With contributions from 14 leading international institutes and companies:

- Ford Motor Company Limited
- BMW AG
- Volvo Car Corporation
- Lotus Engineering
- Saudi Aramco
- Imperial College
- Bosch Mahle Turbo Systems
- Leibniz Universität Hannover
- ThyssenKrupp VDM GmbH
- FEV Motorentechnik GmbH
- MAGNA
- Continental AG
- Voith Turbo Aufladesysteme
- IAV GmbH / Honeywell Turbo Technologies

**Chairman:**

Dr. Geoff Capon,
Turbocharger Systems Specialist, Powertrain Calibration, Development and NVH,
Ford Motor Company Limited, UK

**Highlight Speakers**

Håkan Björnsson,
Technical Specialist Gasoline and Diesel Boosting Systems,
Volvo Car Corporation

Prof. Dr.-Ing. Roland Baar,
Honorary Professor at Leibniz University of Hannover, Head of turbocharger development,
Voith Turbo Aufladungssysteme GmbH&Co KG

Prof. Dr.-Ing. Jörg Seume,
Head of the Institute of Turbomachinery and Fluid Dynamics – TFD,
Leibniz Universität Hannover

Dr. Matthias Linde,
Project Leader, Total Vehicle Architecture and Integration
Thermal Management,
BMW AG, Germany

Come and join our interactive workshops:

A Modelling of advanced charging systems
B Turbocharger – Future demands for downsizing applications
C Turbocharger turbines: Key issues for improved energy extraction and modelling
D Optimizing the single components of innovative turbocharger applications
Dear colleagues,

As you know, everybody in the automotive industry is focusing on how to meet legal emission reduction standards. Intelligent downsizing and turbocharging concepts are currently the only solution to meeting the increasingly strict legislation automotive manufacturers are facing.

There is still considerable development potential both in diesel and gasoline run powertrains. In order to achieve maximal engine performance, ways have to be found to combine downsizing with intelligent boosting technologies. Almost a standard technology in diesel engines, turbochargers are now estimated to make their way into 50% of all gasoline powertrains by 2015.

Find out how to benefit from modern combustion engines’ further development potential at IQPC’s 3rd International Conference on Downsizing & Turbocharging Concepts.

3rd INTERNATIONAL CONFERENCE
DOWNSCIZING & TURBOCHARGING CONCEPTS
Boosting options and trends for highly downsized diesel and gasoline engines
9th – 11th March 2011, Dorint Pallas Wiesbaden, Germany

Experts from international companies such as Ford Motor Company, BMW, Volvo, Voith Turbo Systems, Lotus Engineering and many more will present first-hand experiences and best practices.

- Gain insight into the latest turbocharger technologies and the different engine system requirements to meet your customers’ requirements for maximum engine efficiency and optimised driving dynamics.
- Understand the basic principles of matching turbocharger with engine to maximize its benefit and optimize the overall system’s performance.
- Find out which role turbochargers play in limiting emissions to be in line with upcoming European legislation such as Euro 6.
- Assess advantages and challenges of single-stage versus two-stage charging systems to find the best solution for all applications.
- Find standard solutions to gasoline engine boosting’s major challenges such as knock, vibration and thermodynamics to make innovative downsizing fit for series production.

Get ready for the future! Join us in an open and informal atmosphere to discuss major technical challenges and industry trends with senior international experts. I look forward to meeting you in Wiesbaden.

Best regards

Friederike Kohl
Transport IQ Team

Register for our email updates! Get the latest news on our events, additional download possibilities, early bird deadlines and much more! Register now at www.charging-downsizing-concepts.com/MM.

Who will you meet?

Head, Directors, Senior Engineers, Program Managers, Project Leaders of the following departments:
- Powertrain Development
- Gasoline and Diesel Engine development
- Turbocharger development
- Engine Design
- Injection Systems
- EGR
- Downsizing
- Engine Development/Applications
- Thermal management
- Cooling systems
- Testing, simulation and diagnostics
- Business Development/Product/Marketing/Sales

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**Workshop A**
10:00 – 13:00

**Modelling of advanced charging systems**

Future demands on turbocharged engines lead to even more stringent requirements concerning modelling and simulation quality, because the right decisions about turbocharger matching and engine behaviour have to be made early in the development process. But the limitation of standard turbocharger testing data is one of the main challenges for the simulation engineer and leads to new approaches in describing the behaviour of radial machines. In the workshop, special issues concerning turbocharger modelling shall be discussed like:

- What test data is the right base for simulating turbocharged engines?
- Modelling transient engine response
- Impact of non-steady flow on simulation quality

Stefan Wedowski, Senior Technical Specialist, Business Unit Gasoline Engines, FEV Motorentechnik GmbH, Germany

**Workshop B**
10:00 – 13:00

**Turbocharger – Future demands for downsizing applications**

Apart from future concepts like fuel cells and electrification of the power train, it is a commonplace that the only way to achieve current and future standards of fuel consumption and emissions is a downsized engine. Keeping the power output constant in a downsized engine leads to higher boost pressures and the need for an enlarged operating range of the turbocharger, since a-to-fuel ratio must be constant. But what will the turbocharger of the future look like?

