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‘Energy Consumption of EVs and Charging Equipment’

ALICE Webinar
5 May, 2025

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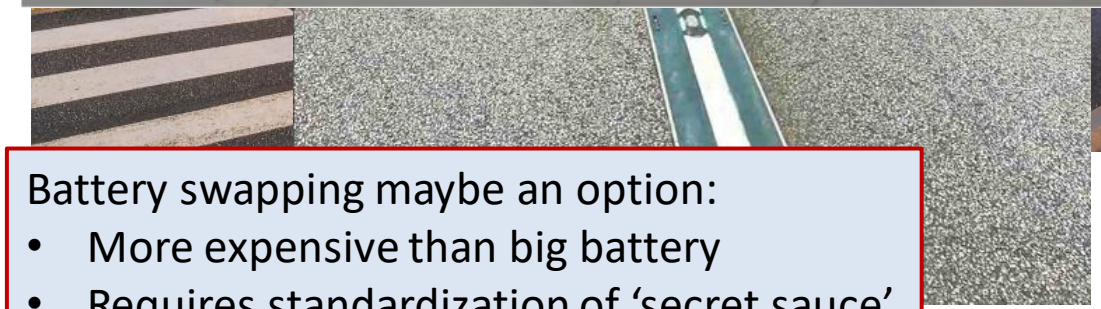
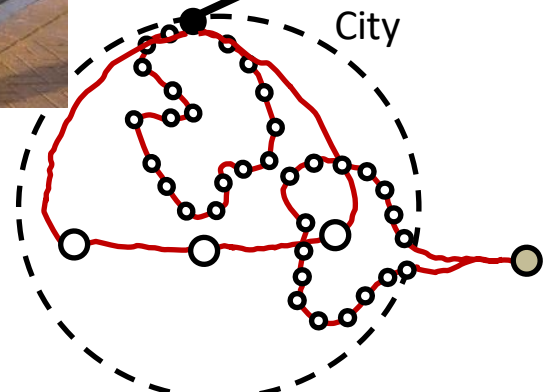
Centre for Sustainable Road Freight

