Introducing FullElectric Turbocharger Technology

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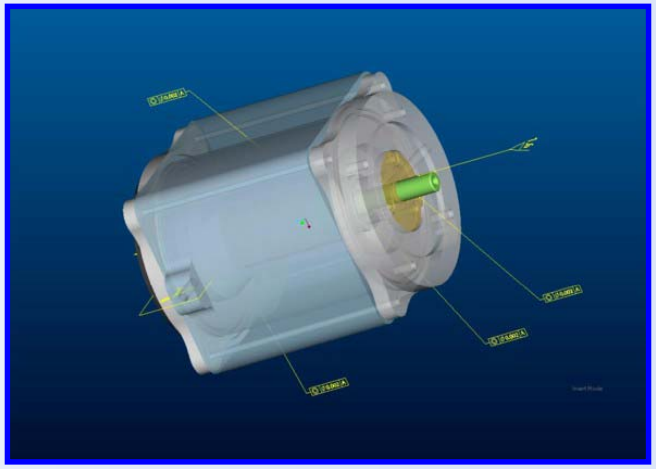
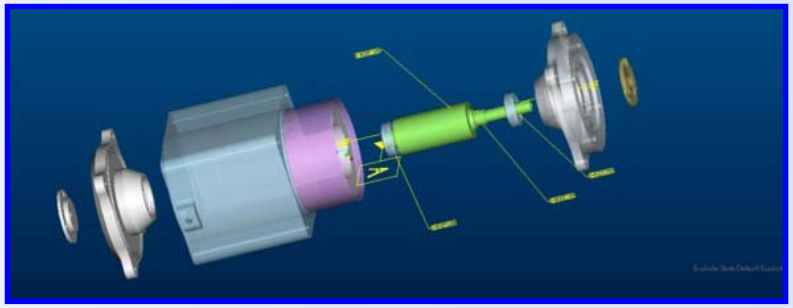
Introduction to Aeristech

- Activities:
  protoype and development
- Technologies:
  high-performance electric machines,
  world-leading electronics control,
  fullElectricTT
- Business model:
  collaboration & licensing,
  high-value design and
  manufacturing





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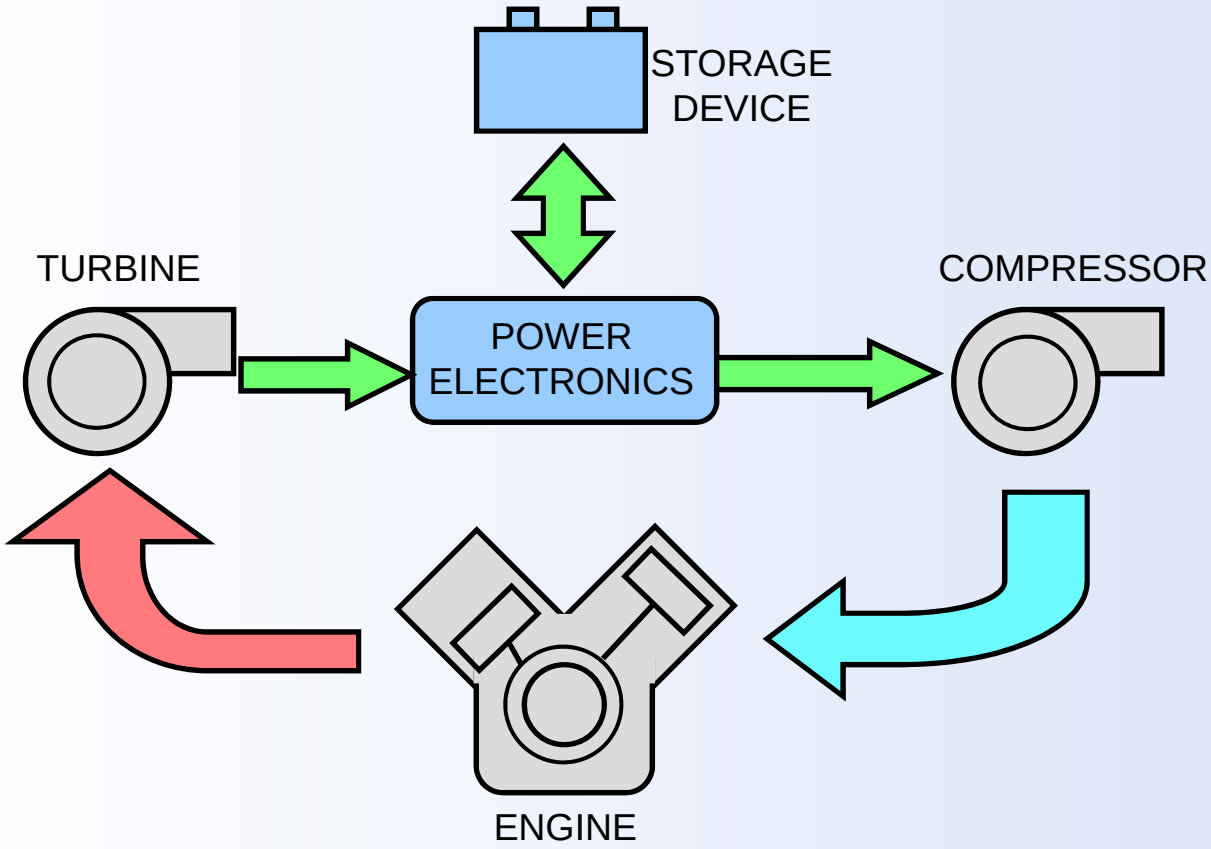
fullElectric Turbocharger Technology



