Alternative Powertrain News
RICARDO INFORMATION SERVICES

ALTERNATIVE POWERTRAIN NEWS

FEBRUARY 2012

A monthly bulletin dedicated to fuel cell, hybrid electric and other alternative powerplants, common issues, components, marketing and industry news
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Alternative Powertrain News is a monthly newsletter, published by the Ricardo Information Services Department. It summarizes the published literature on hybrid, fuel cell and other alternative powerplants, mainly for automotive applications.

Items included in this publication are based on literature received by the Ricardo Library in January. Entries may contain additional information on products covered in earlier editions.

Copies of the source documents may be obtained by quoting the Library reference, which appears in bold at the bottom of each article. Items not published in English may be translated by Ricardo’s Translation Service, on request. An additional charge would be made for these services.

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FUEL CELLS

NON-AUTOMOTIVE APPLICATIONS

Auxiliary power units

NEW CHALLENGES FOR TURBO BLOWER DEVELOPMENT: AIR AND GAS MANAGEMENT FOR SOFC APU SYSTEMS

AVL

Increasing truck idling regulations for both emissions and noise create a high market potential for fuel cell based anti-idling products in long haul heavy-duty trucks. AVL has been developing a 3 kW Solid Oxide Fuel Cell (SOFC) auxiliary power unit since 2003, of which first complete stand-alone prototype systems will be available till end of 2011. For operation, SOFC systems need a fresh air flow and a hot anode exhaust recirculation flow, both being forces by an electric drive. The combination of low pressure ratios at extremely low mass flows under the fuel cell system boundary conditions requires radial blowers functioning at untypical regimes. The design and validation of both a fuel cell air blower, as well as a fuel cell recirculation blower will be presented. Typical fuel cell system boundary conditions and their impact on the blower design will be discussed.

See vCD 36 212.pdf (16th TU Dresden Supercharging Conference, Sep 2011, 18pp.)
COMMON ISSUES

Infrastructure

FCEVS ARE COMING, BUT WHAT ABOUT THE INFRASTRUCTURE?

Late last year came the first rumblings of a serious attempt to take the hydrogen fuel-cell car out of the research and development centre and into the showrooms. Seven major OEMs - in alphabetical order Daimler, Ford, General Motors, Honda, Hyundai-Kia, Renault-Nissan and Toyota - signed an agreement to begin small-scale production in 2012 and to have cars on sale in limited numbers by the middle of the decade. Fuel-cell electric vehicles (FCEVs) will soon be ready for the world - but will the world be ready for them?

FCEVs require a roadside refuelling infrastructure just like vehicles powered by internal combustion engines. Progress in establishing these networks has been slow to non-existent. There are isolated refuelling points all over the world, but mostly to support a few research vehicles or local buses. There is a mere handful the public could use if FCEVs went on sale today. It's a Catch 22 scenario: without the vehicles there is no need for the fuel stations, but without the fuel stations there is no hope of FCEVs ever making a mark.

Some countries have started to build the skeleton of a hydrogen network, however. Korea, a country roughly the size of England, currently has 13 stations, and will expand this to 43 by the time FCEVs are being built in modest numbers in 2015. It is said you can drive anywhere in Korea and be within range of hydrogen.

Covers – Hydrogen infrastructure developments outside Korea.

See Doc.142114 (Automotive World Powertrain, 14 Nov 2011, 6pp.)
HYBRID ELECTRIC POWERTRAINS

AUTOMOTIVE APPLICATIONS

Passenger cars

ROAD TEST: PEUGEOT 3008 HYBRID4

Peugeot
Road test of the Peugeot 3008 Hybrid4 104g passenger car covering acceleration, aerodynamics, boot, brakes, dimensions, engine, equipment, fuel consumption, handling, interior, noise, performance, power, price, ride, rivals, safety, steering, suspension, Hybrid Power Control Unit (HPCU), torque, 6-speed automated manual transmission, tyres, visibility, wheels.
See Doc.142229 (Autocar, 25 Jan 2012, pp56-63.)

HONDA ANNOUNCES REVOLUTIONARY NEXT-GENERATION ‘EARTH DREAMS TECHNOLOGY

Honda
Honda Motor Co Ltd today announced the outline for a revolutionary next-generation technology called “Earth Dreams Technology.”
Key features of Earth Dreams Technology:
1. A gasoline engine which realizes top level driving performance and fuel efficiency.
2. A compact diesel engine which realizes the world’s lightest body, top-of-class acceleration performance and fuel efficiency.
3. CVT which combines at a high level the fun of driving and fuel efficiency.
4. A two-motor hybrid system which realizes top-of-industry efficiency.
5. A high-efficiency, high output electric SH-AWD hybrid system which combines superior driving and environmental performance.
See Electronic Document 5756 (Tokyo, Japan; Honda, 30 Nov 2011, Press release, 4pp.)

Racing cars

ELECTRIFICATION IN MOTORSPORTS

AVL
The electrified powertrain keeps entering in motorsports as well. Hybrid drives are used in Formula 1 since 2009 and for 2013 the FIA plans a special race series for electric vehicles. At present, therefore there is a strong wave of innovation, in which it is still unclear which technologies will prevail. AVL describes various systems and their advantages and disadvantages. Based on simulations the impact on performance parameters, lap time, speed and duration of the race gets clear.
Covers – Kinetic Energy Recovery System (KERS), Formula 1, LMP, sports and touring cars.
See Doc.142178 (MTZ Worldwide, Jan 2012, pp4-10.)

DESIGN OF AN ACTIVE VEHICLE SYSTEM FOR A HYBRID RACE CAR

Università degli Studi di Firenze
The aim of this work is to define the core of a stability control, called Active Vehicle System, for a hybrid Formula SAE car that will compete in the next season in the upcoming Alternative Energies (Class 1A) class. The vehicle on which the control system will act is equipped with two electric motors on the front axle and an internal combustion engine connected to the rear axle by the way of a semi-active differential. The layout of the car under consideration has been defined with the purpose of getting the most effectiveness by the Active Vehicle System, whose role is to define a yaw torque to be applied to the vehicle in order to correct its behaviour during each maneouvre. The results of the Upper Controller will be actuated by two Lower Controllers, one dedicated to the electric motors and one to the semi-active differential. On such controlled vehicle some testing manoeuvres have been performed, in order to check
its functionality. The analyses have been done with a mathematical model of the vehicle, in order to compare the behaviour of the controlled car with respect to the uncontrolled and neutral ones. The results of these simulations have shown that the performance of the Class 1A equipped with the Active Vehicle System are closer to the reference model, effectively increasing the global performance and safety of the vehicle.

See SAE 2011-24-0167 (2011, 9pp.)

Buses

HYBRIDS IN DISGUISE

The truck market has been far slower to adopt hybrid powertrain technology, partly due to the simple fact that even an urban delivery truck will make far fewer regular stops than a bus. Also, in this world, a weight penalty of a battery pack and motor/generator exists.

Yet despite all this, 2011 has been a big year for OEM hybrid introductions in Europe, with DAF, Iveco and Mercedes-Benz providing production versions of their light and mid-weight delivery chassis. A Volvo FE Hybrid plus a Fuso Canter Hybrid are soon to join the ever-growing, eco-friendly party as the truck industry looks to improve fuel consumption and drive down emissions.

