ETN

THE FUTURE OF GAS TURBINE TECHNOLOGY

5TH INTERNATIONAL GAS TURBINE CONFERENCE

27 - 28 OCTOBER 2010, BRUSSELS, BELGIUM

www.etn-gasturbine.eu

KEYNOTE

SPEAKERS

ETN

THE FUTURE OF GAS TURBINE TECHNOLOGY
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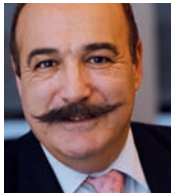
Joseph Strakey is the Chief Technology Officer at The US Department of Energy's National Energy Technology Laboratory (NETL), where he is responsible for providing strategic direction and oversight for NETL's research, development and demonstration programs, including its in-house research efforts. During his 39 years of federal service Dr Strakey has held senior management positions leading national fossil energy R&D programs. He previously headed NETL's Strategic Center for Coal, and prior to that, the Strategic Center for Natural Gas. Dr Strakey has a Bachelor degree in Chemical Engineering from Lehigh University, and Master and PhD degrees in Engineering and Applied Science from Yale University, where he also performed postdoctoral research.



Samuele Furfari is Advisor to the Director General of DG Energy in the European Commission (EC). He joined the EC in 1982, where he has contributed to the coordination and formulation of energy and transport policy. He has been involved with the EU's energy and climate package (20/20/20) from an early stage. Mr Furfari studied Chemical Engineering at the Free University of Brussels, and received his PhD in 1982 with a thesis on coal liquefication. He is teaching Geopolitics of Energy at the Free University of Brussels, and also collaborates closely with the European Energy Forum.

Manfred Klein is the Program Coordinator at the Energy and Environment Gas Turbine Laboratory in the Institute for Aerospace of the National Research Council of Canada since 2007, working on industrial gas turbine research, alternative fuels and energy business development. He is a member of the Canadian Industrial Gas Turbine Applications Committee (former Chair), ASME International Gas Turbine Institute (former Chair, Environment & Regulatory Affairs), the Canadian Gas Association and the CogenCanada Association. Mr Klein received his Bachelor of Mechanical & Aero Engineering degree in 1980 from Carleton University in Ottawa, Canada.

Bernard Quoix has been the Head of Rotating Machines Department of TOTAL Exploration and Production Rotating Machinery Department since 2003. He was elected member of the Turbomachinery Advisory Committee from Texas A&M University in 2005 and again in 2009. He was also elected Board member of the European Turbine Network (ETN) in 2008, and then subsequently elected President in April 2010. Mr Quoix graduated from Ecole Nationale Supérieure d'Electricité et de Mécanique (ENSEM) in Nancy, France in 1978, and then completed his engineering education at Ecole Nationale du Pétrole et des Moteurs (ENSPM) in Paris, specializing in Internal Combustion Engines.

Hans van der Loo is the head of the European Union Liaison Office, Shell International in Brussels since 2004, after having been the senior regional adviser for Europe & Canada as of 2000. He is also a sherpa to the CEO of Royal Dutch Shell in the European Round Table of Industrialists (ERT). Since March 2003 he has been a Board member of A/S Norske Shell. Mr van der Loo graduated from Nyenrode University in the Netherlands, and has a Masters degree from the European School of Management, having studied in Paris, Oxford and Dusseldorf.

Birendra Nath is the Engineering & Technology Manager of International Power, where his team is responsible for managing the lives of components. He has worked in the research and engineering functions of the Central Electricity Generating Board (CEGB) and its successor companies for over 35 years. Mr Nath graduated in Metallurgical Engineering from Banaras Hindu University (BHU) in India, and obtained his doctorate at Manchester University in the UK.

Arnoud Kamerbeek is the Managing Director of Nuon/Vattenfall BG Benelux in Amsterdam, where he works on Business Development & Projects. He is responsible for the development and construction of all assets for the Business Group Benelux. Previously he has worked with McKinsey in Amsterdam and Boston. He studied at Delft University where he received his Masters of Science in Chemical engineering in 1996, and later completed his MBA at INSEAD.