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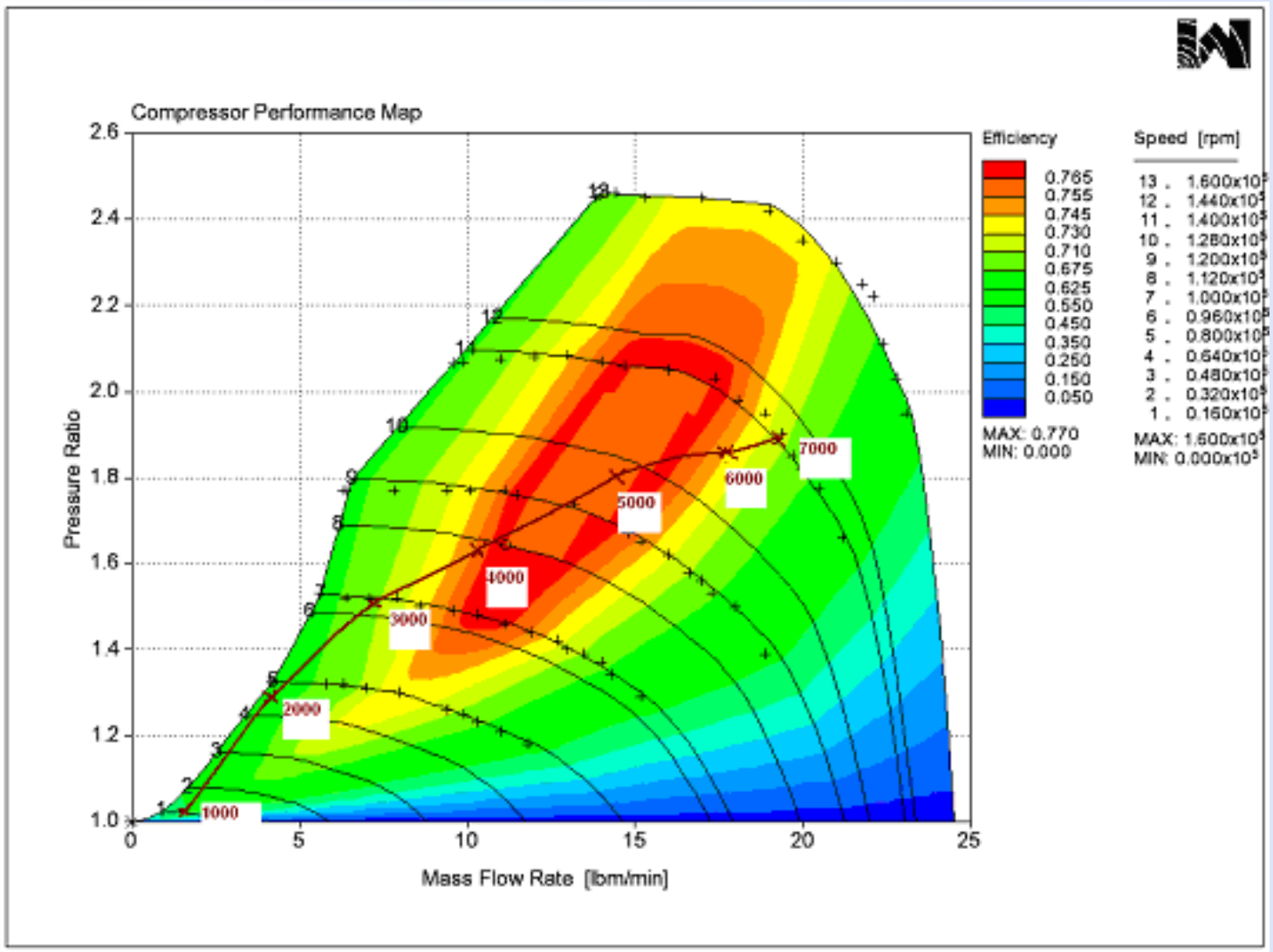
