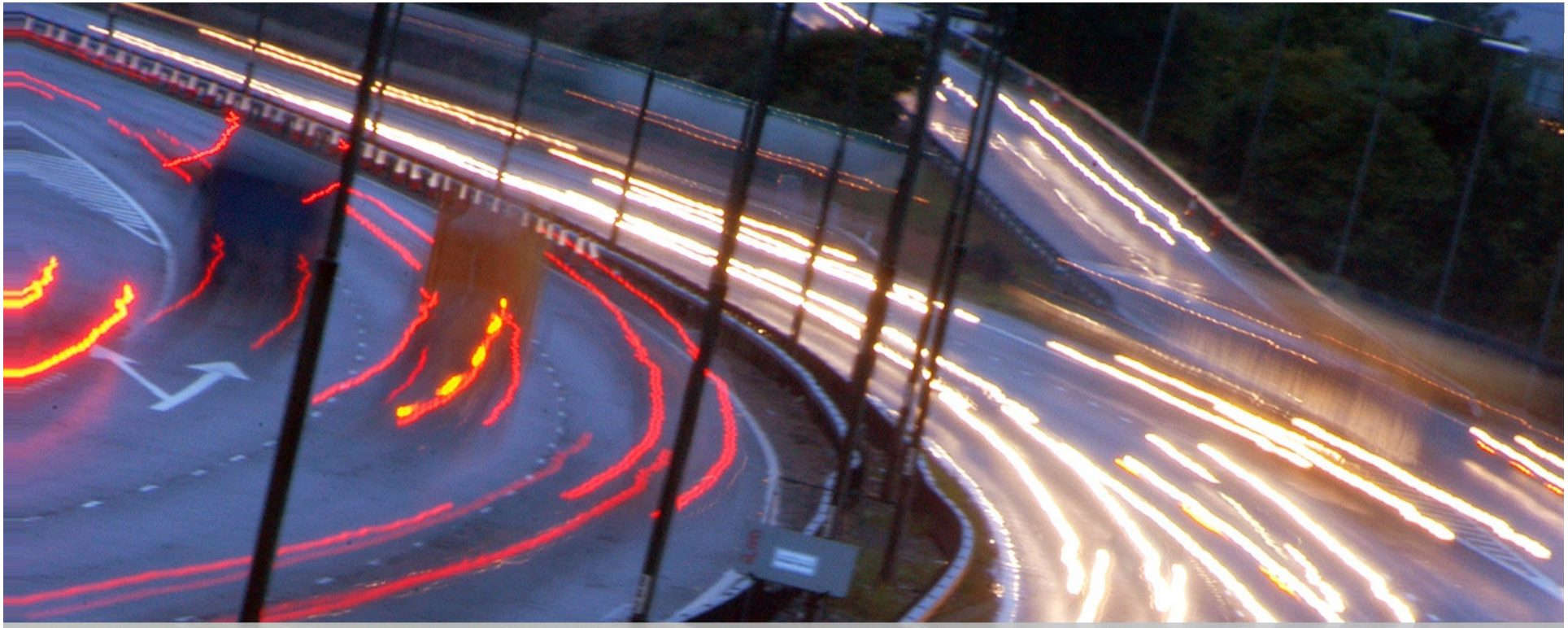


Battery Developments

Future Energy Scenarios 2012

Denis Naberezhnykh

27th September 2012

EV Battery Reuse

- TSB co-funded project

Technology Strategy Board
Driving Innovation

- "Feasibility of re-using electric vehicle batteries for electricity storage in the utilities sector" (TSB ref: 130712)
- Partners:
- Focus: Assess the feasibility of using EV battery technology in in second life applications in the energy utilities sector.
- Report available early to mid-October.

EV Battery Technology
Performance

- Open Circuit voltage of ~4V
- Specific Energy between 100Wh/kg and 150Wh/kg

Most likely chemistries	Advantages	Disadvantages
Lithium nickel, cobalt and aluminium (NCA)	✓ Market ready ✓ Energy density, cycle stability and cold start	× High cost
Lithium nickel, cobalt and manganese (NCM)	✓ Market ready ✓ Energy density, cycle stability and cold start	× High cost
Lithium manganese spinel (LMS)	✓ Comparatively low cost ✓ Safety performance	× Lack of thermal stability of cathode material
Lithium iron phosphate (LFP)	✓ Improved cycle stability (longer life) ✓ Low cost	× Only recent developments overcome cold start and high temperature aging
Lithium titanate (LTO) and Manganese spinel (MNS and MS).	✓ Particularly strong cycle stability ✓ Excellent safety characteristics ✓ Suitable for fast charging	× Lower cell voltage × Reduced capacity × Emerging chemistry

