Soft-Linking a TIMES Model and Sectoral Simulation Model for Individual Policy Measures

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A TRADITION OF INDEPENDENT THINKING

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- …. Modelling on the shoulder of giants
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  - CarSTOCK model development – Hannah Daly[2,3]

[1] Chiodi, A., Gargiulo, M., Rogan, F., Deane, J.P., Lavigne, D., Rout, U.K., Ó Gallachóir, B.P., 2013. Modelling the impacts of challenging 2050 European climate mitigation targets on Ireland's energy system. Energy Policy 53, 169-189.

[2] **Daly, H.E.** & Ó Gallachóir, B.P. (2011), 'Modelling private car energy demand using a technological car stock model', Transportation Research Part D: Transport and Environment 16(2), 93–101.

[3] **Daly, H.E.** & Ó Gallachóir, B.P. (2011), 'Modelling future private car energy demand in Ireland', Energy Policy 39, 7815–7824.

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Overview

- TIMES provides cost-optimal scenarios and technology pathways
- However, the results in certain sectors may be difficult (or infeasible) to achieve
- Simulation models can provide more detail for these sectors and hence can be used to inform individual policies and measures
- Creating a soft-link between these two models can be used to test and inform possible future policies
- A combination of the Irish TIMES model and a model of the Irish private car fleet (CarSTOCK) is presented

CarSTOCK Model

- The CarSTOCK model is a simulation model of the private car fleet in Ireland projected forwards to 2050
- The model takes inputs of percentage share of car sales and drivers and projects the private car fleet stock and energy on an annual basis to 2050
- Vehicles are disaggregated into a range of variables with given specific energy consumption for each type
- This allows for the calculation of total energy and emissions in the private transport sector

CarSTOCK Model

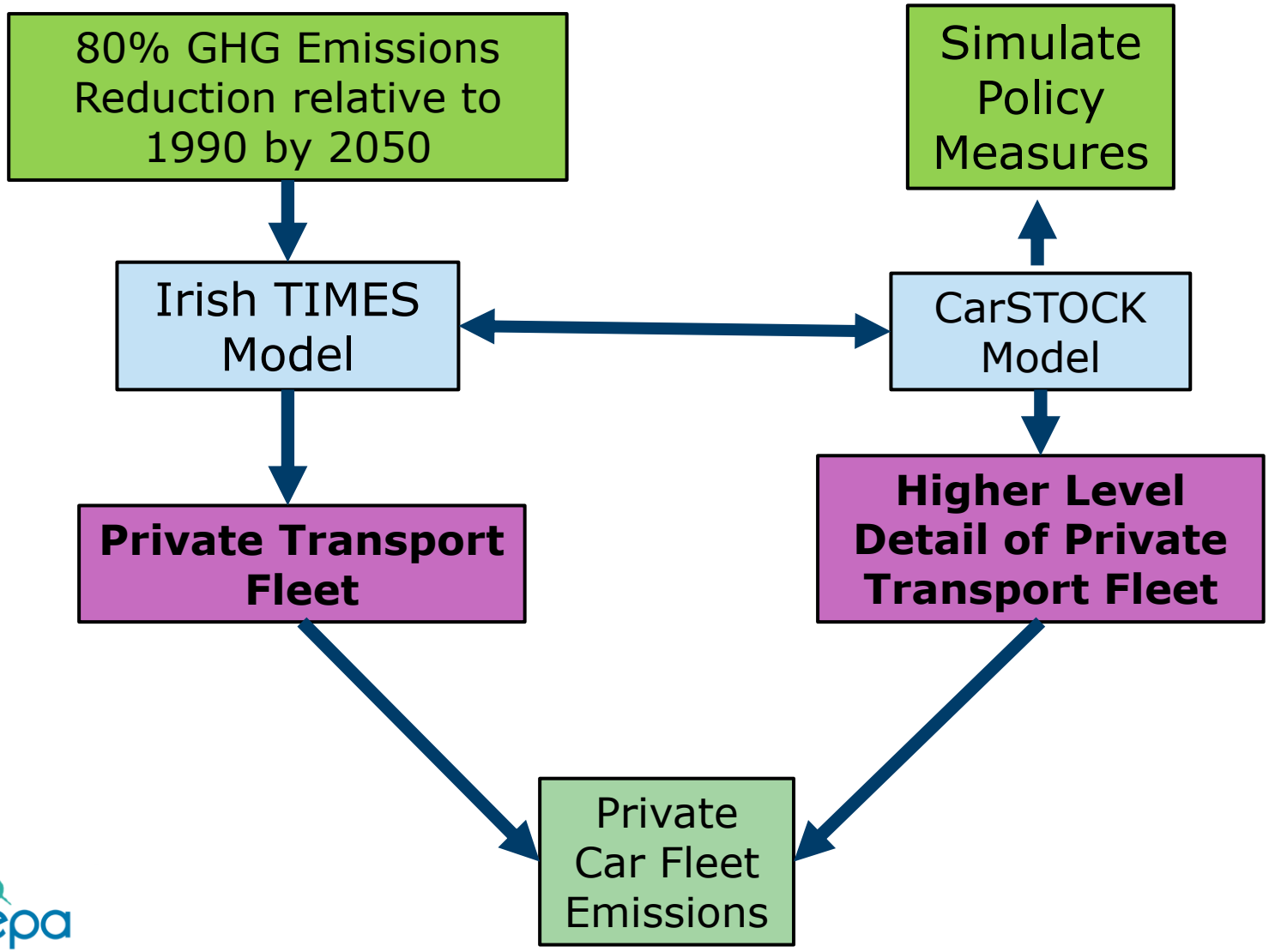
- The CarSTOCK model provides a higher level of detail of the transport sector than the Irish TIMES model

- Disaggregated by fuel type, engine band and age

Variable name	Unit	Fuel type	Engine band	Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Stock	Vehicles	Petrol	<900cc	All	6,563	5,916	5,662	5,497	5,315	5,200	5,066	4,960	4,814	4,659	4,511	4,369	4,229
Stock	Vehicles	Petrol	900-1200cc	All	284,670	261,123	256,807	256,228	254,680	256,137	256,573	258,295	257,795	256,643	255,600	254,725	253,719
Stock	Vehicles	Petrol	1200-1500cc	All	703,671	653,653	655,108	665,800	673,768	689,696	702,940	719,848	730,566	739,275	748,143	757,335	765,969
Stock	Vehicles	Petrol	1500-1700cc	All	278,796	260,627	263,643	270,499	276,335	285,734	294,286	304,739	312,788	320,109	327,638	335,456	343,163
Stock	Vehicles	Petrol	1700-1900cc	All	122,448	112,879	111,850	112,504	112,773	114,496	115,872	117,980	119,163	120,097	121,141	122,322	123,495
Stock	Vehicles	Petrol	1900-2100cc	All	96,959	89,038	87,715	87,732	87,462	88,333	88,947	90,135	90,626	90,946	91,363	91,901	92,450
Stock	Vehicles	Petrol	>2100cc	All	40,699	37,462	37,037	37,181	37,208	37,733	38,159	38,848	39,247	39,578	39,957	40,396	40,845
Stock	Million Vehicles	Petrol	All	All	1.53	1.42	1.42	1.44	1.45	1.48	1.50	1.53	1.55	1.57	1.59	1.61	1.62