But truck and bus manufacturers aren’t the only players in the hybrid sphere. A number of retrofit and aftermarket hybrid systems are being offered or trialed, each promising a considerable cost saving over an OEM hybrid.

The Flybus consortium, which consists of kinetic recovery specialist Torotrak, Allison Transmission, bus manufacturer Optare, and engineering specialist Ricardo, is currently assessing the Flybus flywheel hybrid on an Optare Solo Midibus.

The Flybus system uses Torotrak’s CVT transmission to transfer kinetic energy to Ricardo’s Kinergy flywheel under vehicle braking.

One aftermarket system that is available in the USA is the KersTech hydraulic hybrid. Intended for installation on Class 7 and 8 trucks (18 tons and above), the system uses a hydraulic accumulator to store kinetic energy, with a hydraulic motor and a 90° gearbox mounted behind the transmission.

Staying within the US market, another option is available from Variable Torque Motors, of Indiana. Their VTM system can be installed on new vehicles or retrofitted to older trucks, because the system is mounted between the transmission and the drive axle unit. The big difference here comes in the use of super-capacitors, rather than batteries, to store the energy, with less of a weight penalty.

Unlike the series hybrid system that BAE Systems supplies to a number of bus manufacturers, the truck system uses a parallel version of HybriDrive. This is because the refuse truck has a need for high-speed diesel power to access depots and landfill sites.


Trucks

HYBRID TRACTORS

Given how much environmental flak the US gets from the green lobby, it’s worth noting that in one endeavour, hybrid tractors, American truck makes are demonstrably ahead of their European counterparts. With the notable exception of Mercedes-Benz, Europe’s CV manufacturers have restricted their hybrid truck programmes to rigid chassis up to 26 tonnes GVW, usually for either urban distribution or refuse collection. Compare and contrast the US, where both medium and, more significantly, long-haul hybrid tractors have been developed by Freightliner, Mack, Navistar and Paccar and operated by some of the biggest-name fleets in America including Walmart, Coca-Cola and American Honda.

Obviously something’s stopping European manufacturers, and not just Mercedes, from pushing ahead with hybrid tractors… but what? While a parallel hybrid drivetrain encourages the use of smaller engines (thanks to the extra power provided by the electric motor) partly offsetting the weight of the battery pack, it’s a major challenge to squeeze it all into a short-wheelbase European cab-over tractor chassis.
As part of its ongoing strategy to reduce its global CO2 footprint and fuel consumption, American Honda has also evaluated a Peterbilt 386 tractor on a variety of routes, comparing the hybrid tractor’s fuel economy with a normal truck under various driving conditions. Fellow Paccar company Kenworth has won notable hybrid fleet success too, with Coca-Cola taking more than 150 of its 1370 artics with Eaton’s diesel-electric hybrid system.

See Doc.142180 (Commercial Motor, 12 Jan 2012, pp44-47.)

Tractors

TAKING HYBRIDS TO THE FARMS

MTW and Ruselprom-Electric Drive

The Production Association Minsk Tractor Works (MTW) in Belarus and Ruselprom-Electric Drive Ltd in Russia are taking diesel-electric hybrid technology to the farm as they have jointly developed and agricultural row crop tractor with an electromechanical transmission. According to the developers, the Belarus 3023 is among the world’s first heavy tractors with an electromechanical drive (EMD) to be demonstrated. The companies have built and demonstrated five prototype units in field testing at machine test areas in Russian and Belarus. Preparation for serial production is under way, MTW said.

Looking similar to a conventional tractor, the Belarus 3023 is powered by a Deutz BF06M1013FC diesel engine rated 303 hp.

In the Belarus 3023, the diesel engine is connected to Ruselprom designed and built powertrain that incorporated a 220 kW asynchronous motor-generator (AMG) with integral power converter and microprocessor control system.

Compared with a conventional tractor, the prototype Belarus 3023 with EDM technology has shown improved fuel economy, the company said.

FORMATS

Diesel-based

STUDY OF DIESEL ENGINE SYSTEM FOR HYBRID VEHICLES

Toyota

In this study, we combined a diesel engine with the Toyota Hybrid System (THS). Utilizing the functions of the THS, reducing engine friction, lowering the compression ratio, and adopting a low pressure loop exhaust gas recirculation system (LPL-EGR) were examined to achieve both low fuel consumption and low nitrogen oxides (NOx) emissions over a wide operating range. After applying this system to a test vehicle it was verified that the fuel economy greatly surpassed that of a conventional diesel engine vehicle and that NOx emissions could be reduced below the value specified in the Euro 6 regulations without DeNOx catalysts.

See SAE 2011-01-2021 (2011, JSAE 20119184, 7pp.)

Gas-based

CO2 REDUCTION AND COST EFFICIENCY POTENTIAL OF NATURAL GAS HYBRID PASSENGER CARS

EMPA

CO2 reduction targets are a big challenge for the mobility sector because about 20% of all CO2 emissions origin from road traffic. The problem is intensified by the expected traffic growth which will mainly take place in developing countries. Several powertrain and fuel technologies are competing regarding their CO2 reduction potential compared to conventional gasoline and diesel vehicles. Hybrid electric vehicles with a certain energy saving potential as well as natural gas vehicles (NGVs) with their lower fuel carbon content are expected to gain on importance. But why not combining dedicated natural gas engine and hybrid powertrain technology to achieve very low CO2 emissions even for mid size passenger cars? At a first glance, such a powertrain combination looks just like a combination of two expensive technologies without any market potential. A more detailed analysis shows, however, that NGV hybrids allow high CO2 reductions without additional end-user costs over the vehicle's entire lifetime. The present study addresses both topics: it presents the CO2 reduction potential of mid-size passenger cars driven with an average natural gas-hybrid powertrain and it addresses end-user costs compared with today's gasoline technology.

See SAE 2011-24-0110 (2011, 10pp.)

Plug-in

SYNTHESIS OF REAL-WORLD DRIVING CYCLES USING STOCHASTIC PROCESS AND STATISTICAL METHODOLOGY

University of Michigan

This paper proposes a procedure for synthesising real-world driving cycles to reproduce naturalistic driving patterns for arbitrary driving distances. The procedure combines stochastic processes and statistical methodologies. Vehicle dynamics equations are investigated and two states, velocity and acceleration, are selected to represent real-world driving behaviour with the Markov chain. Then, the information is extracted from the naturalistic driving data measured in Southeast Michigan in a form of transition probability matrices (TPMs). Statistical methods are utilised to guarantee the representativeness of synthesised cycles. Results demonstrate the ability to capture features of a whole category of naturalistic data with a single synthetic cycle.

