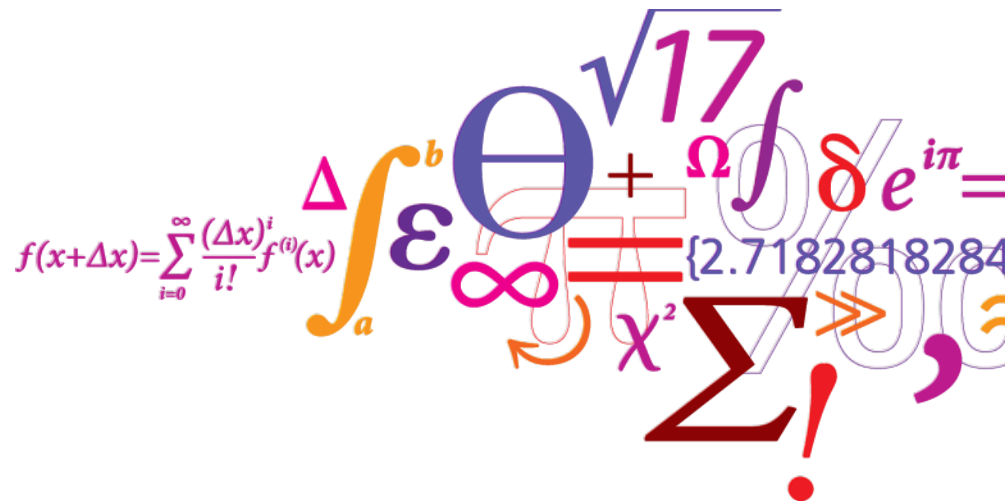


# Improvements to the representation of technology's retirement profile – The case of the Danish car sector

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# Background

Issue identified during analyses for ETSAP book soft-linking TIMES-DKMS and DCSM

*"One limitation relates to the fact that TIMES-DKMS results do not take into account that even with a ban on ICE vehicles in 2025, there would still be some ICE vehicles circulating in 2050 according to DCSM (without any incentive for early scrapping)."*

Tattini et al. (2018). A long-term strategy to decarbonise the Danish inland passenger transport sector. ETSAP Book "Limiting Global Warming to Well Below 2° C: Energy System Modelling and Policy Development"

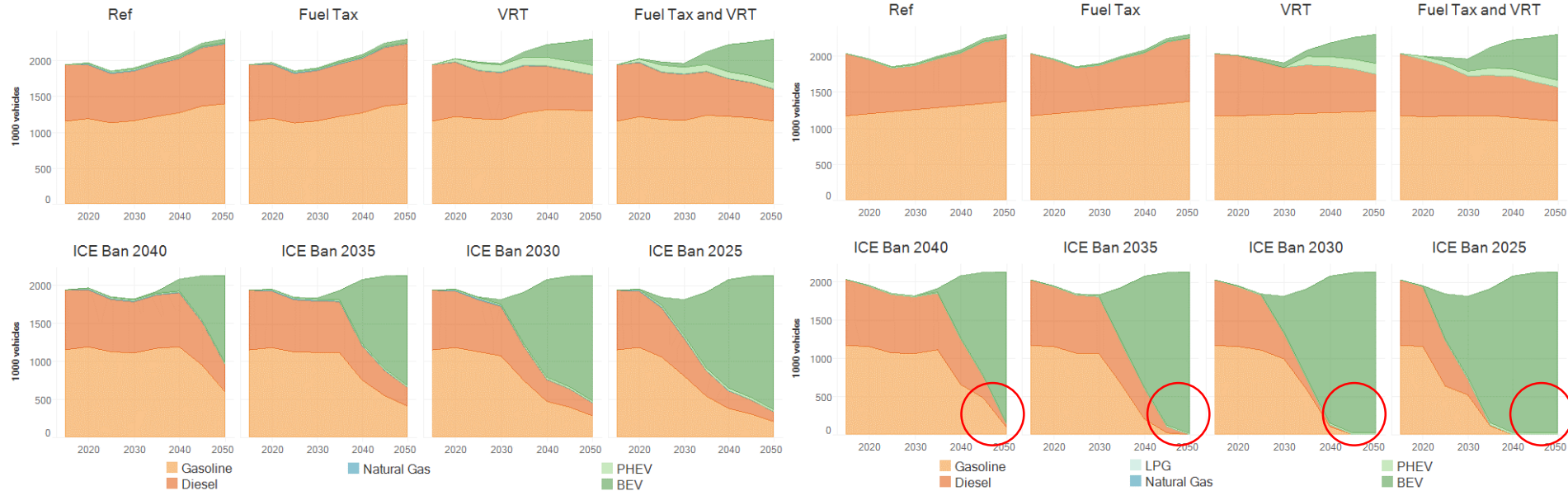
*"The Irish TIMES model uses a constant 15 year lifetime for vehicles, while in the CarSTOCK model lifetimes are based off historic scrappage profiles which are realistically longer than the Irish TIMES assumption. This results in a larger percentage of the car fleet in the CarSTOCK model to be fuelled by fossil fuels in 2050 while the Irish TIMES model has all electric vehicles by this year."*