EV Battery Technology
Cost

- Cost estimates range between £450-1000 per kWh at present
- For scaled production (>100,000 cells per year), costs in 2011/ 2012 are expected to be around the £320 per kWh mark
- Projected to be as low as £160 per kWh by 2020

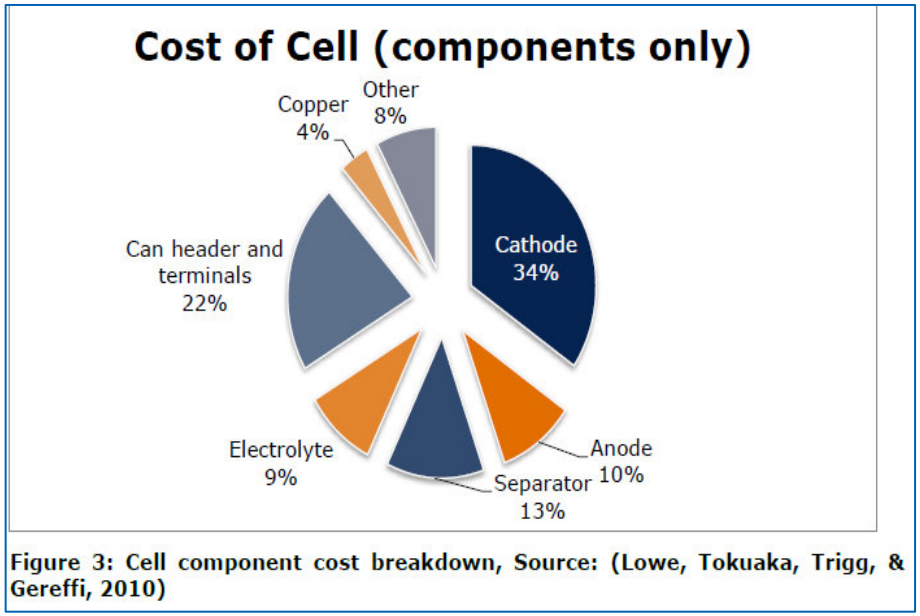


Figure 3: Cell component cost breakdown, Source: (Lowe, Tokuaka, Trigg, & Gereffi, 2010)