Covers – plug-in hybrid electric vehicle

COMMON ISSUES

Charging

FORESIGHT ANALYSIS OF POWER DEMAND DUE TO PLUG-IN ELECTRIC VEHICLES

TIFAC

The increased adoption of electric propulsion in road transport is viewed as a potential solution to the concerns over increasing environmental pollution, and energy security. The technology advances in power electronics and energy storage technologies promises to bring plug-in electric vehicles (both battery electric vehicles and plug-in hybrid electric vehicles) into the commercial domain. Many vehicle manufacturers have planned to introduce their vehicles in the market within the next 3 years. However, charging of plug-in electric vehicles can potentially increase peak power demand on power distribution network, and may have impact on various grid assets including thermal loading, voltage, unbalance, losses, etc. In order to estimate the potential impacts, we must estimate the additional power demands and its temporal variations due to charging of plug-in electric vehicles. A scenario-based analysis of the impact on the electric power grid has been taken, with Delhi as a case example case. It includes an estimation of the projected growth in number of vehicles, share of battery operated and plug-in hybrid vehicles among the various modes of transport. The impact on the electric power demand will depend significantly on the charging pattern of the vehicles. Both the options of charging from normal (household) ac power outlets and the dedicated fast charging stations have been considered. It is desirable that charging of vehicles happen in such a way that the effects on the peak demand on the electric power grid is minimized. Since the use of off-peak power for charging of electric vehicles helps in minimizing the impact on the grid, management of vehicle charging will assume significance as level of penetration increases. New concepts like smart charging may gain focus in such context.

See SAE 2011-26-0049 (2011, SIAT 2011, 10pp.)

CO2

THE IMPACT OF CONTROL STRATEGY OF A LIGHTWEIGHT PLUG-IN HYBRID ELECTRIC VEHICLE ON CO2 EMISSIONS

University of Warwick

Similar to conventional hybrid vehicles, plug-in hybrid electric vehicles use multiple energy sources for propulsive power. The power split between these energy sources must be managed carefully to achieve reduction in fuel consumption and carbon dioxide emissions. The decision to use either or both of the power sources is made by the vehicle supervisory controller. Depending on how the supervisory controller uses the off-board electricity source, supervisory control strategies can significantly impact the component size, cost and overall vehicle energy efficiency.

This paper reports the impact of supervisory control strategies on a full parallel plug-in hybrid electric vehicle's emission performance over two drive cycles. The effects of a limiting speed for electric only driving and carbon dioxide emission under various vehicle operating modes are investigated and reported. The paper also discusses the benefit of light weighting of city cars and its impact on green house gas emissions. It has been shown in this paper that well-to-wheel carbon dioxide emissions less than 50 g/km is possible in real world applications using light weight PHEVs.

See SAE 2011-26-0008 (2011, SIAT 2011, 10pp.)

Control

0D-1D COUPLING FOR AN INTEGRATED FUEL ECONOMY CONTROL STRATEGY FOR A HYBRID ELECTRIC BUS

University of Rome Tor Vergata, University of Tuscia and ENEA

Hybrid electric vehicles (HEVs) are worldwide recognized as one of the best and most immediate opportunities to solve the problems of fuel consumption, pollutant emissions and fossil fuels depletion,
thanks to the high reliability of engines and the high efficiencies of motors. Moreover, as transport policy is becoming day by day stricter all over the world, moving people or goods efficiently and cheaply is the goal that all the main automobile manufacturers are trying to reach. In this context, the municipalities are performing their own action plans for public transport and the efforts in realizing high efficiency hybrid electric buses, could be supported by the local policies.

For these reasons, the authors intend to propose an efficient control strategy for a hybrid electric bus, with a series architecture for the powertrain. To this aim, an integrated approach realized by coupling a zero-dimensional model of the vehicle with a mono-dimensional model of the thermal engine to evaluate fuel consumption and find the most suitable control strategy for the engine (totally decoupled to the mission). A kinematic approach has been implemented. The power required to the motor is defined by knowing the speed and altitude profiles related to the path, while the power request for the engine is calculated by means of a first order filter, which properly cuts the power load of the motor. A sensitivity analysis has been performed in order to define the optimal operating strategy for the engine, to minimize the fuel consumption. Moreover, a control on the state of charge (SOC) has been implemented to assure a correct use of batteries and avoid damages.

See SAE 2011-24-0083 (2011, 15pp, 30 refs.)

SELF-LEARNING NEURAL CONTROLLER FOR HYBRID POWER MANAGEMENT USING NEURO-DYNAMIC PROGRAMMING

University of Michigan

A supervisory controller strategy for a hybrid vehicle coordinates the operation of the two power sources onboard of a vehicle to maximize objectives like fuel economy. In the past, various control strategies have been developed using heuristics as well as optimal control theory. The Stochastic Dynamic Programming (SDP) has been previously applied to determine implementable optimal control policies for discrete time dynamic systems whose states evolve according to given transition probabilities. However, the approach is constrained by the curse of dimensionality, i.e. an exponential increase in computational effort with increase in system state space, faced by dynamic programming based algorithms. This paper proposes a novel approach capable of overcoming the curse of dimensionality and solving policy optimization for a system with very large design state space. We propose developing a supervisory controller for hybrid vehicles based on the principles of reinforcement learning and neuro-dynamic programming, whereby the cost-to-go function is approximated using a neural network. The controller learns and improves its performance over time. The simulation results obtained for a series hydraulic hybrid vehicle over a driving schedule demonstrate the effectiveness of the proposed technique.

See SAE 2011-24-0081 (2011, 13pp, 31 refs.)

Energy management

AN ENERGETIC COMPARISON FOR HYBRID VEHICLES RANGING FROM LOW TO HIGH DEGREE OF HYBRIDIZATION

University of Salerno

The efficiency achievable with effective energy management strategies represents a key issue for modern hybrid electric vehicles (HEVs). In this paper, by comparing different HEVs architectures with the same power to weight ratio, the dependence of energy consumption on different degrees of hybridization and powertrain architectures is analyzed. The fuel economy achievable by using dynamic programming based strategies is considered as the benchmark. The comparative study analyzes also the influence of driving cycles and the impact of plug-in concepts both on fuel economy and battery lifetime. Numerical results on realistic vehicles highlight the higher energy saving potentialities offered by parallel HEVs, while series HEVs remain of interest because of their simpler energy management and higher suitability for plug-in operations.

Covers – effect of plug-in on comparative analysis of series hybrid electric vehicle (SHEV) and parallel hybrid electric vehicles (PHEV) fuel economy.

See SAE 2011-24-0086 (2011, 11pp.)
ANALYSIS OF ENERGY-EFFICIENT MANAGEMENT OF A LIGHT-DUTY PARALLEL-HYBRID DIESEL POWERTRAIN WITH A BELT ALTERNATOR STARTER

Politecnico di Torino General Motors

The paper presents the main results of a study on the simulation of energy efficient management of on-board electric and thermal systems for a medium-size passenger vehicle featuring a parallel-hybrid diesel powertrain with a high-voltage belt alternator starter. A set of advanced technologies has been considered on the basis of very aggressive fuel economy targets: base-engine downsizing and friction reduction, combustion optimization, active thermal management, enhanced aftertreatment and downspeeding. Mild-hybridization has also been added with the goal of supporting the downsized/downspeeded engine performance, performing energy recuperation during coasting phases and enabling smooth stop/start and acceleration.

The simulation has implemented a dynamic response to the required velocity and manual gear shift profiles in order to reproduce real-driver behaviour and has actuated an automatic power split between the Internal Combustion Engine (ICE) and the Electric Machine (EM). Typical parallel hybrid technology functions, such as Stop&Start, regenerative braking and power assistance from the EM have all been implemented in the GT-Drive model.

After model calibration and validation versus the available experimental data, the energy management strategies of such a hybrid configuration were investigated. The results obtained for the New European Driving Cycle (NEDC) and a Real Life Driving Cycle (RLDC) have been discussed, in terms of fuel economy and performance.