Mulholland et al. (2015). Top-down and bottom-up policy evaluation – a multi-model approach, ECEEE Summer Study proceedings

# Motivation

## DCSM

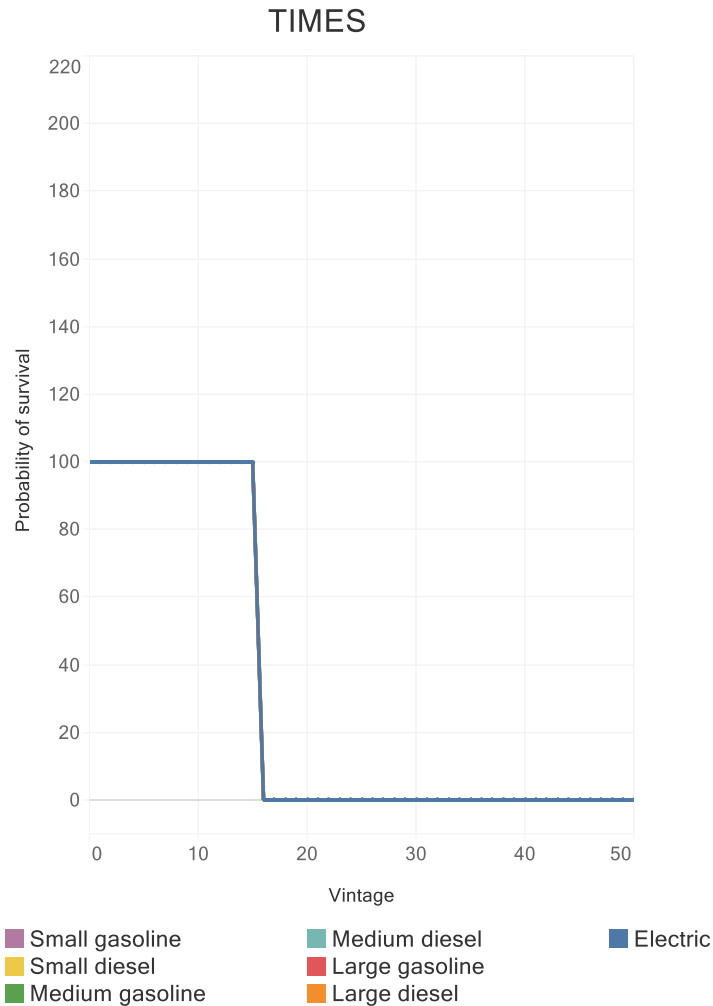
## TIMES-DKMS



- The comparison of the results reveals that TIMES is not flexible enough concerning the definition of the retirement profile of new technologies
- The overestimation of the replacement of current technologies with new low- or zero- carbon technologies has several implications

# Technology retirement profile

Retirement profile for new cars in Denmark



Mulholland et al (2018). The Cost of Electrifying Private Transport – Evidence from an Empirical Consumer Choice Model of Ireland and Denmark. Transp. Res. D

