



www.csrf.ac.uk

Impact of Coasting on Fuel Consumption of HGVs

Mr Joshua Subel, Mr Christopher Denham, Dr Julien Lepine, Dr Daniel Ainalis, Prof. David Cebon

Presented by Mr Joshua Subel

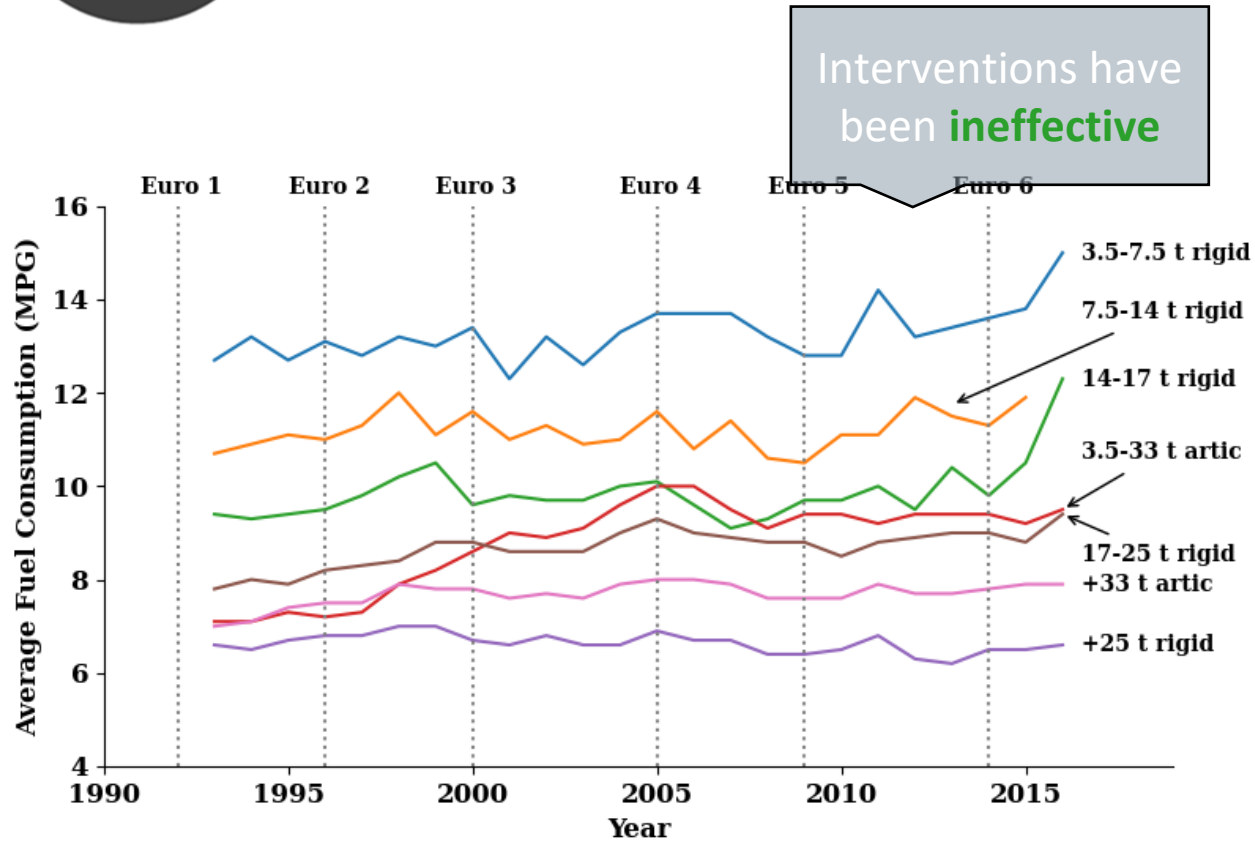
js2408@cam.ac.uk | www.eng.cam.ac.uk/profiles/js2408