See SAE 2011-24-0080 (2011, 18pp, 30 refs.)

EFFECT OF TRAFFIC, ROAD AND WEATHER INFORMATION ON PHEV ENERGY MANAGEMENT

Ohio State University

Energy management plays a key role in achieving higher fuel economy for plug-in hybrid electric vehicle (PHEV) technology; the state of charge (SOC) profile of the battery during the entire driving trip determines the electric energy usage, thus determining the fuel consumed. The energy management algorithm should be designed to meet all driving scenarios while achieving the best possible fuel economy. The knowledge of the power requirement during a driving trip is necessary to achieve the best fuel economy results; performance of the energy management algorithm is closely related to the amount of information available in the form of road grade, velocity profiles, trip distance, weather characteristics and other exogenous factors. Intelligent transportation systems (ITS) allow vehicles to communicate with one another and the infrastructure to collect data about surrounding, and forecast the expected events, e.g. traffic condition, turns, road grade, and weather forecast. The ability to effectively interpret this traffic and weather data to estimate the power demand is important for the energy management and plays crucial role in the battery utilization.

This paper presents an important step towards ITS integration with energy management of PHEVs: the goal of this research is to determine the correlation (or heuristic relationship) between different road events, weather conditions and PHEV energy management performance. The first step of this study utilizes real world data collected from a plug-in Toyota Prius (aftermarket conversion kit Hymotion L5) to determine the correlations between events and velocity profile characteristics. The second step finds the impact of power profile characteristics on the performance of equivalent consumption minimization Strategy (ECMS) for PHEV energy management using a high fidelity, validated PHEV simulator. The goal of this study is to identify the impact factors and define qualitative impact on the energy management algorithm and vehicle fuel economy.

See SAE 2011-24-0162 (2011, 8pp.)

Fuel consumption

DIESEL VS PETROL HYBRIDS: THE FUEL DUEL

In the next revision of the Autocar road test, there might be a case for a new fuel economy test schedule. As it stands, we give very new car we test three opportunities to impress us with how efficiently it can perform.

There is no schedule to reflect the most urban, low-speed, stop-start pattern of usage in which a hybrid is
designed to excel. And so you could argue – Peugeot probably will – that neither our 48.6 mpg touring economy result nor our 41.4 mpg overall economy result does justice to the 3008 Hybrid4. Needless to say, we saw this coming. Which is why, as an addenda of our test on PSA Peugeot-Citroen’s world first, we cooked up a special ‘commuter’ economy test. It’s 25 miles long and factors in equal quantities of motorway, trunk road and stop-start city traffic. At the end of the test, the 3008’s trip computer read a modestly encouraging 52.2 mpg. Perhaps our touring test, with its emphasis on 60 mph running, didn’t do the car justice. Better still for the Hybrid4, our tank-to-tank averages showed that the trip computer was underestimating the car’s fuel efficiency – and by nine percent. But not by enough, it transpired, to beat a Prius. Petrol hybrid narrowly beat diesel hybrid: 57.8 mpg vs 57.1.

See Doc.142233 (Autocar, 25 Jan 2012, pp64-65.)

Thermal issues

POWERTRAIN COOLING CONCEPT SELECTION PROCESS FOR HYBRID ELECTRIC VEHICLES

Ricardo and Tata Motors

Contents:
Project Overview
Vehicle, customer and components requirements
Cooling system concept selection
Building blocks approach
Building block detail 1 to 5
Building block 1-5 simulation results.
Covers – Pugh Matrix, cabin heating technologies, Positive Temperature Co-efficient (PCT) heaters, cabin and battery cooling technologies, battery thermal management, Flowmaster modelling.

See Electronic Document 5761 (IMechE Conference on Innovations in Fuel Economy & Sustainable Road Transport, 8-9 Nov 2011, Pune, India, 27pp.)
MILD OR MICRO HYBRID POWERTRAINS

ROAD TEST: HONDA CIVIC

Honda

Road test of the Honda Civic 2.2i-DTEC EX GT diesel passenger car.
Fitted with lower-friction internals, 'shallow bowl' combustion chambers, a new intercooler and a more efficient lubrication system, the 2.2 diesel now meets Euro 5 emissions standards and produces 148 bhp and 258 lb-ft of torque. Automatic engine stop-start contributes towards CO2 emissions of 110g/km on most trim levels (115g/km on bigger-wheeled EX GT flagship versions like our test car) and combined economy of up to 67.3 mpg.
Covers - aerodynamics, boot, brakes, dimensions, engine, equipment, fuel consumption, handling, interior, performance, power, price, rivals, safety, steering, suspension, torque, 6-speed manual transmission, visibility, wheels.
See Doc.142185 (Autocar, 11 Jan 2012, pp56-63.)
NON-ELECTRIC HYBRID POWERTRAINS

HYDRAULIC

ALTAIR HYDRAULIC HYBRID BETTERS DIESEL-ELECTRIC

Altair

The world's first series hydraulic hybrid transit bus has achieved an overall average of 6.9 mpg, doubling the fuel efficiency of conventional diesel buses and surpassing by 30% the mpg average of hybrid-electric buses, said Mike Heskitt, chief operating officer of Altair Product Design, unveiling the demonstration prototype vehicle in Troy, Michigan.

Called the LCO-140H (Low-Cost of Ownership-1st 40-foot Hybrid), the Altair-designed vehicle, developed under a public-private initiative, underwent fuel-economy trials in spring this year at Ford's Michigan Proving Grounds, based on the US Federal Transit Administration's protocols.

The drivetrain features a primary pump directly geared to the output of the engine and two secondary pumps, attached to the rear axle via a gear reduction unit, that are capable of transferring a combined 600 bhp (448 kW) either to or from the wheels, according to Vance Zanardelli, business unit manager of Parker Hannifin's hybrid drive systems division.

Each bent-axis, variable-displacement Parker C24 pump can seamlessly switch between pumping and motoring modes, depending on power absorption or delivery demand, and each pump/motor unit is capable of transmitting as much as 300 bhp (224 kW) and 850 lb-ft (1152 Nm) of peak torque.

See Doc.142113 (Automotive World Powertrain, 16 Nov 2011, 2pp.)
BATTERY ELECTRIC POWERTRAINS

AUTOMOTIVE APPLICATIONS

LIFE-CYCLE ASSESSMENT OF ELECTRIC VEHICLES

Empa

Outline:
How are (indirect) CO2-emissions (and other environmental indicators) assessed?
How do we model «mobility»?
Functional units and system boundaries
Data
Results: Global Warming Potential (GWP)
Is GWP a suitable environmental indicator for (electric) mobility?
How variable are the results?
What are the reasons for variability?
What are the ranges?
Conclusions.

See vCD 35 Althaus.pdf (Moving to a Life-Cycle Assessment of Vehicle Emissions, IMechE, 14 Nov 2011, 24pp.)

