VTT TECHNICAL RESEARCH CENTRE OF FINLAND LTD

Electric Commercial Vehicles (ECV)

TransSmart final seminar

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The context of ECV

- Transport, mobility and production systems are undergoing a **transformation towards electrification**
- **ECV was set up to support this transformation** in the entire value chain
- **Finland has significant players** in electrical and machine building industries
- **Comprehensive R&D network** of research centres, universities and companies

ECV strategic focus

- **R&D needs** of Finnish electric vehicle, machine building and e-mobility industry
- **Heavy duty commercial vehicles and mobile machinery** – Finland has potential to be a global spearhead
- Aiming at **integral competences and development platforms**
- **Strong** national and international **networking**

The targets of ECV

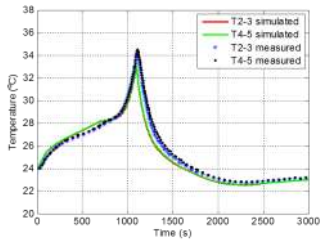
- **From research to new products** together with companies
- Finding **new businesses/business models**
- **Enforcing networking** both national and international
- **Utilising synergies**, e.g. powertrains for electric buses & mobile machinery
- **Product launches and system pilots**
- Special focus on **electrification of public transport**

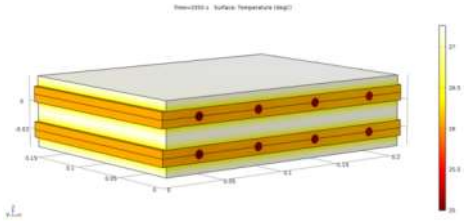
What concrete was achieved?

- **Electrification of public transport**, pilots on-going in HSL, Turku and Tampere
- Linkker Ltd establised as **spin-off from VTT**
  - Current order book ~20 fully electric buses
- Kalmar released hybrid and **fully electric straddle carriers**, FastCharge™
- Visedo **electric and hybrid powertrains** implemented in several vehicles and machines
- **New R&D facilities and capabilities** available at VTT and universities

Batteries: Facilities and competencies

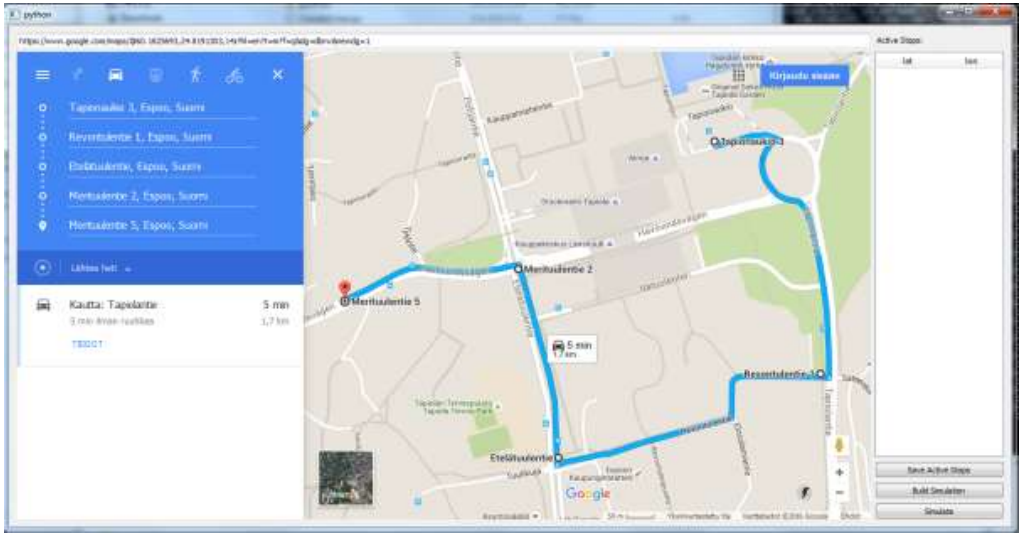
- Battery laboratory for applied research
  - Battecy cell characterisation and cycling, lifetime
  - Battery module and system testing and analtysis
  - Effect of the operation conditions and duty cycles
- Design and modelling of battery systems
  - Scalable electrical models cell – module – system
  - Thermal management of battery systems
  - Hybrid storages (fuel cells, supercaps)
  - Lifetime management, diagnostics
- Dimensioning, design, validation and verification of functionality
- Development platform for systems anc complete solutions for specific use cases