Variable name	Unit	Fuel type	Engine band	Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Stock	Vehicles	Petrol	<900cc	0	9	10	15	15	15	15	15	15	16	16	16	16	16
Stock	Vehicles	Petrol	<900cc	1	28	33	53	69	72	74	70	68	64	60	58	55	56
Stock	Vehicles	Petrol	<900cc	2	36	51	76	107	125	130	128	123	116	107	101	97	95
Stock	Vehicles	Petrol	<900cc	3	110	59	93	128	161	181	182	179	169	158	147	139	135
Stock	Vehicles	Petrol	<900cc	4	128	133	101	146	183	218	235	234	225	212	199	186	178
Stock	Vehicles	Petrol	<900cc	5	131	149	173	152	198	236	268	282	276	264	249	234	222

Process



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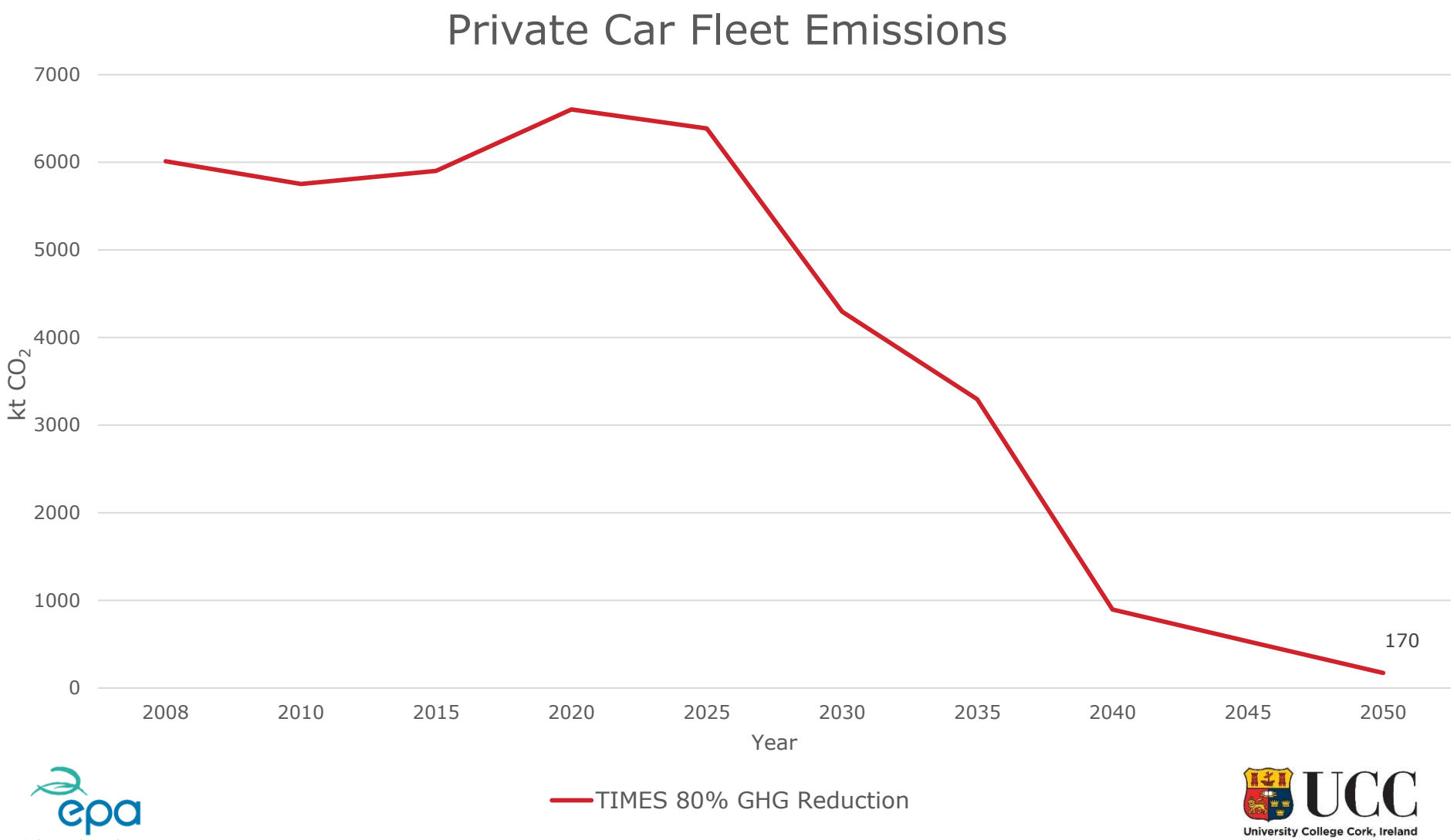
The Low Carbon Roadmap – Irish TIMES Private Transport

(80% overall GHG Emissions Reduction by 2050 relative to 1990)



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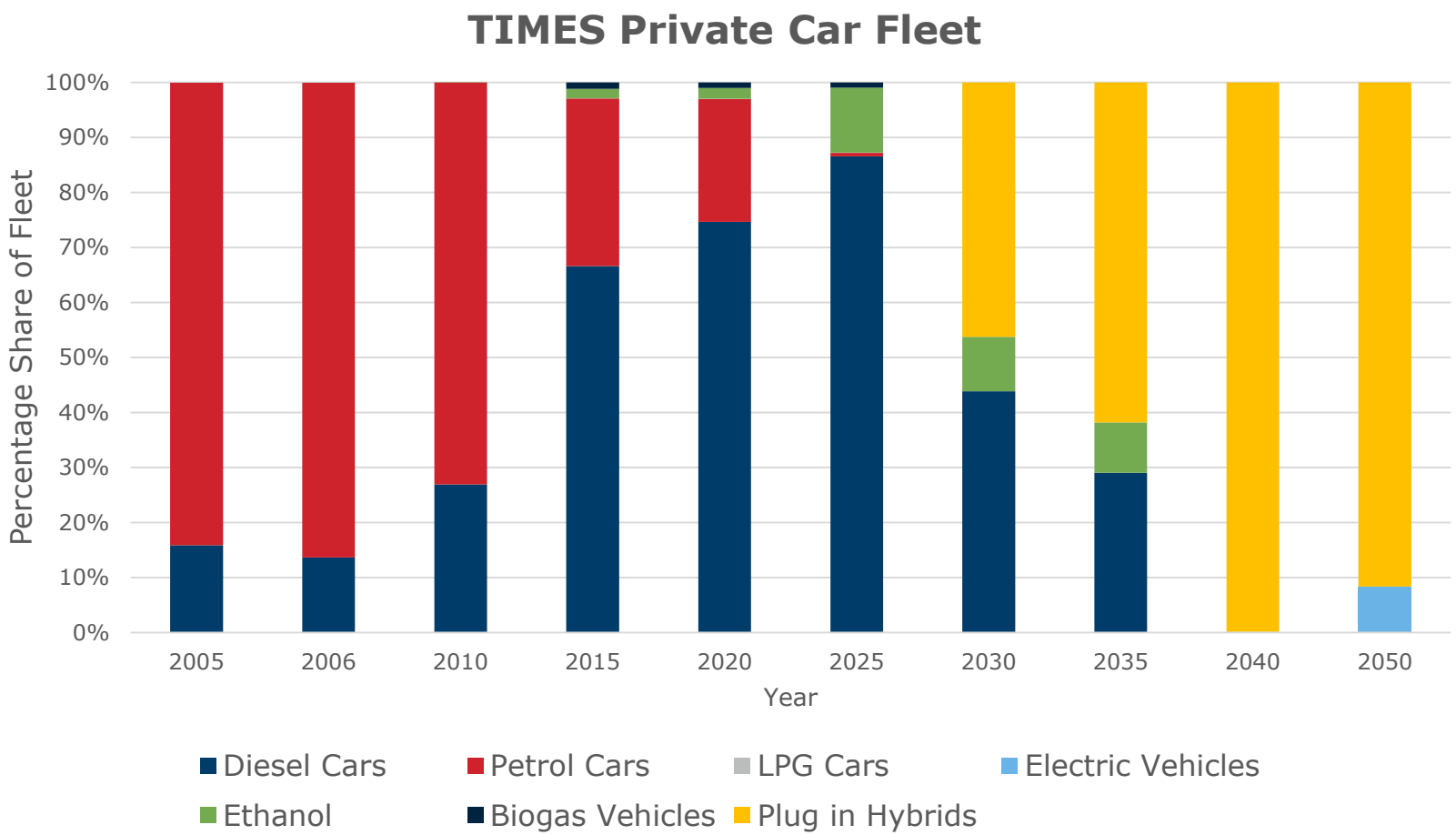
The Low Carbon Roadmap
Private Car Fleet



