicle Type Effects: Rush hour conditions and vehicle types significantly influenced driving styles, with passenger cars engaging in riskier behaviours more frequently during peak hours.

7

Intersection Safety and Efficiency: Understanding these driving patterns is essential for developing strategies that enhance safety and efficiency at intersections.

This study provides a comprehensive understanding of intersection driving behaviours, offering actionable insights to improve urban traffic management and road safety.

How cycling data made an impact

As part of the project, See.Sense sensor data delivered real-world insights into cyclist behaviour, safety, and journey efficiency. By combining this with other traffic data, the project uncovered valuable findings to help design safer, more efficient streets.

Bicycle safety and risk identification

Cycling safety is often compromised at busy intersections and high-traffic areas.

Key findings included:

- **Crash risks at intersections**
  59% of bicycle-involved crashes occurred at intersections.
- **Harsh braking and swerving hotspots**
  See.Sense data was a strong indicator of potential crash sites, effectively identifying hotspots for improvement.
- **Surface quality insights**
  See.Sense data highlighted poor road surfaces, identifying locations needing maintenance to prevent incidents.

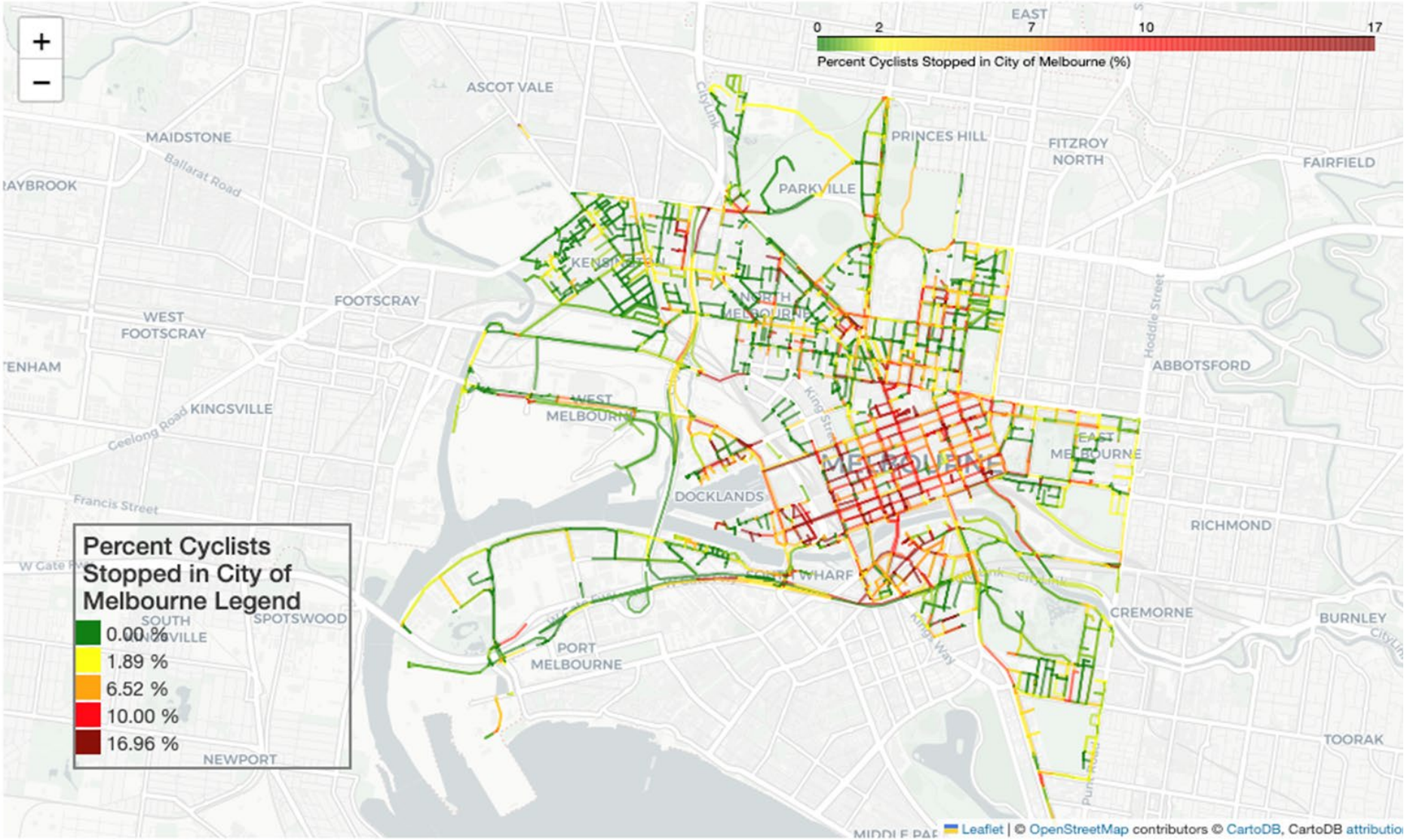
Bicycle flow efficiency

Delays and slow speeds are a common challenge for cyclists, particularly in urban centres.

The data from See.Sense showed:

- **Longer delays at major intersections**, especially where car-prioritised signals dominate.
- **Better performance on dedicated bike paths**, which allowed higher speeds and smoother journeys.
- **Cyclist profiles identified through machine learning**, revealing patterns across commuter, leisure, and delayed cyclist groups.

How cycling data made an impact



Percentage of Cyclists Stopped in City of Melbourne, identified with See.Sense data

Conclusions

This report should signal opportunities to use integrated data streams to deliver some of the following real-world outcomes and highlight the next steps to get there including the following key topics:

1

Data Integration Enables Proactive Traffic Management

Integrating connected vehicle (CV) data, bicycle telemetry, and traditional traffic sources enables real-time, evidence-based decision-making. This improves network efficiency, safety, and emissions management.

2

Advanced AI and Modelling Improve Safety and Efficiency

Deep reinforcement learning, computer vision, and ensemble AI models demonstrated strong potential to predict road conflicts and optimise signal timing, outperforming conventional systems.

3

Micromobility Data Enhances Safety for Vulnerable Users

Incorporating cyclist movement and braking data revealed hidden safety risks and flow inefficiencies, providing actionable insights for intersection and infrastructure design.

4

Real-World Trajectory Data Offers Accurate Emission Insights

Unlike simulations, real vehicle trajectories captured nuanced traffic-emission relationships, highlighting the importance of managing congestion and intersection approaches.

5

Data-Driven Dashboards Empower Transport Operators

Visualisation tools and interactive dashboards bridge the gap between complex datasets and practical traffic operations, enabling responsive and informed management.

6

Collaboration Across Sectors is Essential

Multi-agency and research-industry collaboration were key to unlocking the potential of integrated data. Ongoing partnerships are crucial for national-scale implementation.