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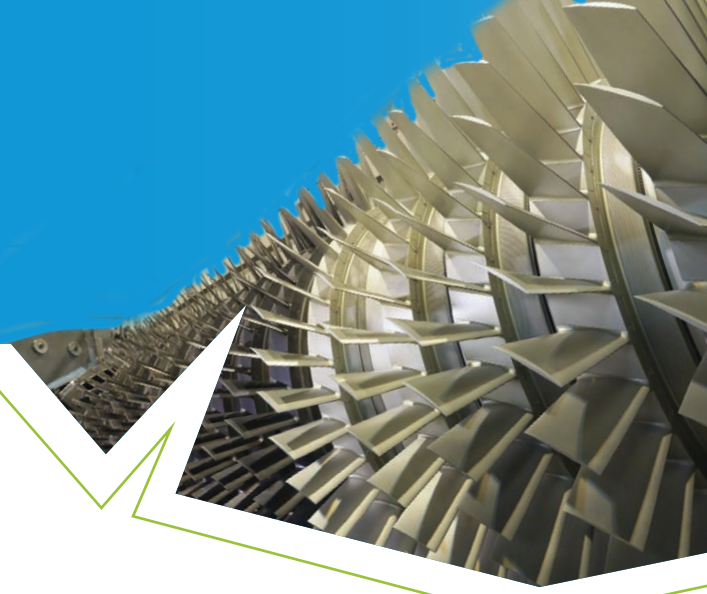
Ola Johansson is the Vice President, Head of Global Technology for Industrial Power within Siemens Energy, and has been working for Siemens Industrial Turbomachinery since 2003. He is currently responsible for Global Technology, including product management, R&D and engineering processes for industrial power. Previously Mr Johansson has worked primarily with R&D in both ABB and Alstom. He has a Master of Science in Mechanical Engineering from Linköping Institute of Technology, Sweden and from Cranfield University, UK. Mr Johansson has an Executive Master of Business Administration from Stockholm School of Economics 2004.

Yves Menat is the Managing Director of GE Energy Products Europe (EPE) since 2005, where he is responsible for managing and coordinating the Energy Products activities in France. Mr Menat joined GE when it acquired Alstom Gas Turbines in June 1999. In July 2001 he was appointed Managing Director of Thermodyn, based in Le Creusot, France, and part of the GE Oil & Gas business. Since 2004 he has been responsible for worldwide operations for PII (a GE Oil & Gas company specialised in expert appraisals and inspection of pipelines), in charge of 20 sites across 15 countries. Mr Menat has an engineering degree from the Institut National des Sciences Appliquées in Lyon, France.

Klaus-Dieter Broichhausen has a professional background of 35 years as an engineer and researcher in the field of gas turbines, energy and aeronautics. He is an Associate Professor at the Institute of Jet Propulsion and Turbomachines of the RWTH Aachen University. Professor Broichhausen also teaches innovation management at the University of St. Gallen, Switzerland. During his industrial career he has held various positions in upper management in the field of engineering and as a manager of international programmes. He also established a think tank on future trends in aeronautics. Professor Broichhausen is a Board member of Schuh & Co. Complexity Management AG in St. Gallen, Switzerland.



Riti Singh is Professor Emeritus of Cranfield University in the UK. He leads the Gas Turbine Engineering & Technology Group within the Department of Power and Propulsion and is Director of the Rolls-Royce University Technology Centre in Performance Engineering. Professor Singh was awarded the ASME International Gas Turbine Institute's Annual International Aircraft Engine Technology Award for 2010, presented to one individual each year for sustained, innovative personal contribution to the field. He has been a Board member of ETN, and is a Board member of the Aerospace Industries Board, Institution of Mechanical Engineers and the International Society of Air Breathing Engines (ISABE).

André Mom was the Managing Director of the Dutch Gas Turbine Association (VGT) from 1994 to 2010, where he represented the Netherlands' gas turbine industry. In 2005 he was elected President of the European Turbine Network, successfully steering it to become the successful platform for gas turbine technology and R&D that it is today, and since April 2010 serves as the President Emeritus of ETN. Mr Mom has previously worked for the National Aerospace Laboratory (NLR), Civi Consultancy and Coopers & Lybrand. He obtained his degree in Physics and Materials Engineering at Delft Technical University in the Netherlands in 1975.

Peter Childs is the Professorial Lead in Engineering Design at Imperial College London, where he is joint course leader for the Industrial Design Engineering degree at the Royal College of Art and working with Design London. Previously, he was the Director of InQbate, Director of the University Technology Centre for Aero-Thermal Systems, and Professor of Engineering Design at Sussex University. Dr Childs has written several books on mechanical design, fluid flow and temperature measurement and is a former winner of the ASME-IGTI John P. Davis award for exceptional contribution to the literature of gas turbine technology.