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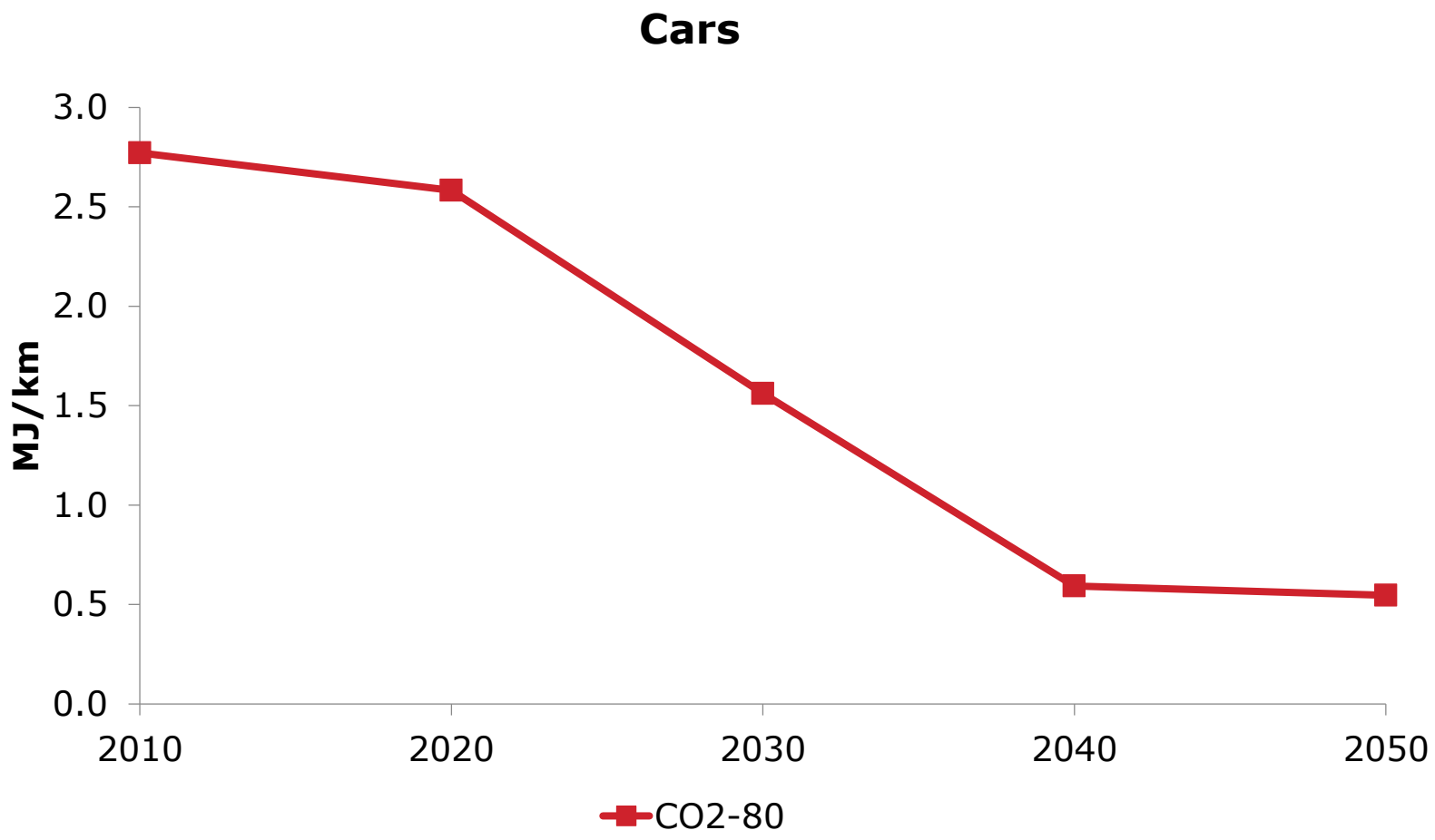
The Efficiency Trend in TIMES



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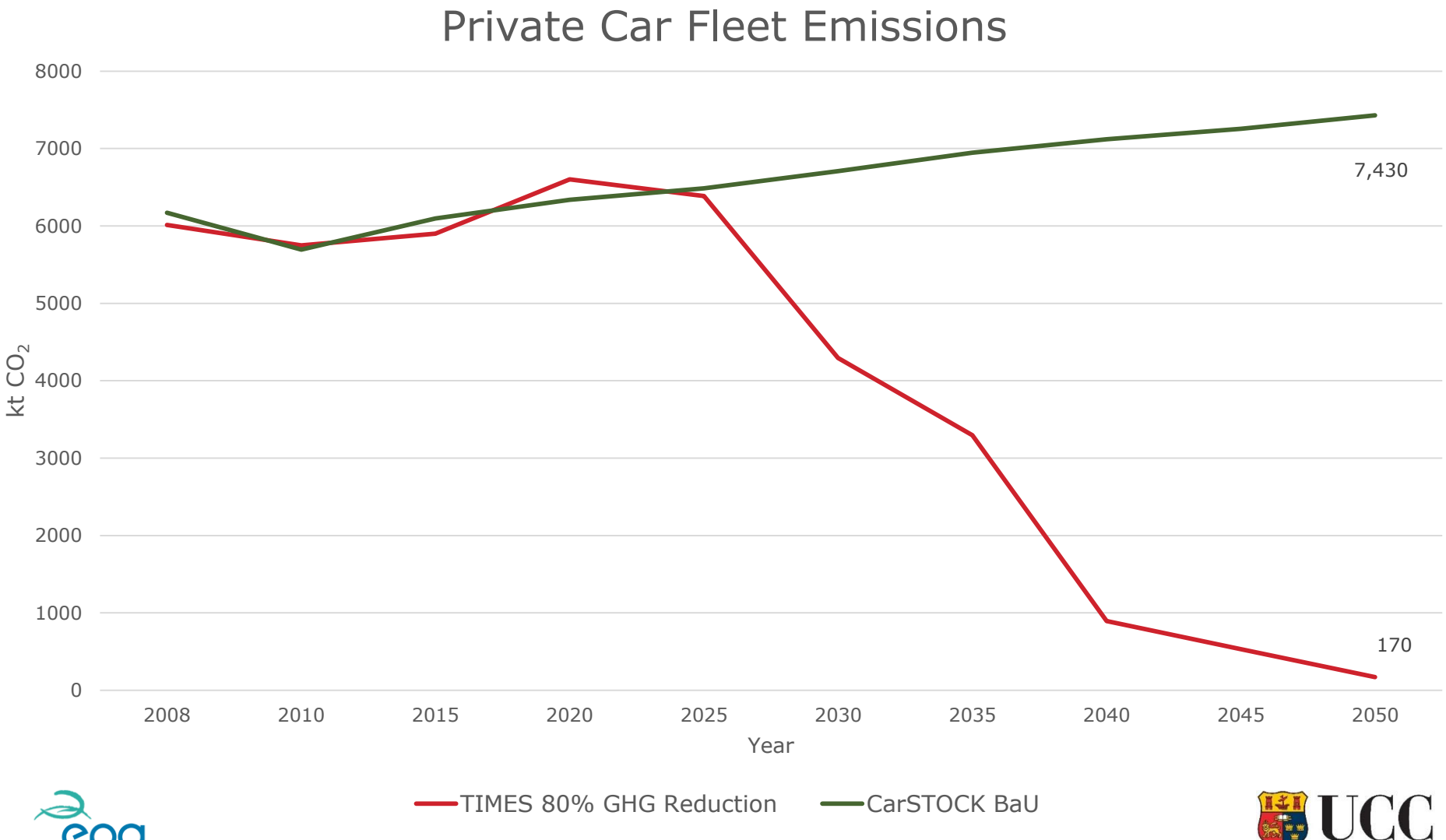
CarSTOCK BaU