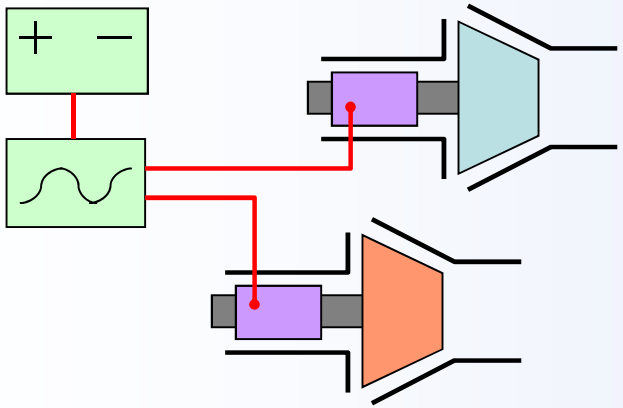
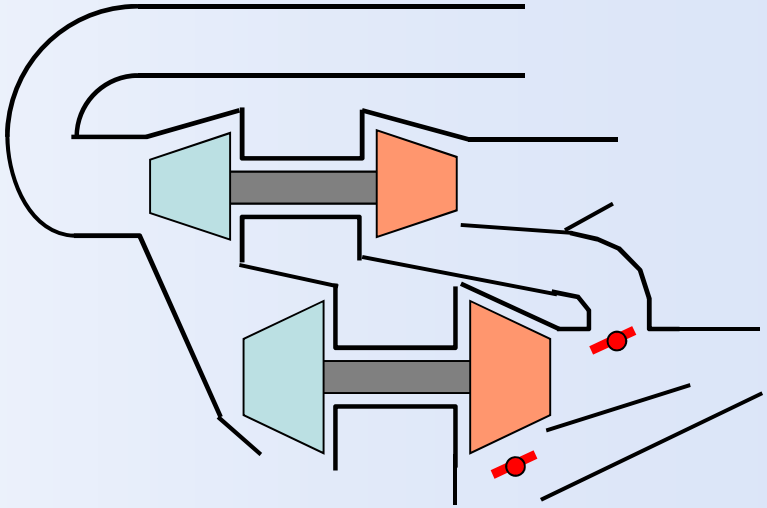