Centre for Sustainable Road Freight

Department of Engineering, University of Cambridge

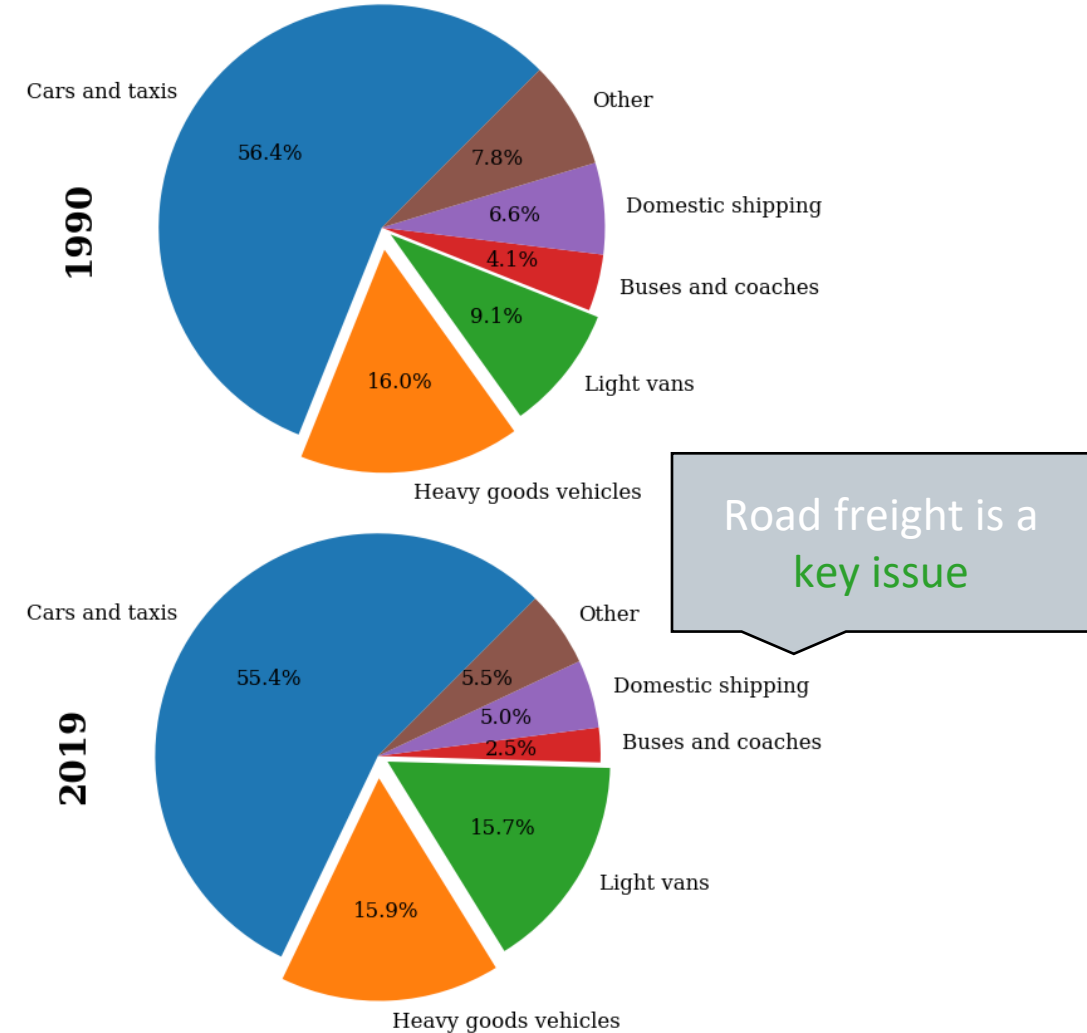


Decarbonising Road Freight: The Role of HGVs



Average UK HGV Fuel Consumption

Source: Department for Transport, 2017
Department for Transport, 2020



UK Transport GHG Emissions by Mode

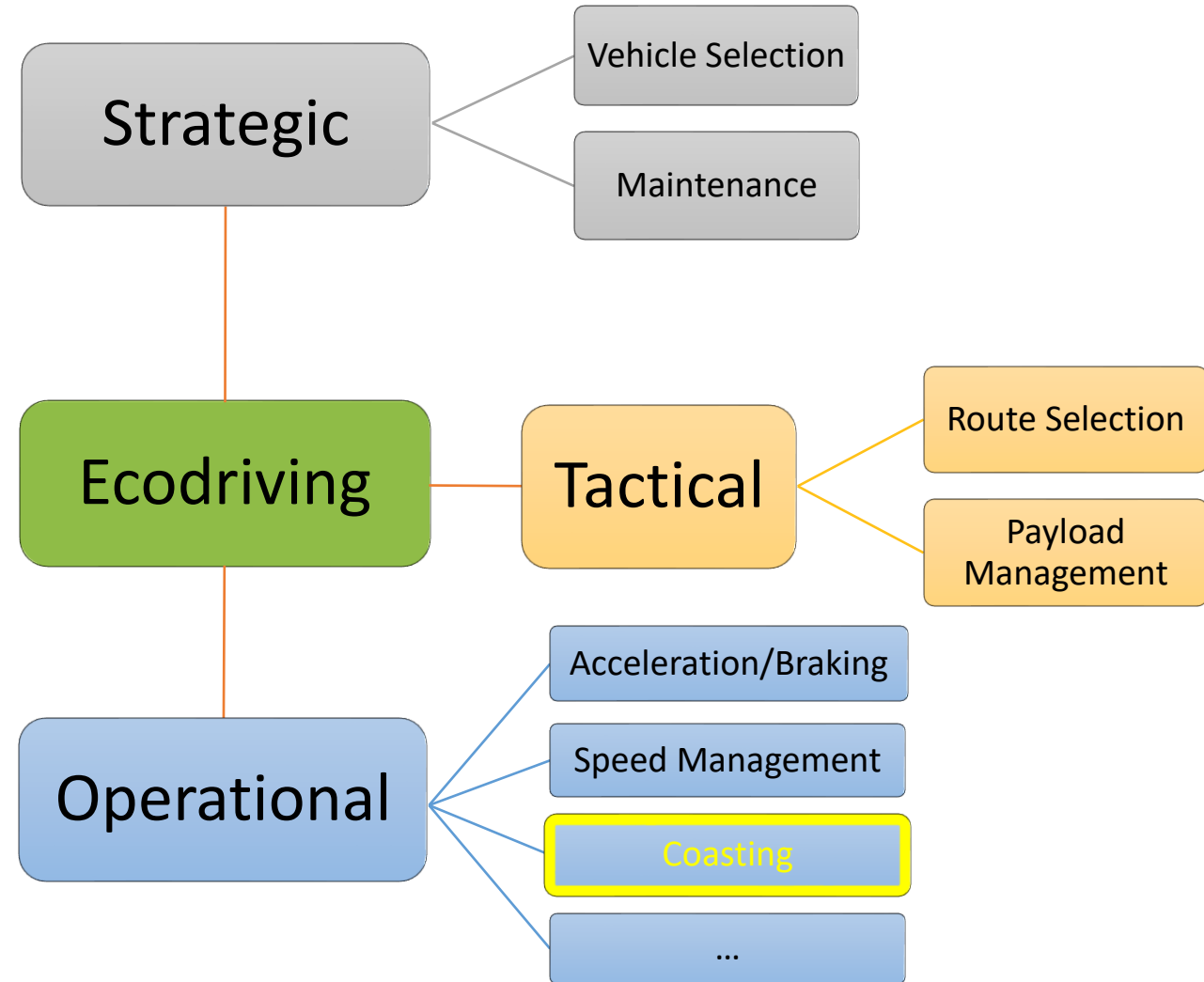


Decarbonizing Road Freight: What is Ecodriving?

