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Energy
Institute

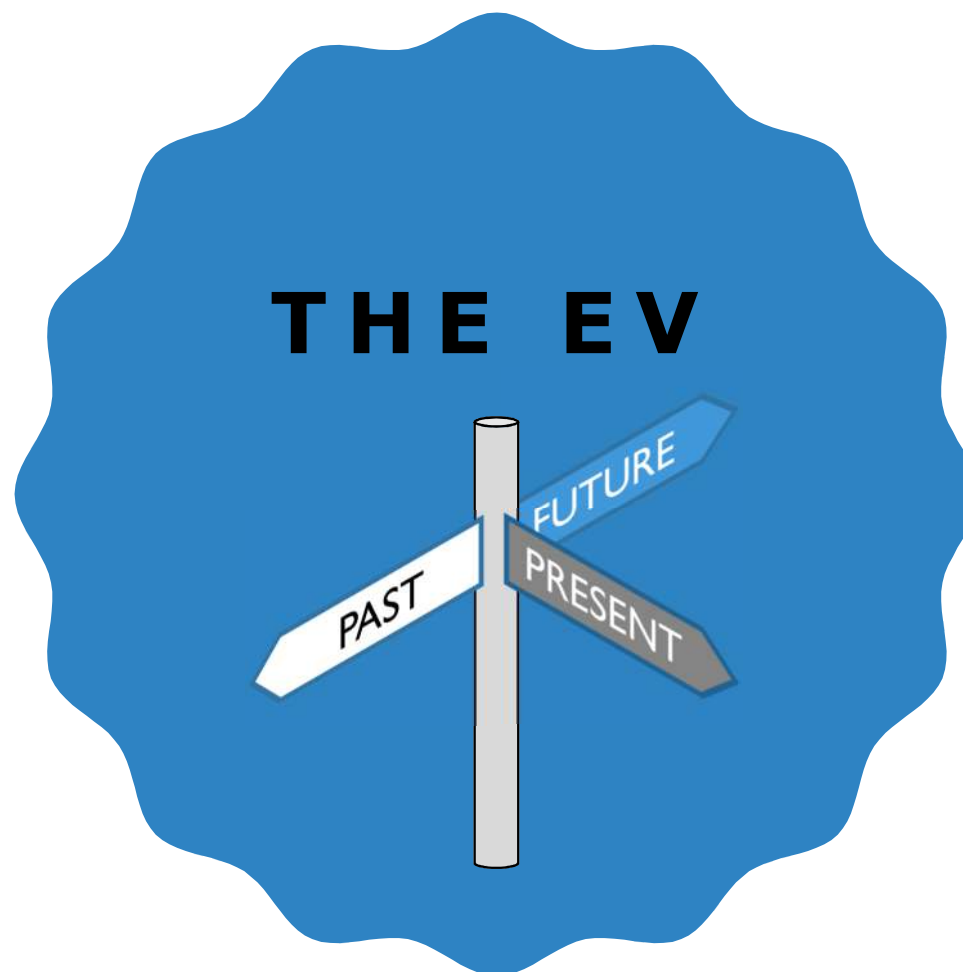
Public lecture: *the electric vehicle - past, present or future?*

Lluc Canals Casals

Professor, Project and Construction Engineering Dept
Universitat Politècnica de Catalunya (BarcelonaTECH)

energy.unimelb.edu.au

@MEIunimelb



Lluc Canals Casals

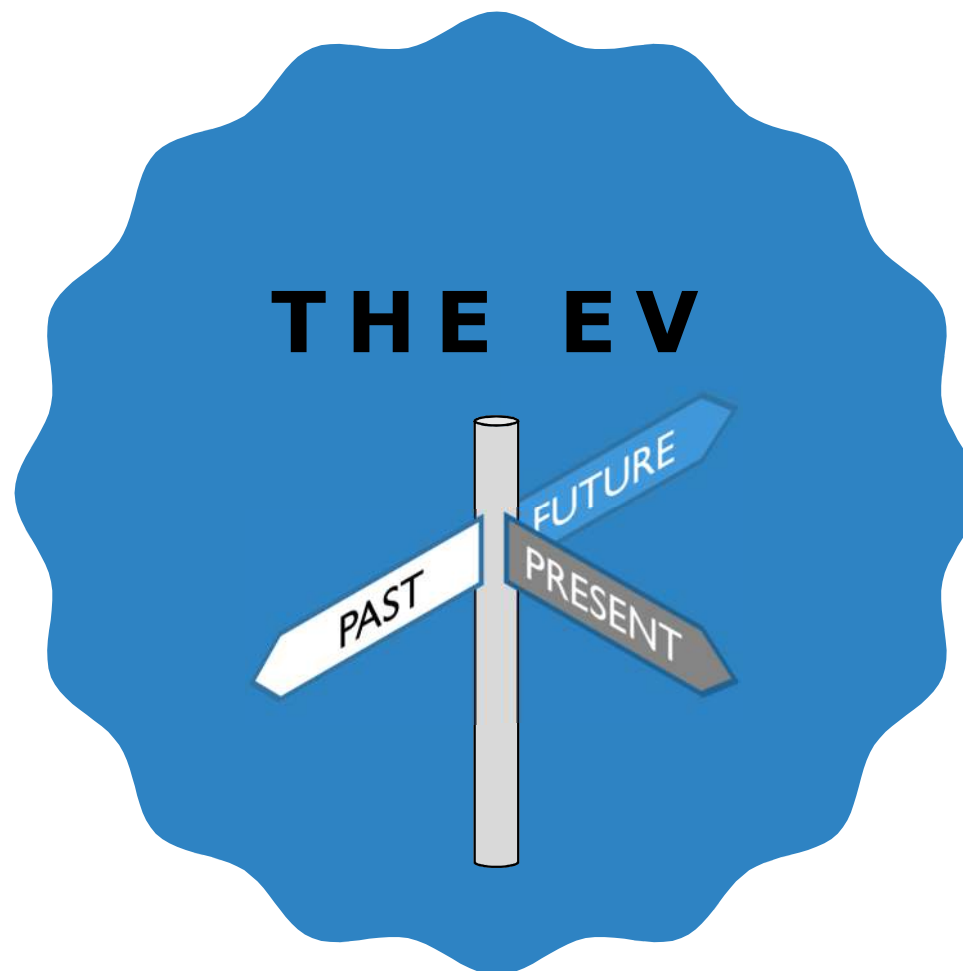
Universitat Politècnica de Catalunya

Acknowledgement of Country

We acknowledge the Traditional Owners of all the lands we are on today as well as where all The University of Melbourne campuses are situated.

We pay our respects to their Elders, past, present and emerging.