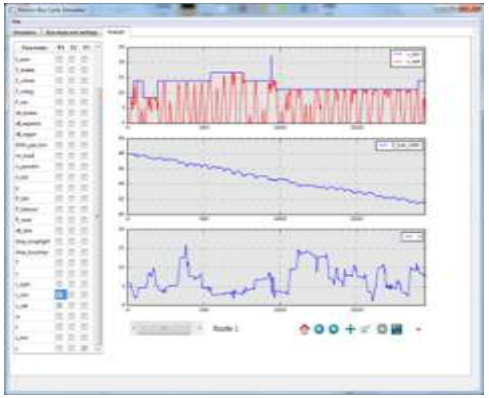


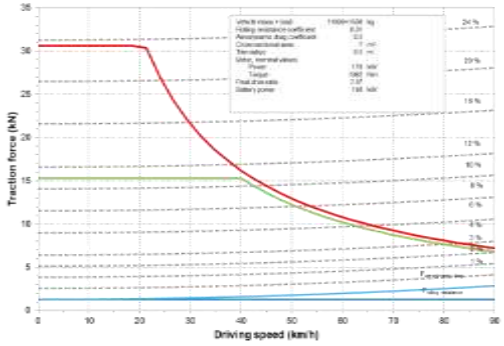


ECV system design: GIS-based tool for the design of electric bus systems

- Combining open-source input with specific expertise
- Utilises existing data from environment, road network and public transportation system registers, schedules etc.
  - Any city, line or duty
- Electric bus database
  - Efficiency maps of components
  - Environmental conditions and energy use
  - Power curves in charging
- Validation by comparing to data collected from real operation







Non-road mobile machinery will be robotised in long term

1 Vision

1. Majority of new machines in segments that are currently dominated by diesel-hydraulic solutions will be equipped with electrical powertrain by 2035
2. Autonomous solutions without human operator promote diversity of operations and new energy logistics
3. Multiple primary fuels: diesel, petrol, gas, hydrogen, electricity

NOTE: Target of the vision is to ensure success in the future!

2 Required technology enablers

- Energy and cost efficient electrical powertrain (machines, drives, energy storages)
- Automatic and easy charging and re-fuelling
- Appropriate manufacturing scale and facilities
- Low content of critical technologies

3 State of the art

- Necessary components are here but they are discrete, custom-made and manufactured in low volume
- Strategy: “find combustion engine, replace with electrical motor”
- Outcome not optimised in cost, reliability, usability, machine layout

4 Drivers & trends

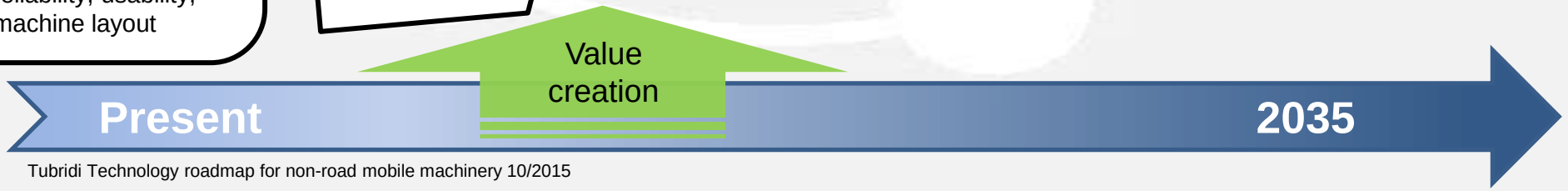
- Understanding life cycle cost and TCO
- Policy to reduce CO_2 and other emissions
- Supply and demand of raw materials and their price
- Everything gets electrified and in Internet
- Laws and regulations