“Ecodriving’ comprises all operational decisions made by the [operator] which act to improve fuel efficiency” - Ayyildiz et al., 2017

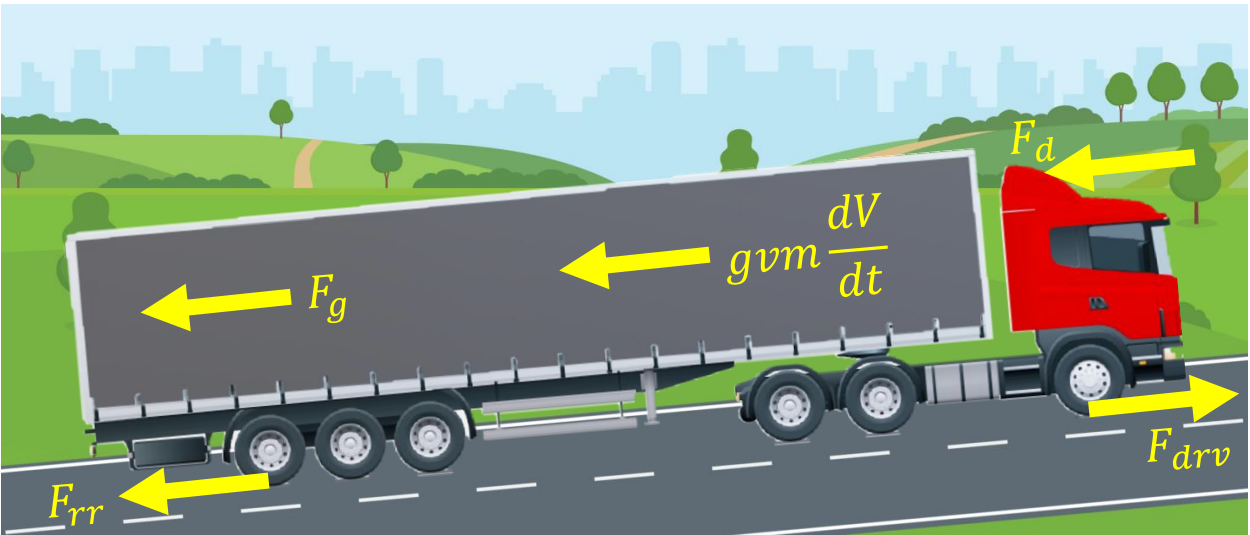
“...estimates of the energy savings range widely: 5% to 20% reductions depending on the driving and experimental context.” –Kurani et al., 2015

“There is no consensus on what behaviors constitute eco-driving: definitions differ by functions, forms, and contexts” –Kurani et al., 2015





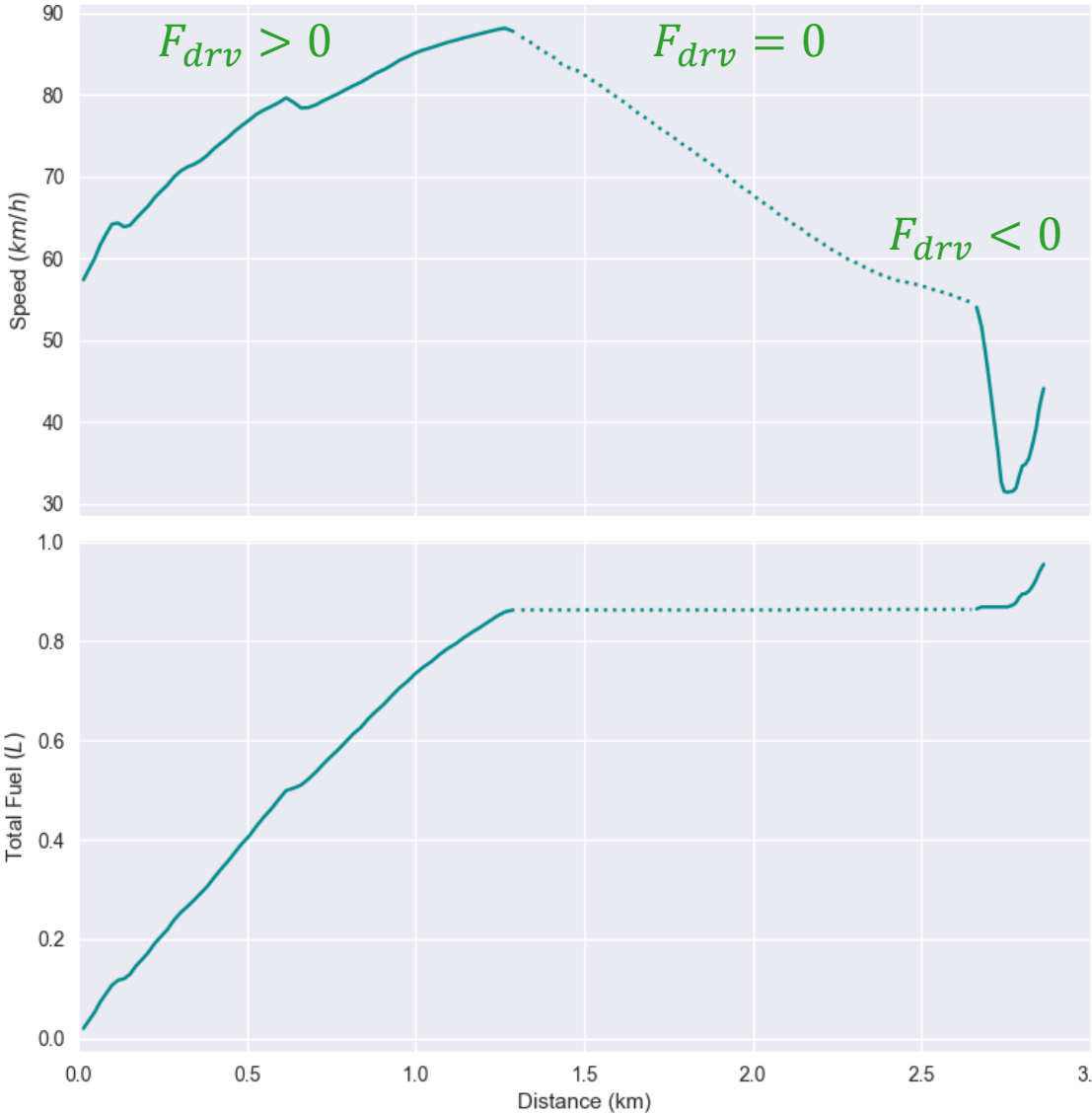
Decarbonizing Road Freight: How Does Coasting Save Fuel?