Lluc Canals Casals

Universitat Politècnica de Catalunya



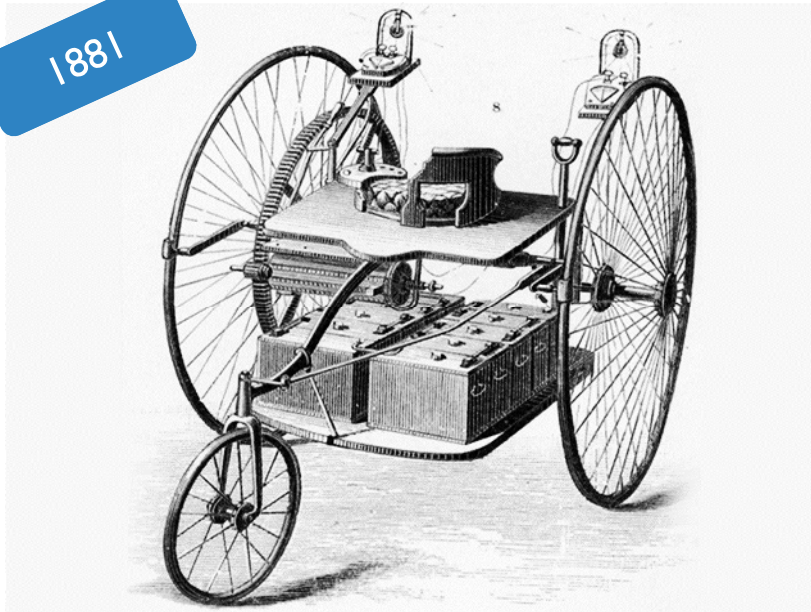
**“THE END IS WHERE
I BEGAN MY
JOURNEY”**

LA RENG A

THE BEGINNING

What's first, the electric vehicle or star wars?

1881



1899



WINTER IS COMING

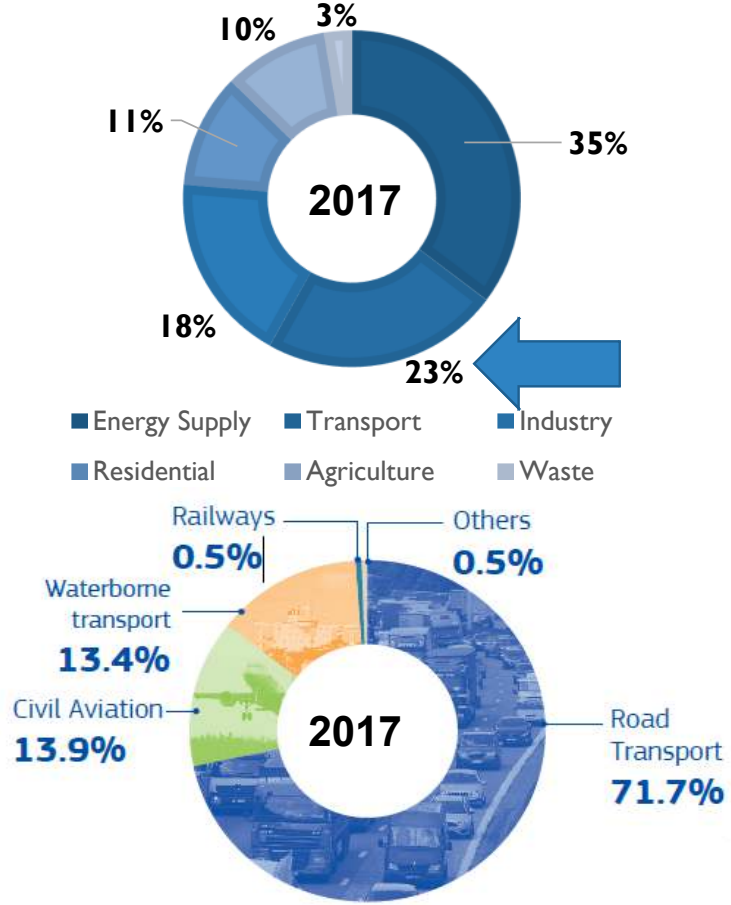
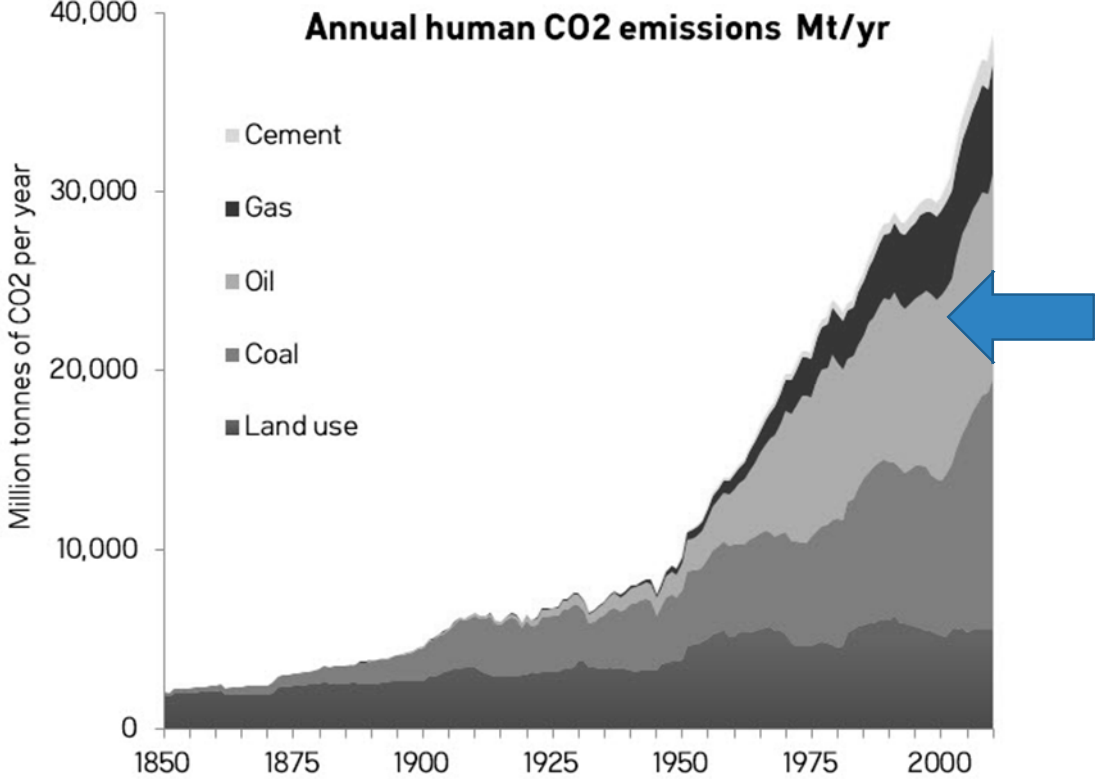
Electric trucks, the safest and cheapest transportation



Jevons paradox



THE FALSE PROMISE OF FREEDOM



3

DARK TIMES FOR THE EV

2nd rise in the 90's... anyone knows this model?



PRESENT TIMES...

3rd rise... These is going to be the good one!



20 years!
What happened?