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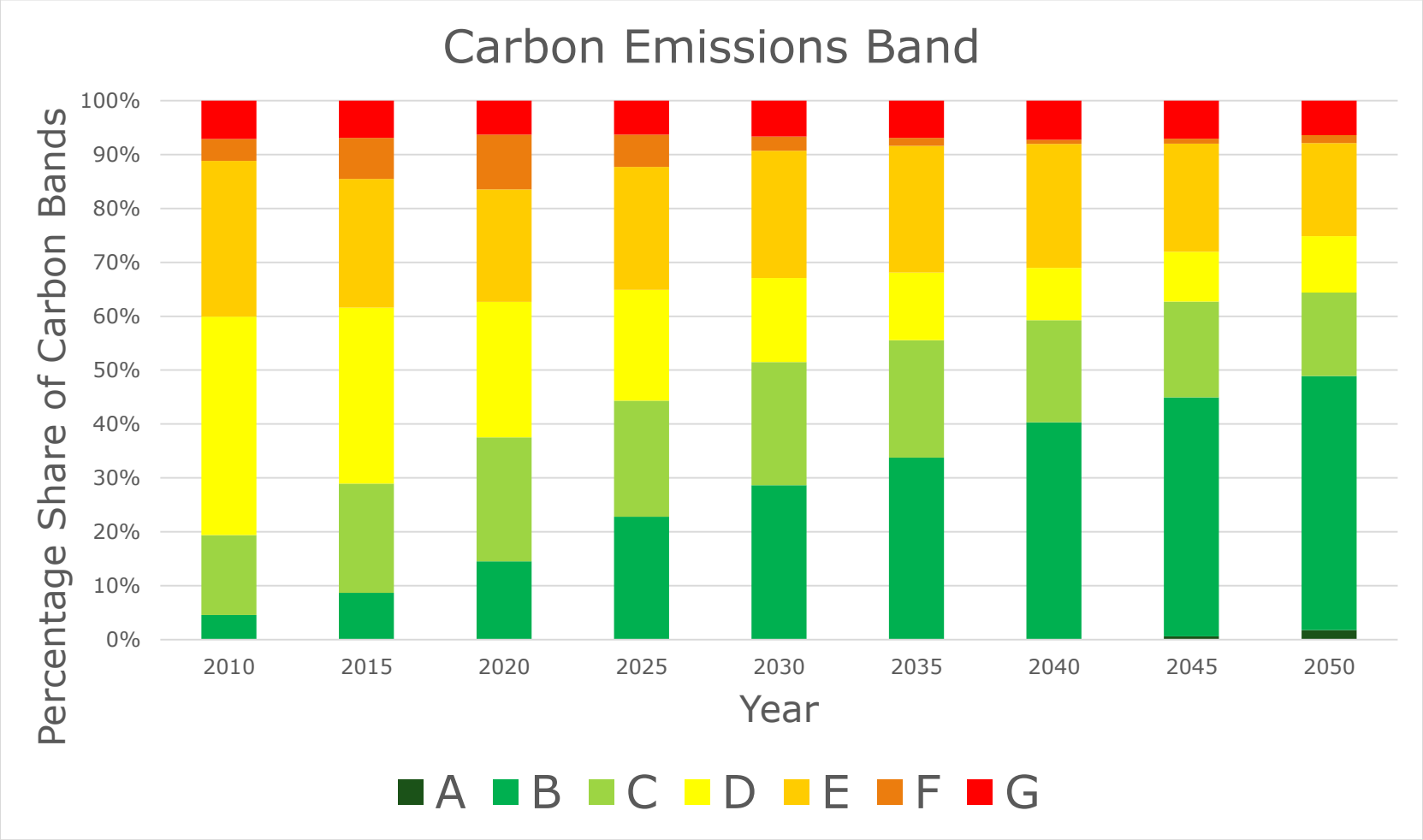
BaU Private Car Efficiency



