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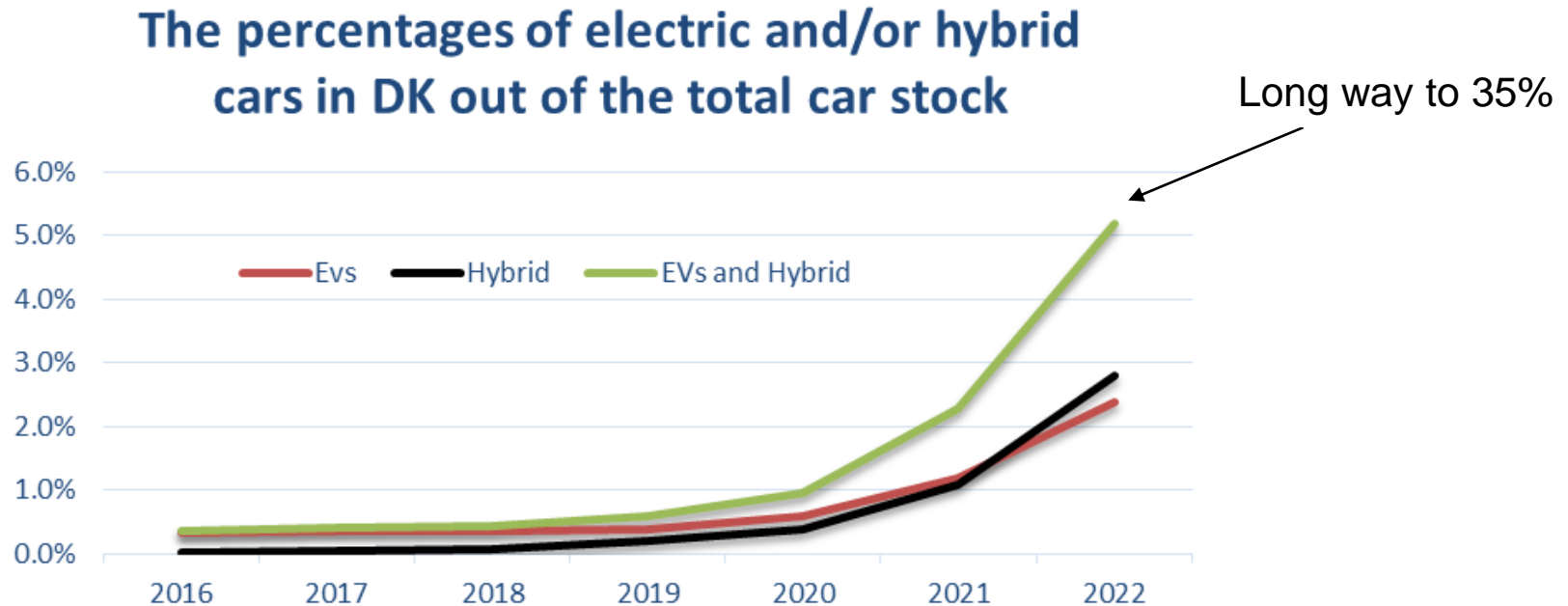


A comparison of crash, person and environment characteristics between electric and conventional vehicle

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Motivation

- **Green transition** – The Danish Government’s goal is to have more than 1. mil. Electric Vehicles (EV’s) on the Danish roads in 2030, about 35% of the stock
- We do see in the statistics that more and more people choose to drive in EV’s and Hybrid but ...



Motivation

What about the safety ??

- Literature document that the missing sound could be a safety issue for pedestrians and cyclists
- More and more media and insurance companies report problems with fire for EV's and hybrid cars



The Emergency forces are ready to stop the fire in EV's and Hybrid cars

53 year old male dies in a traffic crash after his Tesla burst into fire

It is still safer to drive EV's than Internal Combustion Engine Vehicles (ICEV's)

- Do we see the same type of crashes or should we be aware of new problems?

Data

- Crashes recorded by the Police in the Official Road Crash Registry, 2017-2021

- For each crash the following information is listed
 - a model and type for the involved cars which makes it possible to identify EV's (EV's and Hybrid cars), and ICEV's
 - information about driver characteristics, surroundings and crash type
 - a brief text description written by the police officer, based on interviews with drivers and witnesses

- In total, more than 100.000 cars were involved in a crash in the period, 2% were EV's

- In 2017 1% of the cars were EV's. In 2021 it was almost 3%

- 12% of the ICEV's crashes involved person injury, while 14% of the EV's crashes involved person injury

Analysis

- **Natural Language Processing**
 - Text parsing: sentence and word tokenization
 - Synonyms are identified with concordance test within each sentence
 - We identified synonyms for the categories:
 - **No/low sound (< 0.01%)**
 - **Acceleration (0.04%)**
 - **Fire (0.2%)**
 - **Inattention (11%)**
- **Identification and clean-up of *false positives***

False positive example: No/low sound

- “stille” - “Silence”: Two meaning in Danish

*”Part1 holdt **stille** da part2 påkørte part1 bagfra”*

*”Part1 **had stopped** when part2 hit part1 from behind”*

False positive example: Fire and inattention

- “brænd” - “Fire”: one true and one false

*”Part1 var **uopmærksom** da han kiggede på den **brændende** bil i modsatte vejbane og ramte derfor part2”*

*”Part1 **didn’t pay attention** to the road but at a car in **fire** at the opposite direction and therefore hit part2”*

Analysis

- **Adjusting for over sampling**
 - There is only 2% EVs in the data set and therefore we simulate more EV and Hybrid crashes based on the distribution of variables in the original dataset
- **Method**
 - » Train Gaussian Mixture Model (GMM) with 2 component per feature
 - » Use GMM as a generative model to over sample EV to ~50k
- **Logit model**
 - » To identify which characteristics that increase the likelihood that the crash occurred with an EV compared to an ICEV

Results

- Variables that **increase** the probability of the crash being an EV crash
 - Drivers in the age group 45-64 compared to young drivers, below 25
 - Fire and problems with acceleration, mentioned in the text
 - Speeding, more than 30% above the speed limit
 - Locations with road work
- Variables that **decrease** the probability of the crash being an EV crash
 - Female driver compared to male driver
 - Inattention mentioned in the text
 - Drunk driving above the alcohol limit
 - Single crash



Limitations

- Identification of EVs is based on text written by the police, is there spelling mistakes?
 - ✓ We can use the registration number of the car and merge with data at Statistics Denmark

- Can we trust the text report?
 - ✓ The police officer decides what to focus on, but somethings they always find important to mention

- Which effects are due to the car being an EV and which are due to car age?
 - EVs are very new cars (0-10 years old) with new safety equipment some of the ICEV's are old cars with only limited safety equipment.
 - ✓ New analysis is needed maybe remove very old cars from the data set

Conclusion

- Need to merge data at Statistics Denmark to identify the right number of EV in the crash data and maybe also divide into Hybrid and EV
- Some of the problems which are mentioned in the media are indeed **a problem**. EV's more often burst into **fire** and for the crashes there seem to be problems with **acceleration** and **speeding**.
- Due we have a specific EV user group (male and 45-64 years old) or is it just these drivers who are involved in a crash? Behaviour studies, from Denmark, suggest that this is some of the characteristics of the EV user group.
- Driving with **alcohol** in the blood and being **inattention** decreases the likelihood of the crash being with an EV maybe this is due to the user group and the safety equipment in the car?
- Less EV are involved in **single crashes** compared to ICEV.

- EV's are not less safe than ICEV

Thank you for your attention!

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