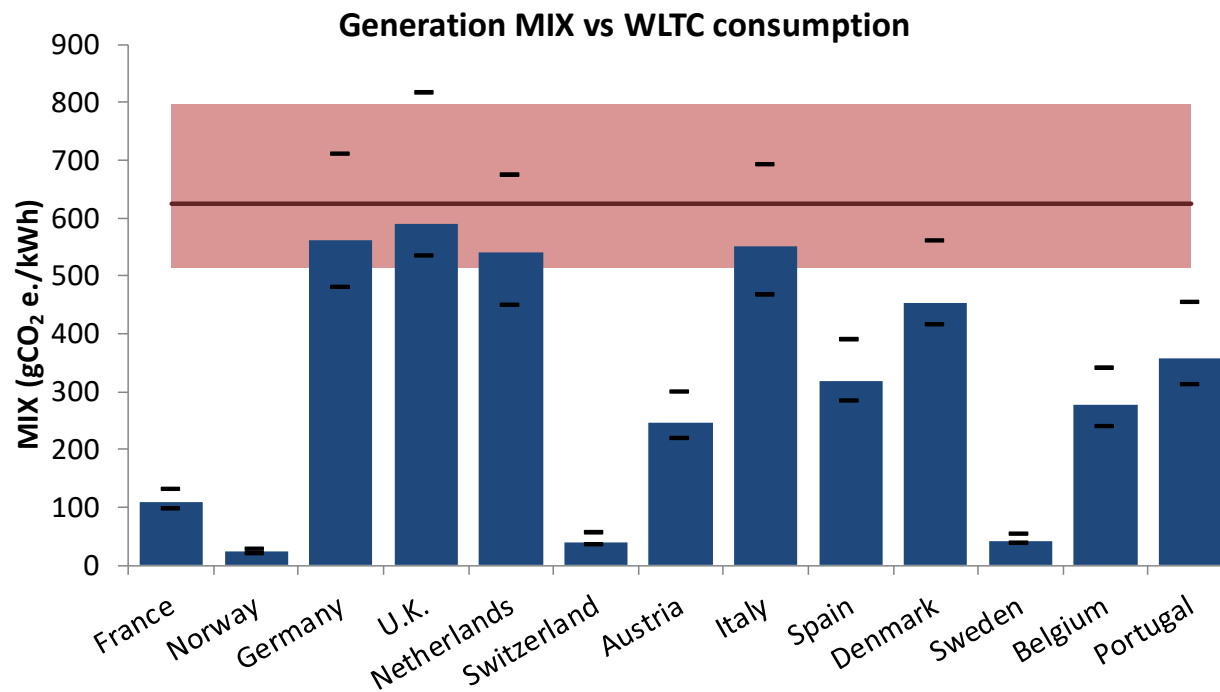


STAR WARS

A NEW HOPE

EPISODE IV

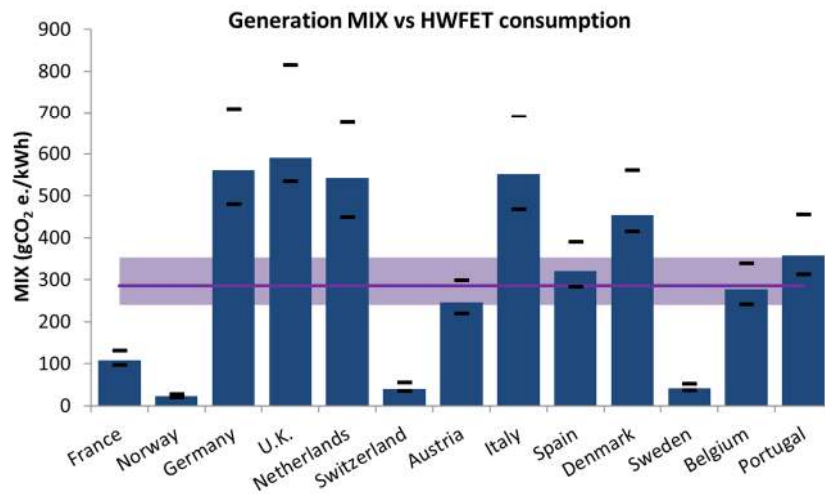
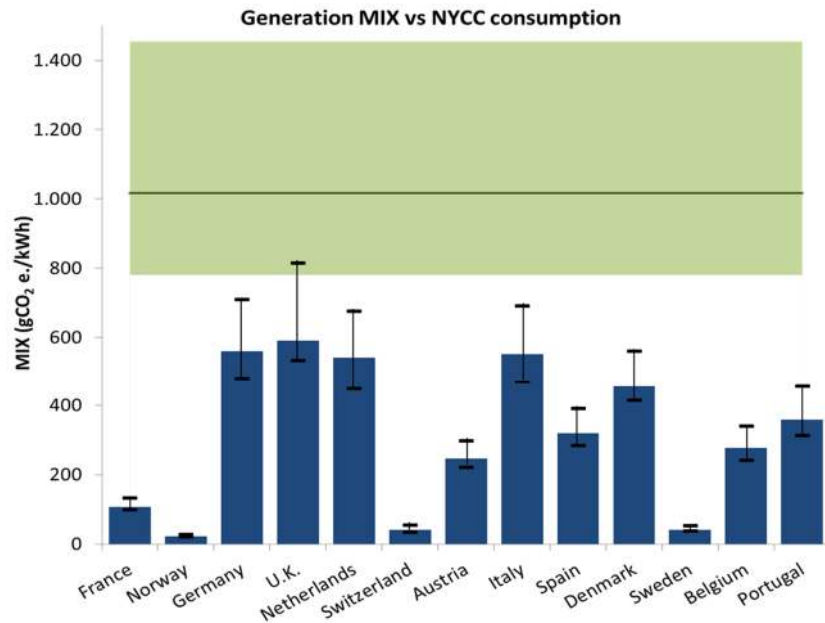
LIFE CYCLE ASSESSMENT



The cleanliness of the EV relies on the cleanliness of the electricity generation

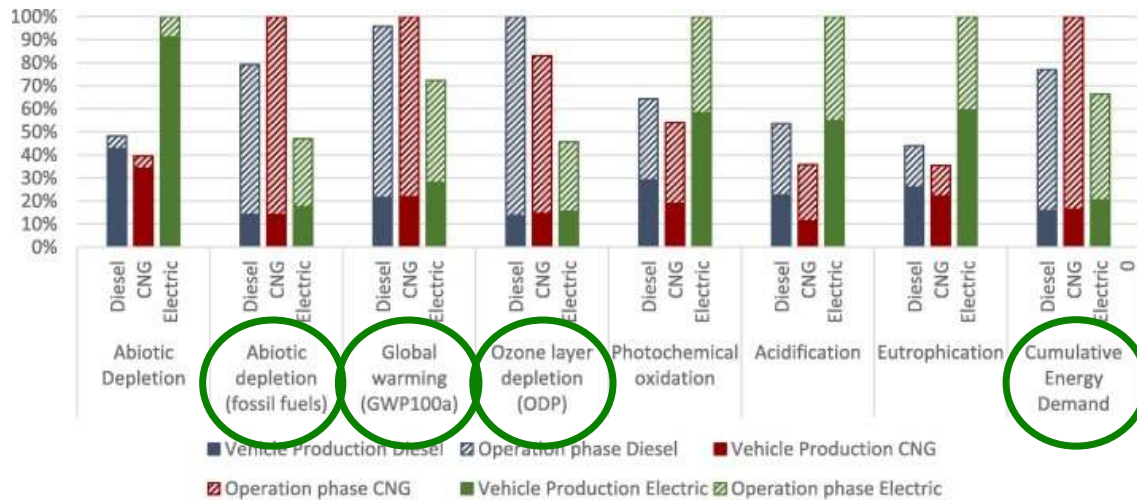
LIFE CYCLE ASSESSMENT

Why do we put so much effort on enlarging the battery capacity, then?