# New TIMES attribute

- Attribute available in TIMES v4.2.0
- $NCAP\_CPX(r,y,p)$
- New **capacity shape attribute** is able to shape the available capacity of a process by age
- It defines how much of the capacity installed in vintage year  $v$  is still available in period  $t$
- The capacity shape attribute is multiplied by the new *SHAPE* index parameter

*Source: Lethila A. (2017), Shaping of available capacity by age - New TIMES feature suggested by M. Gargiulo (Proposal received: 17 Sep 2017)*

# Syntax in VEDA

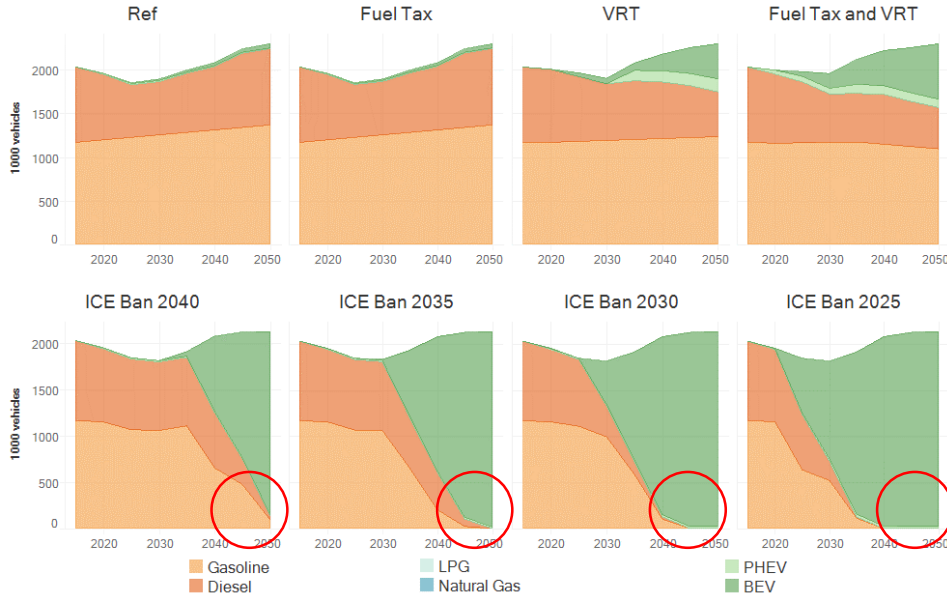
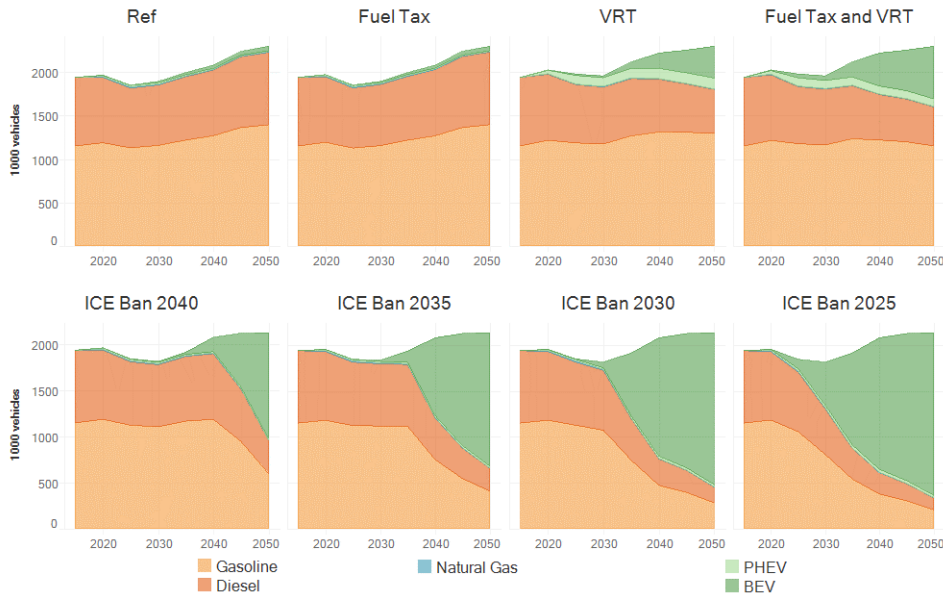
~TFM_INS					
Attribute	Year	Other_Indexes	DKE	DKW	Pset_PN
SHAPE	1	2	1.00	1.00	
SHAPE	2	2	0.95	0.95	
SHAPE	5	2	0.80	0.80	
SHAPE	10	2	0.70	0.70	
SHAPE	15	2	0.50	0.50	
SHAPE	20	2	0.30	0.30	
NCAP_CPX	2012		2	2	TPCGSBL2N
NCAP_CPX	2050		2	2	TPCGSBL2N
NCAP_CPX	0		1	1	TPCGSBL2N

