Help or hindrance?
Demand implications of vehicle automation

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To identify the directions of travel impacts of highly/fully automated vehicles

(with some quantification)

To identify the key areas that require attention

Levels of automation

SAE level	Name	Steering, acceleration, deceleration	Monitoring Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)	Timeline
0	No automation	🧍	🧍	🧍	Eyes On	Now
1	Driver assistance	🚗 🧍	🧍	🧍	Eyes on	Now
2	Partial automation	🚗	🧍	🧍	Eyes On	Now
3	Conditional automation	🚗	🚗	🧍	Eyes Off	2017
4	High automation	🚗	🚗	🚗	Mind Off	2025
5	Full automation	🚗	🚗	🚗	Mind Off	2025

Human monitors environment

Car monitors environment

managed by a *human driver*

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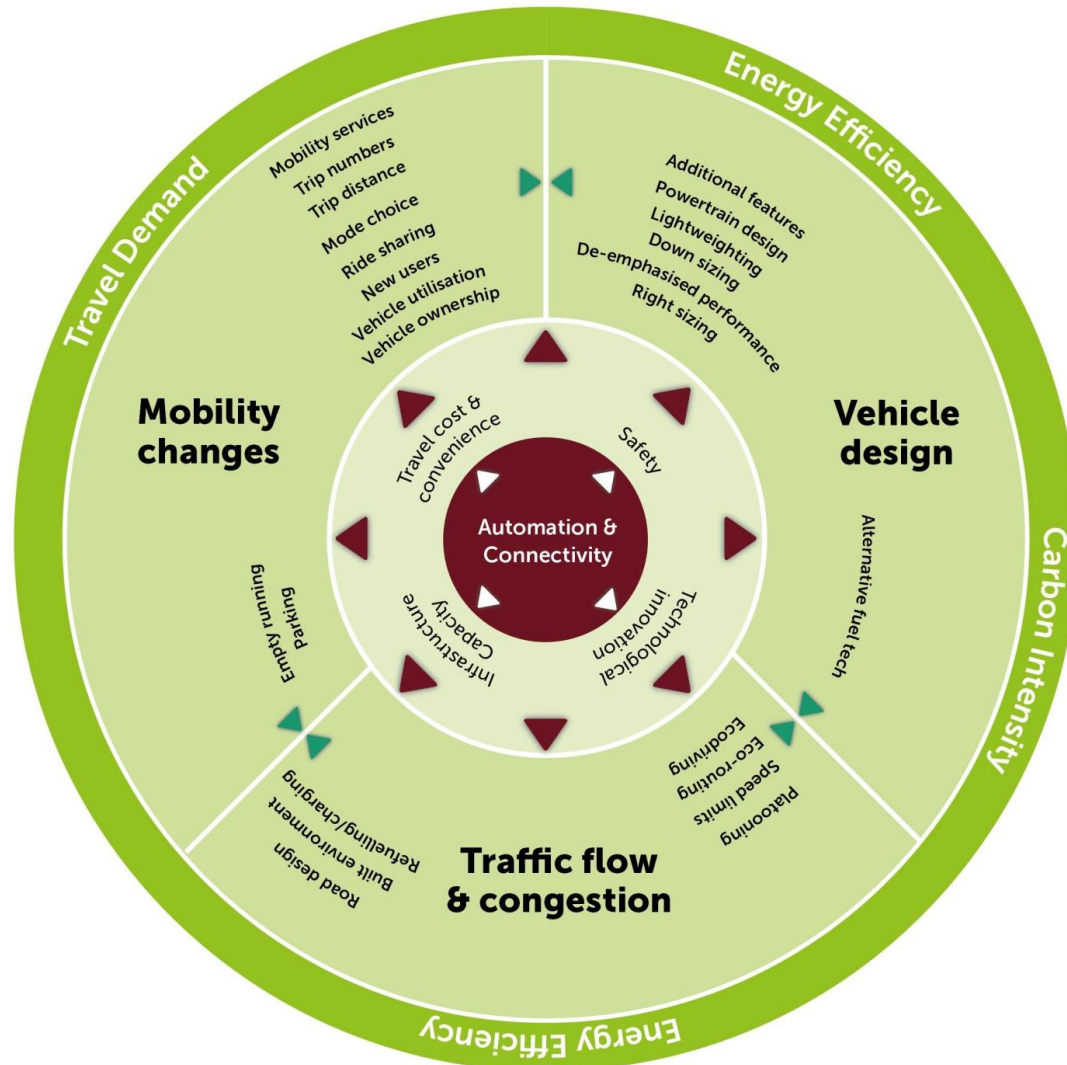
New users