Passenger cars

WORLD PREMIERE OF THE JETTA HYBRID AT THE NORTH AMERICAN INTERNATIONAL AUTO SHOW

Volkswagen

Volkswagen is presenting one of the world’s most efficient automobiles at the North American International Auto Show in Detroit: the Jetta Hybrid. Providing propulsion are a high-tech petrol engine (TSI with 110 kW/150 PS) and a zero-emissions electric motor (20 kW). While this hybrid alliance enables very impressive driving performance (0-60 mph in less than 9 seconds), the new Jetta Hybrid also produces an equally impressive fuel consumption value (combined mode) of 45 mpg. This means that the sporty saloon consumes about 20 percent less fuel than a comparably powered car with a conventional drive system. In city traffic, the fuel economy advantage climbs to 30 percent!
Covers – electric motor and a decoupling clutch, a lithium-ion battery, 7-speed dual clutch gearbox (DSG), extensive safety and convenience features, vehicle NVH.

See Electronic Document 5763 (Detroit, Michigan, USA; Volkswagen, Jan 2012, Press release, 9pp.)

Commercial vehicles

ELECTRIC CARS SPAWN ELECTRIC TRUCKS

Nissan and Mitsubishi

There are generally two ways to foster the growth of any new technology, either reduce the upfront cost or expand the scope of where it can be used to generate economy of scale benefits.
For battery-driven electric vehicles, this equation means that either batteries need to become less expensive or there needs to be a much broader application of electric vehicle technology.
Both Nissan and Mitsubishi are pursuing the latter approach when it comes to the electric drive systems used in automobile applications. The technology and components from the Nissan Leaf and Mitsubishi i-MiEV electric cars are being taken to commercial vehicles.
Nissan recently showed three trucks based on its Atlas F24 vehicle that uses Leaf components and technology. The e-N Tower Atlas Concept uses the Leaf's high-performance 80 kW as synchronous motor and high-output, high capacity, 24 kW-hr lithium-ion battery in the Atlas F24 tilt cab truck chassis, which is normally available with a variety of petrol and diesel engines.
The Minicab- MiEV, which Mitsubishi said it will sell 4000 of in Japan by March, uses technologies and experience gained from the development of the i- MiEV. There are two sizes of lithium-ion batteries and two cruising ranges available. The CD10.5 kW-hr version provides a range of 100 km, while the CD16.0 kW-hr version takes this up to 150 km. The four-passenger i-MiEV automobile uses the 16 kW-hr battery.

See Doc.142184 (Diesel Progress International, Jan 2012, pp32-33.)
DRIVE LINES AND TRANSMISSIONS

OERLIKON DETAILS 4-SPEED EV TRANSMISSION

Oerlikon Graziano

The Turin-based transmission specialist Oerlikon Graziano has revealed further technical details of its multi-speed transmission for EVs, which uses the principles of dual clutch transmissions to provide seamless shifting and up to 15% improvement in vehicle efficiency.

With most current EVs using a single-speed transmission, relying on the electric motor’s torque spread to provide adequate performance, the electric traction motor spends much of its time operating at only 60-70% efficiency. Oerlikon Graziano’s new transmission instead uses two smaller motors to provide four speeds, running the motors closer to their peak efficiency of approximately 90%. The result is an overall efficiency improvement of up to 15%, which translates into increased range or improved performance.

The transmission uses two input shafts, each driven by its own electric motor. The concept is similar to a DCT but using two motors in place of the twin clutches: one drives a shaft which carries first and third gears, while the other drives a shaft carrying second and fourth. This allows pre-selection of the next gear before the previous one has been disengaged, using the two motors to synchronise shaft speeds, so that no synchronisers are needed.

The shift control system was developed by the UK-based Vocis Driveline Controls, itself part-owned by Oerlikon Graziano.

See Doc. 142167 (Automotive World Electric Vehicles, 10 Jan 2012, 2pp.)
COMMON ISSUES

Infrastructures

RAPID-CHARGING STATIONS GEAR UP EVS FOR THE ROAD

ABB
The UK’s first private electric-vehicle rapid-charging station has been launched in Nottinghamshire. ABB claims its Terra 51 DC charger reduces charging times from eight hours to 15–30 minutes for an 80 percent top-up and is currently the only rapid model that can connect to networks of other charging stations via the internet. The installation of a Terra 51 at the site of printing company RCS is seen as the beginning of a large network of privately owned rapid-charging stations that are needed to help overcome consumer issues around ‘range anxiety’. See Doc.142225 (The Engineer, 23 Jan 2011, p6.)

Marketing

ENTERING THE ELECTRIC MOBILITY MARKET

Technische Universitat Berlin
In its National Electromobility Development Plan the Government of the Federal Republic of Germany posts an ambitious aim: up to 2020 one million electric cars shall be driving on German roads, among them battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), which are powered by energy from the grid. At present, electric cars still suffer from various restrictions. Therefore, it is necessary to identify potential target groups for the first generation of series-production electric vehicles with regard to possible and reasonable implementation strategies. See Doc.142155 (ATZ Worldwide, Jan 2012, pp60-66.)

CETELEM STUDY GAUGES EUROPEAN INTEREST IN EVS
An independent study in Europe concludes that enough people are ready for battery-powered electric cars to establish the industry, but how fast and how many vehicles will be purchased depends on outside factors like the price of oil. Cetelem, a leading lender to European consumers and the leading car finance company in France for independent dealers, questioned 6000 people in ten countries in its annual study of the automotive industry. Some 71% of Europeans are interested in electric cars, and 57% of those people are ready to consider buying one despite their drawbacks, said Flavien Neuvy, who runs L’Observatoire Cetelem, the company’s in-house analytical department. Thus, 41% of Europeans, according to the study, would consider buying a pure electric vehicle. Some 48% of the Europeans surveyed said they would not spend a penny more for an electric vehicle, although 27% said they would be willing to spend 1-9% more for an electric car, and 5% said they would be willing to spend 30% or more. Consumers in different countries varied widely on the question. In Great Britain, 68% said they would spend no more, and in Turkey, only 21% were in that pessimistic camp. See Doc.142169 (Automotive World Electric Vehicles, 11 Jan 2012, 4pp.)

NVH

EXTERIOR SOUND DESIGN FOR INCREASED ELECTRIC VEHICLE SAFETY

LMS International
The design of a warning sound system for electric vehicles requires a proper sound development, balancing warning effect with ambient annoyance, and a sound system configuration design to locate and size the sound sources. For the presented sound synthesis approach by LMS the noise of an electric
vehicle was decomposed into its different contributions allowing a parametric resynthesis. Furthermore, this approach permits the accurate prediction of sound dispersion and the simulation of sound levels at listener locations.

See Doc.142153 (ATZ Worldwide, Jan 2012, pp10-12 & 14-16.)
RANGE EXTENDER POWERTRAINS

THE FUTURE OF EXHAUST AFTERTREATMENT DESIGN FOR ELECTRIFIED DRIVE TRAINS

Emitec

Combustion engines used as range extenders in electric vehicles in consequence of their increased number of cold starts make high demands on the exhaust gas aftertreatment systems. Emitec has developed and optimised a range extender catalyst system which reduces cold start emissions up to 90%, especially by preheating and thermal insulation.

Covers – heating behaviour in cold starts – e-catalyst with pre-heating function, cooling behaviour during engine off times - minimisation of heat loss.

See Doc.142177 (MTZ Worldwide, Jan 2012, pp18-24.)