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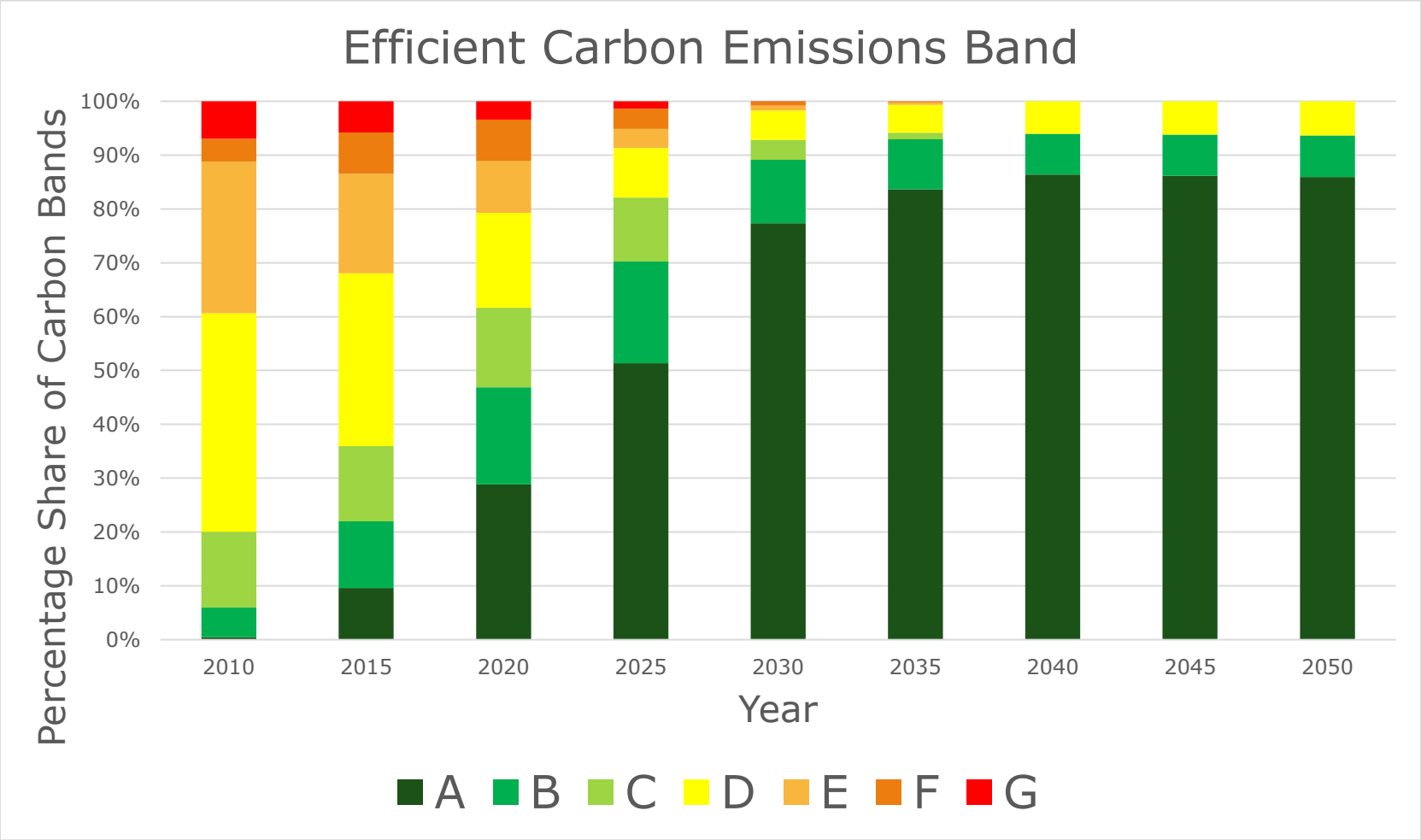
More Efficient Vehicles Scenario



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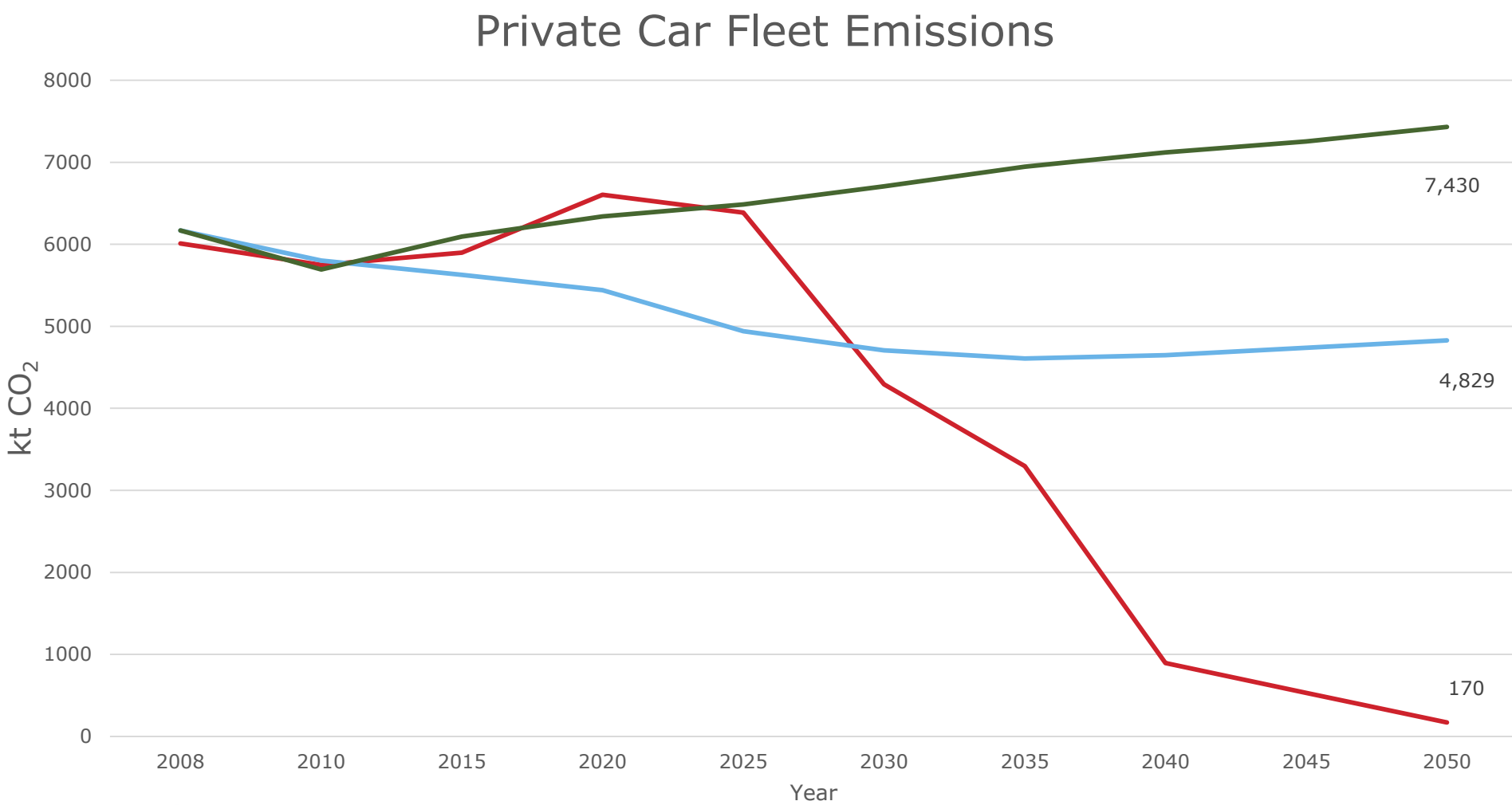
CarSTOCK BaU