Existing users

Trip distance

Trip numbers

Mode choice

Own vs.

mobility on demand

Wadud & Anable 2016

11.6 million disabled people in the UK

6.5 million mobility-impaired

Immense wellbeing benefits

Younger generation – parental escort vs. driverless escort?

USA: elderly 2-10% increase in demand
Wadud et al. 2016

Parking & empty running

Trade-off: Public transport vs. private car

VTTS will certainly be lower, but how much lower?

Trip distances, trip rates

Role of time use and VTTS crucial

"Time, not material goods, raises happiness"
-BBC News this morning

Time use

How do people intend to use time in automated cars?

How do people use time in cars now?

Is there a correlation between perceived usefulness of travel time and intended use of automated cars?

What is the effect of motion sickness?

"The commute felt like it took half the time"
-Tesla autopilot user

Time use results: Current vs. intended time use

| Activity on which most time is or will be spent	Revealed ranking for current car passengers	Ranking of stated intention in future FAVs
Still watching roadway	-	-
Working/ studying	2	1
Window gazing/ people watching	4	4
Thinking/ planning	1	3
Phone calls/ messaging	9	10
Online social media	5	6
Reading for leisure	10	7
Emailing/ browsing internet	7	8
Eating/ drinking	11	12
Sleeping/ snoozing	7	9
Listening to music/ radio	6	5
Watching video/ playing games	12	11
Talking to other passengers	2	2
Rank correlation	**0.92**	

Wadud & Huda 2017

Time use results: Perceived usefulness of travel time & interest to use automated vehicles