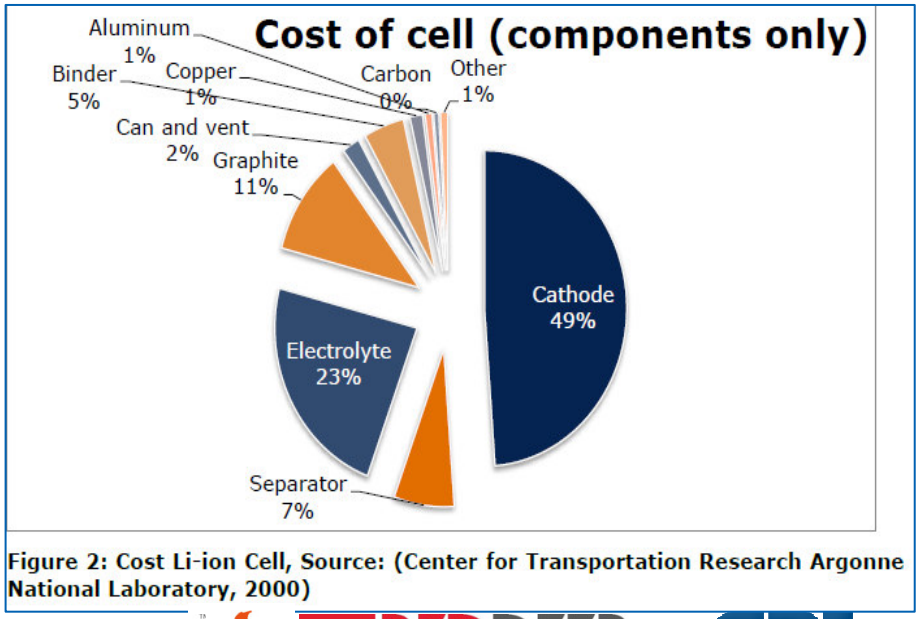
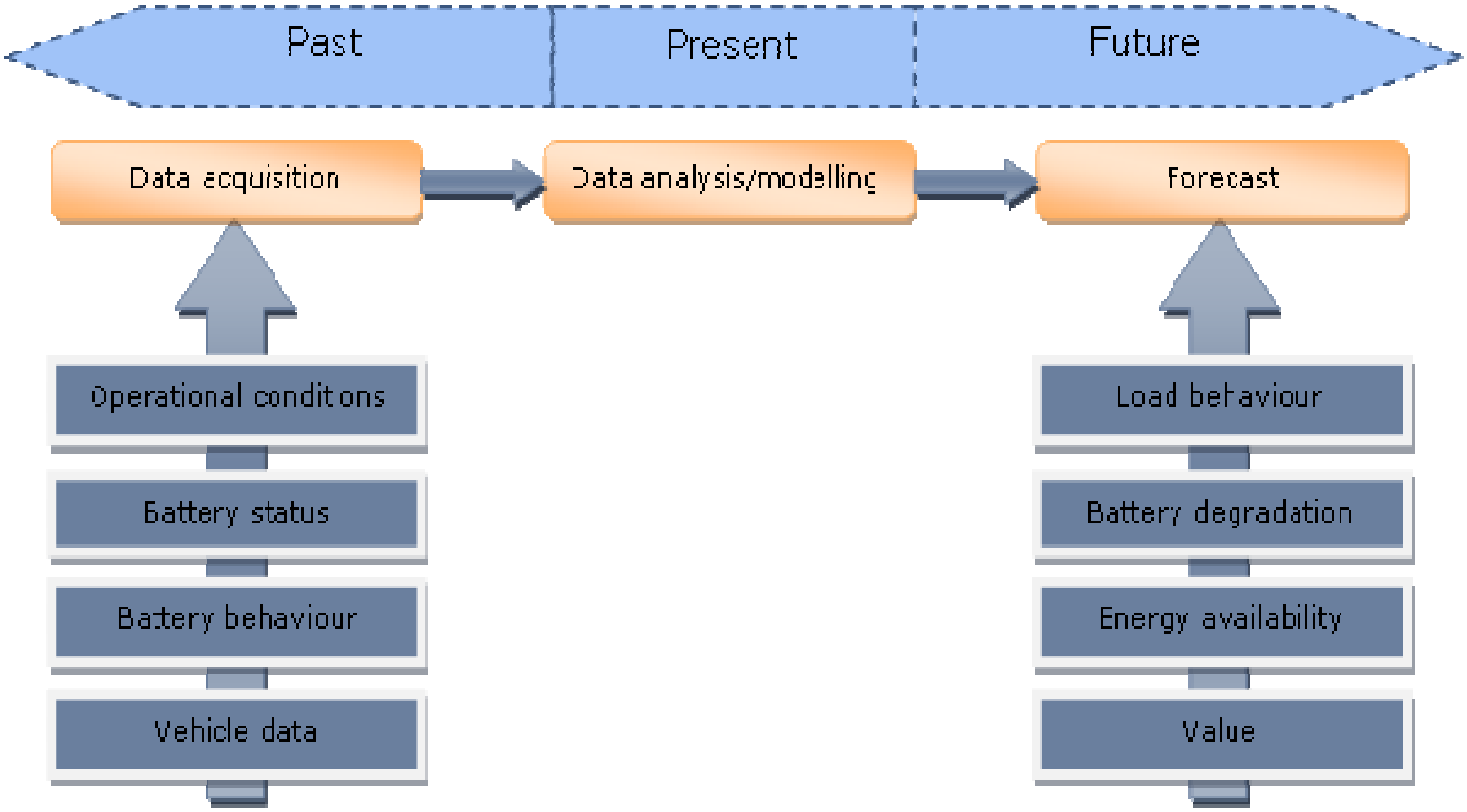


Figure 2: Cost Li-ion Cell, Source: (Center for Transportation Research Argonne National Laboratory, 2000)

EV Battery Technology
Tracking and monitoring



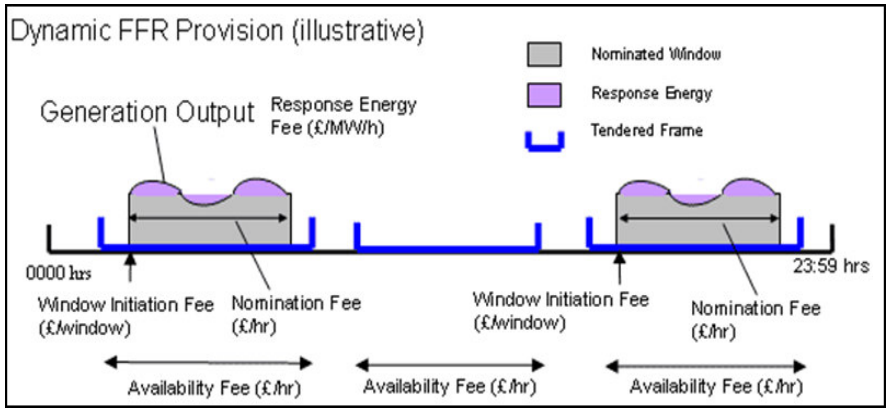
EV Battery Technology
Use in the energy industry