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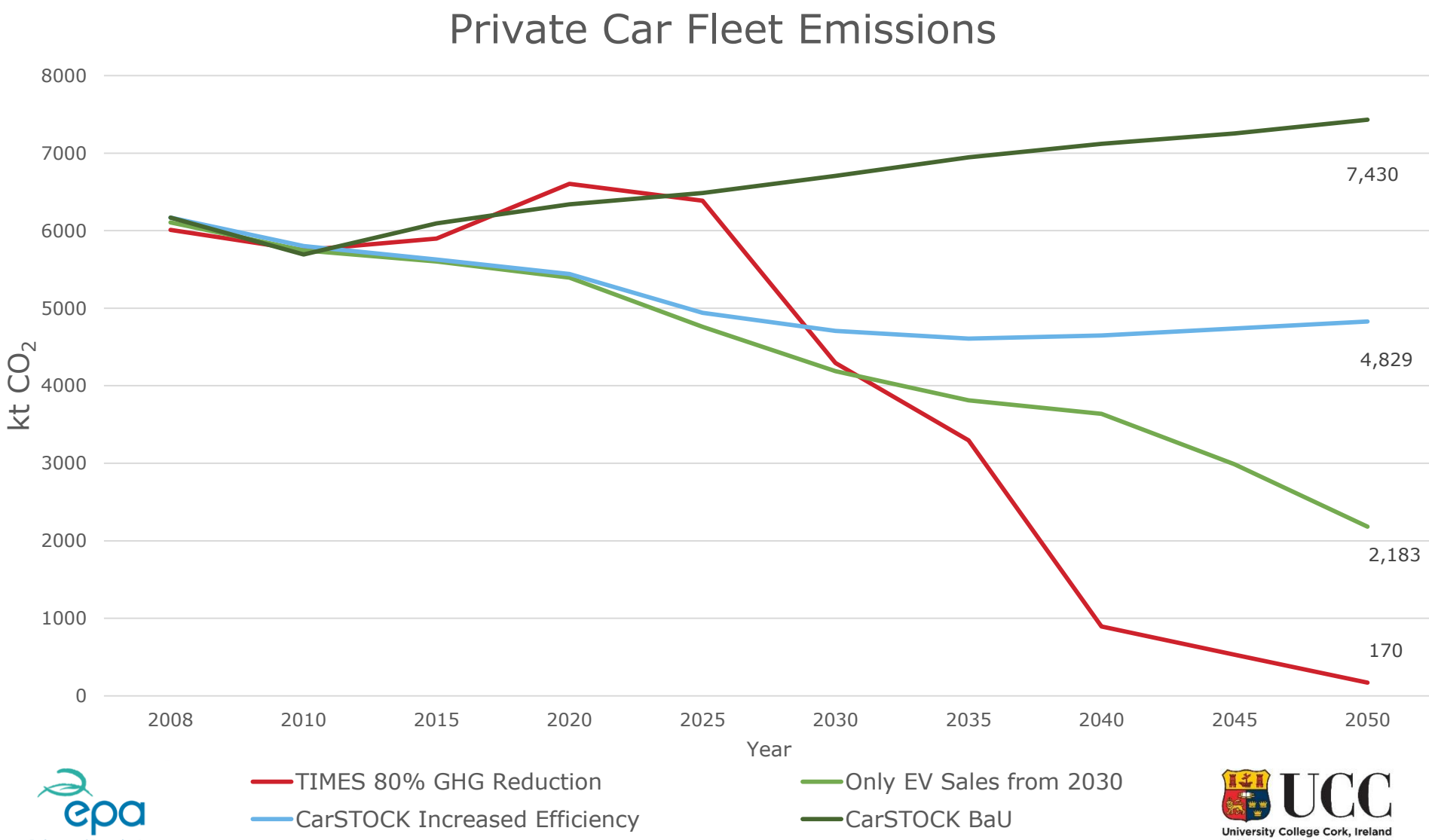
Only EV Sales from 2030



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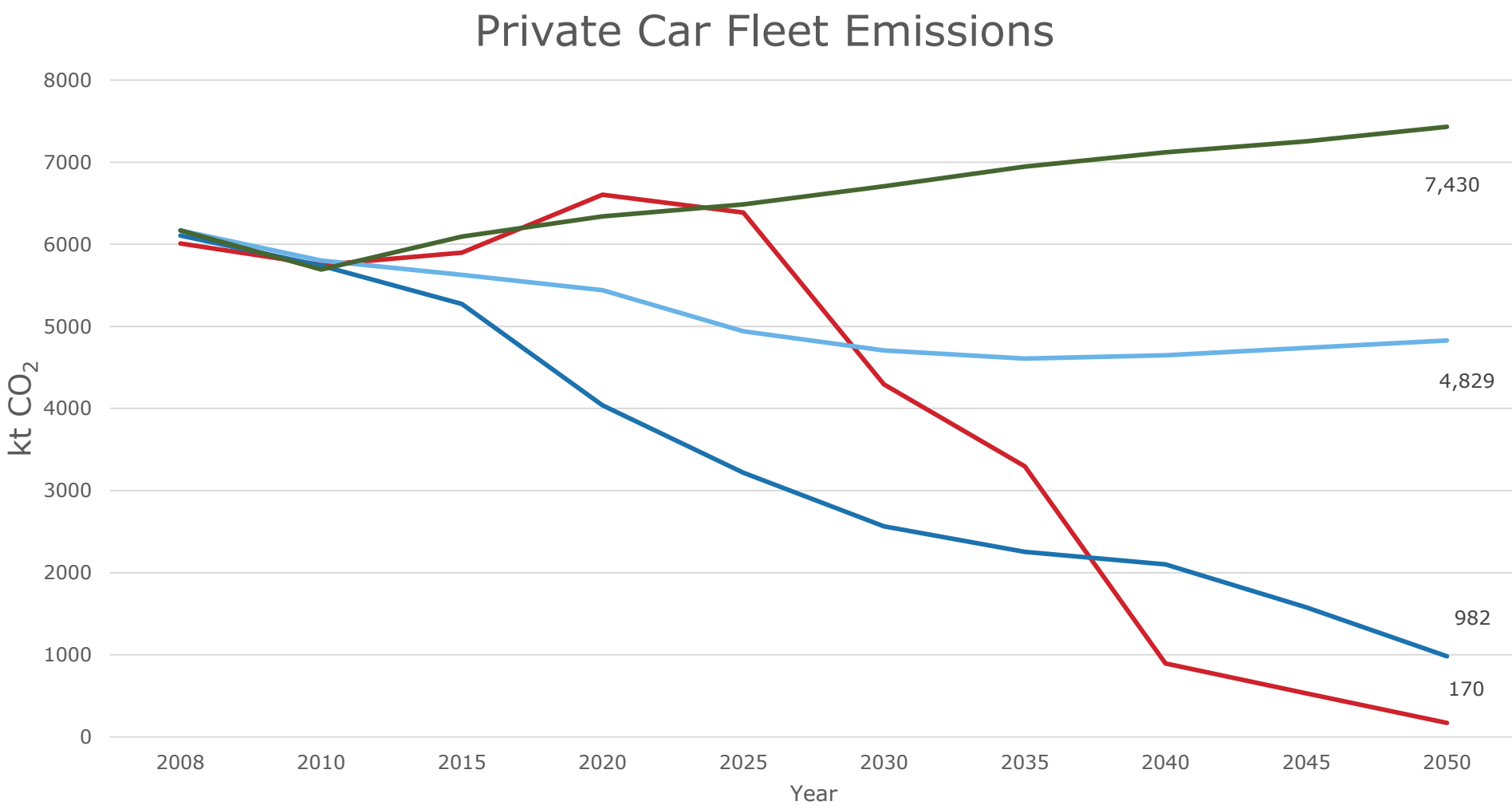
EVs + Smarter Travel