Source: Sustainability analysis of the EV use in Europe for CO2 reduction

LIFE CYCLE ASSESSMENT



Source: The transport of goods in the urban environment: A comparative life cycle assessment of electric, compressed natural gas and diesel light-duty vehicles



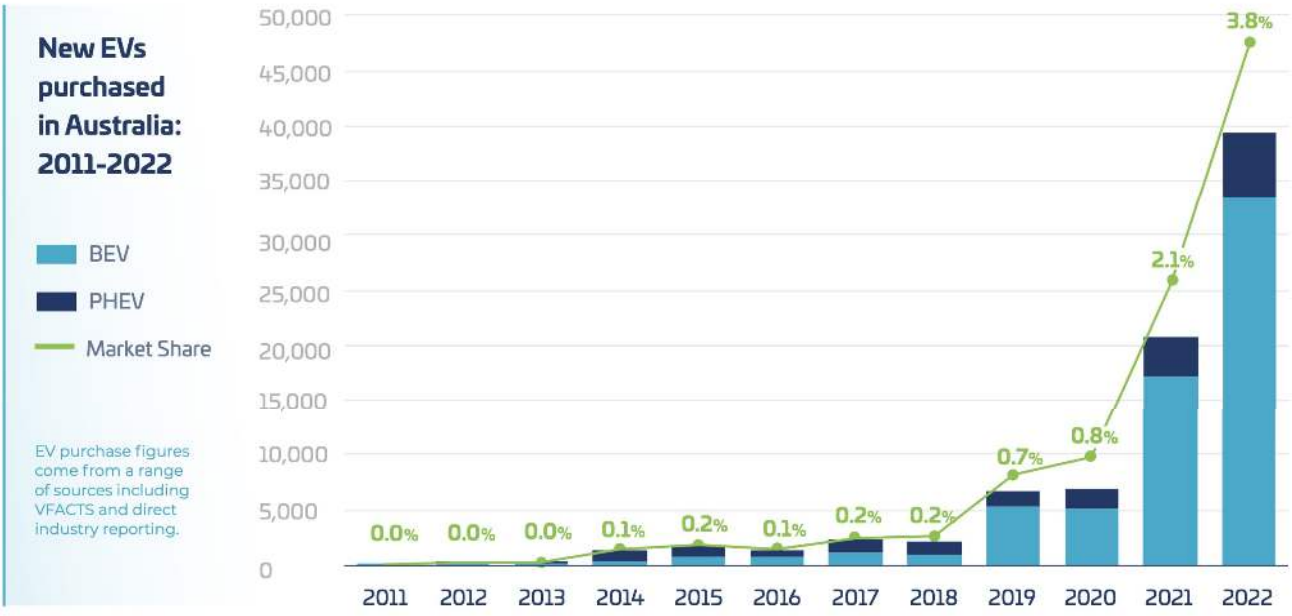
LIFE CYCLE ASSESSMENT

THE BATTERIES

Recent evolutions

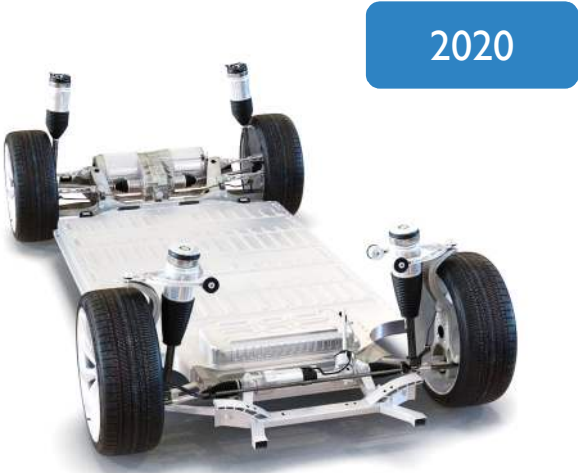
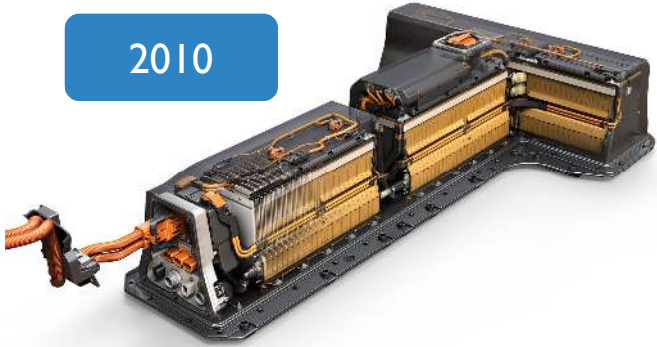
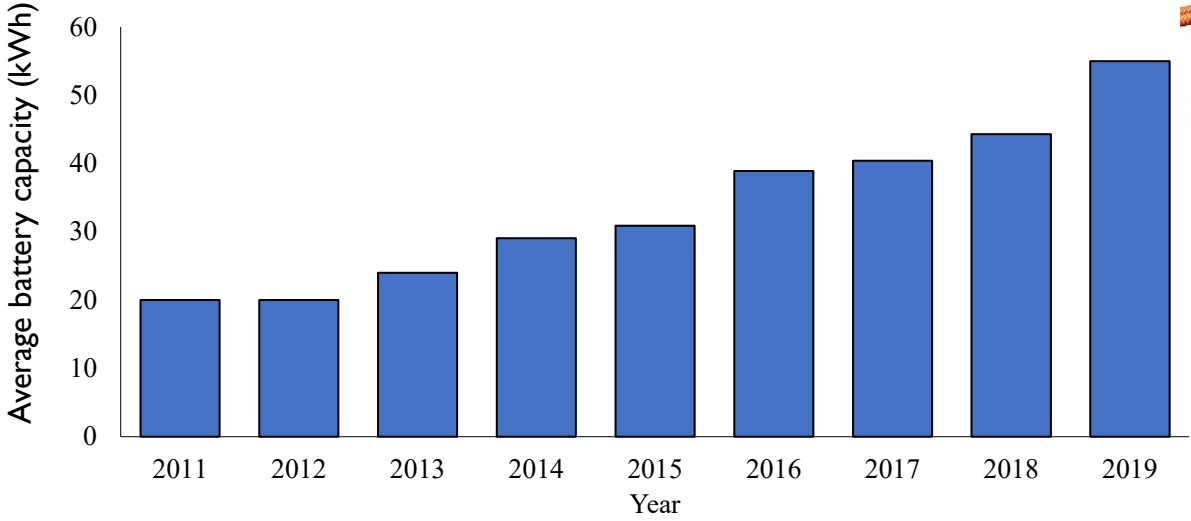


THE BATTERIES



Source: Electric Vehicle Council

THE BATTERIES



Source: Electric Vehicle Battery Health Expected at End of Life in the Upcoming Years Based on UK Data

WHICH ARE THE EV PROBLEMS?



