On-Board Charger for Electric Vehicles

delta motorsport

bosal

Electric Vehicles Drawbacks

- Limited real-world range
- Acquisition price higher than ICE vehicles
- Heavy and expensive batteries
- Poor overall lifecycle performance of large battery packs and BEVs

Philosophy

- 130km electric range covers 98% UK daily driving requirements
- 30kWh battery system can cover this range
  Roughly1/3rd of any premium car battery size
- Range extender used to cover occasional longer trips

Impact of having 130km electric range and On-Board Charger on sample vehicles

Assumptions: - Battery specific energy density = 0.2kWh/kg - OBCsystem mass = 60kg	Battery Capacity	WLTP Range	Battery Capacity Required for 130km Electric Range	Vehicle Mass Reduction (including battery capacity reduction to cover 130km electric range and OBC system mass added)
Model	kWh	km	kWh	kg
BMW i3 120Ah	42.2	311	20.3	49
Renault Zoe R110 ZE40	41.0	299	20.5	43
Hyundai Kona Electric 39kWh	42.0	290	22.2	39
Kia e-Niro 64kWh	67.0	455	25.5	152
Nissan Leaf	40.0	270	20.4	38
Mercedes EQA	60.0	401	19.6	142
DS 3 Crossback E-Tense	50.0	325	20.3	89
BMW iX3	70.0	401	22.9	176
Jaguar I-Pace	90.0	470	30.9	236
Audi e-tron Sportback	95.0	401	37.8	226

Concept: Turbomachinery Coupled with an Electric Machine

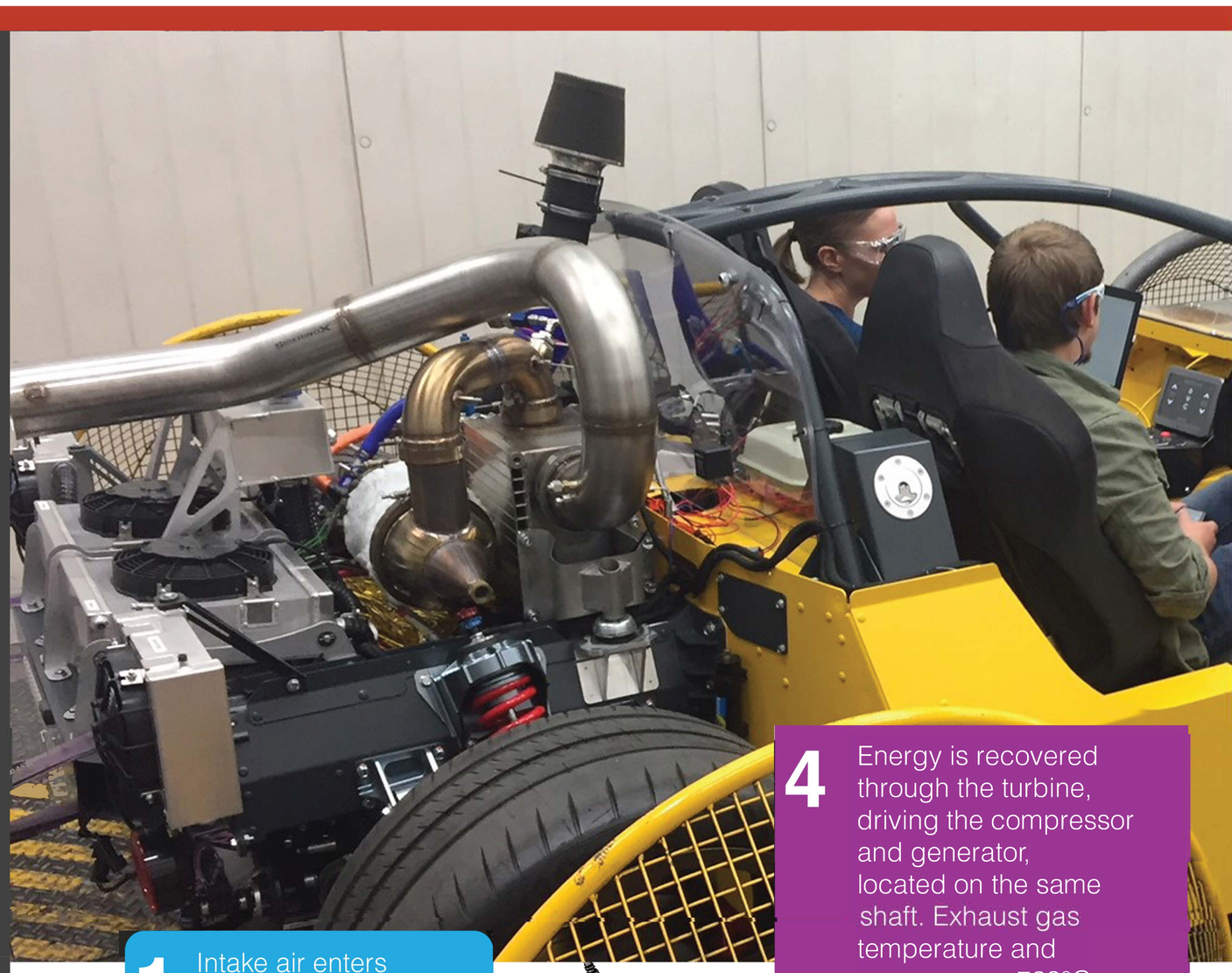
- High speed = Low torque = Small generator
- Optimized temperatures and pressures to use mainstream materials
- Recuperated cycle to increase turbine efficiency
- Single set point operation to optimize emissions and efficiency
- Low emissions
- Simple vehicle integration
- One moving component
- Simplicity and cost saving
- Low cost

System Benefits Compared to Equivalent Piston Range Extenders

- Runs very cleanly:
  - Very low CO and NOx emissions
  - Emissions after-treatment system not required even for most stringent applications
- Lower system mass and size
- Low cost at high volume
- Fuel quality tolerant
- Can be used with different fuels without extensive modifications
- Reliable
- Low maintenance
- Easy integration in different applications
- Works in any position and orientation
- Reduced NVH

Vision

- ✔ No range anxiety
- ✔ No need for a conventional second vehicle
- ✔ No requirements for large batteries
- ✔ Reduced end of life impact
- ✔ Reduced weight and price



1 Intake air enters through the filter and is compressed. Its temperature and pressure increase to 205°C and 4.4 bar respectively.

2 It then passes through the recuperator (heat-exchanger) and heats up to 600°C, thanks to exhaust gas energy recovery.

3 Hot air enters the combustor, mixes with fuel and burns continuously at 1050°C to further increase flow energy.

4 Energy is recovered through the turbine, driving the compressor and generator, located on the same shaft. Exhaust gas temperature and pressure are 730°C and 1 bar at the turbine exit.

5 Once back through the heat exchanger, flow exits at temperature < 350°C

TIMELINE

2014	2016	2018	2019	2020
Project start	17kW OBC prototype in E4 coupe	35kW OBC prototype for HiPerCaR	35kW OBC for prototype integration	Pre-production units

On-Board Charger will be available for prototype integration from autumn 2019

Applications of On Board Charger

- **HiPerCaR 2 – High Performance Carbon Reduction Sports Car**
  Advanced Propulsion Centre funded project
- **Urban vehicles (car, van, truck)**
- **Off highway vehicles**
- **Marine**
- **Aviation**
- **Stationary power**

References

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