A COMPACT 10 KW ELECTRIC POWER RANGE EXTENDER SUITABLE FOR PLUG-IN AND SERIES HYBRID VEHICLES

CNR Istituto Motore

The paper discusses the concept, specification and overall performance of a 10 kW electric power range extender suitable for electric plug-in and series hybrid vehicles, based on a single cylinder, high speed, four stroke internal combustion engine, tested and developed at Istituto Motore CNR of Italy. This unit has been conceived from the beginning as a compact on board recharging system for the mentioned kind of means, and especially for city cars and small commercial vehicles. The paper starts by defining some characteristics, advantages and drawbacks of an electric city car, followed by the criteria adopted to characterize the nominal power of the range extender. Then, the ratio which leaded to the adoption of a single cylinder internal combustion engine is discussed, followed by an explanation of the main design characteristics of the whole unit. The latter has been re-designed and constructed by means of mass produced elements only, in order to reduce cost coming from new design and manufacture. The use of liquid cooling for the engine and the electric generator permitted to make the whole unit very compact and completely packaged, allowing an easy application on the vehicle. After field test, a complete description of its running behavior has been reported; the unit has been tested with conventional unleaded gasoline, but it's ready to be converted to ethanol and methanol gasoline blends or LPG if required.

See SAE 2011-24-0085 (2011, 7pp.)
OTHER ALTERNATIVE POWERTRAINS

ULTIMATE EV

University of Michigan and Ricardo

Three thousand kilometres at over 80 km/h and with all its energy drawn from available sunlight – electric vehicle engineering challenges don’t come any more extreme than those faced by the University of Michigan’s solar car team and their Ricardo advisers.

Covers - vehicle weight, vehicle specifications.

See Doc.142124 pp20-23 *(Ricardo Quarterly Review, Q4 2011, Dec 2011.)*
UNCONVENTIONAL INTERNAL AND EXTERNAL COMBUSTION ENGINES

AN ENGINE THAT REALLY COOKS

Next Generation Power

It isn’t often that you see an engine where the torque rating is higher than the horsepower. But then again, you don’t see many engines that have one turbocharger for each cylinder and a pressure cooker on top to manage the boost into the carburetor, either.

Next Generation Power, a designer and manufacturer of generator sets for the marine, RV, industrial, automotive and racing markets, cooked up just such an engine, based on a Chevy V8 gasoline engine that has been installed in a 1923 T-bucket hot rod. The engine is outfitted with eight turbochargers and a pressure cooker mounted on top of the carburetor. The engine delivers a respectable 460 hp, along with an off-the-charts torque of 580 lb-ft.


Hydrogen engines

OPTIMIZATION OF HYDROGEN JET CONFIGURATION BY SINGLE HOLE NOZZLE AND HIGH SPEED LASER SHADOWGRAPHY IN HIGH PRESSURE DIRECT INJECTION HYDROGEN ENGINES

Tokyo City University and National Traffic Safety and Environment Laboratory

A new ignition-combustion concept named PCC (Plume Ignition Combustion Concept), which ignite rich mixture plume in the middle of injection period or right after injection of hydrogen is completed, is proposed by the authors in order to reduce NOx emissions in high engine load conditions with minimizing trade-offs on thermal efficiency. In this study fundamental requirements of hydrogen jet to optimize PCC are investigated by using single and multi-hole nozzle with a combination of high speed laser shadowgraphy to visualize propagating flame. As a result, it was inferred that igniting the mixture plume in the middle of injection period with minimizing jet penetration to chamber wall is effective reducing NOx formation even further.

See SAE 2011-01-2002 (2011, JSAE 20119076, 9pp.)

HIGH-PRESSURE HYDROGEN JET AND COMBUSTION CHARACTERISTICS IN A DIRECT-INJECTION HYDROGEN ENGINE

Okayama University

Hydrogen spark-ignition (SI) engines based on direct-injection (DI) promise significant advantages in terms of thermal efficiency and power output, as well as a means of overcoming problems related to knocking, backfiring, and pre-ignition. In a DI hydrogen engine, the fuel/air mixture is formed by injecting a jet of hydrogen into the air inside the combustion chamber. An Ar-ion laser beam was used as a light source to visualize the hydrogen jet in a constant-volume chamber. This allowed us to study the structure of the jet in addition to other physical processes resulting from hydrogen gas injection. Combustion experiments were conducted in a single-cylinder SI optical research engine equipped with a DI system to detect the early kernel growth assisted by the spark, as well as flame propagation. Various equivalence ratios and fuel injection timings were analyzed to identify the effects on combustion.

See SAE 2011-01-2003 (2011, JSAE 20119144, 13pp.)

DEVELOPMENT OF HIGH PRESSURE H2 GAS INJECTORS, CAPABLE OF INJECTION AT LARGE INJECTION RATE AND HIGH RESPONSE USING A COMMON-RAIL TYPE ACTUATING SYSTEM FOR A 4-CYLINDER, 4.7-LITER TOTAL DISPLACEMENT, SPARK IGNITION HYDROGEN ENGINE

Tokyo City University and National Traffic Safety and Environment Laboratory (NTSEL)

Key requirements of engines for vehicles are large output power and high efficiency, low emission as well as small size and light weight. Hydrogen combustion engines with direct injection have the characteristics to meet these factors. Tokyo City University, former Musashi Institute of Technology, has studied hydrogen fuelled engines with direct injection since 1971. The key technology in the development of
hydrogen fuelled engines is the hydrogen injector for direct injection with the features such as high injection rate, high response and no hydrogen gas leakage from the needle valve of the hydrogen injector. A common-rail type system to actuate the needle valves of the high pressure hydrogen injectors was intentionally applied to fulfil good performances such as large injection rate, high response and no hydrogen gas leakage. Eventually, high pressure hydrogen injectors have been developed for direct hydrogen engines at the injection pressure of 20 MPa at the maximum, capable of performing large injection rate, high response and no hydrogen gas leakage from the hydrogen needle valves. The leakage of hydrogen gas was not observed definitely for such time as 700 hours.

See SAE 2011-01-2005 (2011, JSAE 20119376, 10pp.)

MIXTURE FORMATION IN DIRECT INJECTION HYDROGEN ENGINES: CFD AND OPTICAL ANALYSIS OF SINGLE- AND MULTI-HOLE NOZZLES

Argonne National Laboratory, Sandia National Laboratories and Duisburg-Essen University

This paper describes the validation of a CFD code for mixture preparation in a direct injection hydrogen-fuelled engine. The cylinder geometry is typical of passenger-car sized spark-ignited engines, with a centrally located injector. A single-hole and a 13-hole nozzle are used at about 100 bar and 25 bar injection pressure. Numerical results from the commercial code Fluent (V6.3.35) are compared to measurements in an optically accessible engine. Quantitative planar laser-induced fluorescence provides phase-locked images of the fuel mole-fraction, while single-cycle visualization of the early jet penetration is achieved by a high-speed Schlieren technique. The characteristics of the computational grids are discussed, especially for the near-nozzle region, where the jets are under-expanded.

Simulation of injection from the single-hole nozzle yields good agreement between numerical and optical results in terms of jet penetration and overall evolution. The 13-hole nozzle creates intense jet-to-jet interaction, with all jets merging into a single effective jet immediately downstream of the under-expanded region. This phenomenon (usually referred as Coanda Effect) is more challenging to the numerical simulation and requires higher level of detail in numerical simulation and grid resolution, with particular regard to the fields near the injector nozzle.