5 Short term actions

- Get your electrical mobile machinery platform ready
- Create user demand from TCO
- Search for/focus on right segment and try to spot the right moment

6 Mid term actions

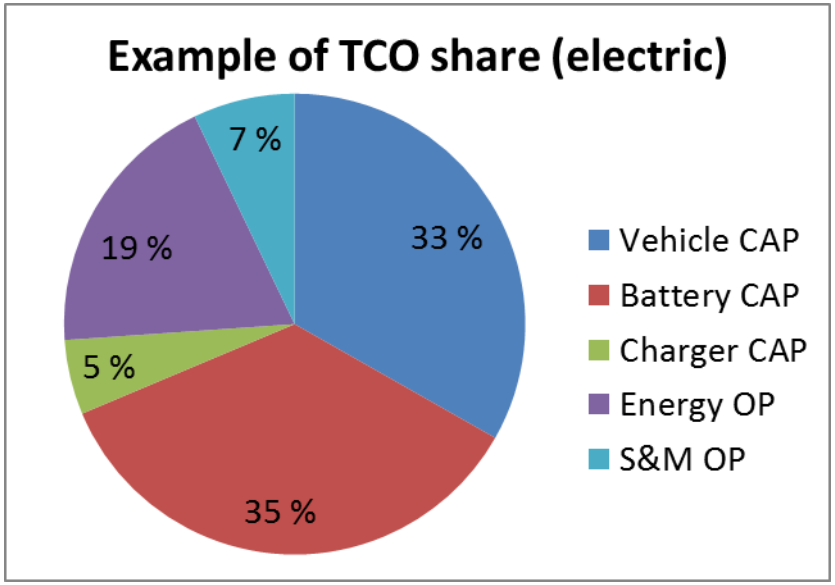
- Start system integration and product development, i.e. stop the strategy “find combustion engine, replace with electrical motor”
- New user experience from electrical control



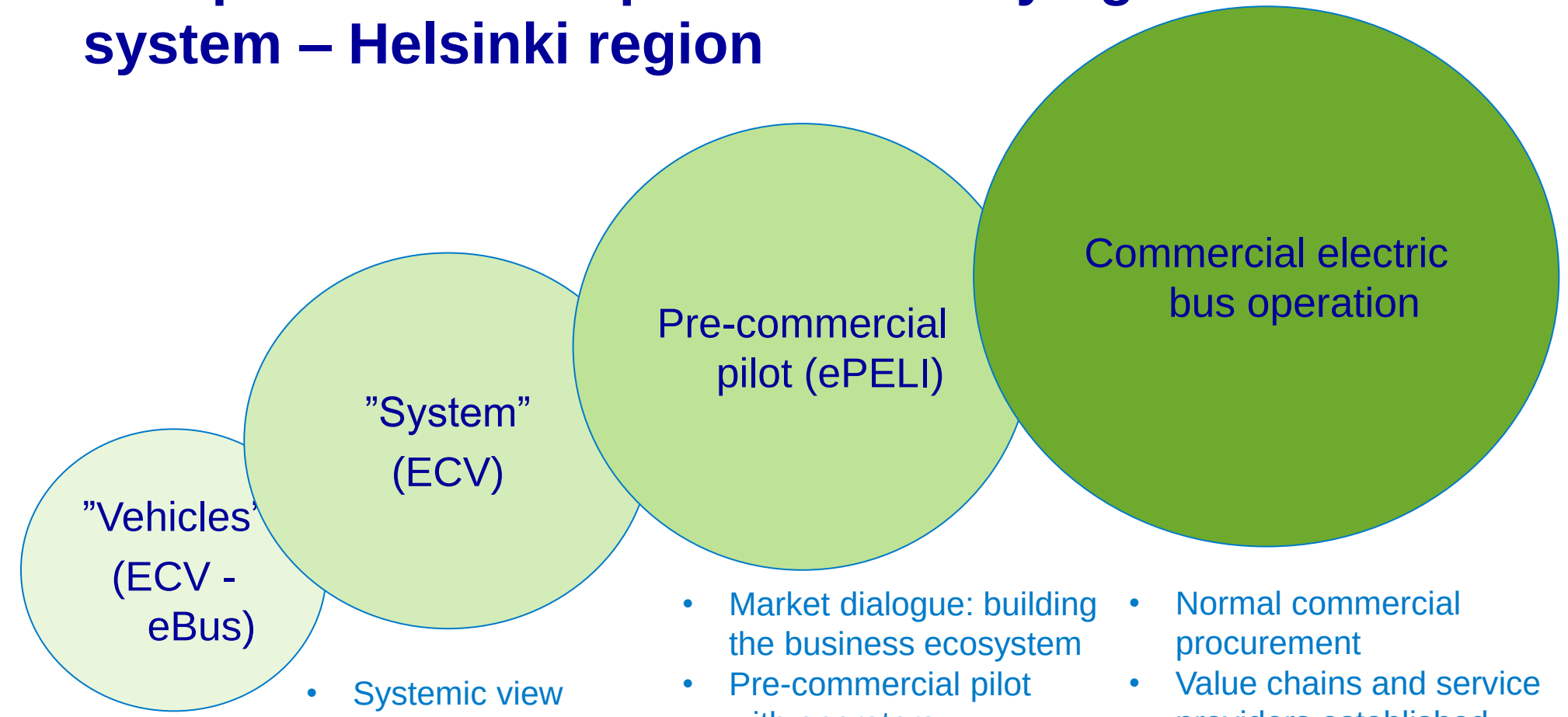
Tubridi Technology roadmap for non-road mobile machinery 10/2015

