Hydrogen Electric Cars

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SUSTAINABILITY PROBLEM

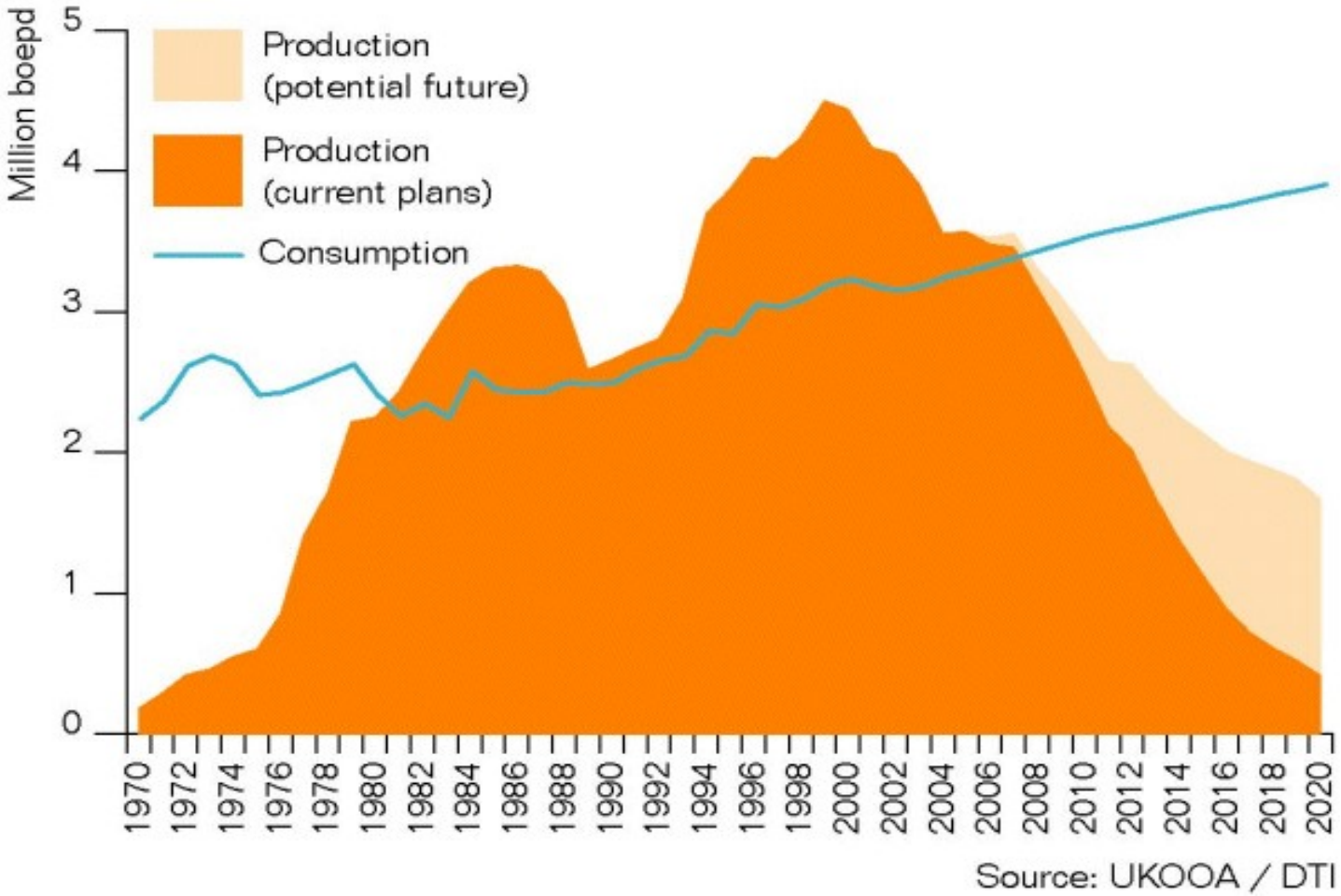
- **Transport takes about 30% of our energy**
  planes, ships, trucks, cars etc

- **All of it is fossil fuel; carbon problem**

- **Half of this is our cars**

WE NEED TO TAKE PERSONAL ACTION

UK OIL AND GAS SUPPLY AND DEMAND



CARS CAUSE DEATH

- **Approx 8,500 people die in UK as a result of particulate emissions from vehicles**

- **Every 10 μg/m3 PM10 =1% increase mortality (all cause)**

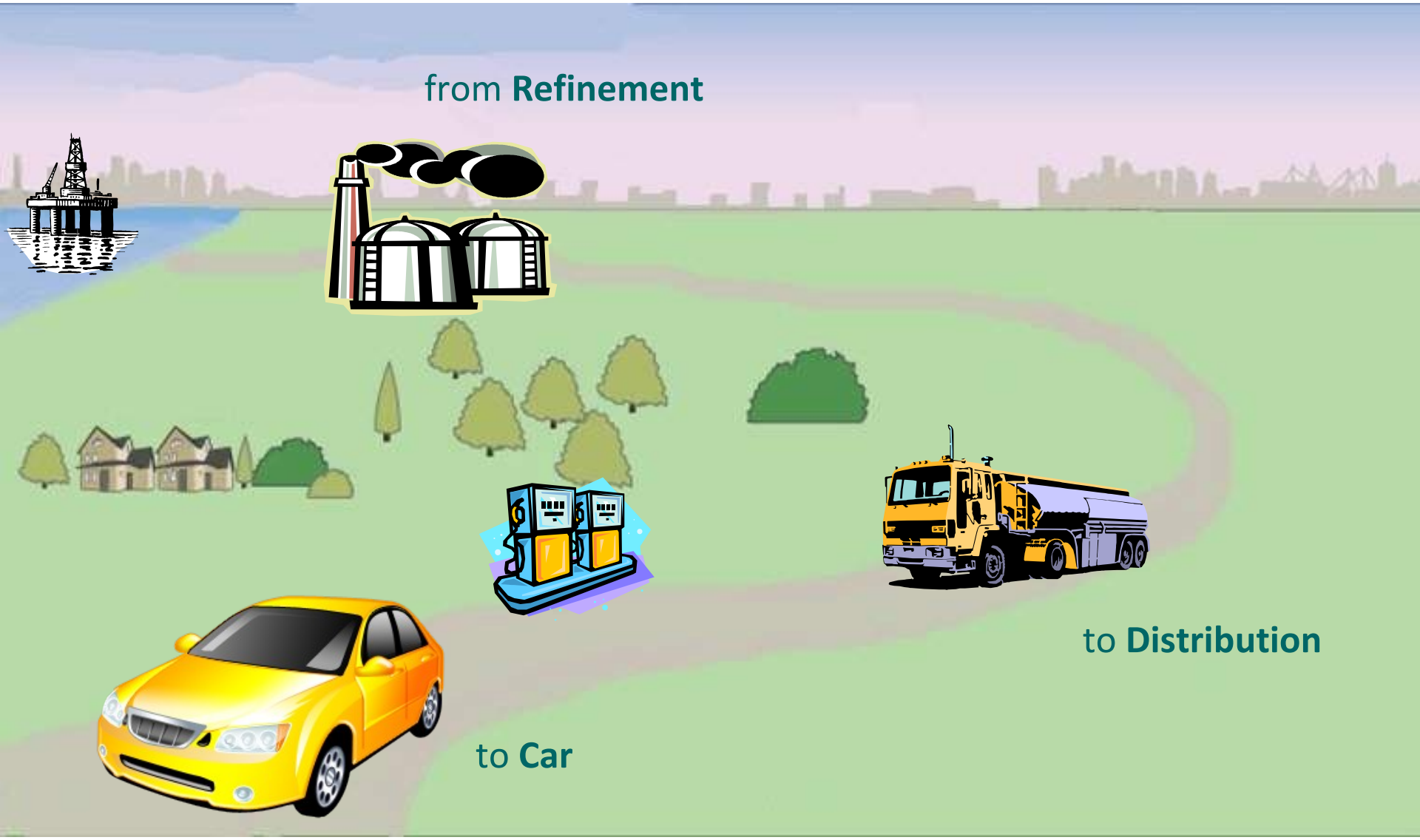
  [COMEAP Prof Jon Ayres]