See SAE 2011-24-0096 (2011, 16pp, 29 refs.)

EFFICIENCY AND EMISSIONS POTENTIAL OF HYDROGEN INTERNAL COMBUSTION ENGINE VEHICLES

Argonne National Laboratory

This paper reviews and summarizes recent developments in hydrogen (H2) powered engine and vehicle research. Following an overview of mixture formation strategies, general trade-offs when operating engines on hydrogen are analyzed and highlights regarding accomplishments in efficiency improvement and emissions reduction are presented. These include estimates of efficiency potential of direct-injection hydrogen engines based on single-cylinder research engine data, fuel economy and emissions results of hydrogen powered passenger cars and pickup trucks as well as the impact and potential of hydrogen/methane blended operation.

Gives properties of hydrogen compared to fossil fuels.

See SAE 2011-26-0003 (2011, SIAT, 2011, 10pp.)

Miller cycle engines

EMISSION REDUCTION USING HYDROTREATED VEGETABLE OIL (HVO) WITH MILLER TIMING AND EGR IN DIESEL COMBUSTION

Aalto University School of Engineering

Several high-speed diesel engine test runs were carried out during 2010 in Aalto University using a single-cylinder research engine. The main focus was on miller cycle and EGR tests using hydrotreated vegetable oil (HVO) as fuel. But also reference tests were run using both HVO and regular EN590 diesel in normal engine configuration and running parameters.

The miller tests included a sweep of three different intake valve closing timings and also a sweep with advanced start of injection. The results showed a reduction in both NOx and smoke emissions.
EGR tests showed a significant decrease in NOx emissions as was expected. The lower smoke emissions of HVO compared to EN590 enable higher EGR percentages with similar PM emission and hence bigger NOx emission reduction.

See SAE 2011-01-1955 (2011, JSAE 20119322, 7pp.)
COMMON ISSUES IN ALTERNATIVE POWERTRAINS

ALTERNATIVE POWERTRAINS FOR SPECIFIC APPLICATIONS

Buses

ENVIRONMENTAL LIFE-CYCLE ASSESSMENT OF TRANSIT BUSES WITH ALTERNATIVE FUEL TECHNOLOGY

Northwestern University

The paper presents a life-cycle assessment of costs and greenhouse gas emissions for transit buses deploying a hybrid input–output model to compare ultra-low sulphur diesel to hybrid diesel-electric, compressed natural gas, and hydrogen fuel-cell. We estimate the costs of emissions reductions from alternative fuel vehicles over the life cycle and examine the sensitivity of the results to changes in fuel prices, passenger demand, and to technological characteristics influencing performance and emissions. We find that the alternative fuel buses reduce operating costs and emissions, but increase life-cycle costs. The infrastructure requirement to deploy and operate alternative fuel buses is critical in the comparison of life-cycle emissions. Additionally, efficient bus choice is sensitive to passenger demand, but only moderately sensitive to technological characteristics, and that the relative efficiency of compressed natural gas buses is more sensitive to changes in fuel prices than that of the other bus types.

See Doc.142216 (Transportation Research Part D, Jan 2012, pp39-47.)

Locomotives

WELL-TO-WHEEL ANALYSIS FOR ELECTRIC, DIESEL AND HYDROGEN TRACTION FOR RAILWAYS

University of Birmingham and Vehicle Projects Inc

This paper derives the energy efficiencies and CO2 emissions for electric, diesel and hydrogen traction for railway vehicles on a well-to-wheel basis, using the low heating value and high heating value of the enthalpy of oxidation of the fuel. The tank-to-wheel and well-to-tank efficiency are determined. Gaseous hydrogen has a WTW efficiency of 25% low heating value, if produced from methane and used in a fuel cell. This efficiency is similar to diesel and electric traction in the UK, US, and California. A reduction of about 19% in CO2 is achieved when hydrogen gas is used in a fuel cell compared to diesel traction, and a 3% reduction compared to US electricity.

See Doc.142218 (Transportation Research Part D, Jan 2012, pp28-34, 29 refs.)
COMPONENTS

Batteries

THERMAL MANAGEMENT OF HIGH-PERFORMANCE LITHIUM-ION BATTERIES

Mahle International and Behr

A new method permits the optimisation of the temperature control system for lithium-ion traction batteries with regard to cost and weight, while still ensuring the integrity of the cooling function. The greatest cost-reduction potential is afforded by an intelligent coordination of system components and the use of Lathin technology from Behr. This technology makes it possible to use smaller pumps and reduced-power components without adversely affecting the temperature homogeneity of the batteries. Covers – Battery Cooling Plate and Lathin.

See Doc.142158 (ATZ Worldwide, Jan 2012, pp30-34.)

Transmissions

GREENER GEARS

Forward, reverse, park: single-speed transmissions are currently fitted in the majority of EVs today, from the exotic Tesla Roadster to the family-friendly Nissan Leaf, as well as the urban, about-town Smart Fortwo Ed.

Given that full torque is instantly available from the start-up of an electric motor, single-speeders have been considered adequate for the first-generation of production ready EVs. However, demand for greater sophistication, a less compromised driving experience and better management of the battery range are all factors that increasingly need to be considered when developing transmissions for the growing electric vehicle and hybrid sectors – and a variety of multispeed solutions are now on the brink of production.

BorgWarner engineers have developed a three-speed version of its single-speed eGearDrive unit that already features in the Ford Transit Connect Electric, Tesla Roadster and the CODA sedan. The technology also features in the Proterra EcoRide BE35 electric bus.

Meanwhile Getrag, whose Smart Fortwo-based BEV demonstrator features a two-speed transmission, is seeing energy efficiency gains of 8% compared with a single-speed transmission, as well as better performance.

In Britain, Zeroshift engineers have started in-vehicle testing of its AMT for EVs, as managing director Bill Martin explains: “Multiple ratios enable peak motor efficiency for more of the drive cycle. “The simulations are seeing 10% gains. Three ratios are better than two, and we believe in most applications that four ratios would be optimal.”

Zeroshift has also developed an eight-speed AMT for hybrid vehicles, as has Aachen-based FEV, which is in discussion with several OEMs.

BorgWarner, however, has experience in DCTs for conventional IC engine vehicles, so it makes sense for the Tier 1 to develop designs based from these existing transmission architectures.

Covers – Fallbrook Technologies, NuVinci continuously variable, planetary geared (CVP) concept as a transmission.

See Doc.142116 (Electric & Hybrid Vehicle Technology International, Jan 2012, pp44-45 & 47-48.)
CO2

POTENTIAL VEHICLE FLEET CO2 REDUCTIONS AND COST IMPLICATIONS FOR VARIOUS VEHICLE TECHNOLOGY DEPLOYMENT SCENARIOS IN EUROPE

European Commission, Joint Research Centre

The continuous rise in demand for road transportation has a significant effect on Europe’s oil dependency and emissions of greenhouse gases. Alternative fuels and vehicle technology can mitigate these effects. This study analyses powertrain deployment scenarios for passenger cars and light commercial vehicles in EU-27 until 2050. It considers European policy developments on vehicle CO2 emissions, bio-energy mandates and reductions in the CO2 footprint of the European energy mix and translates these into comprehensive scenarios for the road transport sector. It quantifies and assesses the potential impact of these scenarios on well-to-wheel (WtW) CO2 emission reductions primary energy demand evolution, and cost aspects for the prospective vehicle owners. The study reveals that, under the deployed scenarios, the use of bio-fuel blends, technological learning and the deployment of hybrids, battery electric, plug-in hybrid and fuel cell vehicles can decrease WtW CO2 emissions in EU-27 passenger road transport by 35–57% (compared to 2010 levels) and primary energy demand by 29–51 Mtoe as they would benefit from a future assumed decarbonised electricity and hydrogen mix in Europe. Learning effects can lead to acceptable payback periods for vehicle owners of electric drive vehicles.