Questions this workshop will address:

- Will single stage turbocharging meet future demands of downsizing engines?
  - What is the potential of variable turbine and compressor geometry?
  - What is the potential of modified wheel designs e.g. mixed flow turbines and back to back compressors?
- Will two-stage turbocharging become more cost-effective?
  - What are the most promising approaches to reduce cost and complexity and simplify controllability?
  - Will electrical turbocharging play a role in high volume production?
  - What is the potential of electrical turbocharging in non electrified vehicles and modern hybrid vehicles?
- How long will turbocharged combustion engines represent the state of the art in modern vehicle drives?
  - What is the potential of hybrid drive trains and fully electrical drive trains?

Jasper Kammeyer, Institute of Turbomachinery and Fluid Dynamics – TFD, Leibniz Universität Hannover, Germany

Dipl.-Ing. Christoph Natkaniec, Assistant Group Leader Turbocharger, Institute of Turbomachinery and Fluid Dynamics – TFD, Leibniz Universität Hannover, Germany

**Workshop C**
14:00 – 17:00

**Turbocharger turbines: Key issues for improved energy extraction and modelling**

As we increase the specific power requirements of the internal combustion engine, more and more will be demanded from the turbocharger turbine. Pushing the BMEP to the limits while maintaining the BSFC of the engine will require greater use of the available exhaust gas energy and improvements in our ability to predict performance in our models. One of the key issues that is yet to be fully understood, is the importance of harnessing the full potential of pulsating flow in the turbine.

- **Pulsating flow**: its impact on the turbocharger turbine
- **Importance of two-entry turbines** for energy extraction and for IC engine effects
- **Building in flexibility to the turbine to operate under a wider range**
- **Improved modelling** of the turbocharger turbine
  - Pulsating flow modelling
  - Extending map width, meanline methods
- **Heat Transfer** effects on turbochargers

Dr Colin Copeland, Research Associate, Turbocharger research group, Imperial College, UK

Alessandro Romagnoli, Research Associate, Turbocharger research group, Imperial College, UK

**Workshop D**
14:00 – 17:00

**Optimizing the single components of innovative turbocharger applications**

To gain maximal output from downsized systems, a complete understanding of the whole systems is essential. This workshop will discuss which points one has to consider while developing a downsized engine. How can charging substitute the drawbacks of downsizing and therefore offer a technical solution to maintain good drivability? How can an innovative turbocharger counteract against the contradictory requirements of downsized engines?

This workshop will explore some of the reasons why particular configurations are chosen, focussing on the following aspects:

- What functionality/performance parameter should we optimise for?
- How can we optimise performance, considering each of the airpath system components in turn
- How can engine pressure be optimised?
- Discussion of major system architecture philosophies

Dr. Geoff Capon, Turbocharger Systems Specialist, Powertrain Calibration, Development and NVH, Ford Motor Company Limited, UK
**CONFERENCE DAY ONE | Thursday, 10th March 2011**

**09:15** Registration & coffee

**09:55** Chairman’s welcome and opening address

Dr. Geoff Capon, Turbocharger Systems Specialist, Powertrain Calibration, Development and NVH, Ford Motor Company Limited, UK

**10:00** Boosting options and trends for highly downsized engines
- Assessment of needs for downsized engines and major challenges
- Boosting options and technologies available
- Electrification of the internal combustion engine and links to hybridization
- Overall expected CO2 potential in light of stringent regulations and aims
- Research issues around downsized engines

Ricardo Martinez-Botas, Reader in Turbomachinery and leader of turbocharger research group, Mechanical Engineering, Imperial College, UK

**10:45** The effects of engine downsizing on the charging system
- Principle and examples of downsizing
- Meaning of the turbocharger
- Compressor limits (max. speed, surge, map width)
- Turbine regulation demands
- Mechanical limitations

Prof. Dr.-Ing. Roland Baar, Honorary Professor at Leibniz University of Hannover, Head of turbocharger development, Voith Turbo Auffadungssysteme GmbH&Co KG, Germany

**11:30** Refreshment break and networking

**12:00** Turbocompressor and turbine design for downsizing applications
- Particular challenges for turbochargers in downsizing applications
- Enlarging the compressor operating range
- Increasing turbine efficiency
- Improving bearings
- Reducing blow-by

Prof. Dr.-Ing. Jörg Seume, Head of the Institute of Turbomachinery and Fluid Dynamics – TFD, Leibniz Universität Hannover, Germany

**12:45** Networking luncheon

**14:15** High temperature resistant materials for boosted engines
- The challenge of material fatigue and deformation in small-size, turbocharged engines
- Processing of high temperature resistant materials, Welding of parts possible
- Weight reduction of components