ANSWER: ELECTRIC CARS

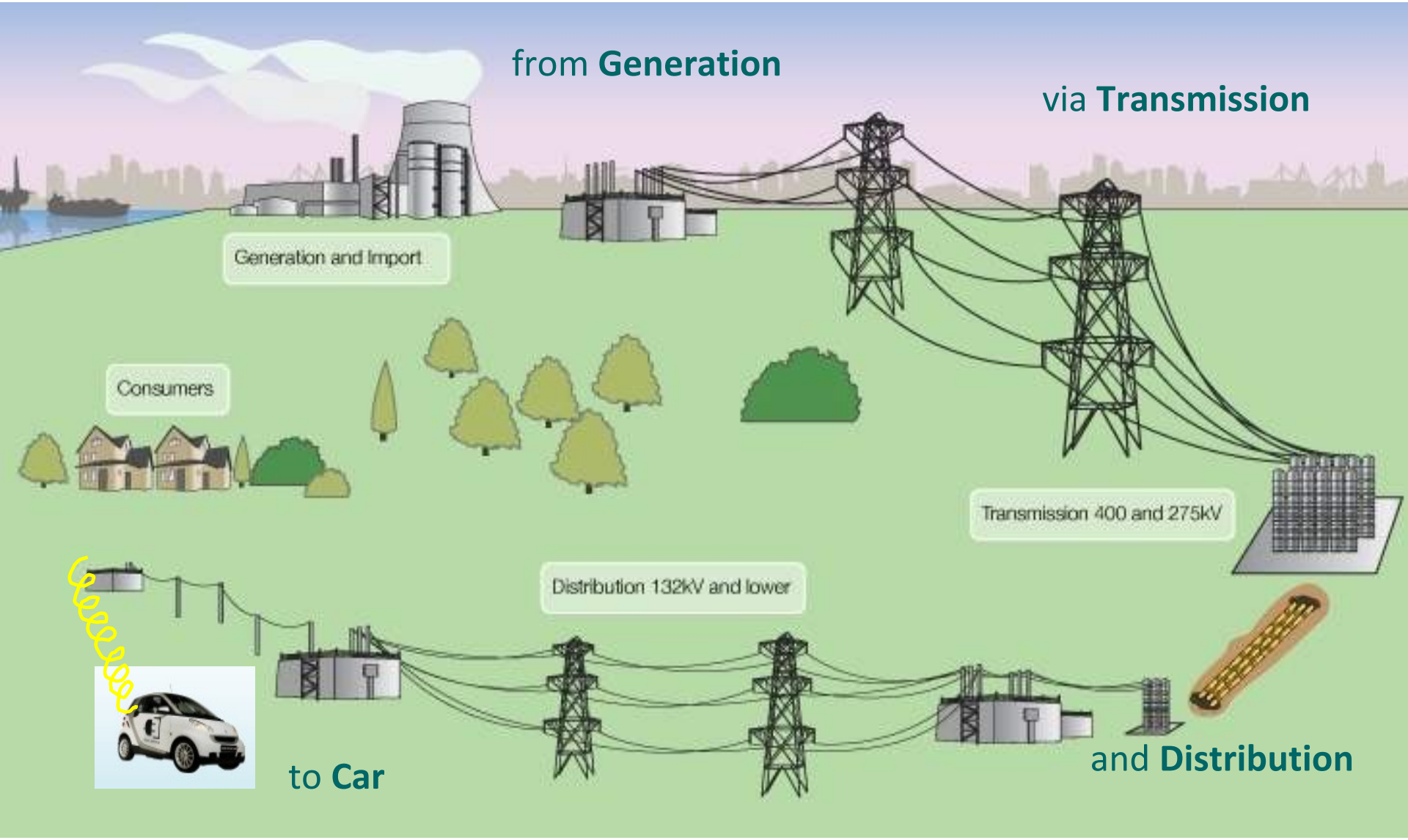
- **Are electric cars better?**
- **CABLED demonstration project**
- **Early indicative results**
- **Solve problems with hydrogen hybrid**

NEEDS ACTION IN BIRMINGHAM

Well to Wheel Approach for Fossil Fuels

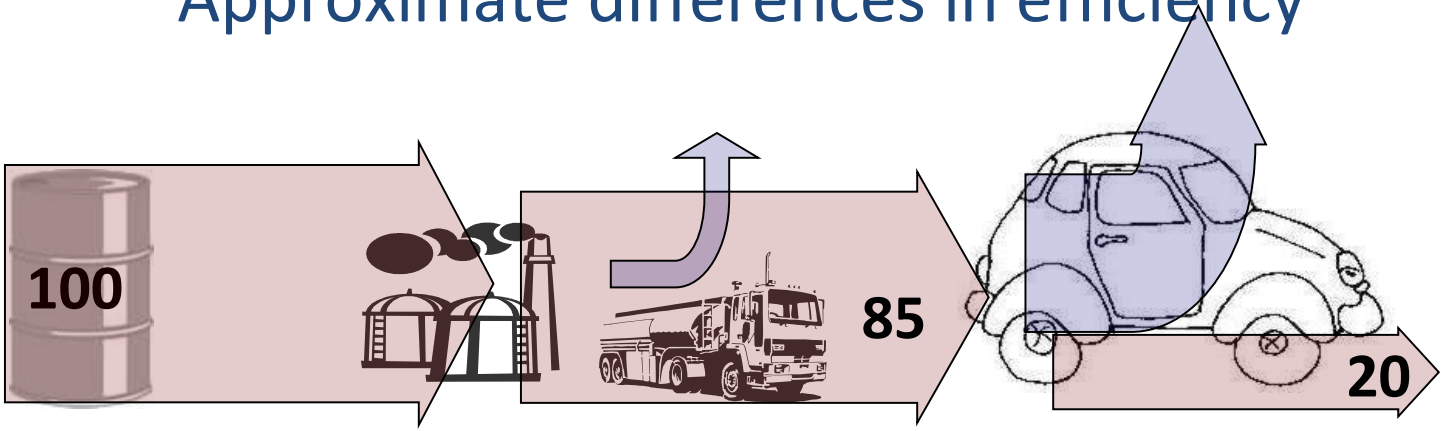


Well to Wheel Approach for Electricity

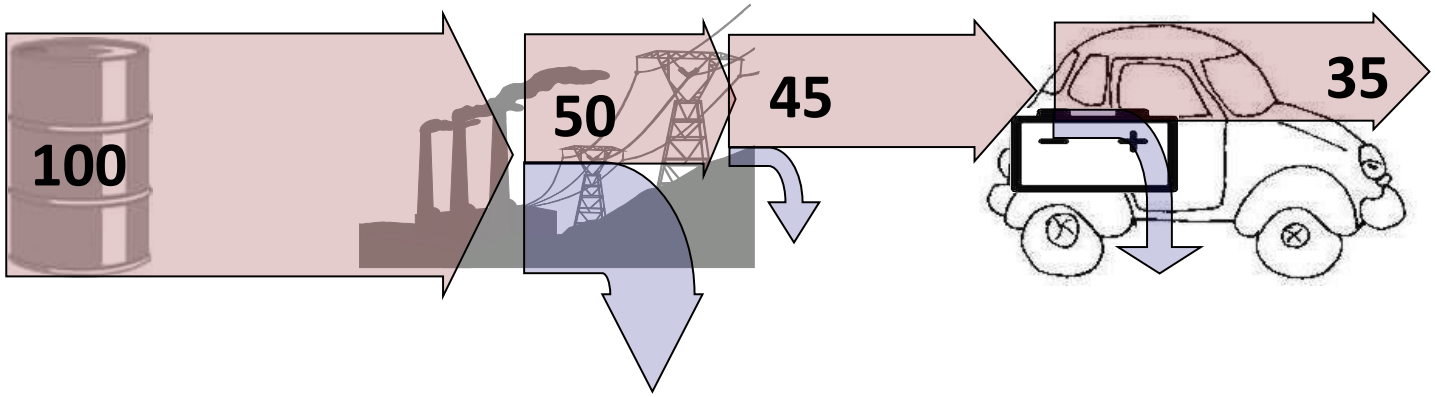


Comparison of Well to Wheel Efficiency

Approximate differences in efficiency



ICV



EV

Possible New Generation

Wind **Off-shore wind** **Wave** **Solar** **Nuclear**

ONE SOLUTION

1.4 kW

Feed in tariff 40p/unit

Save £500/year

Cost £7000

Return 8%

25 delivered 12 Dec 2009

CABLED – Coventry And Birmingham Low Emission Demonstrator

- Consortium of 13 organisations
- Arup as Project Managers
- 6 vehicle manufacturers
- E.ON – electricity supplier
- Birmingham City Council
- Coventry City Council
- 3 universities
  - Aston
  - Birmingham
  - Coventry