Electrification options for Long Haul





Static Charging: *Warehouses*

National or Regional DC

Static Charging: *Truck stops*

Dynamic Charging: *Electric Road System*

ocal DC
upermarket
JCC

National or Regional DC

City

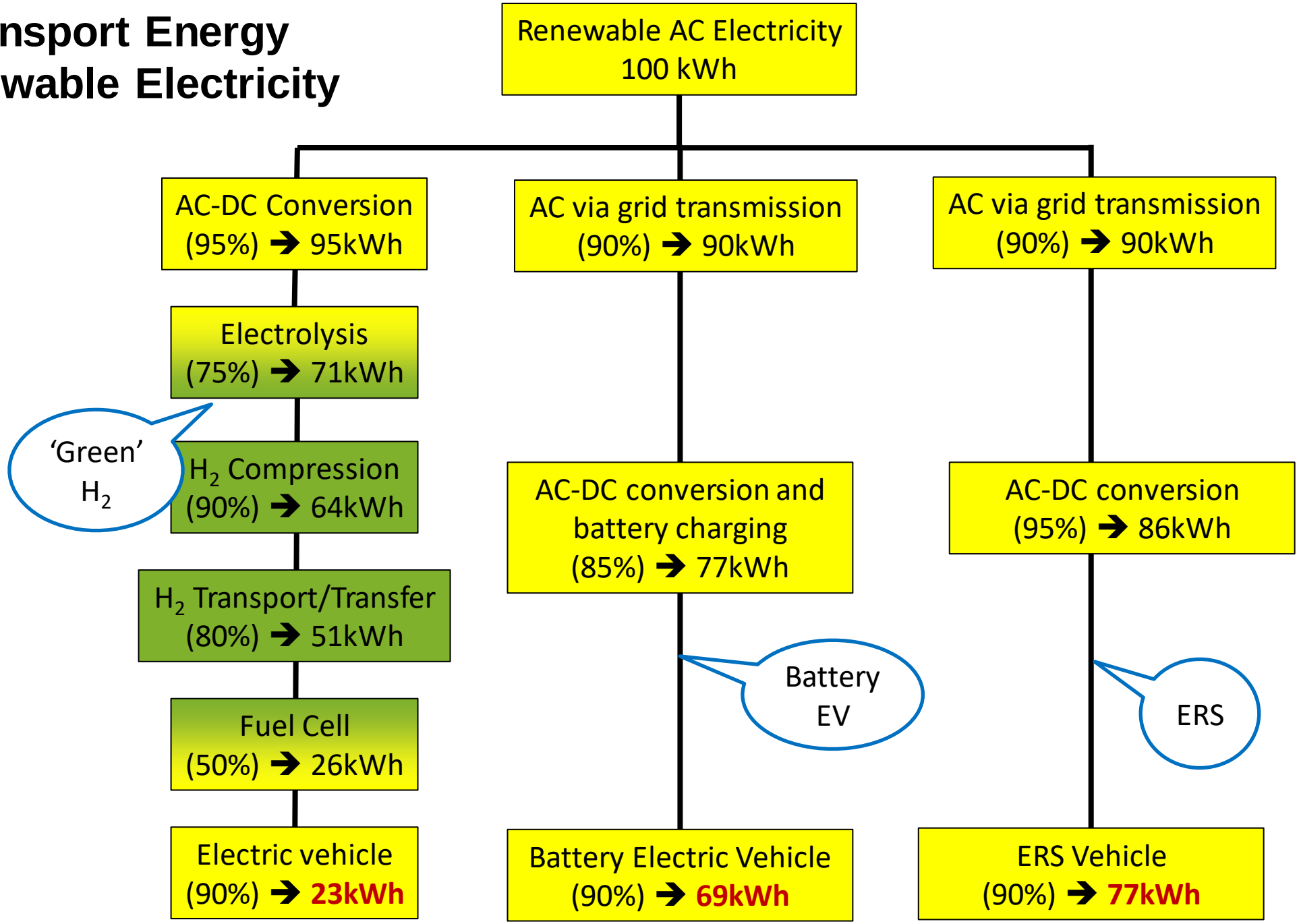
City

Battery swapping maybe an option:

- More expensive than big battery
- Requires standardization of ‘secret sauce’
- Not favoured in Europe