- Possible reuse scenarios include:
  - Investment deferral for DNOs
  - Use of batteries with renewables in commercial (light industrial) premises
  - Firm Frequency response (FFR)
  - Fast reserve (FR).

- Consortium developed a model / tool that can be used to estimate technical feasibility and Net Present Value
  - Very high NPV – based on current value of service.

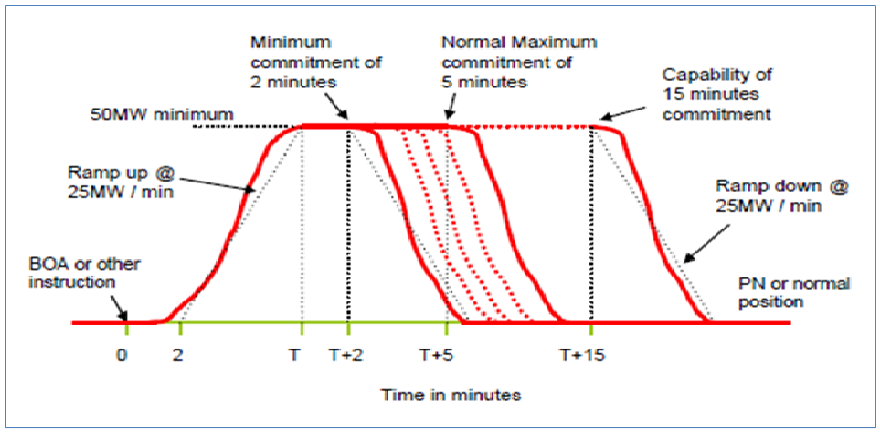
EV Battery Technology
Use in the energy industry

- FFR

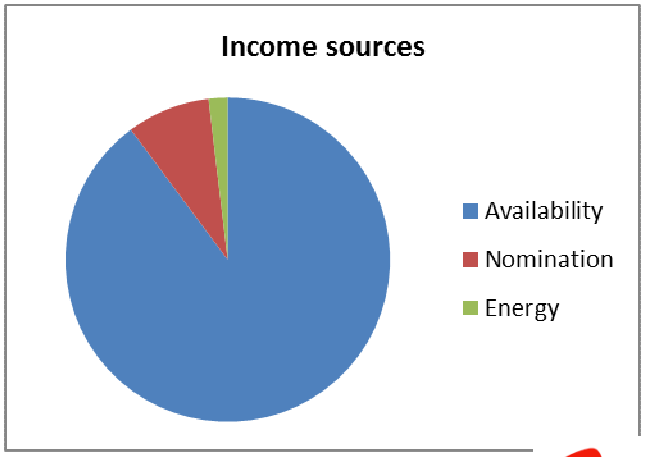


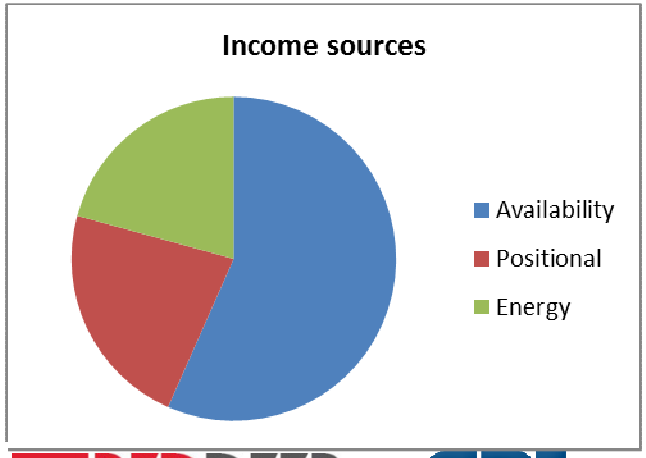
Source: National Grid

- FR



Source: National Grid





Thank you

Denis Naberezhnykh
TRL, Senior ITS Consultant
Tel: 01344770689
Email: dnaberezhnykh@trl.co.uk