ECV system analysis: Total Cost of Ownership

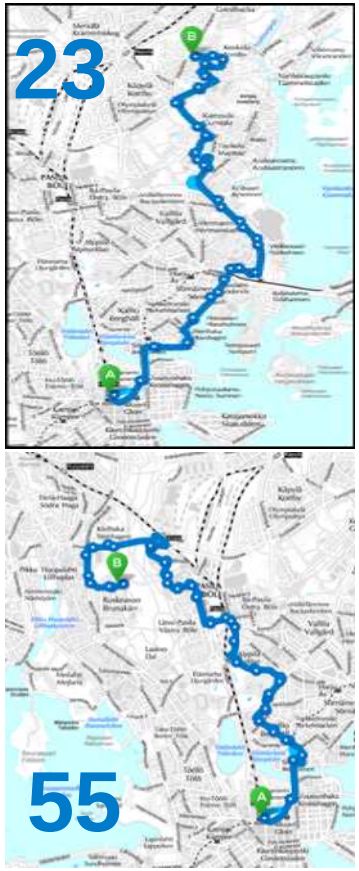
- Powertrain efficiency → vehicle specific energy use
  - Energy efficiency of the vehicle, energy and thermal management
- Auxiliary system consumption and management
- Vehicle chassis weight and battery system weight
- Efficiency of the battery & charging
- Traction battery type selection and dimensioning
  - Battery size, weight, price, cycle life
  - Battery capacity 50 – 300 kWh
- Load carrying capacity depends on battery size (”passengers vs batteries”)



Comprehensive steps into electrifying the bus system – Helsinki region



Implementation: Practical measures in Helsinki



- Fast automatic charging at ends of the lines (300 – 350 kW)
- The 12 buses will operate on 4 – 6 bus lines by 4 – 5 PTO’s




ECV – ELECTRIC COMMERCIAL VEHICLES
FINAL SEMINAR & NORDIC ELECTRIC BUS INITIATIVES 2 CONFERENCE held on May 11th – 12th, 2016, Helsinki, Finland

Presentations available at: https://www.ecv.fi/news/


TECHNOLOGY FOR BUSINESS