~TFM_INS					
Attribute	Year	Other_Indexes	DKE	DKW	Pset_PN
LIFE	2012		25	25	TPCGSBL2N

# New results – Evolution of the car stock

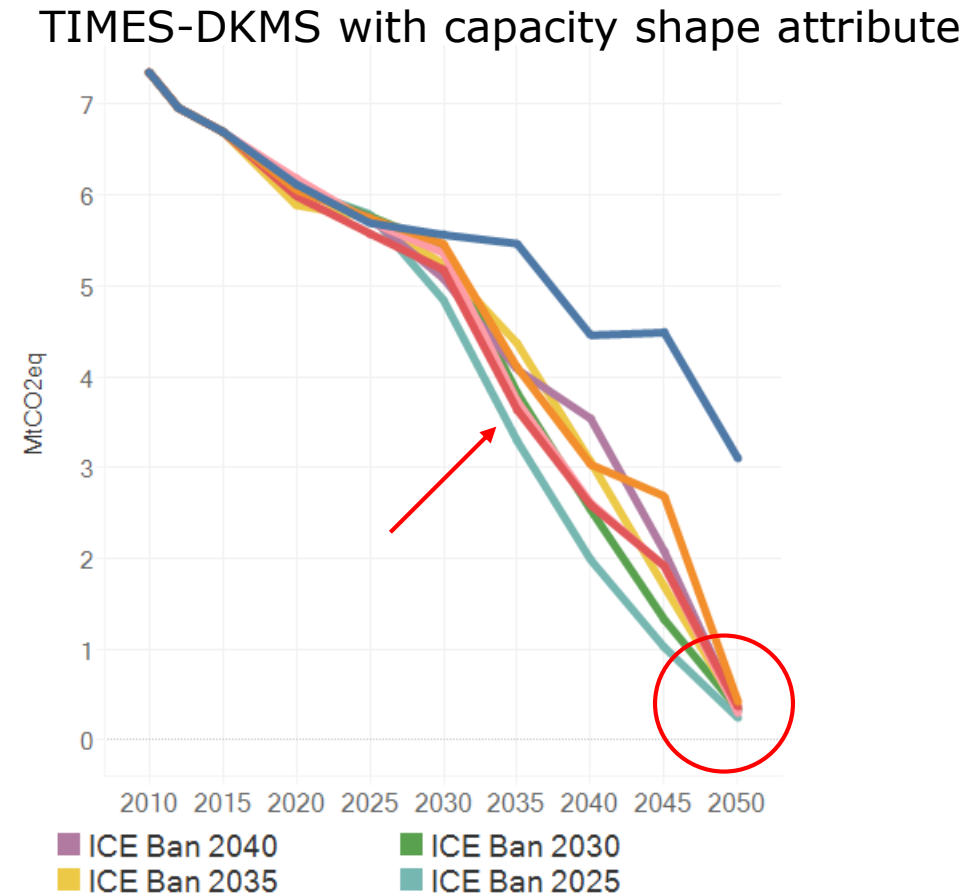
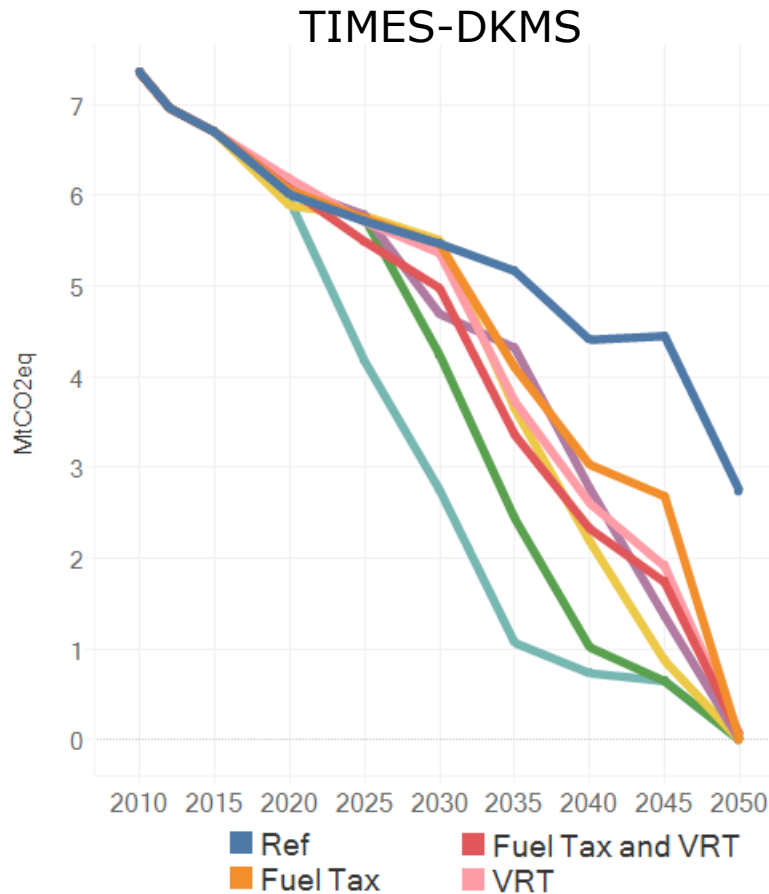
DCSM