$$F_{drv} = F_d + F_g + F_{rr} + gvm \frac{dV}{dt} \qquad FI_m = \frac{f}{gvm \cdot x}$$

Symbol	Name	Unit
F_d	Aerodynamic Drag	N
F_g	Gradient Force	N
F_{rr}	Rolling Resistance	N
$\frac{dV}{dt}$	Acceleration	$\frac{m}{s^2}$

Symbol	Name	Unit
FI_m	Fuel Mass Index	$\frac{L}{t \cdot km}$
f	Fuel Used	l
gvm	Gross Vehicle Mass	t
x	Distance Travelled	m





Comparing Performance: How Does Coasting Save Fuel?

Increase
Speed

Maximise
Coasting

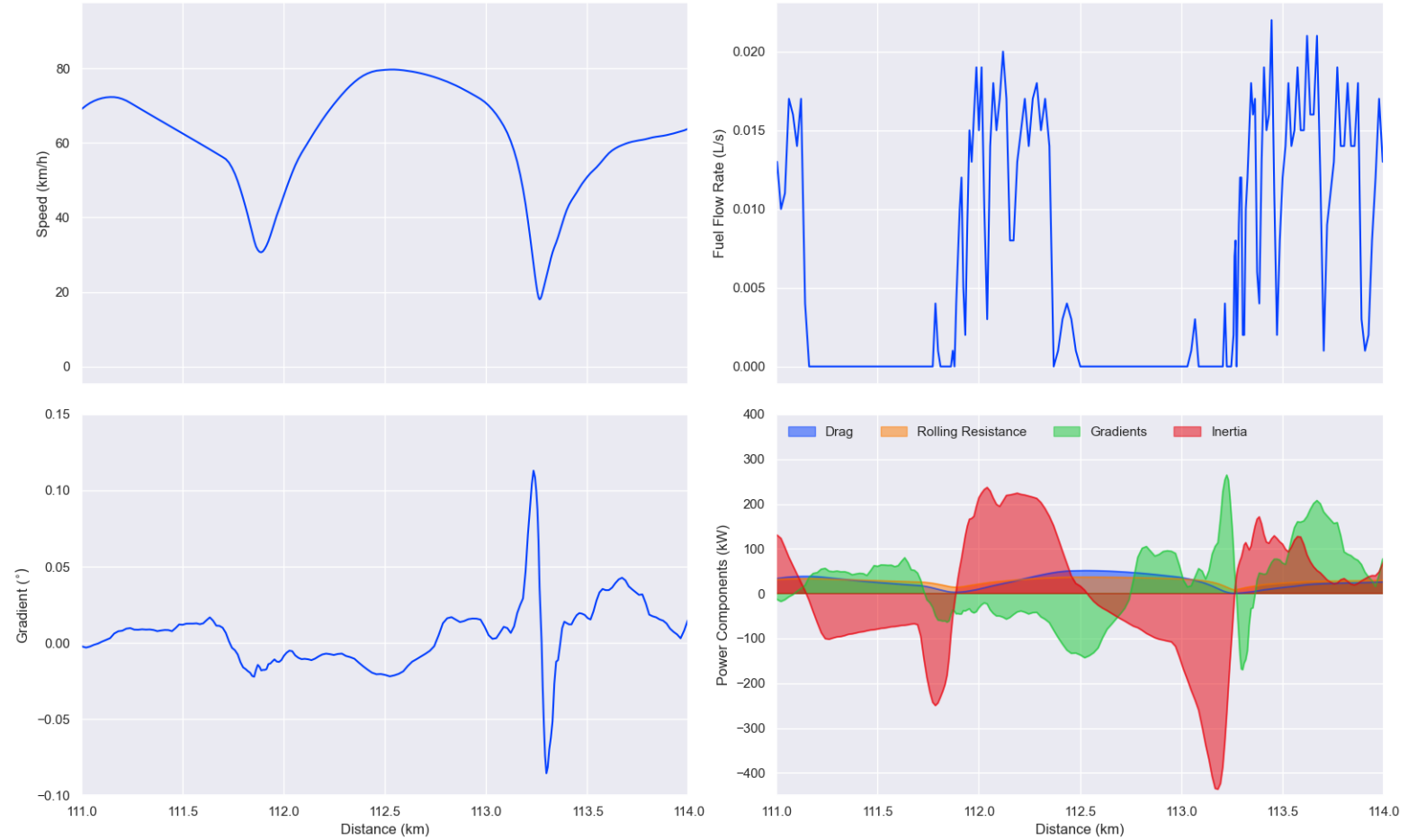
Less energy
wasted to
braking

Work done