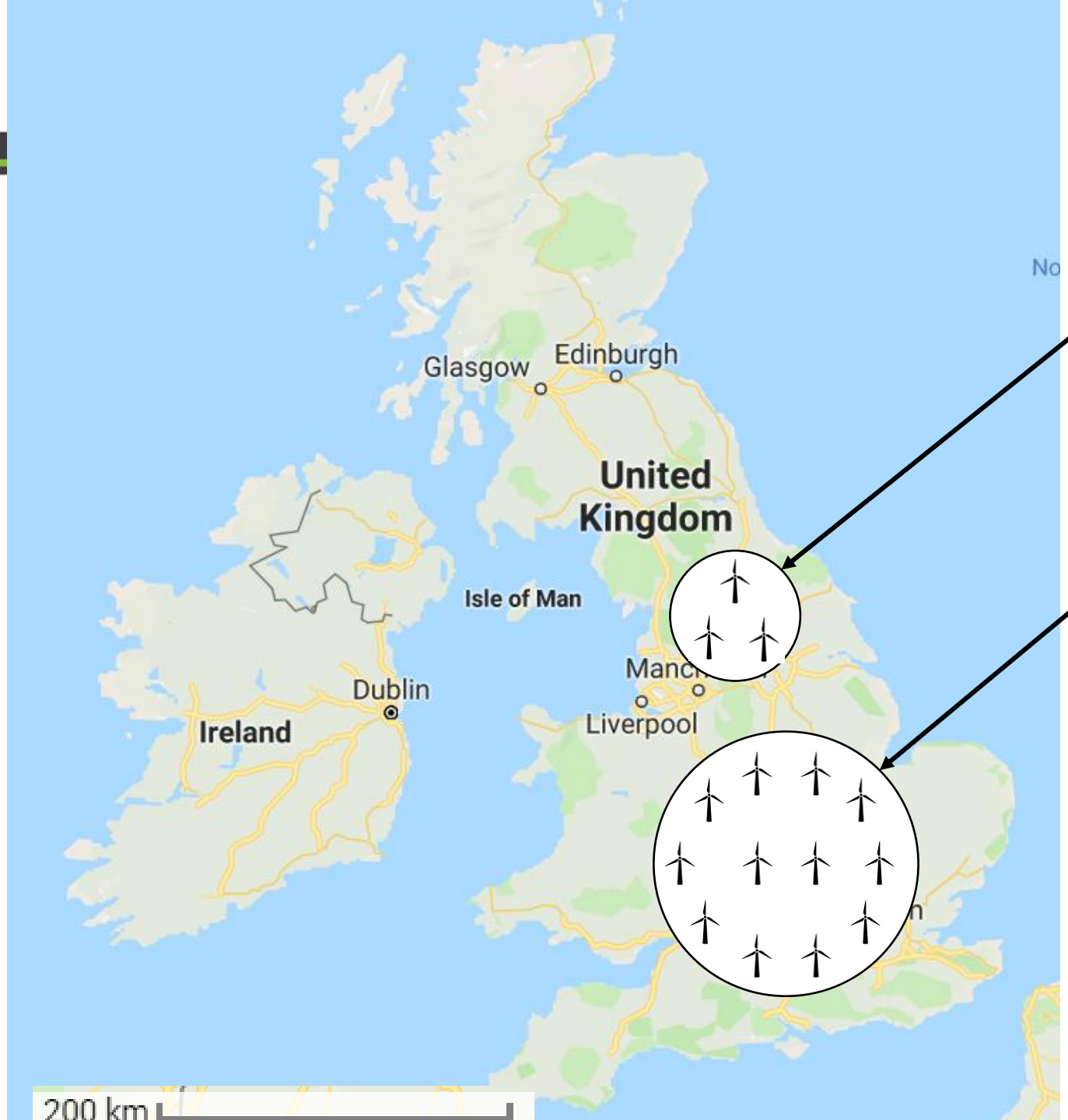
Electric trucks charging at St Pancras Station, London, 1907

Useful Transport Energy from Renewable Electricity



Hydrogen is too expensive..

Costs:
CAPEX x 2
OPEX x 3



ERS:

- 10.6 GW
- 3,500 wind turbines
- Land Area=5,300 km^2

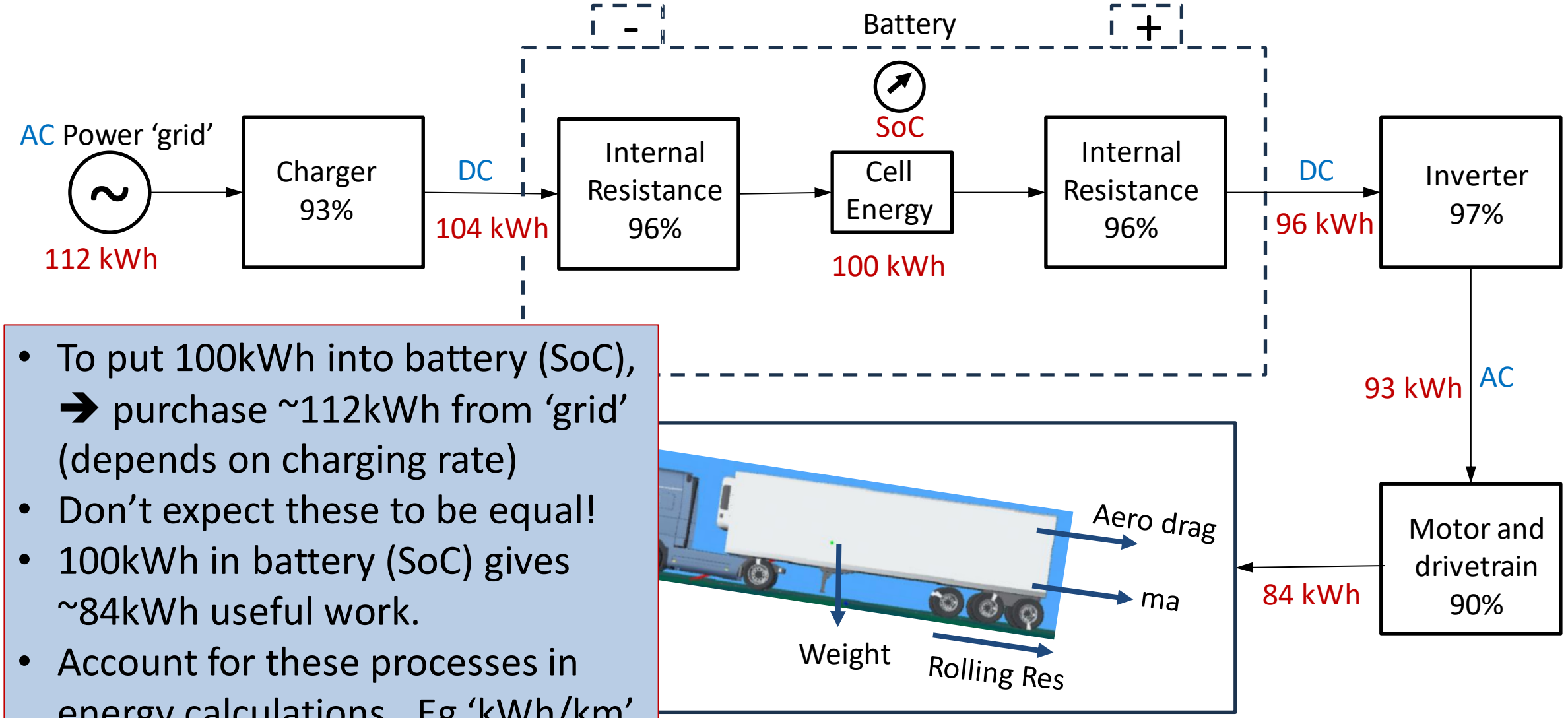
'Green' Hydrogen:

- 35.6 GW
  (31 GW = UK average)
- 12,000 wind turbines
- Land Area=18,000 km^2

Assumptions:

1. UK freight: 189b t.km per year
2. 0.19 kWh/t.km (44t), LF=0.75
3. Efficiencies:
   - 0.77 ERS
   - 0.23 H_2
4. Turbine power: 3MW
5. Wind power density: 2 W/m^2