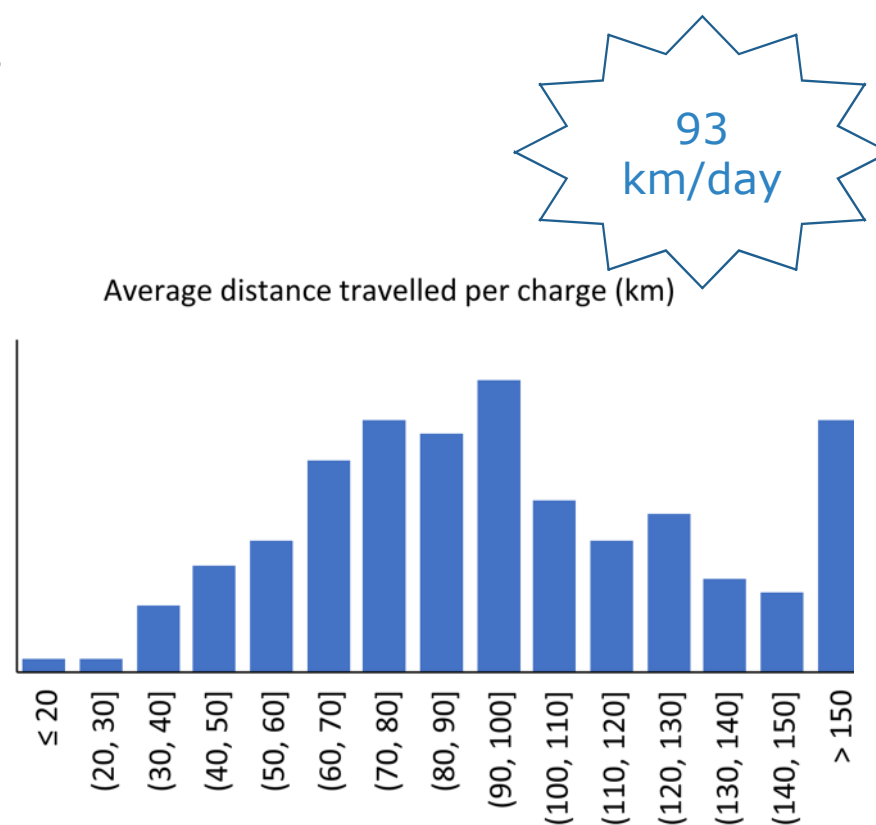
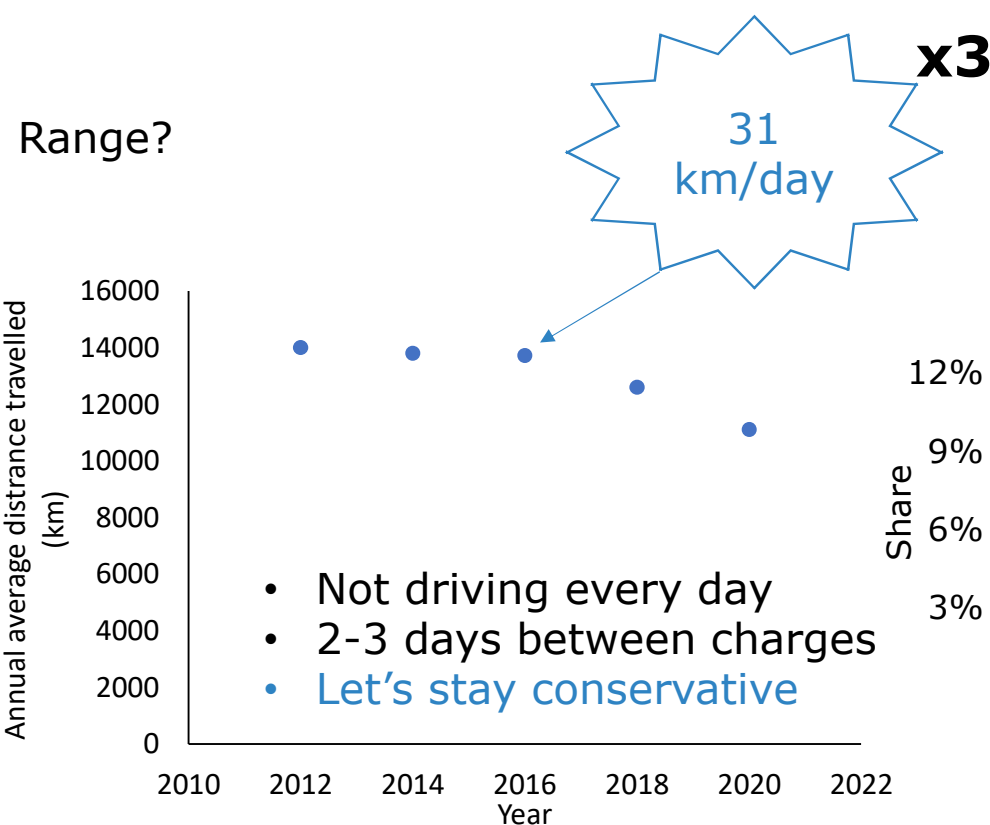
Range

Charge time

Price

Lifespan

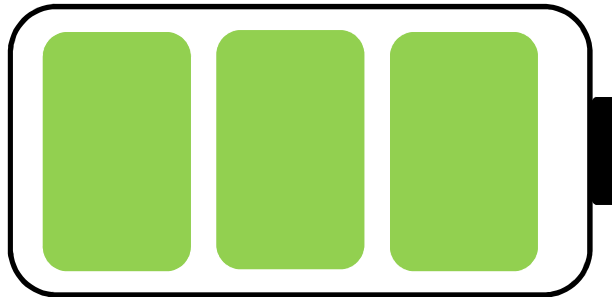
WHICH ARE THE EV PROBLEMS?



Source: Bureau of Statistics Australia

WHICH ARE THE EV PROBLEMS?

Range is capacity!

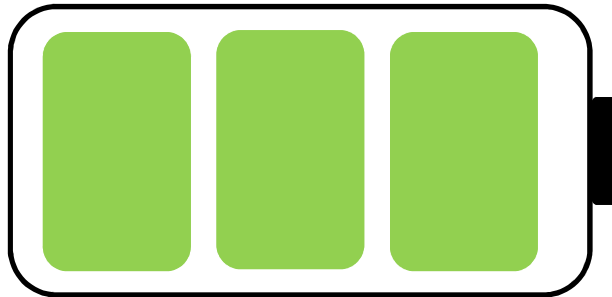


- 10-25 kWh average charge
- 2/3 of the battery remain mostly unused!



WHICH ARE THE EV PROBLEMS?

Charge time?



- 2-5 h to charge the battery
- 10-24hours plugged-in!



WHICH ARE THE EV PROBLEMS?

Price?

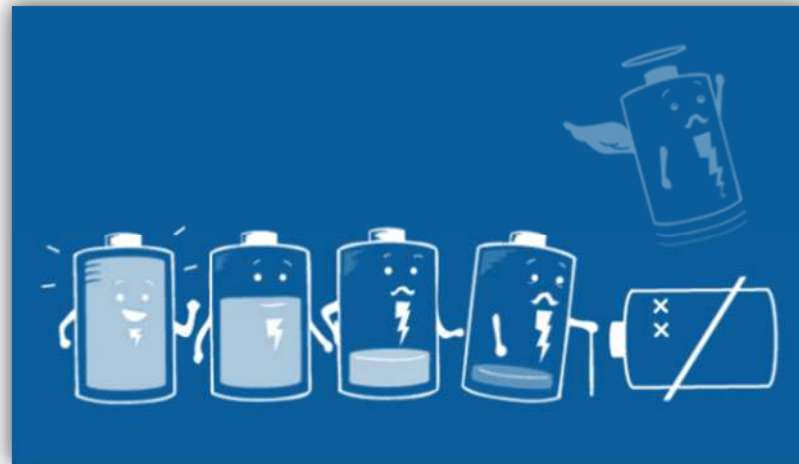


- 1/3 of the car price comes from the battery
- We use 1/3 of the battery...



WHICH ARE THE EV PROBLEMS?

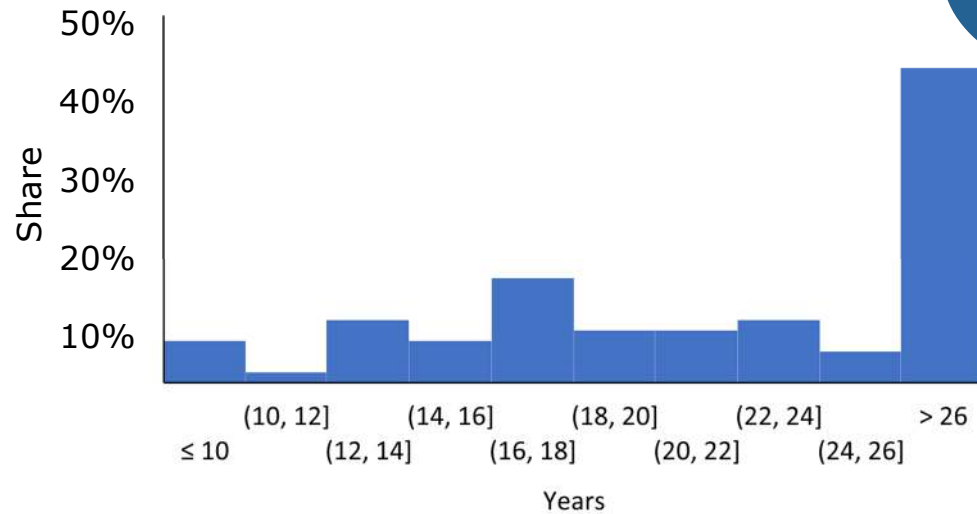
Lifespan?