Compresser performance at various Engine Speed (RPM)

Price & Packaging

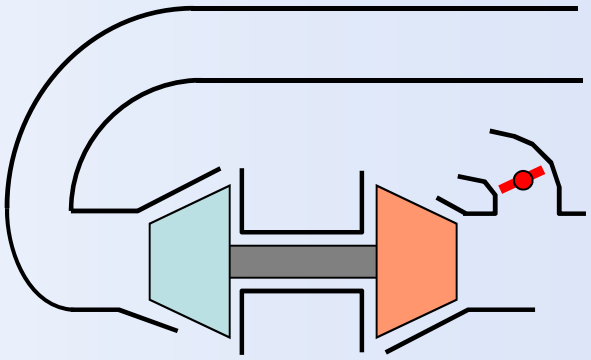


fullElectric Turbocharger



Multi-Stage Turbocharger

- Less pipe-work than a standard turbo
- Better control than multi-stage
- Price point between the two



Standard Turbocharger

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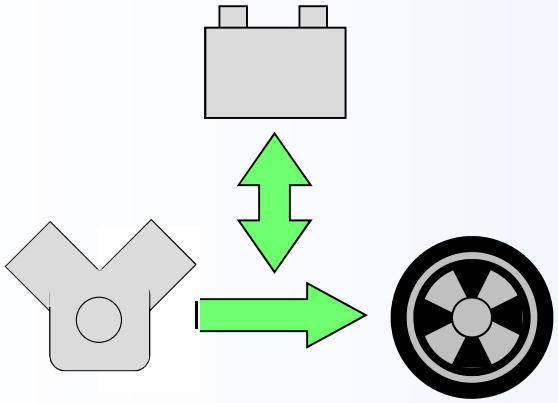
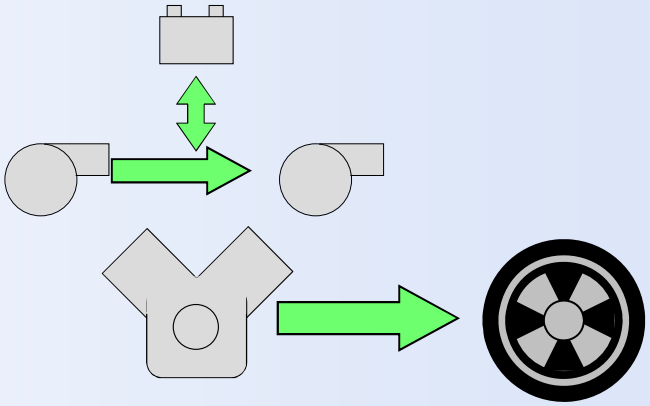
Hybridisation & Downsizing



Hybrid vehicle



Hybrid Turbocharger

- Like-for-like, the fullElectric turbocharger gives more downsizing with a smaller storage reservoir compared to a hybrid powertrain on a standard driving cycle.