BEV Efficiencies: Deep Dive

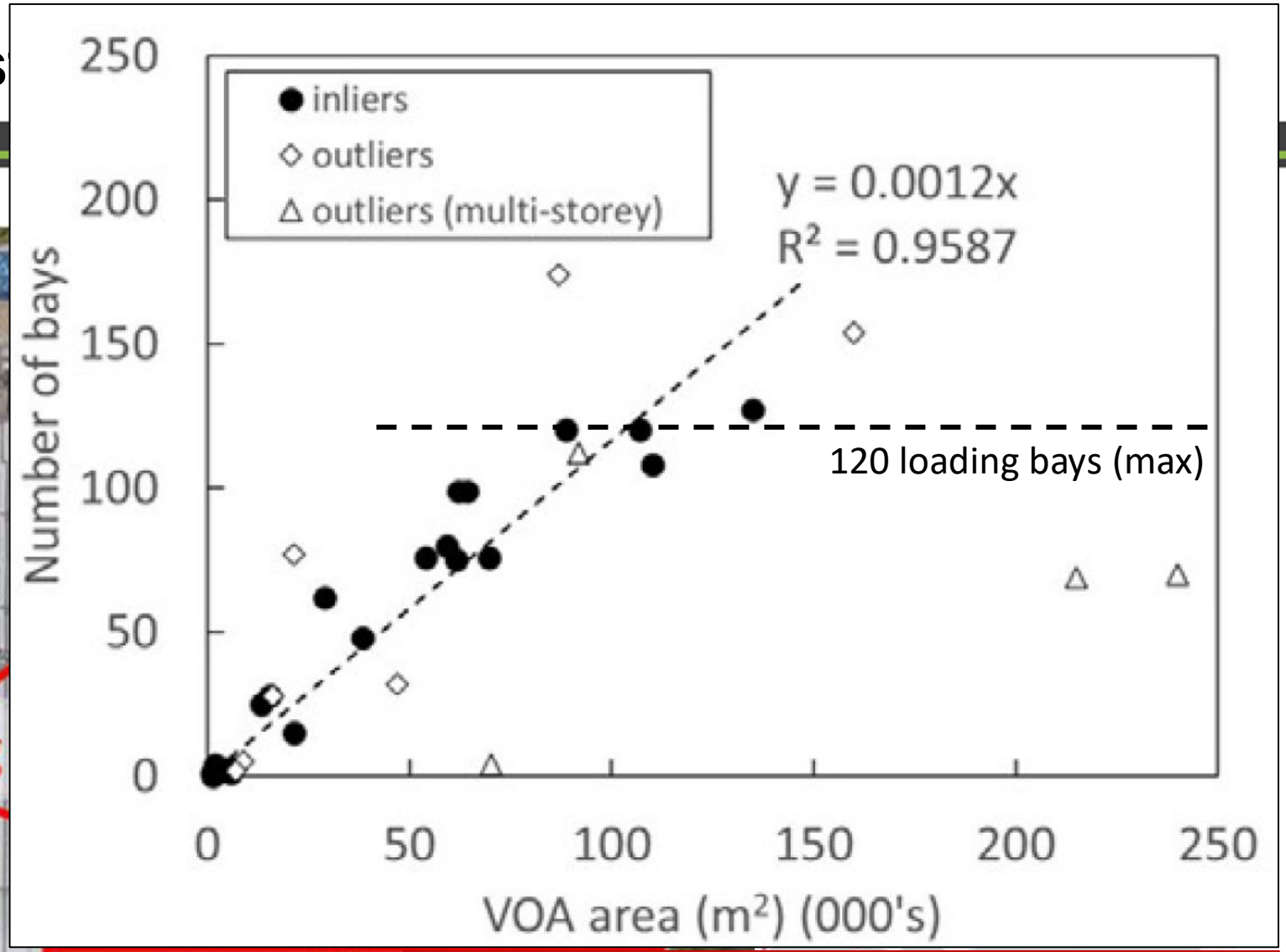


- To put 100kWh into battery (SoC), ➔ purchase ~112kWh from 'grid' (depends on charging rate)
- Don't expect these to be equal!
- 100kWh in battery (SoC) gives ~84kWh useful work.
- Account for these processes in energy calculations.. Eg 'kWh/km'

Logistics Penalties with BEVs

1. Mass Penalty for heavy loads…
   - 44t x 6-axle Diesel artic carries 29t
   - 42t x 5-axle BEV artic carries 22t
   - Payload loss is 7/29 = 24%
   - 4 BEVs to move same freight as 3 Diesels… 33% extra cost
2. Time Penalty
   - BEV can drive for ~4 hours (320km) between charges
   - Charge for ~1 hour out of 5 hours…. 20% of the time
   - Most driver rest stops in UK occur during logistics stops (unload/load)
   - Outcome:
     - Charge during the driver break at warehouses… large grid connection or
     - Take an extra stop at a public charging point… 20% additional cost.

How many logis



Conclusion: 20,000 facilities > 2000 m² needing 4-20 MW electricity connections

deSaxe et al, 'A dataset of logistics sites in England and Wales: Location, size, ty

Conclusions

1. Hydrogen is a non-starter… CAPEX x2; OPEX x3 compared with EV.
2. Battery Electric Vehicles (BEV)
   - 42t BEVs are available now, but with substantial payload loss 29t ➔ 22t
   - Electric logistics is doable with time and weight penalties: 10% to 25% increase in logistics costs
3. Charging is the challenge!
   - Energy losses during charging process can be significant ~10%
   - Truck Stop Charging is necessary, but not sufficient.
   - Warehouse Charging is essential to reasonable journey durations.
   - Electricity supply to warehouses is very challenging – Potential blocker
4. Logistics cost penalties must be overcome for widespread roll-out of Evs!