- 5 -10 years
- 100.000-150.000 km
- 80-70% State of Health

WHICH ARE THE EV PROBLEMS?

Lifespan manufacturer limits



Our estimations >60 kWh

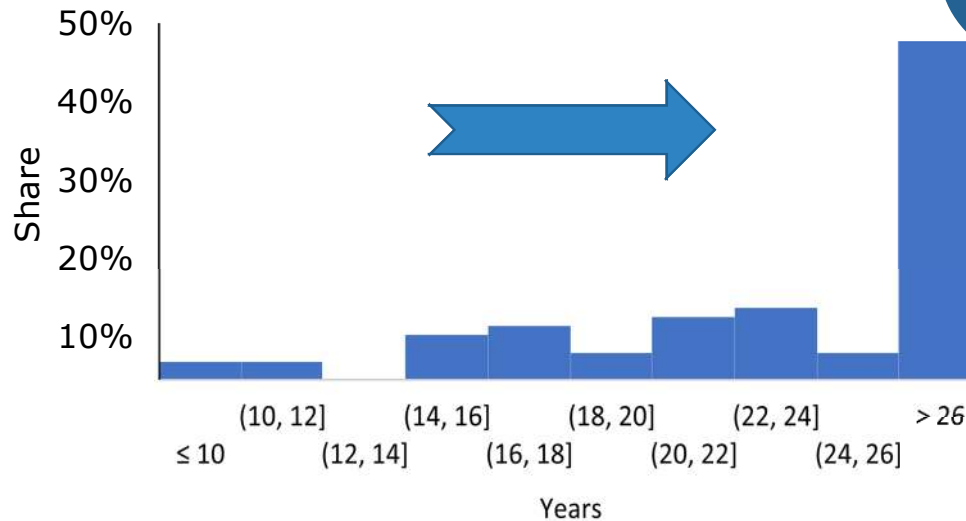
Car makers say that EVs will last 15-20 years

- 5 -10 years
- 100.000-150.000 km
- 80-70% State of Health

Why?

WHICH ARE THE EV PROBLEMS?

Lifespan Functional needs



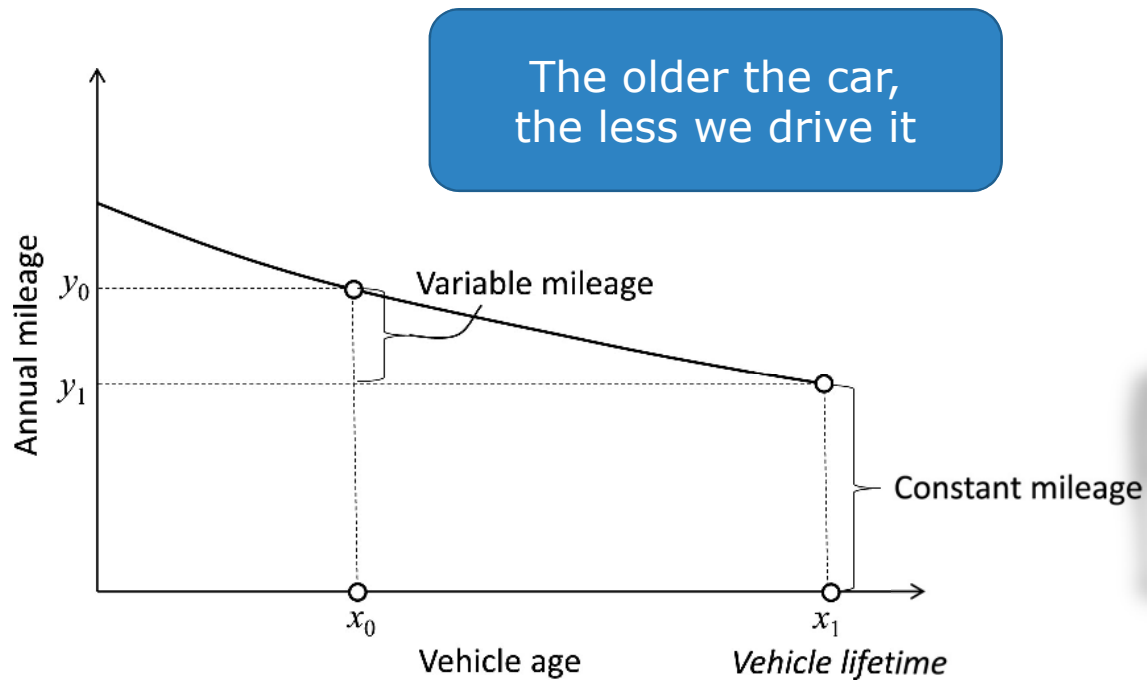
Our estimations
>60 kWh

NO FEAR!!

- Until user requirements not filled
- Sky is the limit
- Down to 60% State of Health

WHICH ARE THE EV PROBLEMS?

