Electric RaceAbout ERA

30.9.2008

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ERA
Illustration Juha Rautio

ERA –Electric RaceAbout

- Finnish engineers at ***Helsinki Metropolia University of Applied Sciences*** and designers at ***Lahti University of Applied Sciences*** developing superefficient and clean car as a solution to environmental concerns regarding individual mobility
- The Automotive X-prize competition is a perfect forum to demonstrate the performance

Previous Projects

Completed by Stadia Automotive Engineering Teams

Helsinki Metropolia University of Applied Sciences

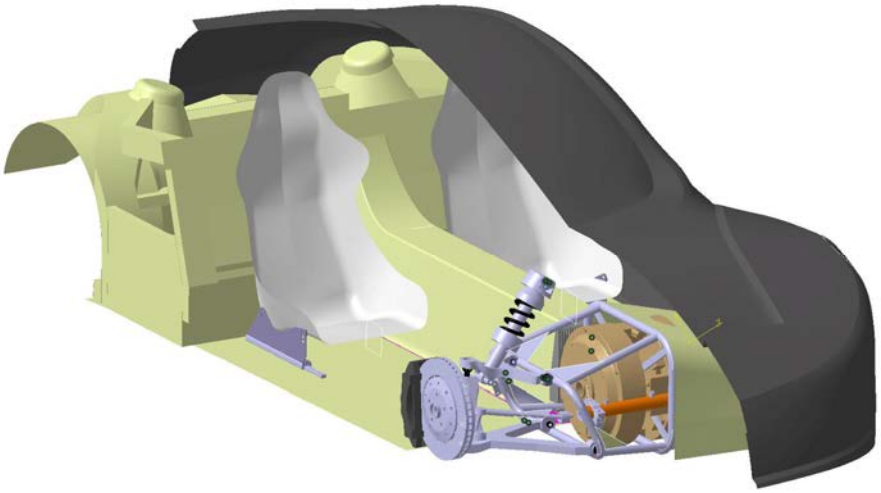
Project objectives

- Contribute to climate change prevention
- Demonstrate that electric vehicle is a viable option for individual mobility
- Win X-prize competition in the alternative class
  - www.progressiveautoxprize.org
- Add a new business to automotive industry
- Make Metropolia Automotive recognized worldwide
- Promote Finnish engineering

Design objectives

- Design and build the most advanced AWD electric vehicle suitable for small series manufacturing
- Registered to road traffic
- Green: modern technology, efficient, recyclable, lightweight
- Part of the RaceAbout family; sportiness, simplicity and desirable
- Using already existing components in certain areas
  - Audi R8 suspension
- Simple structure, usability, serviceability
- Vehicle simulated to meet safety regulations
- Affordable (in sport vehicle range)

Body properties



- Composite monocoque
- Self supporting
- Enclosed cabin
- Low BOW weight (target 90kg)
- Torsional stiffness same as in today ´ s production vehicles
  >14 000 Nm / deg)

ERA in detail

- Target weight 1400 kg

- Performance
  - Acceleration 0-100 km/h — < 5 sec.
  - Top speed — >200 km/h
  - Oper. Range — >300 km
  - Fuel consumption — < 2,35 l/100 km (equivalent)

- Li-Ion (Fe) battery packets, total 450-570 kg
- Four wheel drive, 2WD option for PIAXP race
- Composite monocoque

- Advanced, next generation stability control
- Optimal weight distribution & very low centre of gravity
- Capacity 2 passengers & > 140 l of cargo space

Team

- Faculty group of 7
- 8 Automotive engineering students from Helsinki Polytechnic
- 5 Industrial design students from Lahti Polytechnic

Partners

- AEZ
- Audi Finland
- Bayermann Recaro
- Colornet
- Componeering
- Diagno
- Fevt
- Finnish Cultural Foundation
- Flexible Products
- Henry Ford Fund
- Idesco
- ITW Plexus
- IWS International
- Lahti University of Applied Sciences
- Lappeenranta University of Technology
- Meca-Trade
- Navicron
- Nokian Tyres
- Patria Land & Armanent
- Pilkington Automotive
- PKC Group
- Ruukki
- Savo Consortium for Education
- Scan Mould
- Sika Finland
- Sika Tooling & Composites
- SMI
- US-Parts Finn-Am
- Valmet Automotive
- VTI Technologies
- Wela
- YTM-Industrial
- Örum