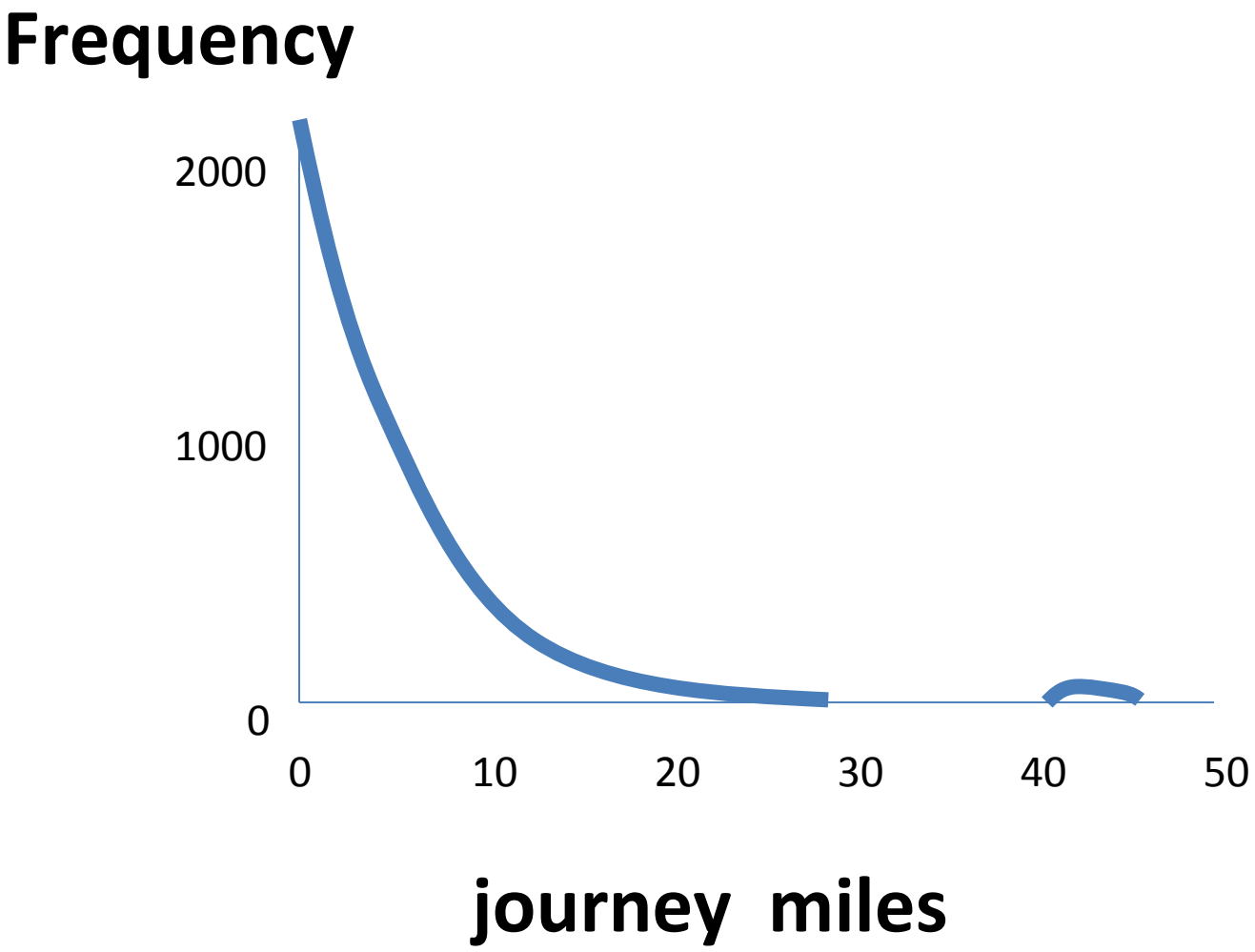
- £7.5 M subsidy from TSB & AWM

37 charging points in West Midlands

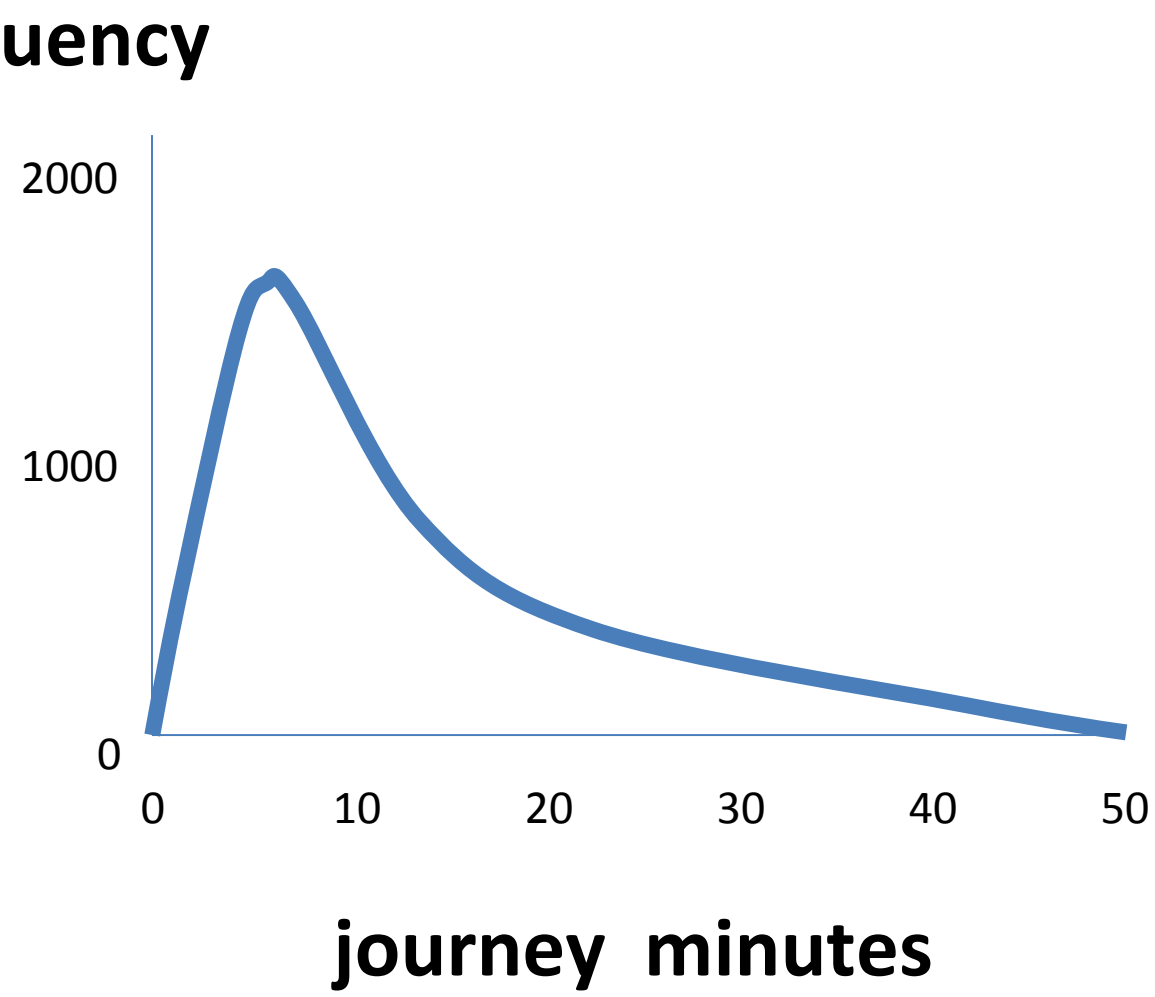
RESULT

Nominal Range	**80 miles**
True range	**56 miles**
Worst	**30 miles**
Average trip	**20 miles**