Lifespan Functional needs

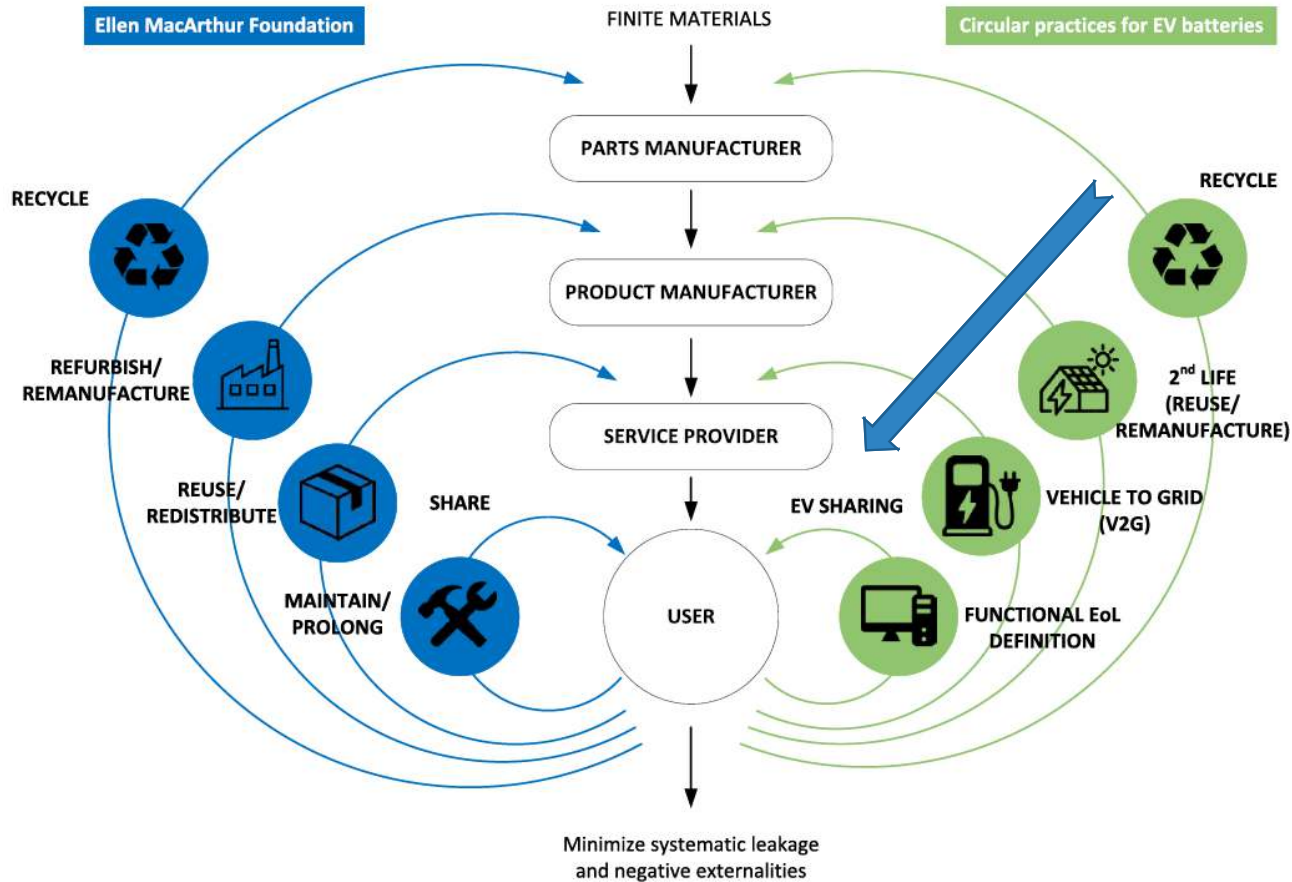


NO

FEAR!

Source: Driving propensity and vehicle lifetime mileage: A quantile regression approach

THINKING IN THE FUTURE

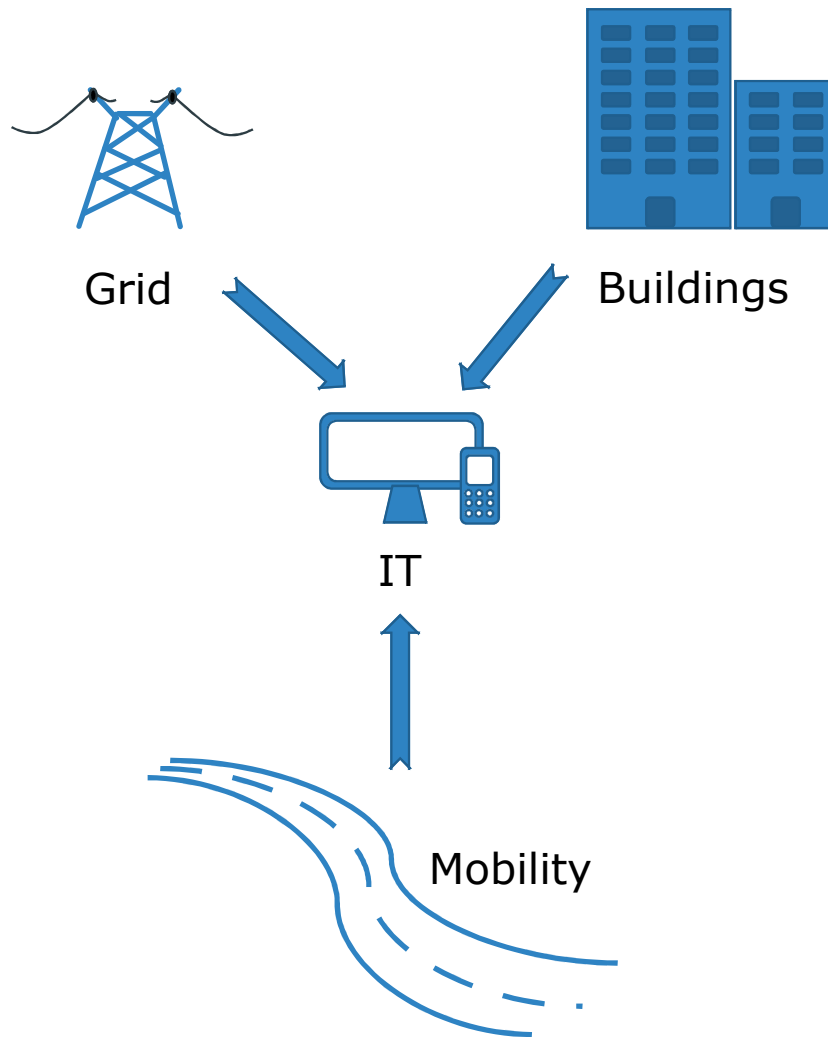


How many have heard about:

- Recycling
- Second life?
- V2G?

We have to do V2G!!!

Source: Are electric vehicle batteries being underused? A review of current practices and sources of circularity



THE NEW FRAMEWORK

+ renewable energy distributed resources



5-15 kWh/day

5-15 kWh/day

10-25 kWh/Charge

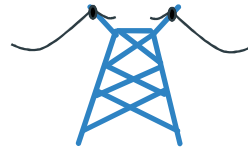
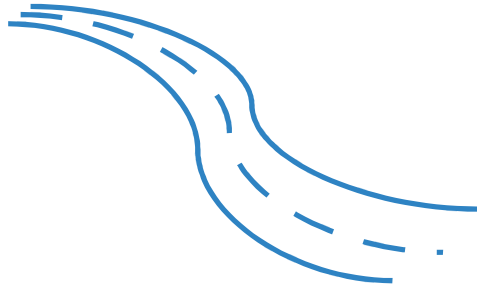
25-100 kWh battery



EV AT HOME

Doubles the electricity consumption

Can be a fantastic backup for several neighbours...



10-25 kWh/Charge

2-5 hours charging

Mostly at night

Thermal congestion
(transformers/feeders)