Commute

Leisure
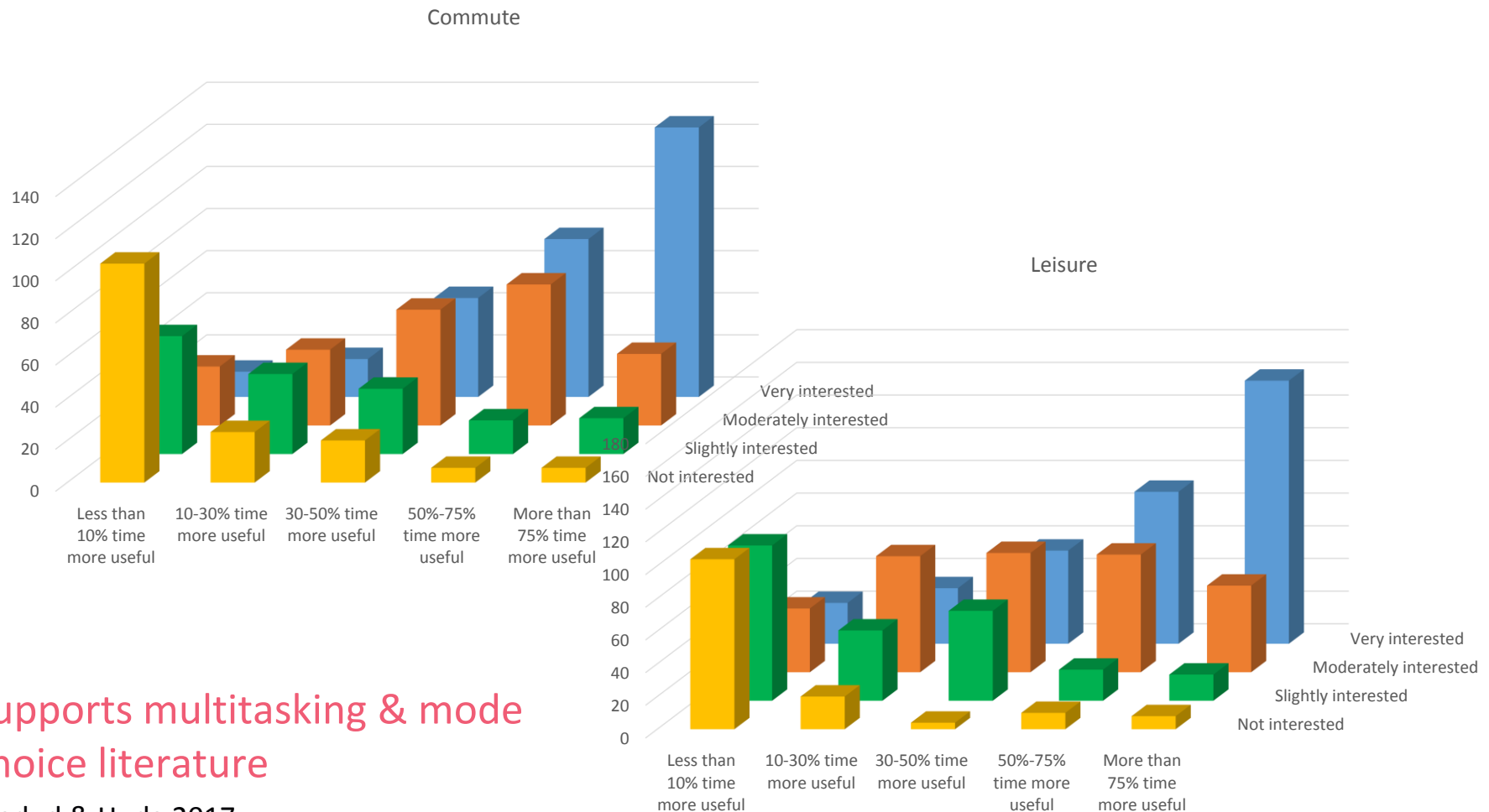
Supports multitasking & mode choice literature