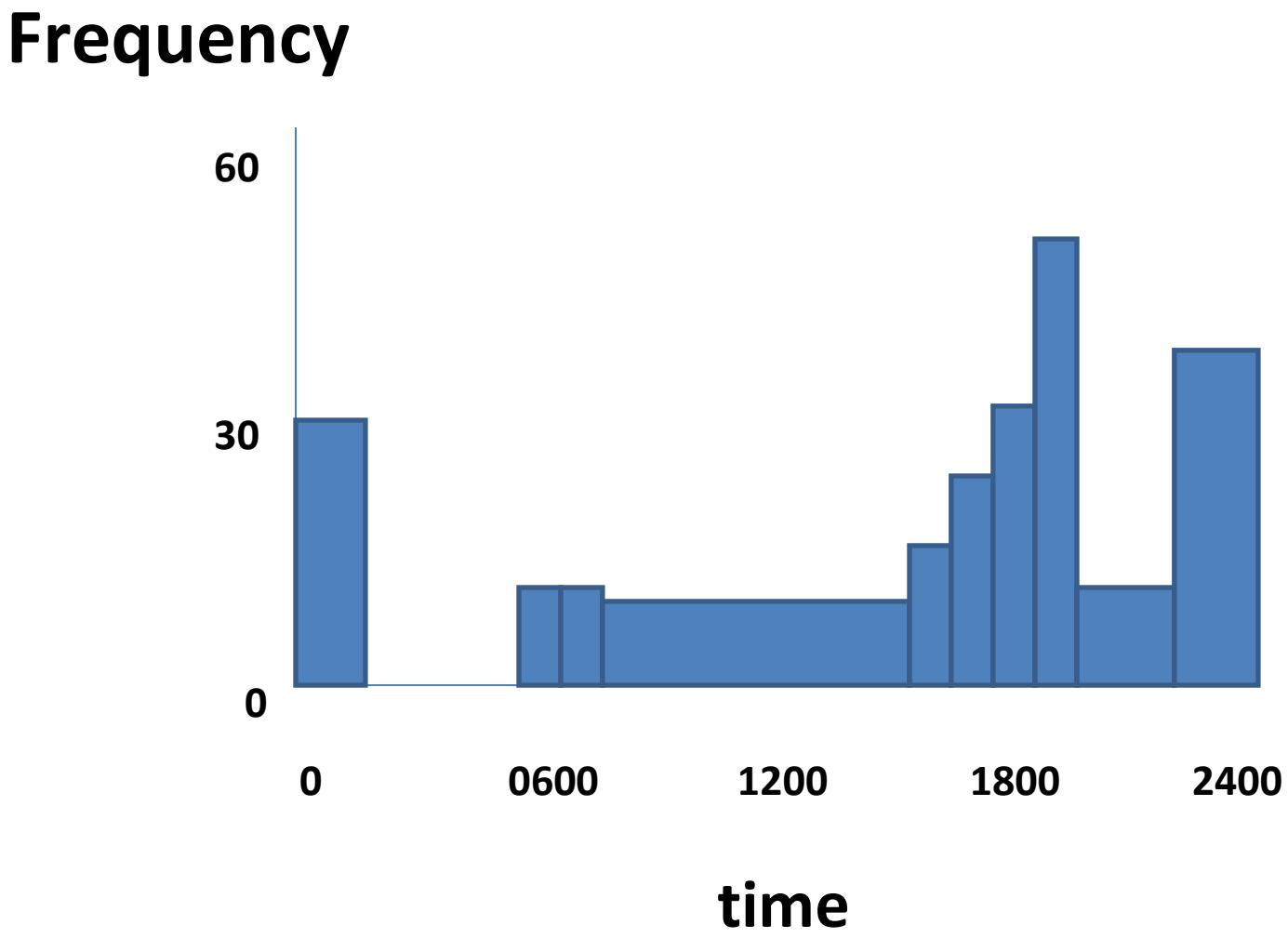
JOURNEY MILES



JOURNEY TIME



PLUG IN START TIME



PROBLEMS OF ELECTRIC CARS

- **Low range**
  a problem
- **Too long to charge up**
  makes life difficult
- **No charging points**
  real pain
- **Cycle life – not known**
  50 cycles no problem

HYDROGEN HYBRID CAR

- **Hydrogen gives energy storage**
- **Microcab- fuel cell recharges battery**
- **Smaller battery**

BENEFITS OF HYBRID FC vehicle

1. Small fuel cell
2. Lighter + cheaper batteries
3. No deep discharge ; long life
4. Fast refuel

Economic, Low mass,
Long life, Rapid refuel

Fuel cell hybrid car 2005

£50k prototype vs £4M for GM

MICROCAB & HYDROGEN STATION

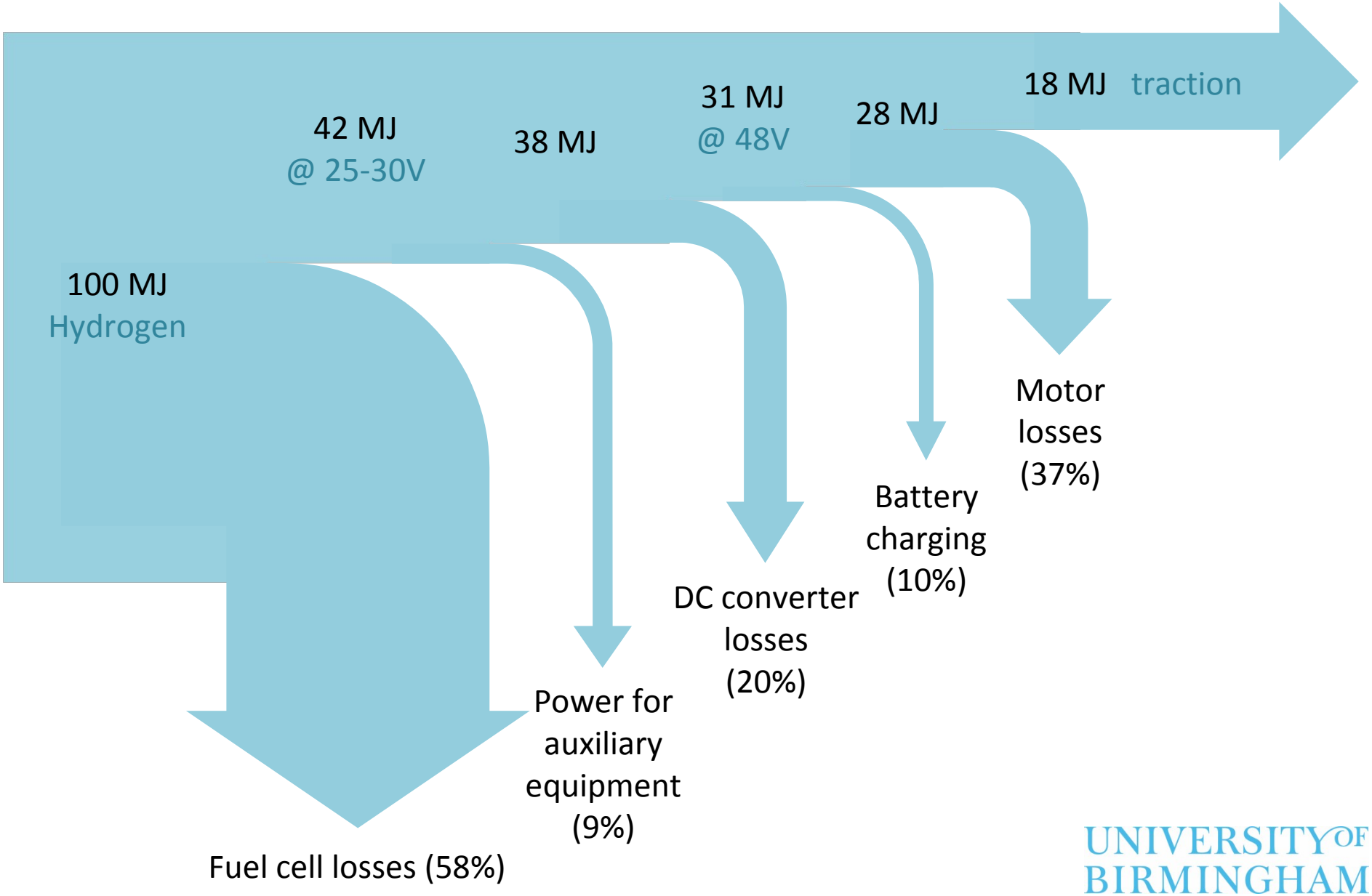

MICRO:CAB
UNIVERSITY OF BIRMINGHAM
H4 005
MICRO:CAB
UNIVERSITY OF BIRMINGHAM
H4 003
MICRO:CAB
UNIVERSITY OF BIRMINGHAM
H4
MICRO:CAB
UNIVERSITY OF BIRMINGHAM
H4 002
UNIVERSITY OF BIRMINGHAM
H4 004

Mail Run

RESULTS

- Combined 3,000km travelled
  (approx. 3,000 trips around campus)
- Racked up 5,000 hours operational time
  (>2,000 in the leading vehicle)
- Over 120 refuelling events
  (58kg of hydrogen transferred with no incidents)

Tank to wheel efficiency



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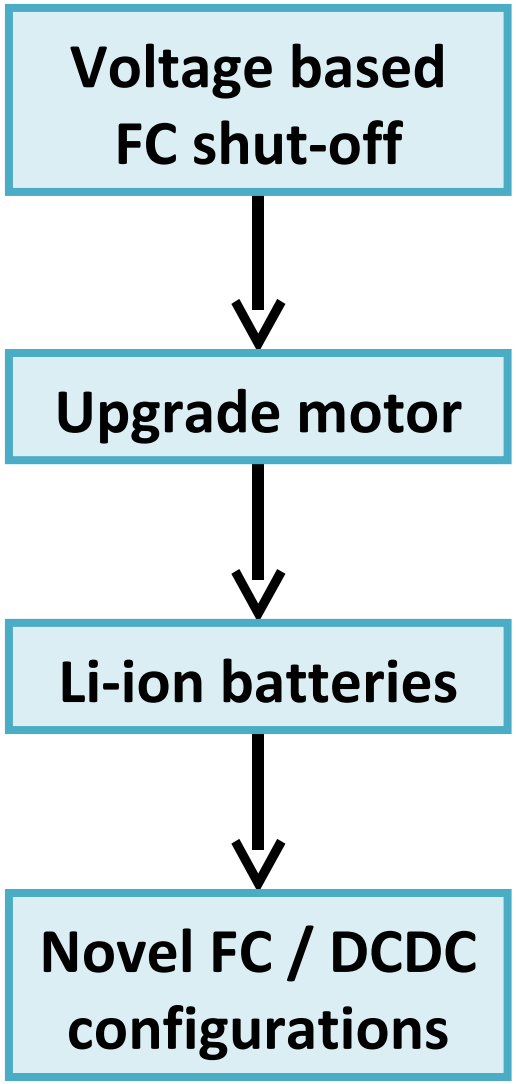
Proposed Microcab Improvements