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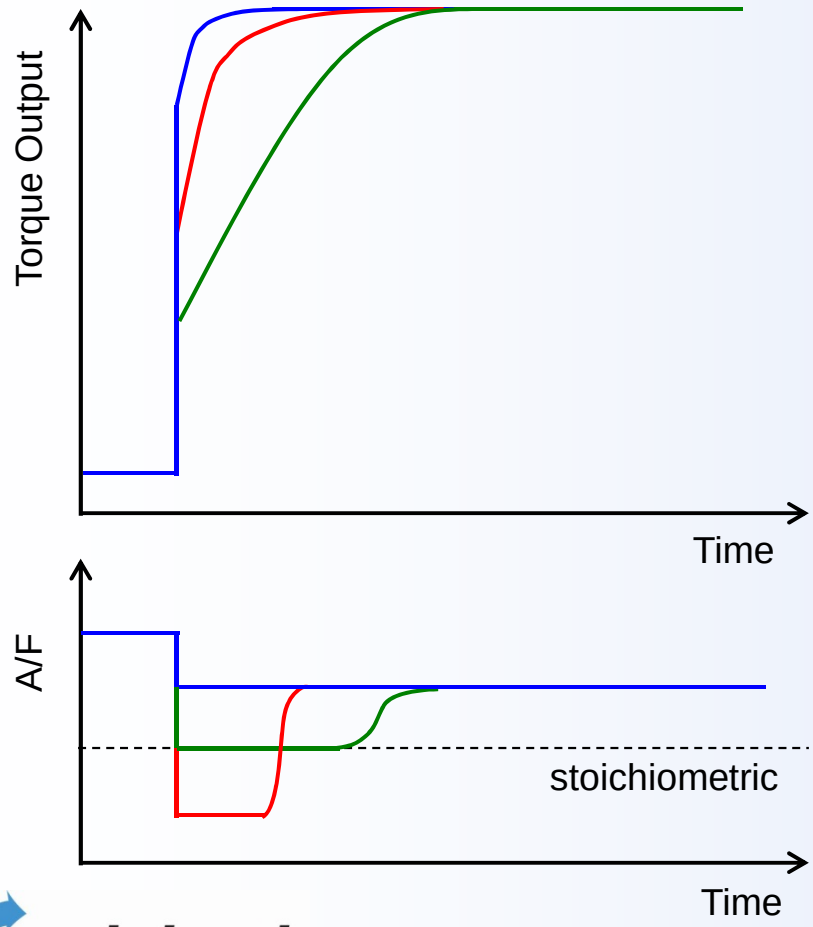
Diesel Particulate Reduction



- ‘Natural’ response
- With over-fueling
- With HTT

- **HTT allows the ECU to maintain ideal A/F ratio during acceleration.**
- Therefore particulate emissions are reduced.
- NOx / CO balance is under control by A/F, independent of fuel flow

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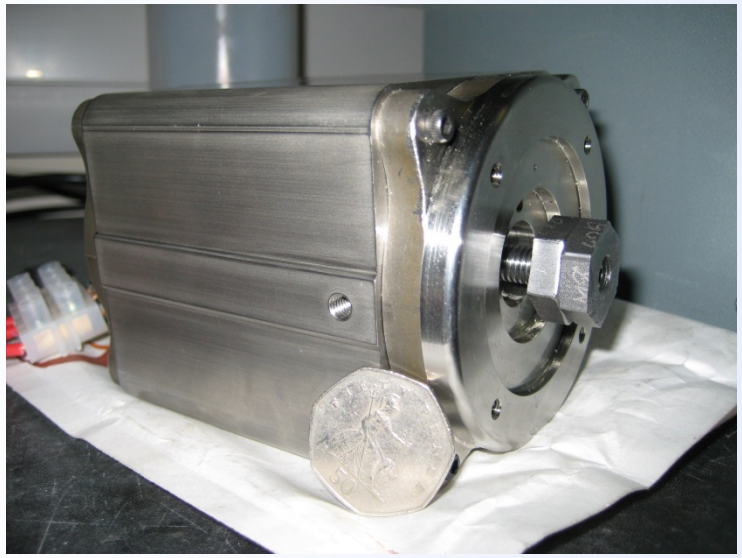
Testing and Development

- University-assisted studies showed feasibility
- In-house prototype testing completed 2008
- Two customer engine projects currently underway



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Summary of fullElectricTT

Features:

- The ECU controls the turbo – no need to tune around it
- Turbomachines are optimised for efficiency, with fewer design constraints (Let the electronics handle the transients)
- Turbo speeds can be brought down, reliability increases
- Controlled to get maximum benefit from VGT systems
- Works with EGR – as good or better than a standard turbo
- Lower cost than other advanced turbos
- Electronically controls and protects the turbo and the engine in extreme performance applications

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Summary of fullElectricTT

Benefits:

- Engine downsizing
  - Improved engine response and no loss in peak power
  - No turbo lag
- Exhaust sourced electricity
- Sport / Economy modes in one turbocharger
- Flexible packaging (benefits pedestrian impact)
- A lot of engine output from a little stored electricity

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