Wadud & Huda 2017

Automated vs. manual vs. automated taxi operations: costs

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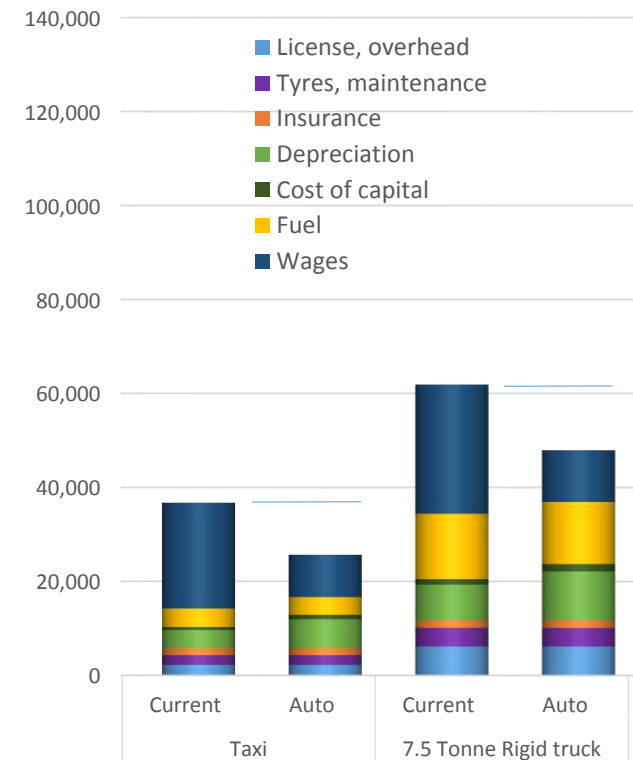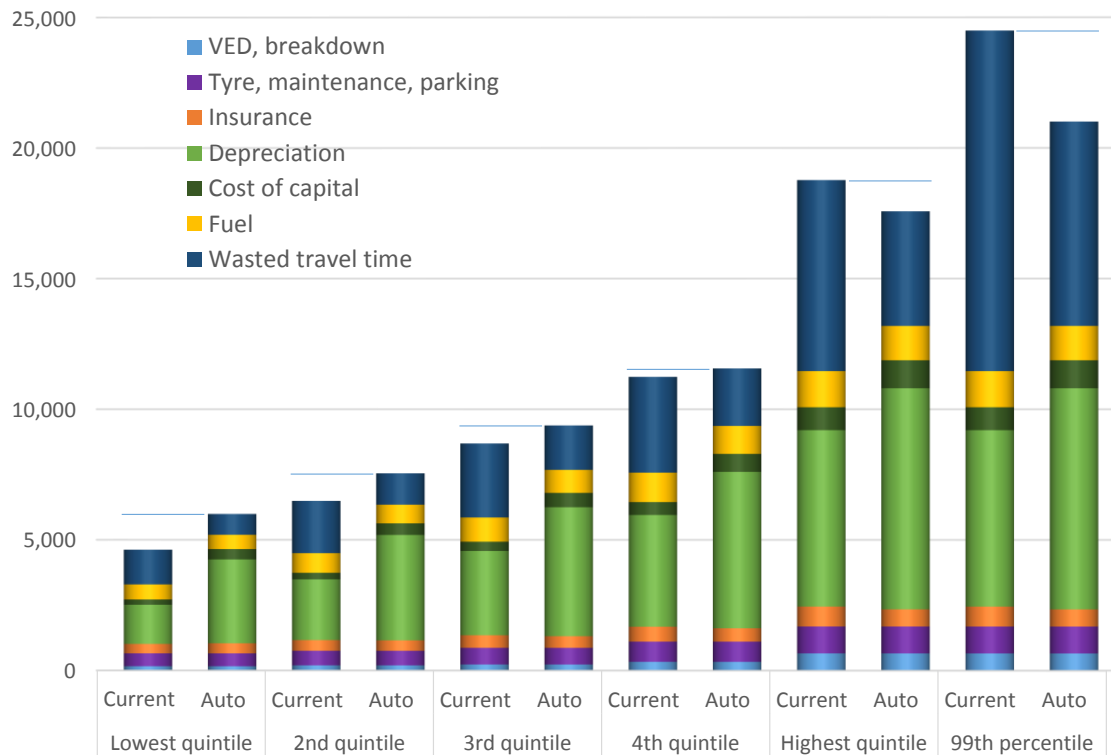
MoD: Marginal cost pricing – should curb demand in theory

Self-selected bunch

Empty running

Public transport to on-demand-services? Vicious circle

VMT won't fall – unless "ridesharing";

Evidence of some sharing – but who uses MoD?

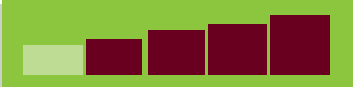Some capacity benefits through

"rightsizing" MoD

…. But induced traffic

Cars parked 95% of the time;

1 car club car removes 9 cars on street;

Does it matter?