See Doc.142159 (Energy Policy, Jan 2012, pp404-421, 76 refs.)
ELECTRIC POWER

WIRELESS TRANSMISSION OF ELECTRIC ENERGY

Drive, ISAT LTI

This article focuses on the wireless transfer of energy. It describes the operation of a transformer without a magnetic circuit associated with a resonant inverter to meet the constraints imposed by mobile sources (catenaries with magnetic induction to power electric vehicles). The receiving and transmitting units consist of an air-gap transformer and a generator who feeds the transformer. In this article, we show how to determine the transformer’s parameters and configuration needed for this transfer to be efficient. The transformer is fed by a half-bridge converter for serial resonant load. The primary winding of the transformer is fixed on the ground. The secondary winding can move horizontally in a parallel plane of that of the primary. This application targets mainly the transfer of static electricity for the charging of batteries and super capacitors in electric cars and trams.

See SAE 2011-24-0084 (2011, 8pp.)
HYDROGEN

LOTS MORE IN STORE

RE Hydrogen
A British firm is hoping to spur small-scale hydrogen production by making it easier and cheaper to compress and store the gas.
RE Hydrogen has developed a device that it claims can compress hydrogen to the high pressures needed for storage at just 30 percent of the cost of existing equipment.
The company believes the compressor will make it easier to produce hydrogen from water and electricity using small electrolysers because, unlike most conventional equipment, it can raise the pressure of gas with a small flow rate to 350 bar in a single step.
See Doc.142226 (The Engineer, 23 Jan 2012, p7.)
HEAD acoustics

The increasing electrification of the powertrain after 125 years of continuous development of the internal combustion engine will lead to reduced sound pressure levels of vehicle exterior noises. With this expected development road traffic noise affected persons in urban areas hope for quiet cities and a better quality of life in general. The creation and successful preservation of quiet zones in cities and to avoid harmful effects of noise exposure are special focuses in European noise policy. Here quiet vehicles play a major role in realizing these ambitious goals.

However, different surveys have shown the increased risk of accidents for pedestrians and cyclists with respect to collisions with quiet vehicles, which caused a lively discussion about acoustical warning systems for the prevention of crashes. A report from the American NHTSA concluded that hybrid electric vehicles (HEVs) have a higher incidence rate of pedestrian and bicyclist crashes than do internal combustion engine vehicles (ICEs) in certain vehicle maneuvers. This has caused the general demand for acoustical warning signals for quiet vehicles in order to alert blind and visually-impaired persons.

Here, the UNECE thinks about a pause switch, where any kind of acoustic vehicle alerting system can be stopped in its operation temporarily (for example for stop and go situations). All in all, it is of vital importance that further research will be performed with respect to the development of intelligent and comprehensive approaches to warn drivers as well as pedestrians about potential collision danger far beyond concepts of simply continuously emitting a warning signal and hoping that the vulnerable pedestrian hears early enough the approaching vehicle.

Finally, the authors expect that due to the favored differentiation of brands in the automotive industry, a certain acoustic image and emotional bonding is preferred by the manufacturers. This means that a standard alerting signal for all electric vehicles is presumably not in the interest of the manufacturers and maybe even of the customers. Since an added alerting sound to the vehicle exterior noise of electric vehicles should be unmistakable and distinctive and should not confuse the identification, the creation of warning signals appears very limited. Nevertheless, different sound concepts are thinkable fulfilling these requirements.

See vCD 37 Paper 20.pdf (1st International ATZ Conference on Automotive Acoustics, 7-8 Jul 2011, Zurich, Switzerland, 14pp.)

ELECTRIC DRIVE ACOUSTICS – MERCEDES-BENZ E-CELL AND F-CELL CARS

Daimler

The noise and the sound of passenger cars have been dominated by the characteristic of the combustion engine for a long time. But now there is a change: Electric motors are getting more powerful not only attending but also substituting the combustion engine. But not only the acoustic of the electric powertrain is important for passenger cars.Missing the covering sound of the combustion engine, electric powered units for power steering, brake booster, air conditioning, etc, are getting more and more relevant for the sound in several operating conditions and the acoustics of these cars is totally different from the cars we use today. The technical challenges are numerous and complex: What noise level is acceptable and which sound is expected from passengers in the car and pedestrians in the street? The balanced optimum is the target for Daimler’s NVH-engineers: quiet, comfortable, characteristic, and a powerful feedback. And sound design – interior and exterior – is the task. Experience from the current electric cars A-Class, Smart, Vito and B-Class FuelCell is the basis for the acoustics of the next vehicle generation: Mercedes-Benz BlueZero – the modular concept in e-mobility.

See vCD 37 Paper 21.pdf (1st International ATZ Conference on Automotive Acoustics, 7-8 Jul 2011, Zurich, Switzerland, 14pp.)
Seminars & Events
Related to the automobile industry

Advanced technology seminars, workshops and training courses

Ricardo is recognised worldwide as a leading authority in the development of the latest powertrain and vehicle technologies. While perhaps best known for our engineering and consulting programmes, an increasingly popular service is our regular series of seminars and training courses through which aspects of the company’s knowledge and expertise can be shared with customers. These events are typically hosted at Ricardo Technical Centres and are led by some of our most experienced engineers and research scientists.

We constantly strive to develop new seminars and courses reflecting the very latest thinking and most topical areas of automotive technology and product development. We also strictly limit delegate numbers in order to create an environment conducive to discussion of aspects of particular interest to participants. Modestly priced, our Ricardo seminars and courses provide exceptional value for money but are consequently in high demand.

Our current programme of seminars is listed below. Most of these will be hosted at the Shoreham Technical Centre on a number of dates during this time, and further presentations may also be made at other Ricardo facilities or at customer sites subject to demand.

Seminar programme:

- **Internal Combustion Engine Fundamentals**
  Two one-day seminars covering the fundamentals of gasoline and diesel engine technology
- **Basic introduction to the use of Biodiesel by OEMs**
  Half-day seminar
- **Introduction to Noise Vibration & Harshness (NVH)**
  Two-day workshop
- **Diesel Particulates and NOx Control**
  One-day seminar
- **Introduction to Hybrids**
  One-day seminar
- **Introduction to Onboard diagnostics**
  One-day seminar
- **Diesel Engine Calibration training**
  Two-day workshop
- **Manufacturing training course**
  Two-day course covering the manufacturing processes and techniques used by Tier 1 and OEMs in the automotive industry
- **High Voltage Electrical Awareness**
  Half-day seminar

For more information about our current seminar programme or to discuss and individual company-specific training requirement, please contact: seminarinfo@ricardo.com.