Selecting Batteries for Vehicle Propulsion

Case Electric RaceAbout ERA

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Vehicle usage

- Driving profile
  - Operational/charging/parked
- Vehicle type
  - Number of passengers
  - Load carrying capacity
  - Versatility
- Required reserves
  - Range (daily average vs. minimum required)
  - Acceleration
  - Speed
- Charge time
- Operating conditions
  - Ambient temperature
  - Humidity

Energy consumption figures

	Including kinetic energy recovery									
	Mwheel_rn	rpm_ave'	dist_m'	E_total_J'	kwhpkm'	lp100km'	E_total_J_	kwhpkm_b	Pmotor_av	Ploss_mot
'nedc'	56.8	279	11028	4.34E+06	0.109	1.221	4.00E+06	0.101	4866	567
'ftp7'	79.2	283	17769	4.77E+06	0.075	0.832	4.39E+06	0.069	5745	672
'us06'	125.7	641	12888	8.35E+06	0.180	2.009	7.68E+06	0.166	17618	2258
'ushw'	44.2	644	16507	7.65E+06	0.129	1.437	7.04E+06	0.118	8649	1312
'nycc'	83.6	95	1898.4	5.67E+05	0.083	0.926	5.21E+05	0.076	3070	415
'la92'	99.9	329	15797	7.41E+06	0.130	1.455	6.82E+06	0.120	8694	1006
'udds'	78.4	261	11990	3.20E+06	0.074	0.828	2.94E+06	0.068	5272	613
'aroa'	80.2	476	17272	6.81E+06	0.109	1.222	6.26E+06	0.101	9759	1080
'aurb'	96.9	146	4869.8	1.52E+06	0.087	0.968	1.40E+06	0.080	4876	596
'amot'	78.4	826	29545	2.27E+07	0.214	2.387	2.09E+07	0.197	19887	2495
'moto'	439.0	873	3458.2	4.15E+06	0.334	3.725	3.82E+06	0.307	128000	12152
	No kinetic energy recovery									
	Mwheel_rn	rpm_ave'	dist_m'	E_total_J'	kwhpkm'	lp100km'	E_total_J_	kwhpkm_b	Pmotor_av	Ploss_mot
'nedc'	43.2	279	11028	5.95E+06	0.150	1.672	5.47E+06	0.138	4866	497
'ftp7'	59.2	283	17769	1.00E+07	0.157	1.751	9.23E+06	0.144	5745	530
'us06'	98.8	641	12888	1.12E+07	0.242	2.704	1.03E+07	0.223	17618	1949
'ushw'	37.8	644	16507	8.49E+06	0.143	1.594	7.81E+06	0.131	8649	1285
'nycc'	63.1	95	1898.4	1.47E+06	0.214	2.394	1.35E+06	0.197	3070	261
'la92'	71.6	329	15797	1.15E+07	0.201	2.248	1.05E+07	0.185	8694	758
'udds'	58.2	261	11990	6.60E+06	0.153	1.706	6.07E+06	0.141	5272	472
'aroa'	59.6	476	17272	1.04E+07	0.167	1.859	9.53E+06	0.153	9759	933
'aurb'	70.6	146	4869.8	3.85E+06	0.219	2.450	3.54E+06	0.202	4876	371
'amot'	64.2	826	29545	2.59E+07	0.244	2.718	2.38E+07	0.224	19887	2391
'moto'	266.5	873	3458.2	1.14E+07	0.915	10.213	1.05E+07	0.842	128000	5916

Main issues

- Safety
  - Intrinsic safety = chemistry
  - System level
  - Crash
- Cost
  - Cells
  - Package
  - Battery Management System
- Availability
  - Only few players supplying automotive spec. batteries
- Life time
  - Capacity degradation rate

Battery specification

- Capacity [Ah]
  - Capacity vs Power
  - Usefull capacity %
  - Degradation factors
    - Ageing
    - Cycles and Depth of Discharge profile, DOD
  - Specific Energy [kWh/kg]
    - Cell level
    - System level
  - Energy density [kWh/l]
- Power [kW]
  - Max Charge and Discharge currents [A]
  - Internal resistance
  - Degradation factors
    - State of Charge, SOC
    - Ambient and battery temperature

Battery specification

- Self discharging
- Cell size (capacity)
- Cell Voltage (chemistry)
- Number of cells
- Battery Management system
  - Over- & Undervoltage protection
  - Charge & Discharge overcurrent protection
  - Overtemperature protection
  - Temperature control
  - Cell Balancing

PIAXP presentation

PIAXP draft guidelines

Contact

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