Travel demand

Mechanisms	Impacts	Automation level
Distances	✗ ✗	
Modal shift	✗ ✗ ✗	
Trip number	✗	
New user groups	✗	
Mobility on demand	✗	
Empty running	✗	

Smaller impact at low levels of automation

Step change at high levels of automation

But demand will almost certainly increase

USA: up to 60% increase in demand, range 5% (low levels)-60% (full automation)

Wadud et al. 2016

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Two important hypothesis challenged

Marchetti constant/
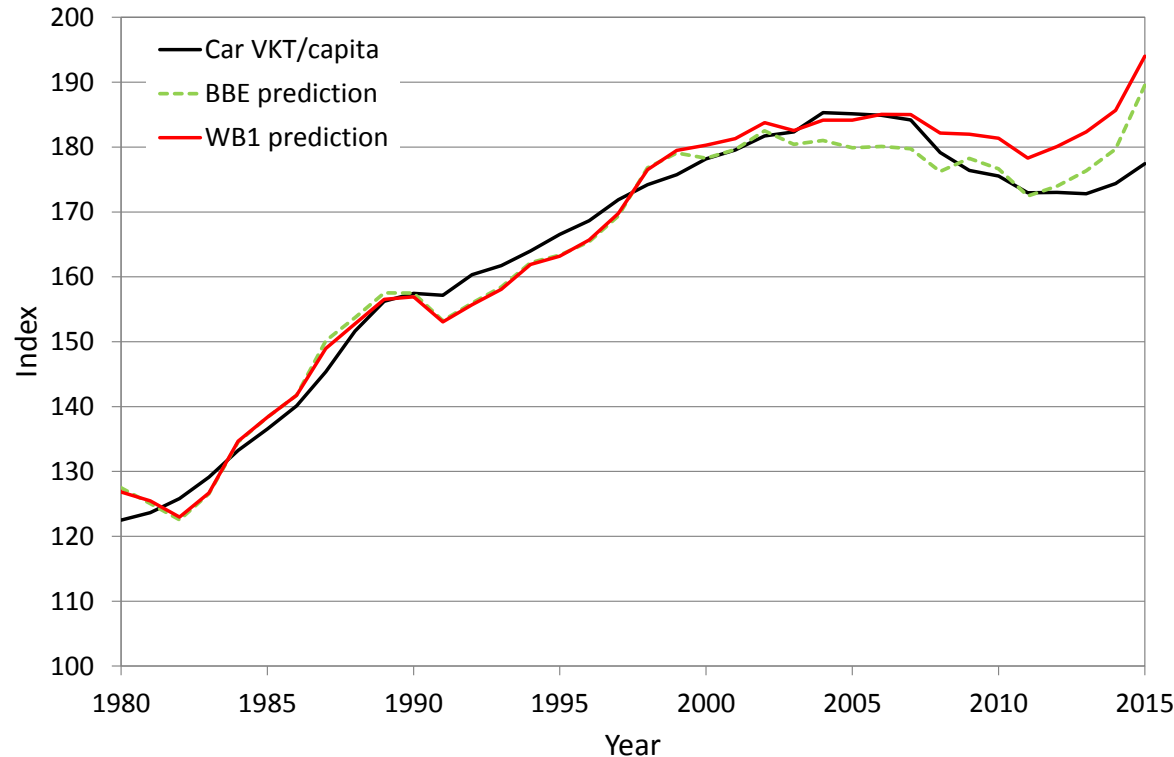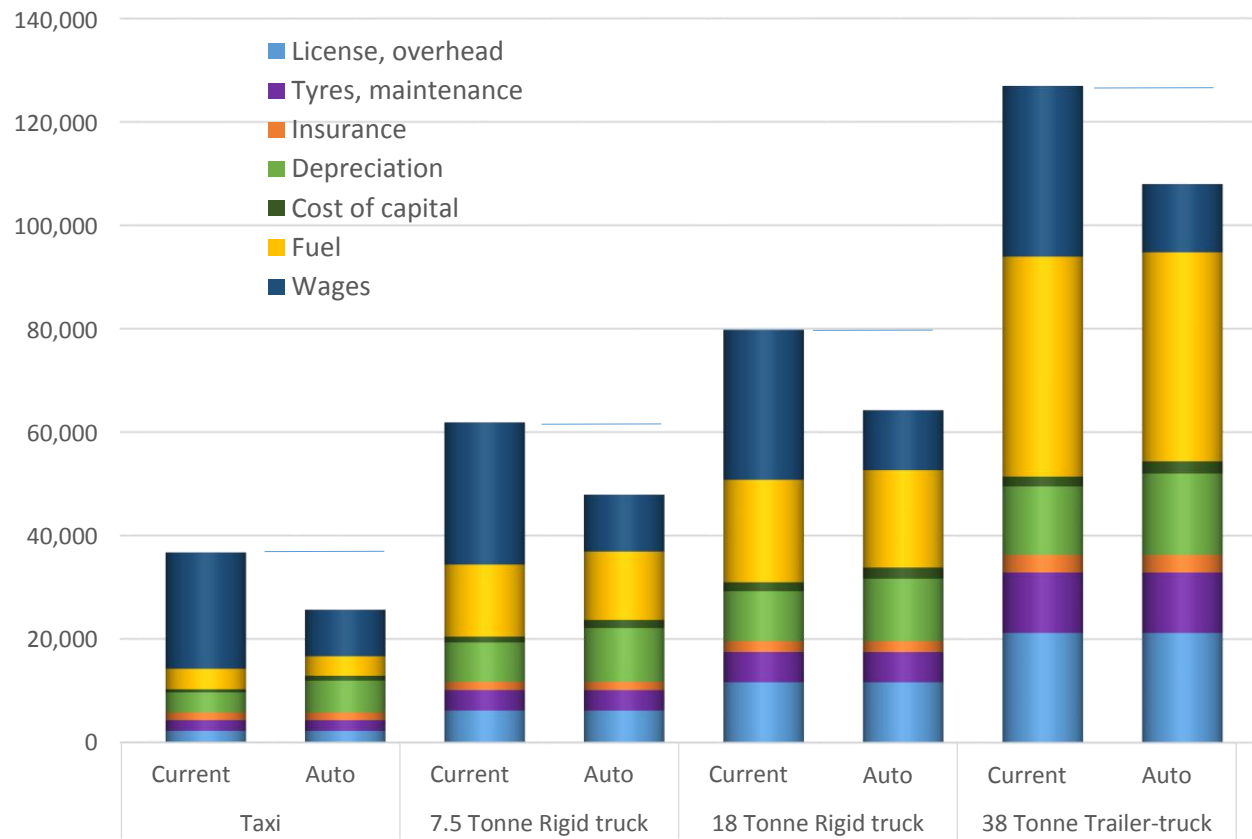Zahavi Travel time budget

Peak car

1 hr/day
commute

Total cost of ownership analysis (UK) for trucks

Same conclusion: VMT by trucks, vans, lorries goes up

Wadud 2017

VTTS will certainly fall, but by how much?

VTTS vs. value of reliability?

Own vs. ridehail vs. rideshare: Not either/or – all will coexist

What is the equilibrium share?

Who & where from switch occurs?

Overall VMT will almost certainly go up, absent any policies

Although some directions uncertain – trips escorting children?

How much will it go up?

Urban or intercity? Which types?

Nearly all studies use stated preference/intention

Any evidence from revealed behaviour?

AUTOMATED VEHICLES:
AUTOMATICALLY LOW CARBON?

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Mobility & Energy Futures Series

SELF-DRIVING CARS
WILL THEY REDUCE ENERGY USE?

Energy
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Thank you

The use and usefulness of travel time in fully automated vehicles, 2017 (under review)

Fully automated vehicles: A cost of ownership analysis to inform early adoption, 2017

Help or Hindrance? The travel, energy and carbon impacts of highly automated vehicles, 2016

Energy consumption impacts (USA)

% changes in energy consumption due to vehicle automation