TIMES-DKMS with capacity shape attribute



- Thanks to the new capacity shape attribute it is possible to describe new technology's retirement profile with higher realism
- This implies that, even with a ban on ICE in 2025, in 2050 there are still some gasoline and diesel ICE cars in the stock

# New results – Annual GHG emissions from inland passenger transport sector

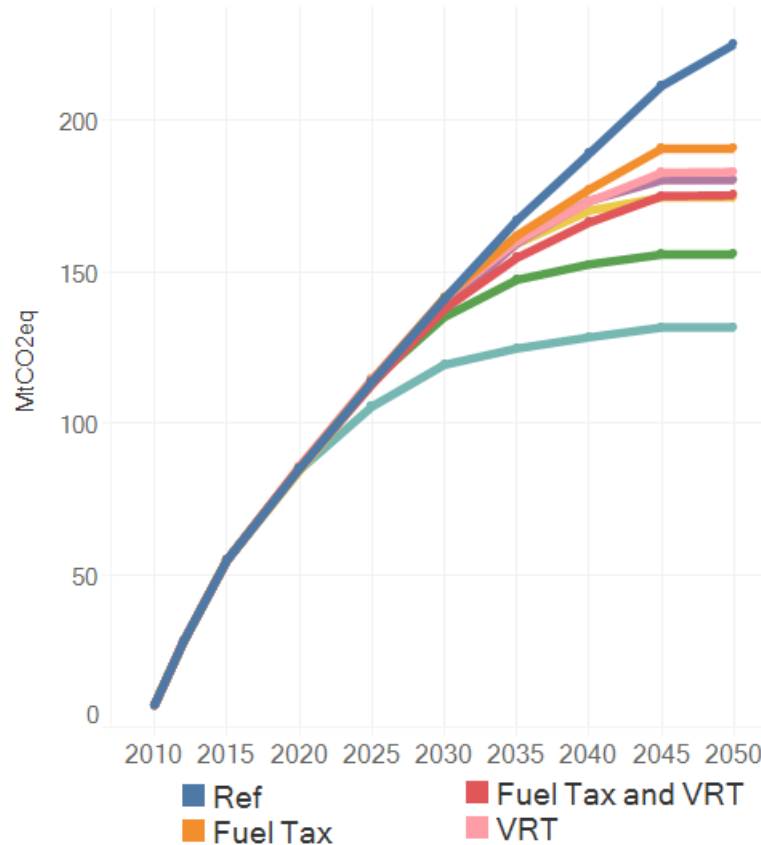


- Inland passenger transport sector does not completely decarbonize in 2050
- GHG emission reduction trend happens at slower pace in most scenarios

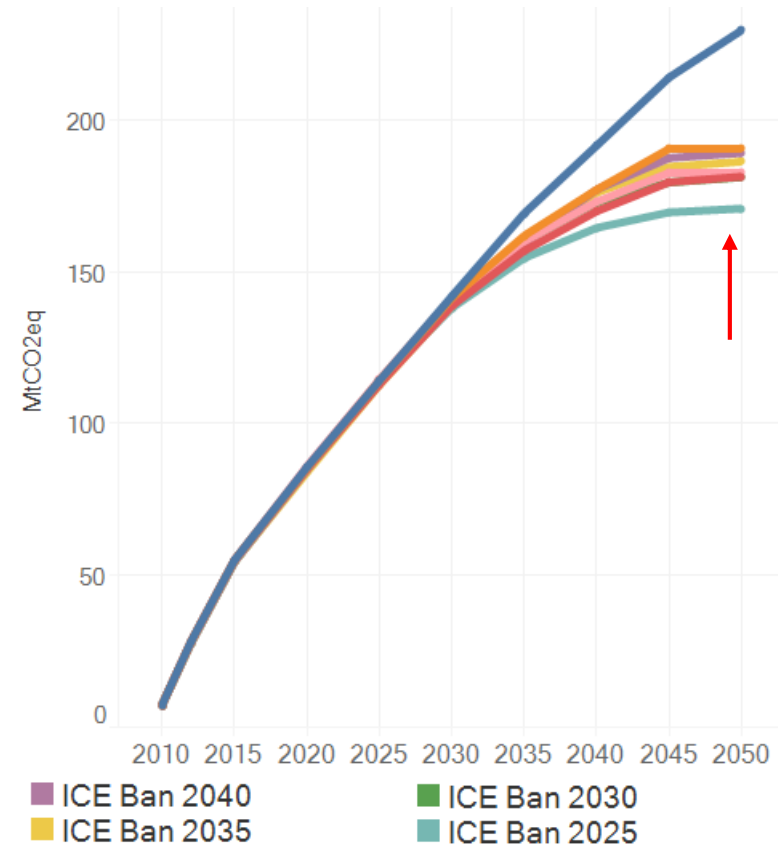


# New results – Cumulative GHG emissions from inland passenger transport sector

TIMES-DKMS



TIMES-DKMS with capacity shape attribute



- Slower decarbonization entails higher cumulative emissions!!

# Conclusions

- New **capacity shape attribute** in TIMES v4.2 enables to define more realistically the capacity of future available technologies by vintage
- Capacity shape attribute is easy to incorporate in the model
- Attribute tested on TIMES-DKMS, analyzing the effect in car sector
- More detailed and realistic representation of cars' retirement profile highlights that long permanence of cars in stock implies higher efforts for decarbonizing the car sector than initially evaluated
- "Early" scrapping incentives needed for Denmark to fulfill its decarbonisation targets for 2050



**...QUESTIONS, SUGGESTIONS?!?!**

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- **Irish TIMES and scrappage profile:** *Mulholland E., Rogan F., Ó Gallachóir B. (2015). Top-down and bottom-up policy evaluation – a multi-model approach, ECEEE Summer Study proceedings*