on only
some
gradients

More energy
spent on
acceleration
and drag



Fuel Savings



Contributions of Resistive Forces to Driving Work



The Impact of Coasting: A Case Study

Route Overview

- 182 km refrigerated delivery
- 68 road segments spanning 37 m – 30 km
- 02:20 – 03:30 typical duration

Driving Style

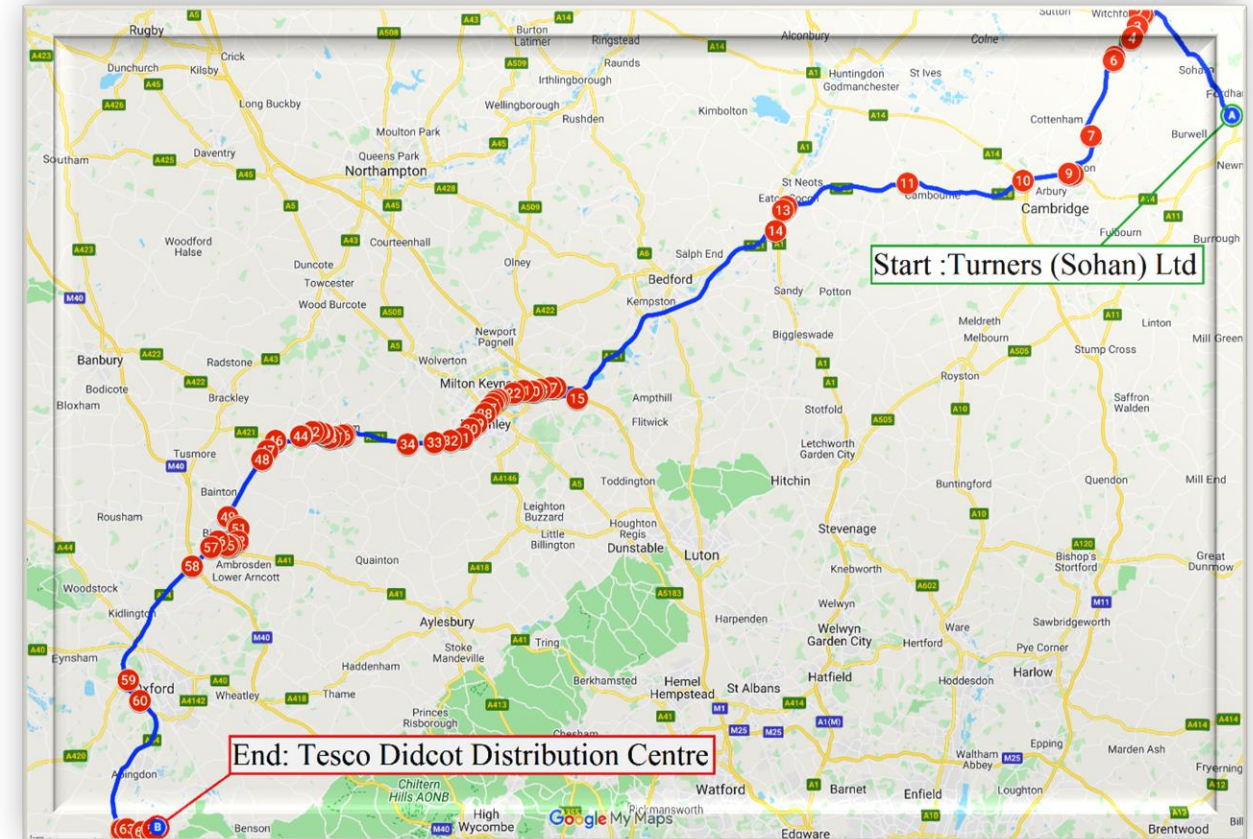
- 52 – 78 km/h average speed
- 47 km coasting (total, unaided)

Improvements

- 47 % increase in coasting (69 km total, with driver assist)
- No increase in trip duration