- Ensure batteries are left at high SOC
- Cut off fuel cell before inefficiency creeps in
- Cost: £10

- Increase top speed to 40 mph
- Efficiency 63% -> 88%
- Cost: £2,000 for 10 kW

- More storage / less weight (90 Wh/kg)
- Greater charge/discharge efficiency
- Cost: £2,500 for 5 kWh

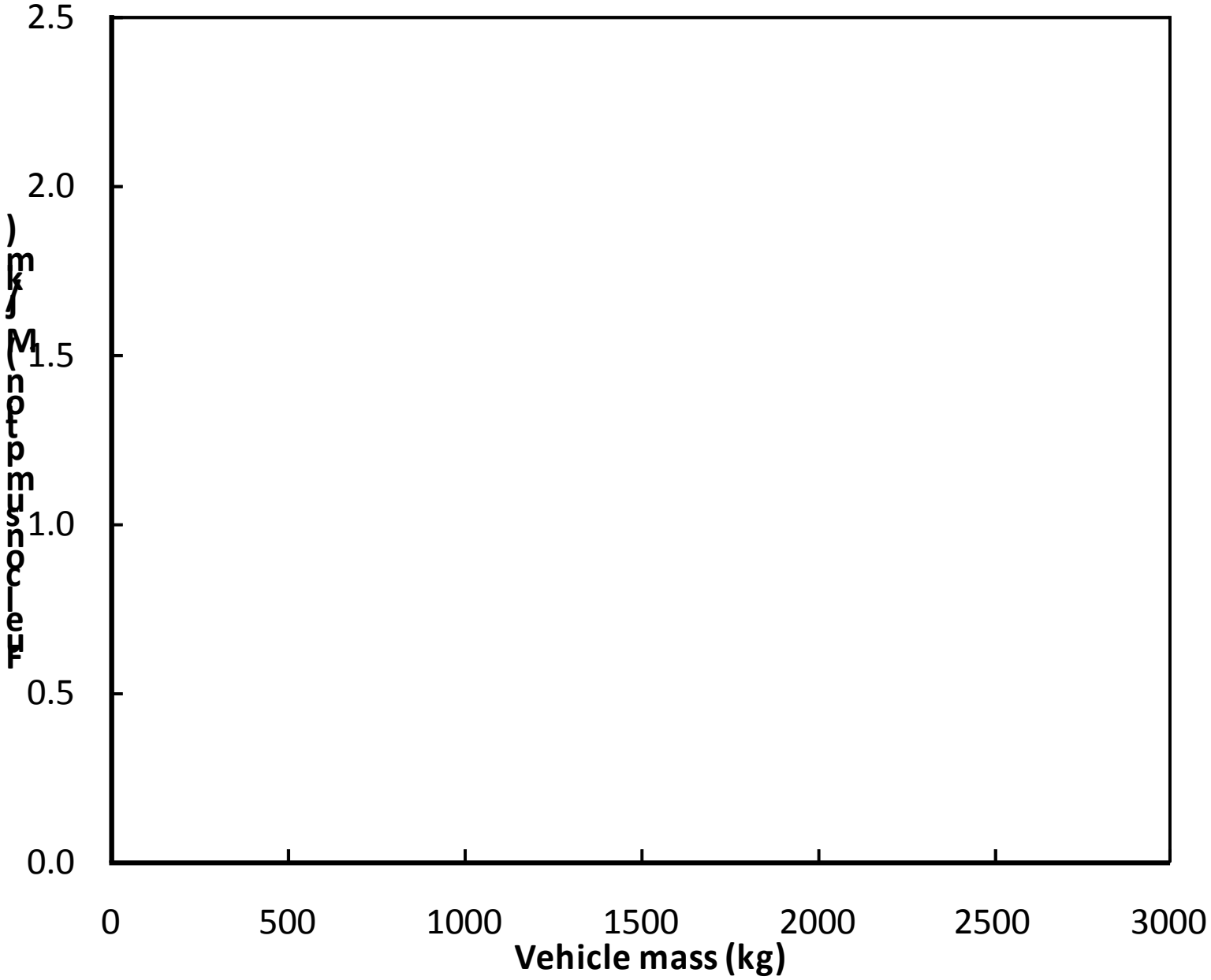
- 2 fuel cells in series
- No DC converters?
- Cost: £3000

So, what does all this mean?

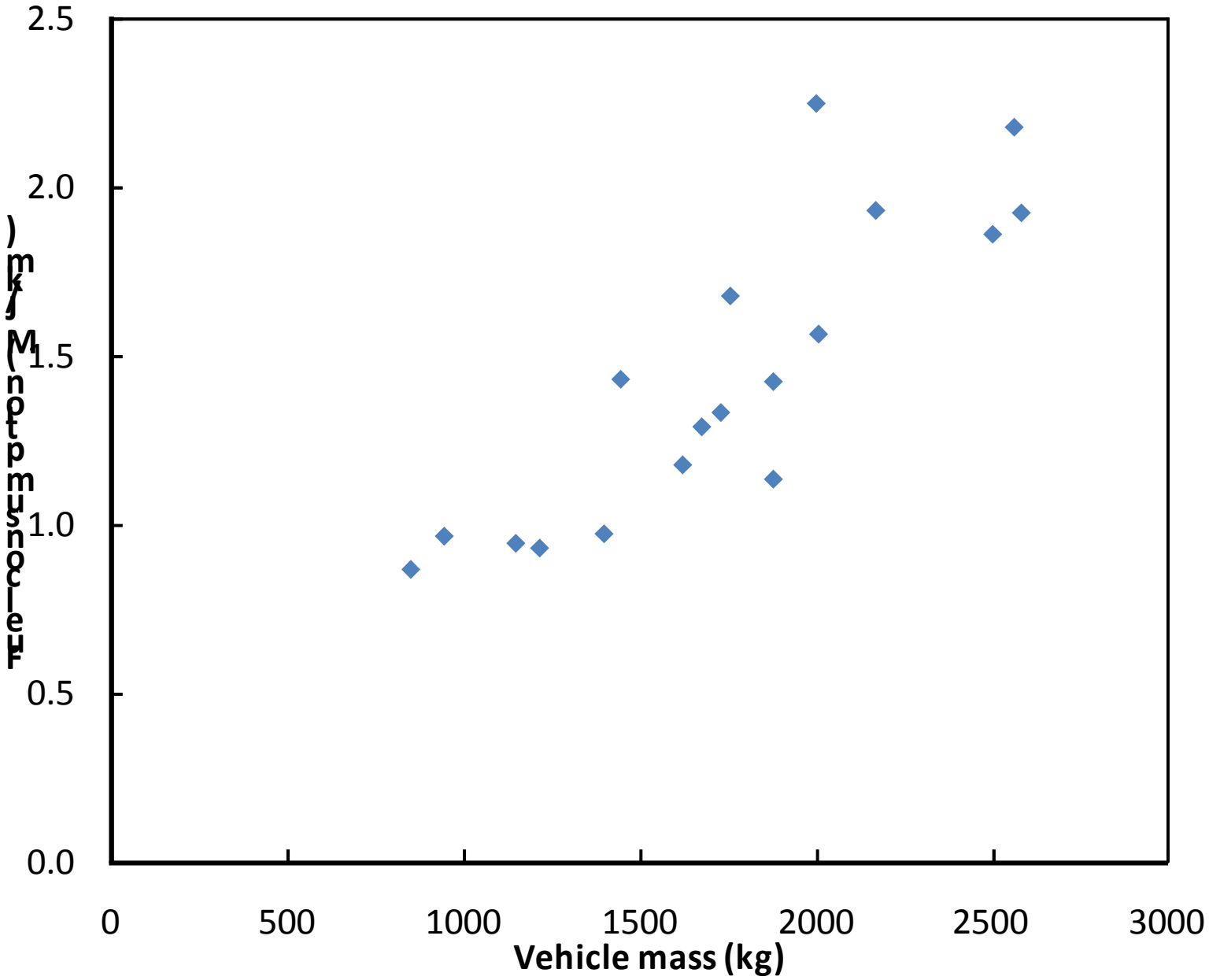
- How does the Microcab compare with other hydrogen vehicles?

- How do these compare with today's cars?