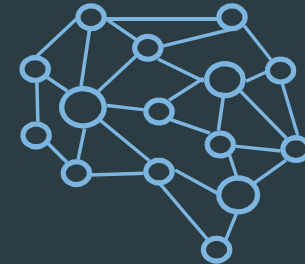
Voltage drop

Phase unbalance

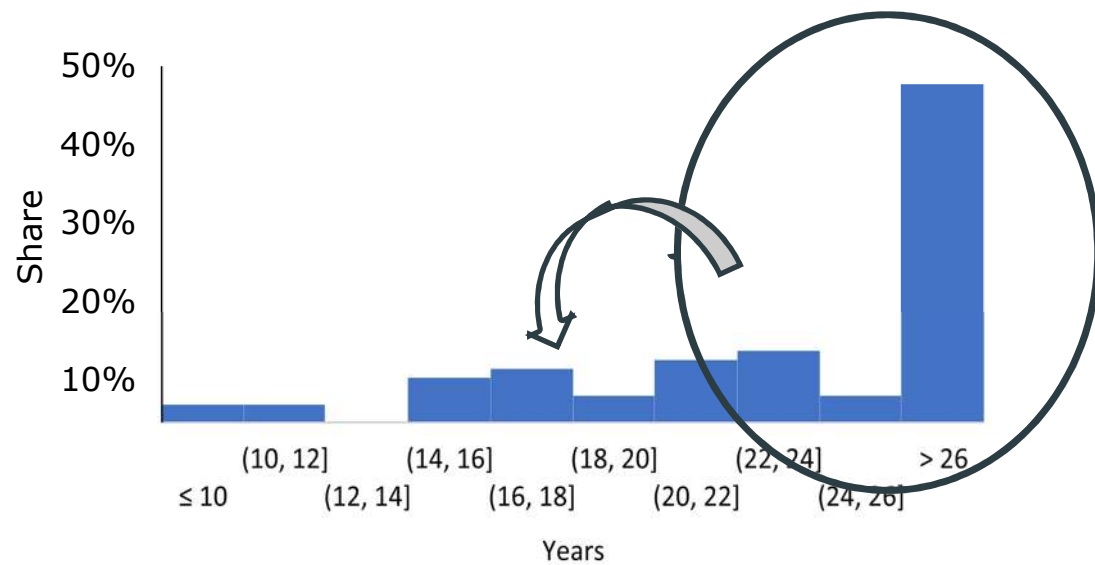
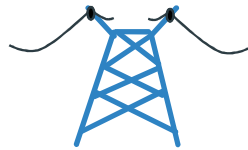
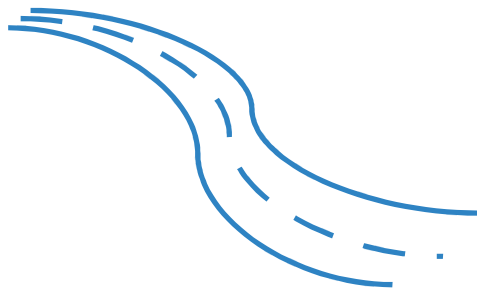
So inversely
similar to solar
electricity
generation

EV AND GRID

We need a brain...

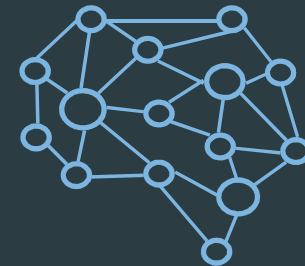


so the EV is not a problem,
but a solution



EV AND GRID

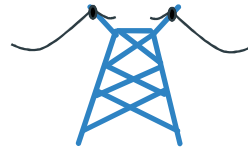
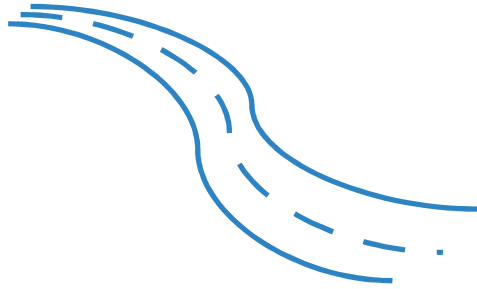
Can we do that?



Sure we can!

BACK TO THE FUTURE





10-25 kWh/Charge

2-5 hours charging

Mostly at night

10-24h connected

Charges every 2-3 days

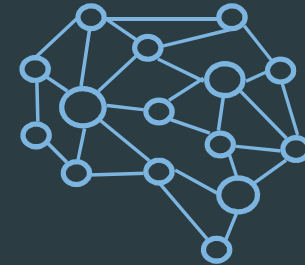
Move charges

>10 kWh/day available
from the EV without
affecting lifespan

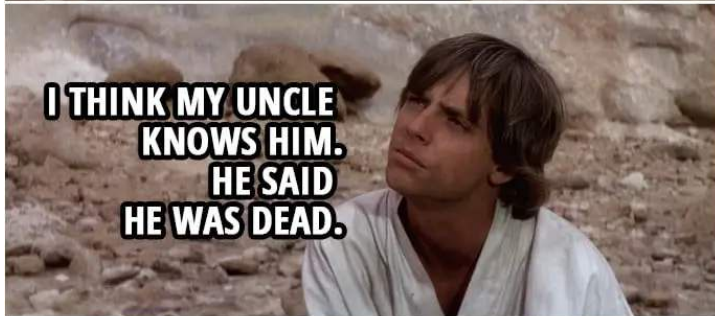
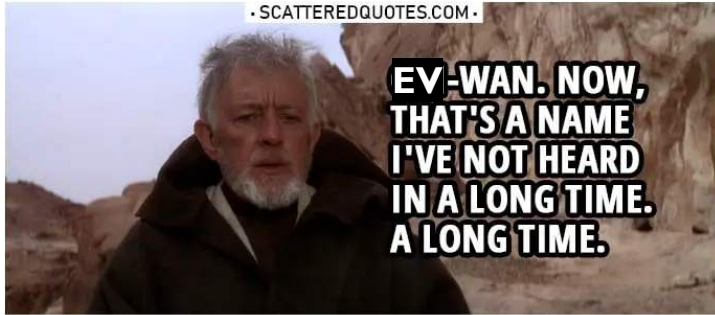
A lot of
time

EV AND FUTURE

Let's use that brain



• SCATTEREDQUOTES.COM •



EV AND FUTURE

Battery EV is **NOT** our only hope...

It's just another interesting
alternative if used wisely

UNDERSTANDING THE EV

- **The EV is a battery with wheels**
- **The smaller the better**
- **Let's use them IN the EV!**





THE EV:
WE'VE MESSED IT
UP IN THE PAST,
LET'S DO IT RIGHT
IN THE FUTURE



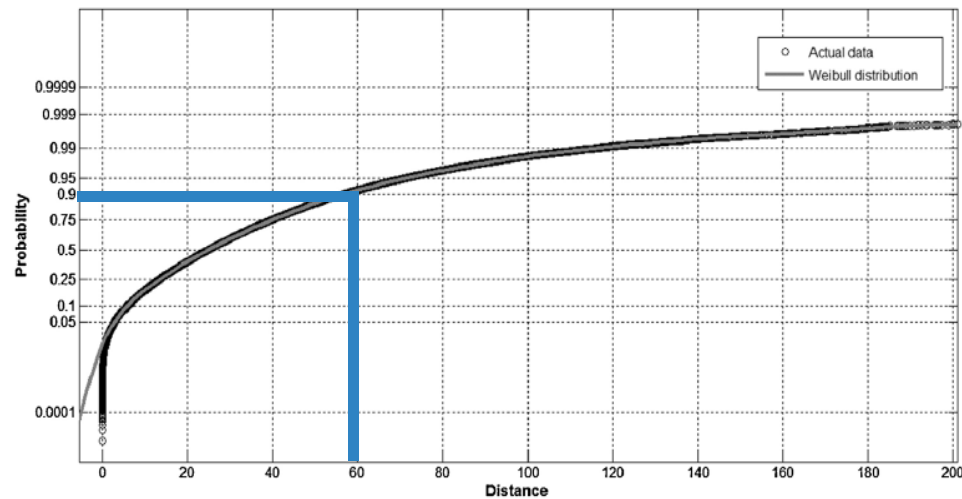
There is **no** planet B

Lluc Canals Casals

lluc.canals@upc.edu

lluc.canalscasals@unimelb.edu.au

DAILY TRIPS



60 km → 90% of trips

Source: Tehrani, N.H.; Wang, P. Probabilistic estimation of plug-in electric vehicles charging load profile. *Electr. Power Syst. Res.* **2015**, *124*, 133–143, doi:10.1016/j.epsr.2015.03.010




THE UNIVERSITY OF
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**Melbourne
Energy
Institute**

www.energy.unimelb.edu.au


CONTACT US

 mei-info@unimelb.edu.au

 Melbourne Energy Institute
Level 1, Melbourne Connect,
700 Swanston St, Carlton
VIC 3053

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