Potential Savings

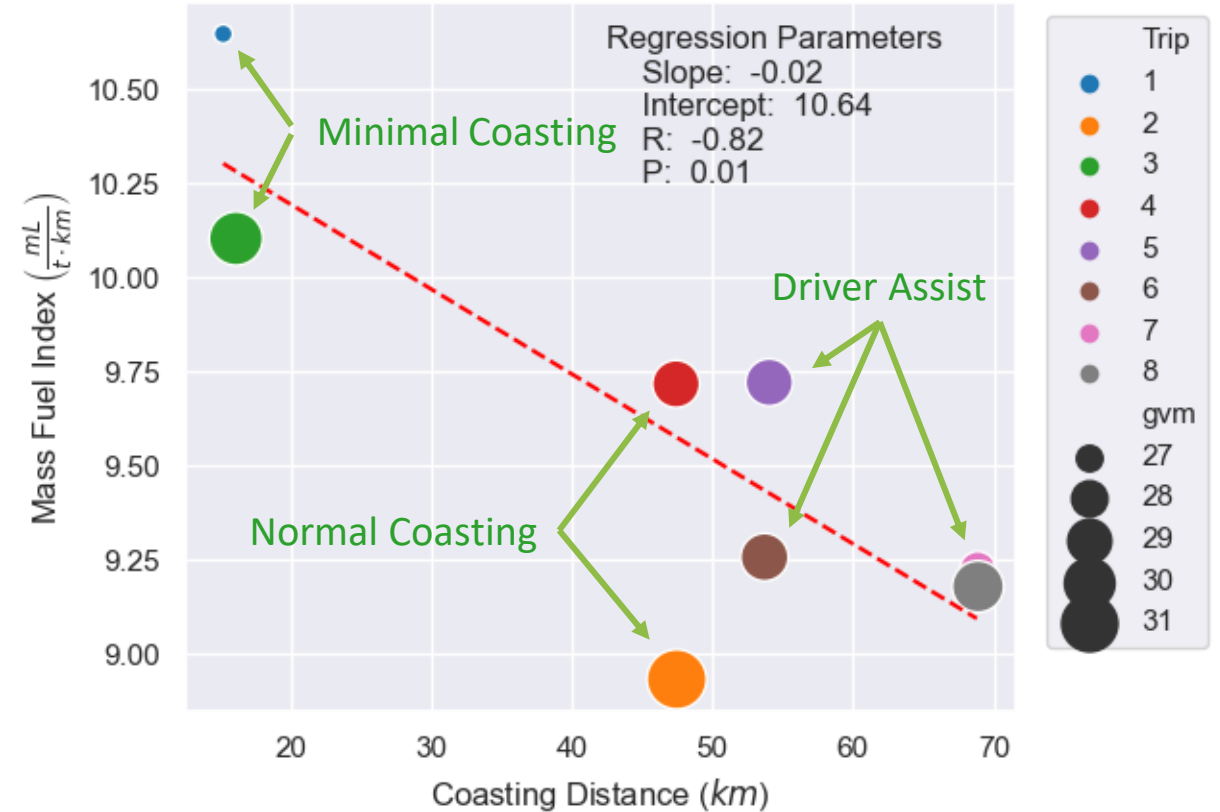
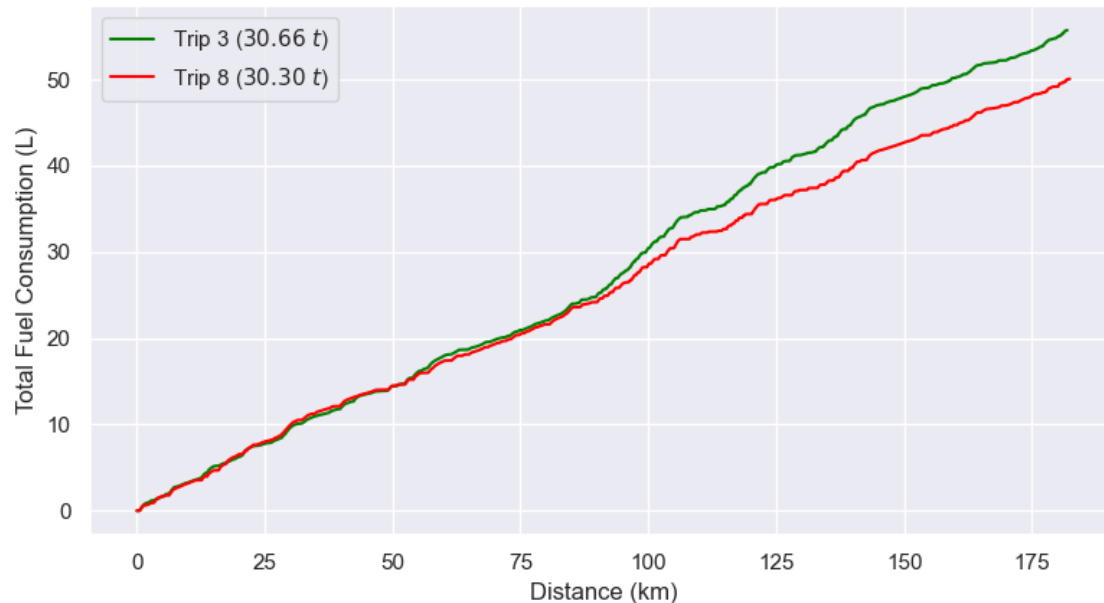
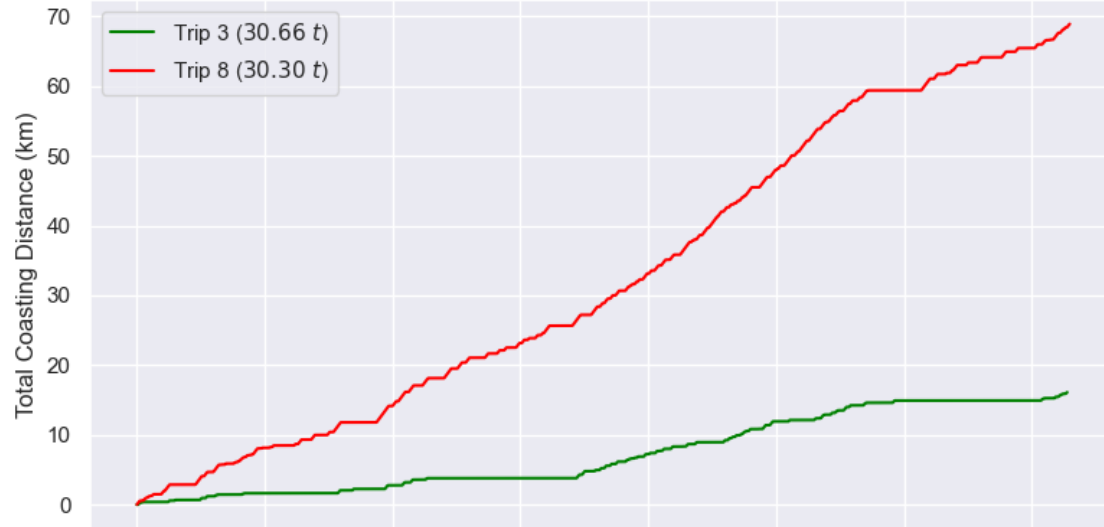
- Roughly GBP 3.08 per trip (30 t vehicle)
- 2 % fuel reduction per 10 % increase in coasting distance