Fuel economy of major FCVs



Fuel economy of major FCVs



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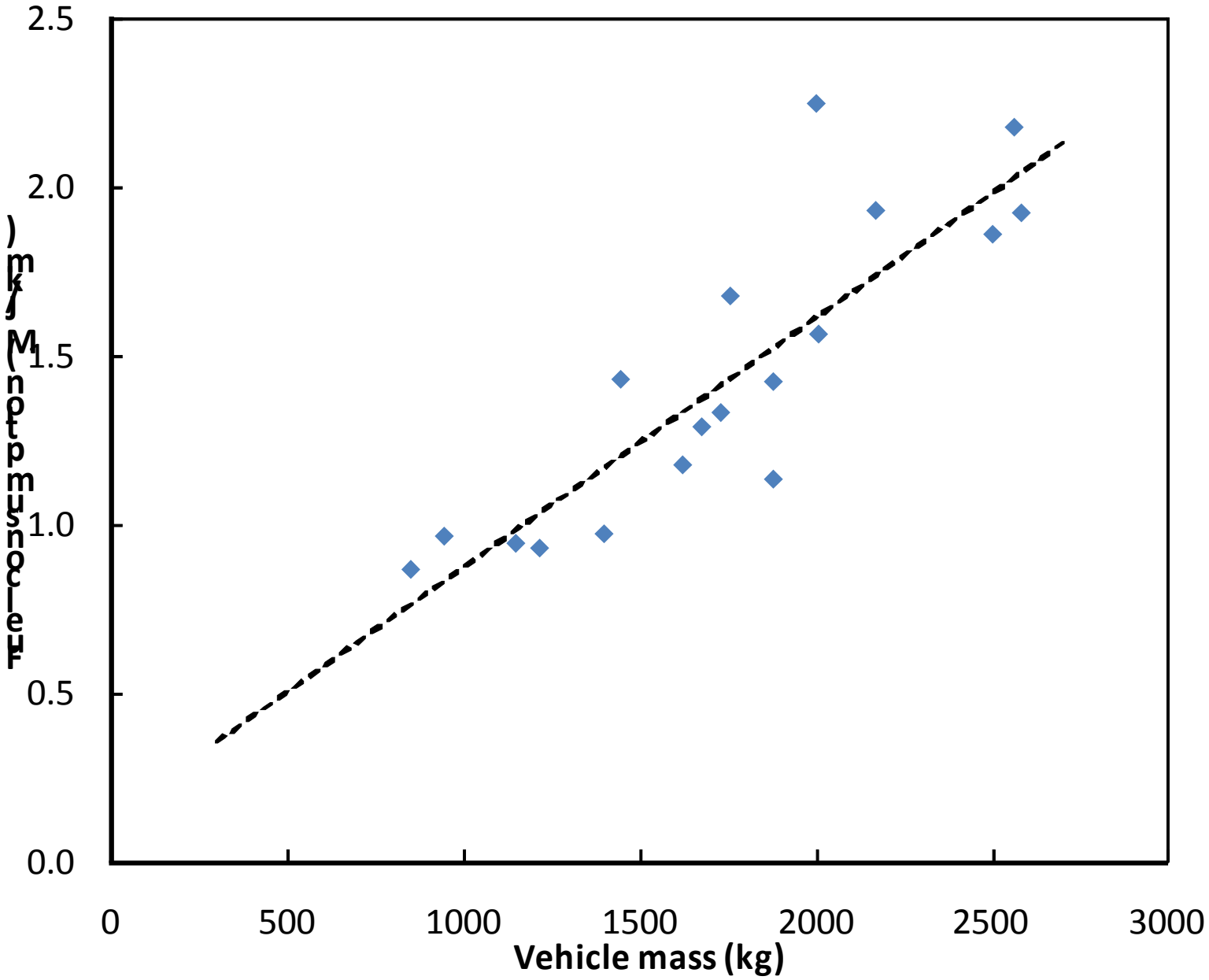

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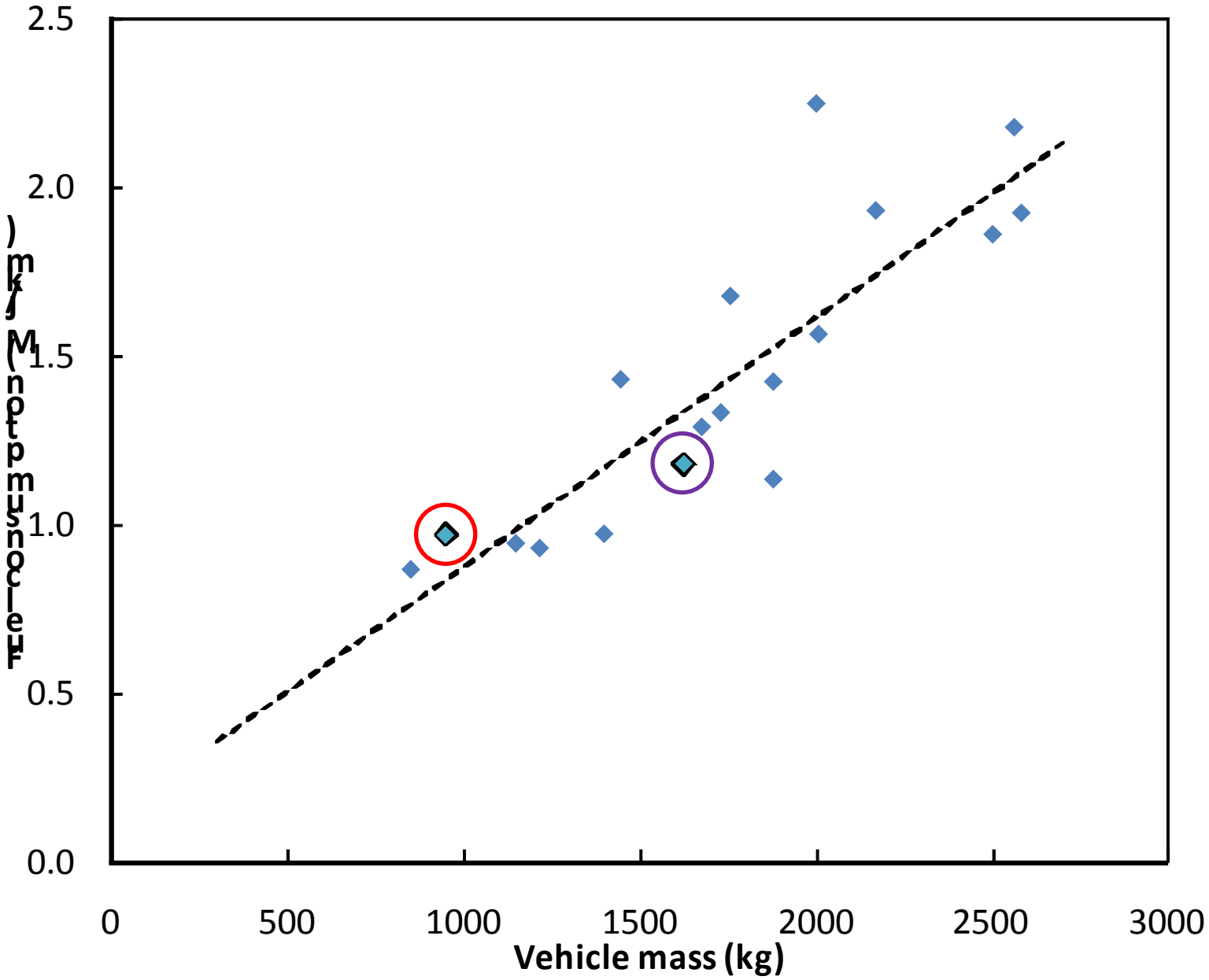
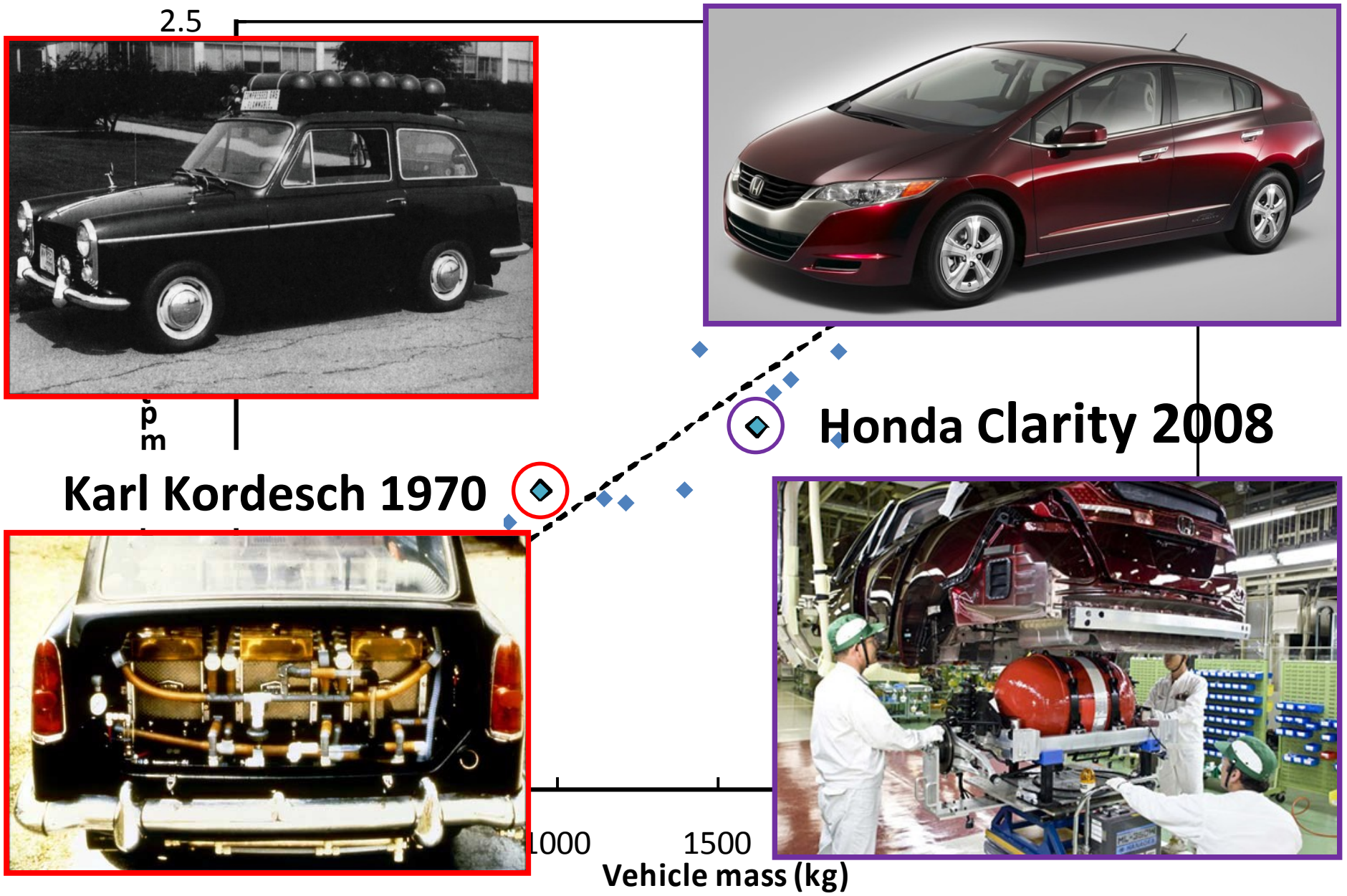