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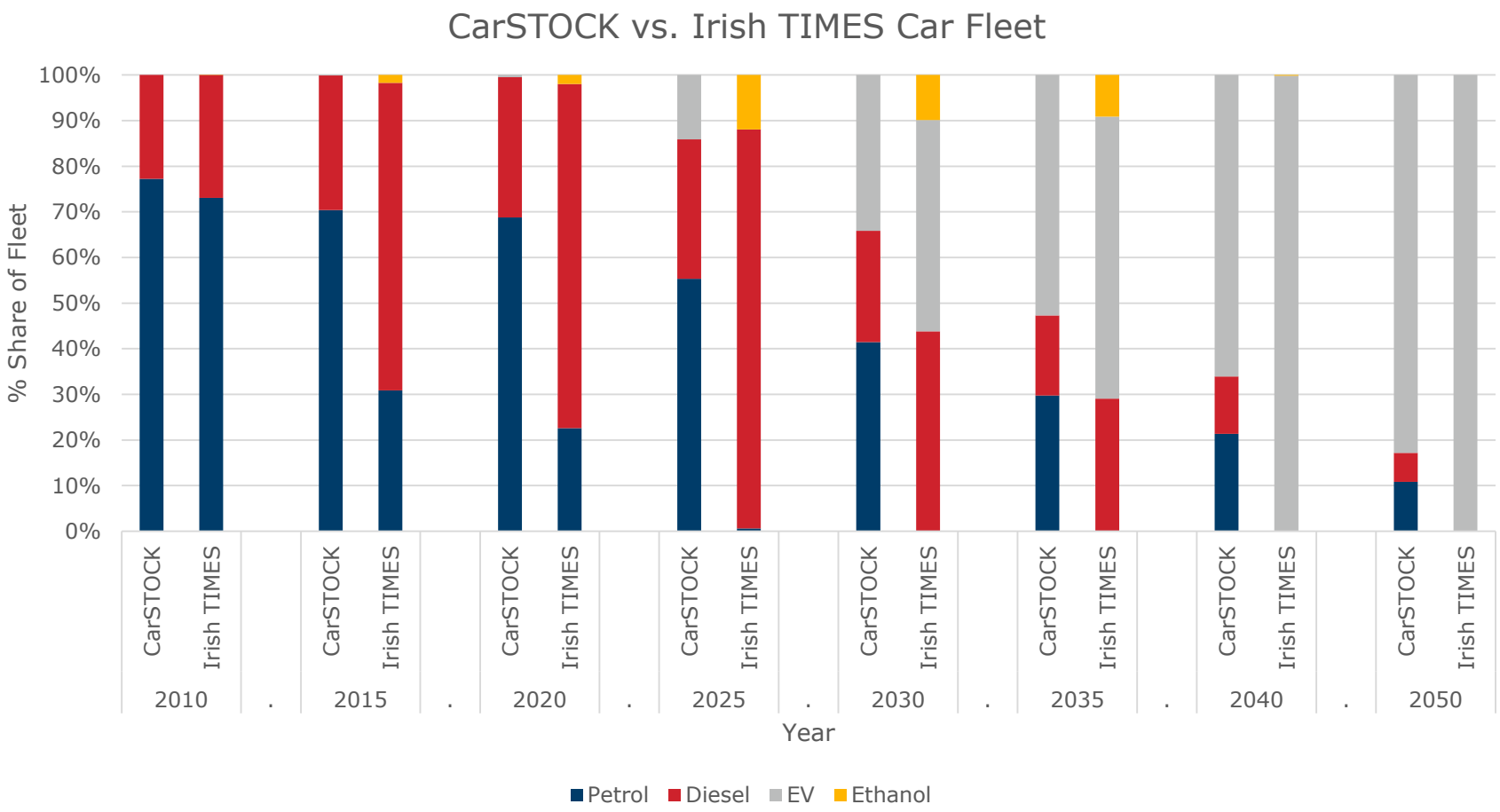
CarSTOCK and TIMES Private Car Fleet Comparison



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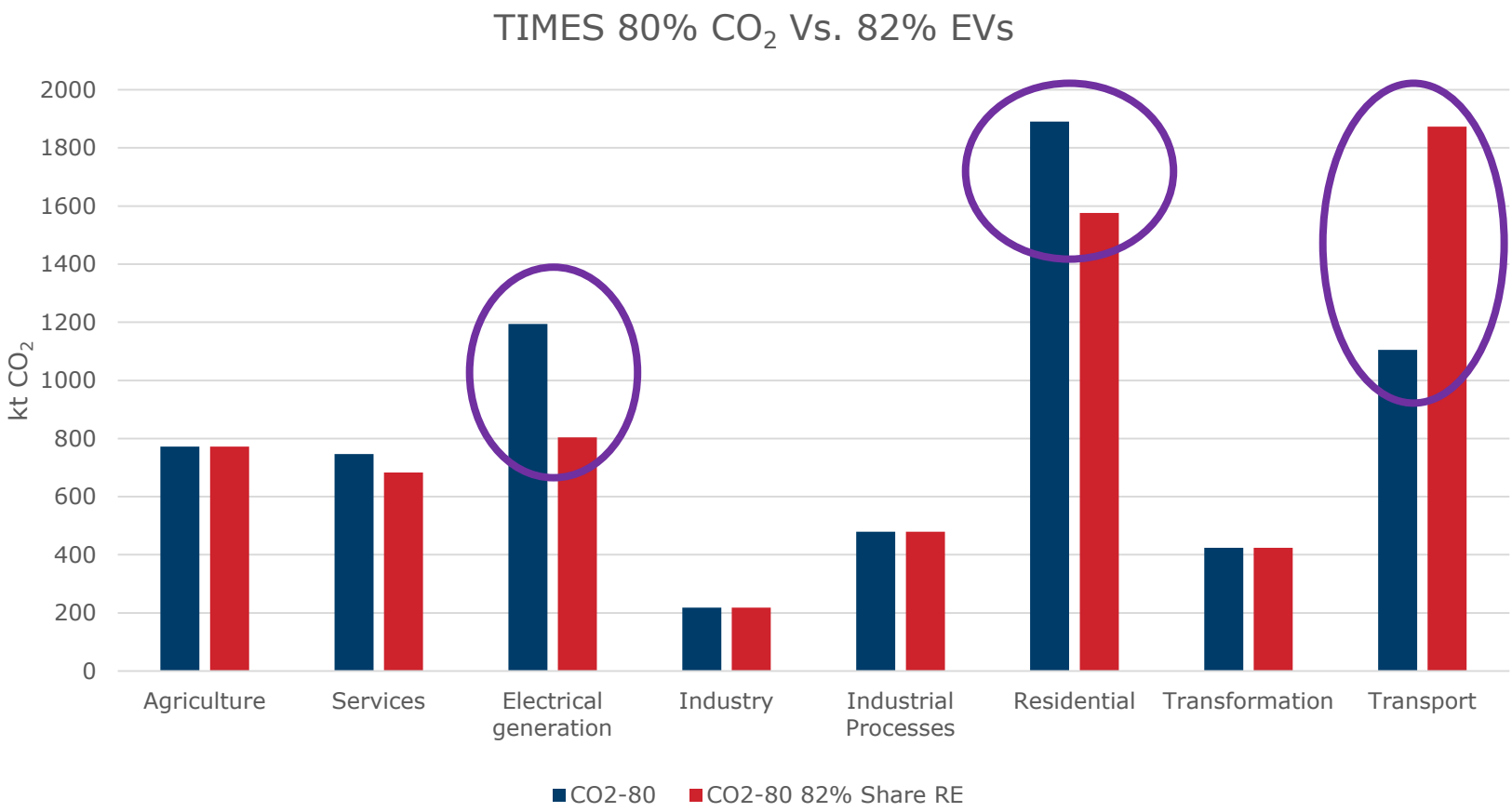
Insights into Individual Policy Measures

- These results can be used to give several insights into individual policy measures:
  - Only selling Electric Vehicles from 2030 onwards
  - Introduction of incentives to create a shift towards public transport use or for better bicycle infrastructure
  - After that, introducing a scrappage scheme may be necessary to meet our 80% GHG reduction by 2050 according to TIMES
- Otherwise it may be required to change the inputs for Irish TIMES.