Frank Scheide, Manager Technical Marketing Automotive, ThyssenKrupp VDM GmbH, Germany

**15:00** Using CFD methods for development of turbocharged engines
- Describing the impact of complex air and exhaust path design
- Better understanding of TC flow phenomena
- Support of 1D-modeling approaches

Stefan Wedowski, Senior Technical Specialist, Business Unit Gasoline Engines, FEV Motorentechnik GmbH, Germany

**15:45** Refreshment break and networking

**16:15** Water-cooled turbochargers for automotive gasoline engines - a challenge for the numerical simulation
- Target of developing a water-cooled turbocharger
- How to perform the transient CFD- and FE-simulations
- Optimization of the turbine housing
- Summary of the simulation results

Marc Hiller, Simulation Engineer, Continental AG, Germany

**17:00** The EGR TEG, one way to industrialize a TEG concept for an automotive application
- Methods for waste heat recovery
- The Thermolectric Generator (TEG)
- The TEG EGR cooler concept.
- The influence of the fouling factor on the thermal energy conversion
- The integration of the electrical energy to the vehicle
- Electrical power prognosis and further outlook

Dr. Matthias Linde, Project Leader, Total Vehicle Architecture and Integration Thermal Management, BMW AG, Germany

**17:45** Closing remarks of the chairman and end of conference day one

The Dorint Pallas Wiesbaden invites you to an evening reception. This is an excellent opportunity for you to meet the other attendees and make new business contacts.

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08:55 Chairman’s welcome and opening address
Dr. Geoff Capon, Turbocharger Systems Specialist, Powertrain Calibration, Development and NVH, Ford Motor Company Limited, UK

09:00 Turbocharging the automotive diesel engine for economy and emissions
- Boosting to high specific powers
- Maximizing fuel economy
- Legal emissions compliance
- Good vehicle performance feel and drivability
- Customer acceptance
Dr. Geoff Capon, Turbocharger Systems Specialist, Powertrain Calibration, Development and NVH, Ford Motor Company Limited, UK

09:45 Upgrading diesel turbocharging systems to fulfill CO₂ and Euro 6 requirements
- Optimisation of a Mono-VNT-Turbo regarding:
  - Bearing systems
  - Aerodynamics
  - Long-term behaviour
- Evaluation of resulting downsizing/downspeeding
Marcel Pannwitz, Advanced Diesel Engineering, IAV GmbH, Germany
Co authors: Torsten Tietze, IAV GmbH, Germany
Pierre Barthelet, Denis Jeckel, Honeywell Turbo Technologies, France

10:30 Refreshment break and networking

11:00 Concepts for boosting small gasoline engines – a comparison of different charging systems and their potential
- Turbocharger concepts – layouts of existing solutions
- Mechanical driven boosters – concepts and potential
- Electrical boosters
Dr. Valentin Kordesch, Manager Engine Engineering ASIA, MAGNA, Austria
Co author: C. Doppelbauer, MAGNA, Austria

11:45 Investigation of appropriate technologies for a highly-downsized DISI engine
- Investigation of different charging system solutions
- Modelling to avoid abnormal combustion
- New detail solutions for fuel delivery and gas exchange
James Turner, Chief Engineer – Powertrain Research, Lotus Engineering, UK
Co-authors: Richard Pearson, Nick Luard, Lotus Engineering, UK

12:30 Networking luncheon

14:00 Charging of small SI engines
- Evaluation of different charging systems concerning:
  - full load
  - fuel consumption at part load
  - transient engine behavior
- Discussion of the effect of variable cam timing
Stephan Gauger, Simulation engineer, Bosch Mahle Turbo Systems, Germany
Co-author: Martin Rauscher, Bosch Mahle Turbo Systems, Germany

14:45 Refreshment break and networking

15:15 Boosting system & engine/vehicle response.
A reflection
- Customers’ acceptance of downsized diesel and gasoline engines
- The key question: Responsiveness
- Challenges: To reach the transient torque behavior of a large natural aspirated engine in spite of an increase of the specific torque and power and applications of small engines to larger vehicles
Håkan Björnsson, Technical Specialist Gasoline and Diesel Boosting Systems, Volvo Car Corporation, Sweden

16:00 Fuel requirements of turbocharged engines
- The challenge: higher pressure in turbocharged engines for a given mixture temperature
- Increasing pressure makes auto-ignition more likely
- Advantages of non-paraffinic fuels compared to paraffinic fuels: higher resistance to auto-ignition
- Turbocharged engines will need higher RON/lower MON fuels while current fuel specifications and other initiatives are pushing fuels in the opposite direction
- At a given pressure/temperature, fuel mixtures with lower laminar burning velocity will be more resistant to pre-ignition
Prof. Gautam Kalghatgi, Senior Research Science Consultant, Saudi Aramco, Saudi Arabia

16:45 Closing remarks of the chairman and end of the conference

"Information on the latest technology available & future thoughts for development."
R. Satishkumar, Manager Engine Design, Tata Motors
4 Ways to Register

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