Fuel economy of major FCVs

2.5
2.0
1.5
1.0
0.5
0.0
0
500
1000
1500
Vehicle mass (kg)

Fuel economy of major FCVs



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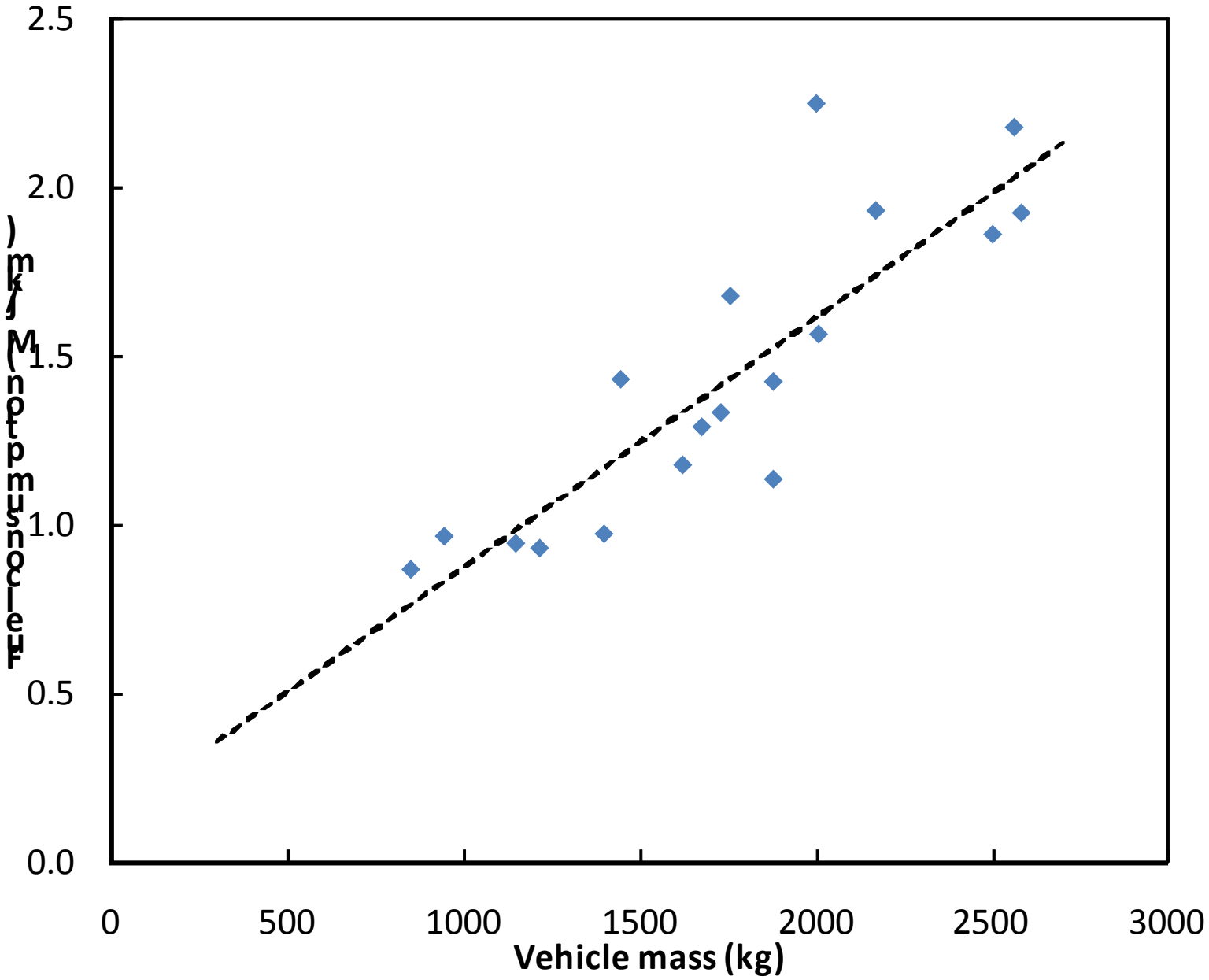