Testing Route: Newmarket to Didcot, UK



The Impact of Coasting: Trip-Wide Fuel Savings



Neglect Coasting



⊘ 7 % Losses ⊘

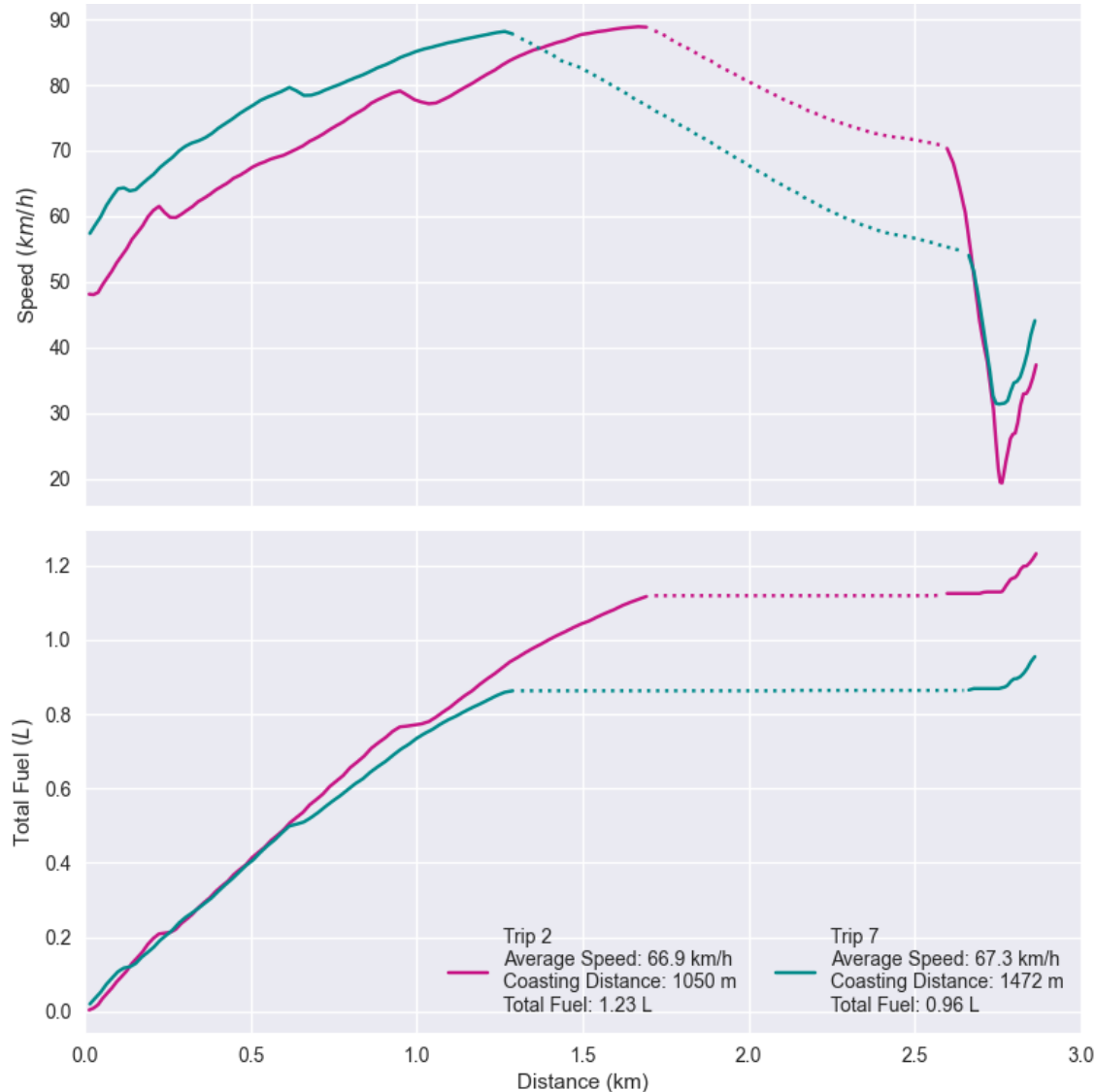
Driver Assist



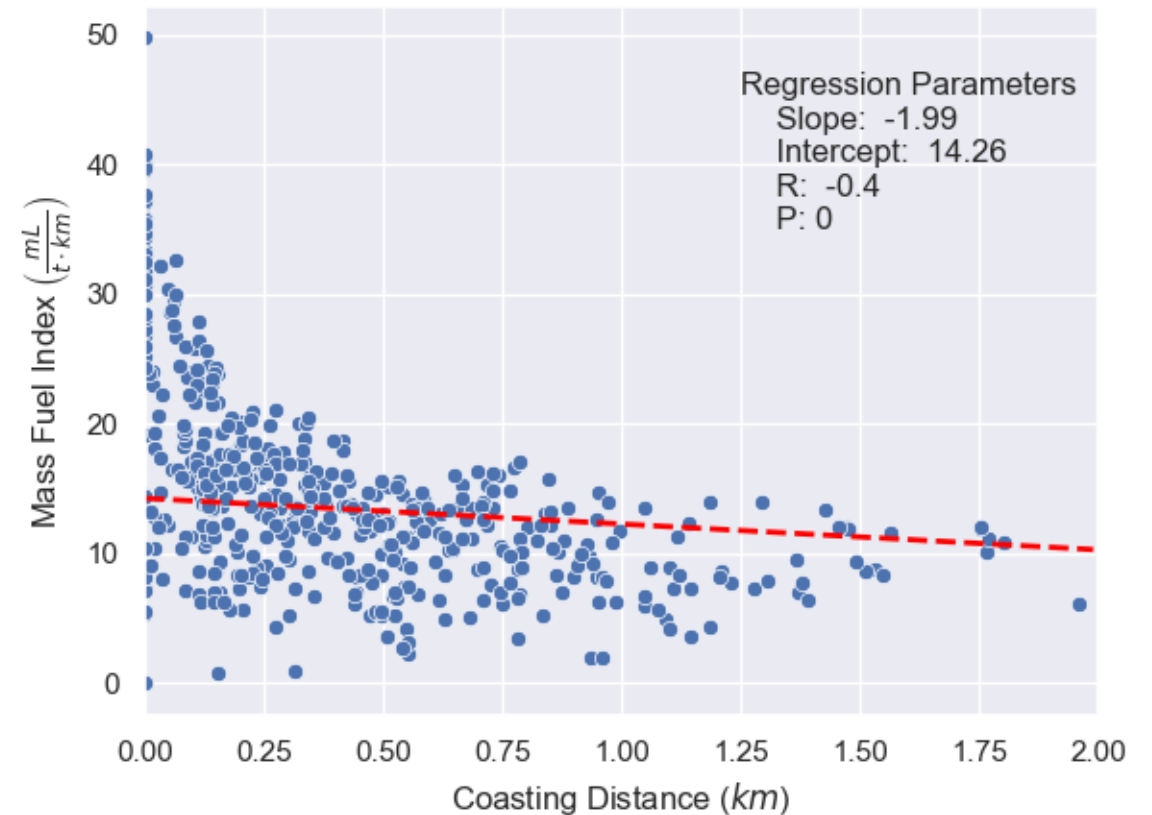
✓ 4 % Savings ✓



The Impact of Coasting: Segment-by-Segment Fuel Savings



- Coasting distance on some segments can be **doubled**
- Up to **20% fuel savings** on individual segments





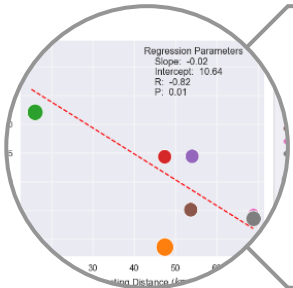
Conclusions & Future Work

Put to the Test: Coasting In Ecodriving



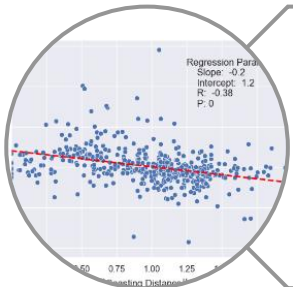
Where

- Newmarket to Didcot (UK)
- 182 km refrigerated delivery route
- 68 road segments spanning 37 m – 30 km



Why

- GBP 3.08 fuel savings per trip (30 t vehicle)
- 4% savings per trip
- Up to 20 % fuel savings per segment



How

- 47 % increase in coasting distance through driver assist
- Doubling of coasting distance on individual segments

Observation



High Total Coasting Distances

High Segment Coasting Distances

Outcome



Low Fuel Consumption

Strategy



Maximise coasting distance

Short Road Segments

Low Initial Speed

High Coasting Distances

Low Fuel Consumption

Coast early to pre-empt acceleration



Questions?

www.csrf.ac.uk

Acknowledgements

The authors wish to thank Turners (Soham) Ltd for facilitating this research, especially through access to their vehicles and drivers. Particular thanks to Steven Thorpe, Sandra Bennis and Terry Skelton of Turners for their invaluable contributions.

References

- Ayyildiz, K., Cavallaro, F., Nocera, S., and Willenbrock, R. (2017) 'Reducing fuel consumption and carbon emissions through eco-drive training', *Transportation Research Part F: Traffic Psychology and Behaviour*, 43(A), pp. 96-110.
- Department for Business, Energy & Industrial Strategy (2021) *Final UK greenhouse gas emissions national statistics: 1990 to 2019*, Available at: <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2019> (Accessed: 16th September 2021).
- Department for Transport (2020) *Average heavy goods vehicle fuel consumption: Great Britain*, Available at: <https://www.gov.uk/government/statistical-data-sets/energy-and-environment-data-tables-env#fuel-consumption-env01> (Accessed: 16th September 2021).
- Department for Transport (2020) *Greenhouse gas emissions by transport mode: United Kingdom*, Available at: <https://www.gov.uk/government/statistical-data-sets/energy-and-environment-data-tables-env#fuel-consumption-env01> (Accessed: 16th September 2021).
- Kurani, K. S, Sanguinetti, A., & Park, H. (2015). 'Actual Results May Vary: A Behavioral Review of Eco-Driving for Policy Makers', *UC Davis: National Center for Sustainable Transportation*. Retrieved from <https://escholarship.org/uc/item/39z9766p>