Irish TIMES 82% EVs Constraint – Results



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Conclusion

- Creating a soft-link between a sectoral simulation model with an optimisation model can provide insights into individual policy measures
- It can test a range of possible policies which could inform on the paths to be taken in reaching given targets
- It also creates an iterative methodology whereby the constraints of the optimisation model can be changed according to the sectoral simulation model
- This soft-linking methodology can be used with any sector in order to create effective policies[4]

[4]Deane, J.P., Dineen, D., Chiodi, A., Gargiulo, P. Gallagher, Ó Gallachóir, B.P., 2013. The Electrification of Residential Heating in Ireland Using Heat Pumps. Working Paper

Thank You

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Survival Rates in CarSTOCK

$$Surv_t(Y-v) = Avg_y \left(\frac{Stock^{y}_{t,y-(Y-v)} - Stock^{y-1}_{t,y-(Y-v)}}{Stock^{y-1}_{t,y-(Y-v)}} \right)$$

$$Stock^{Y}_{t,v} = Stock^{Y-1}_{t,v} \times \left(Surv_t(Y-v) + 1 \right)$$

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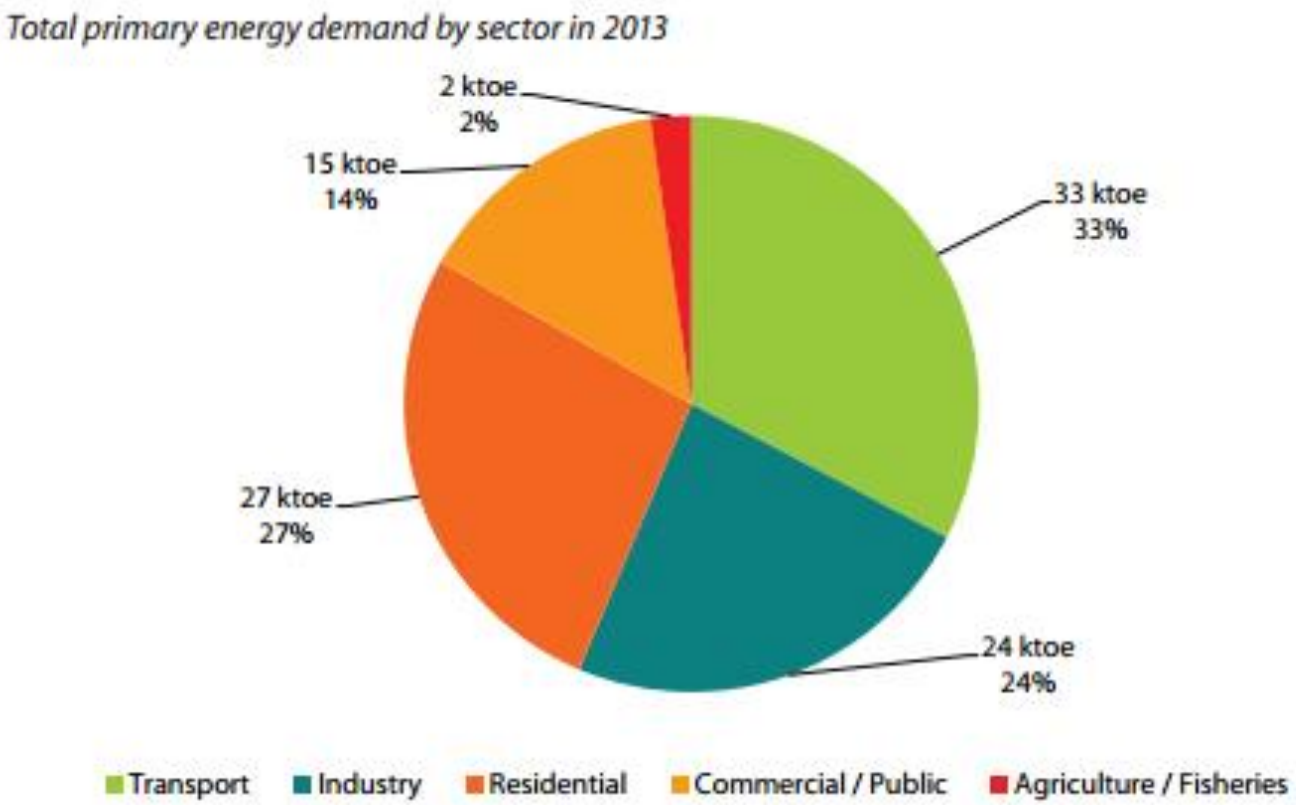
TPER in Ireland 2013



Source: SEAI

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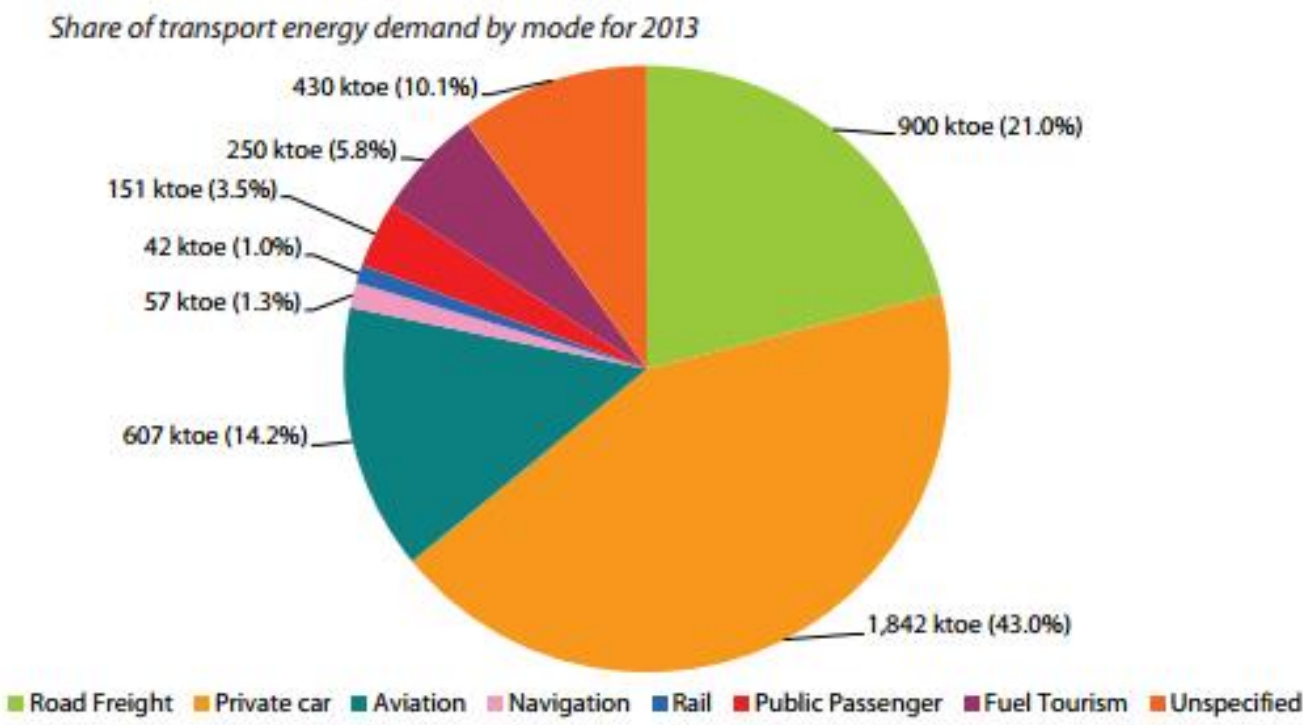
Transport Energy Demand 2013



Source: SEAI

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