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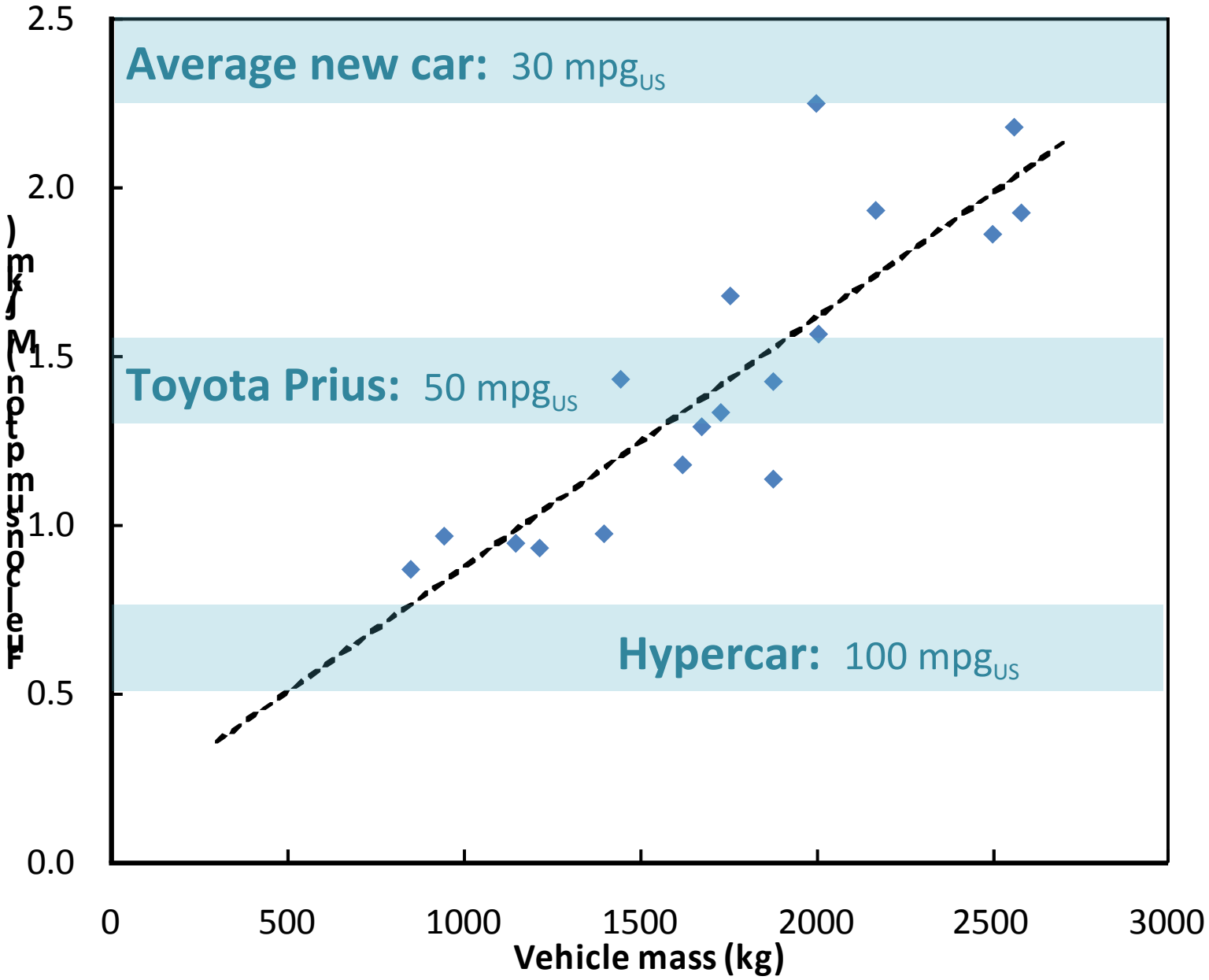
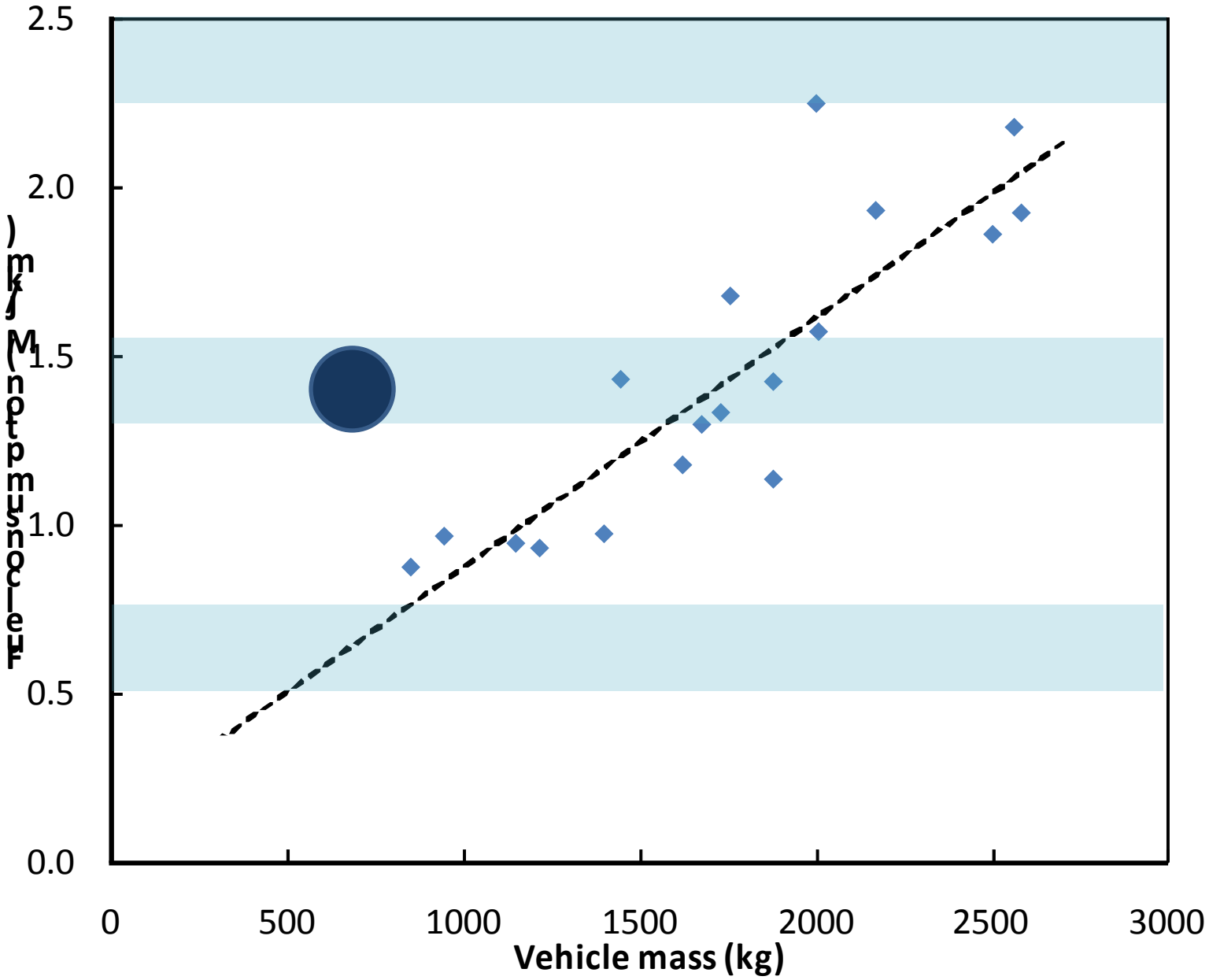


Fuel economy of UK prototypes



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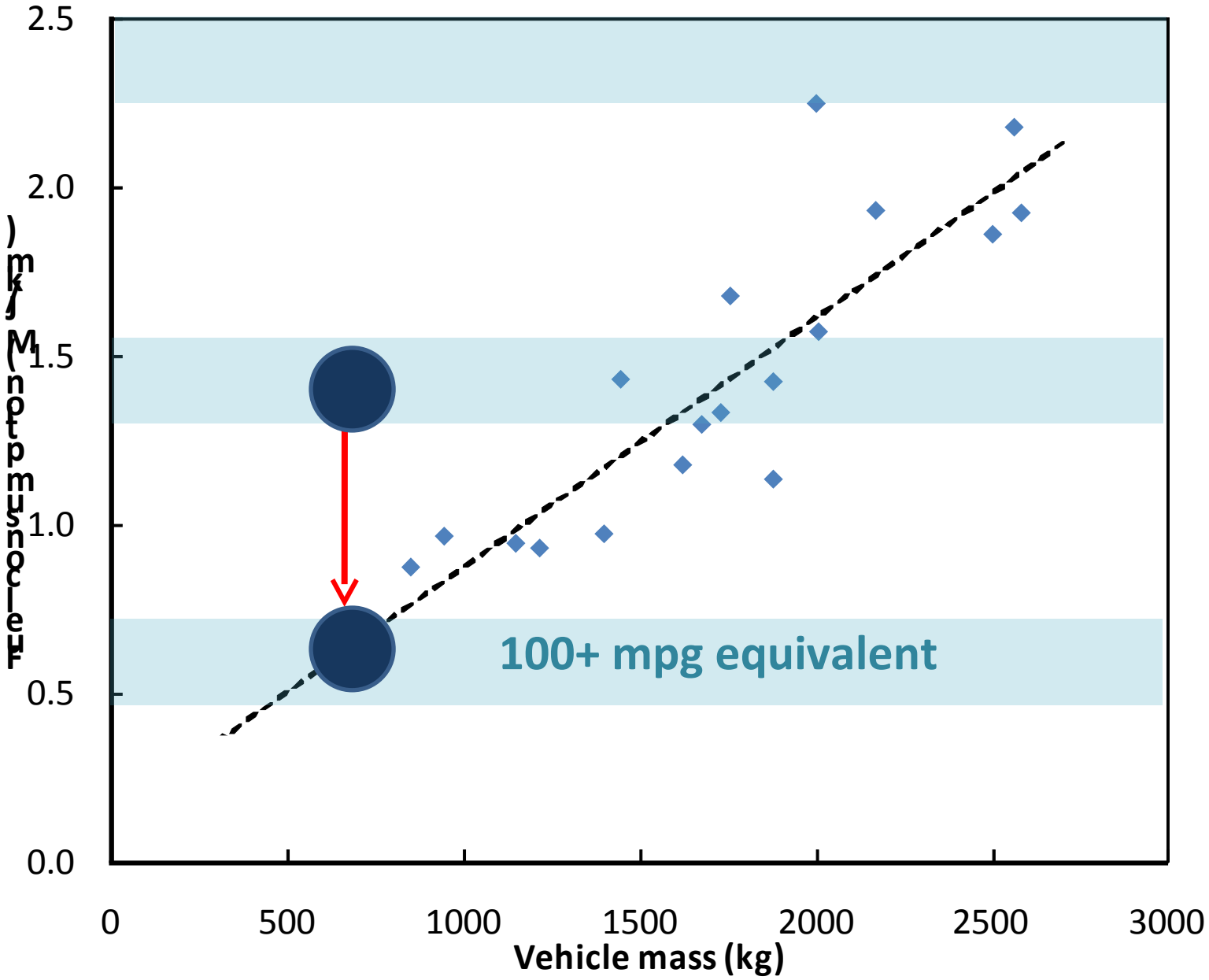

CONCLUSIONS

- **Electric cars are coming**
- **CABLED project is demonstrating**
- **Hydrogen cars can solve problems**
- **Need :- ACTION NOW**