Junior Isles is the Editor-in-Chief of The Energy Industry Times newspaper and a well-known commentator on the power and energy sector. He set up Man in Black Media Ltd in 2007 to provide editorial and media consultancy in the power and energy business and in 2008 launched The Energy Industry Times newspaper. Mr Isles has a Bachelor of Engineering degree in Electronic Engineering from Middlesex University in the UK.

THE FUTURE OF GAS TURBINE TECHNOLOGY

DAY 1

ETN MORNING, 27 OCTOBER 2010

THE FUTURE OF GAS TURBINE TECHNOLOGY
5th INTERNATIONAL GAS TURBINE CONFERENCE

07:00	**Registration and welcome coffee**
08:20	**Welcome and introduction** Christer Björkqvist, Managing Director, ETN and Bernard Quoix, President, ETN
08:30	**THE ENERGY MARKET IN 2025 AND THE ROLE OF GAS IN THE FUTURE ENERGY MIX** **Chair**: Hans van der Loo, Head of European Union Liaison, Shell International **Reconciling International Energy Issues and Sustainable Development** Samuele Furfari, Advisor to the Director General for Energy, European Commission **CCS and Advanced Turbine Technology: Key Components in Helping Meet the Global CO_2 Challenge** Joseph Strakey, Chief Technology Officer, NETL, US Department of Energy (DOE) **Future Strategies for Implementation of IGCC with CCS** Arnoud Kamerbeek, Director Business Development & Projects, Nuon/Vattenfall BG Benelux **Panel discussion** **Moderator**: Junior Isles, Editor, The Energy Industry Times **Panellists**: S. Furfari (EC), Dr. J. Strakey (DOE), A. Kamerbeek (Nuon/Vattenfall BG Benelux), H. Van der Loo (Shell)
10:30	**Coffee break**

OVERVIEW OF THE ENERGY MARKET AND THE ROLE OF GAS IN THE FUTURE ENERGY MIX

The IEA's World Energy Outlook 2009 reveals that although gas has a significant role to play in the future energy mix, the extent of that role depends on gas prices and how tough governments get on climate change. With nuclear and CCS being longer term options for cutting CO_2, gas turbine combined cycle plants are likely to be one of main base load options in the near/mid-term. Yet there are questions surrounding the longer-term role of gas turbine-based power generation.

* With the price volatility and security of supply issues surrounding gas, will government policies and utilities be looking at shifting away from gas?
* Will gas from shale be the game changer in securing the long-term future for gas fired generation?
* Do current emissions strategies in Europe and the US jeopardise or encourage gas fired generation?
* Will natural gas plants be forced to be capture-ready? And if so, how will this affect the use of gas in the future?
* Will the economics of IGCC-CCS ever be favourable?
* Given the uncertainty on environmental policy, how can utilities prepare for IGCC-CCS?

The opening session at this year's conference will focus on the policies and strategies that will drive a low carbon economy in Europe and the US and analyse the mid- and long-term importance of gas.

11:00 **ENERGY POLICIES AND MARKET IMPACT ON GAS TURBINE TECHNOLOGY DEVELOPMENT**

Chair: Riti Singh, Cranfield University

Potential GT Developments and Contributions to Clean Energy
Manfred Klein,
Program Coordinator, Energy and Environment Gas Turbine Laboratory, National Research Council Canada (NRCC)

Future Technical GT Requirements from the Oil and Gas Industry
Bernard Quoix,
Head of Rotating Machines Department of TOTAL Exploration and Production

Future Technical GT Requirements and Challenges from a Utility Perspective
Birendra Nath,
Engineering & Technology Manager, International Power

Panel discussion
Moderator: André Mom, President Emeritus ETN
Panellists: M. Klein (NRCC), B. Quoix (Total), B. Nath (International Power), O. Johansson (Siemens Industrial Turbomachinery), Y. Menat (GE Energy), R. Singh (Cranfield University)

12:45 Lunch

IMPACT OF ENERGY POLICY ON GT TECHNOLOGY: POTENTIAL TECHNICAL CONTRIBUTIONS AND USER REQUIREMENTS

Future energy policy will have an impact on gas turbine technology. Gas turbine manufacturers are already working on solutions that will increase turbine efficiency to enable emissions to be cut from gas fired generation. With CCS high on the agenda, there is also significant ongoing work to adapt GTs to run on hydrogen. Environmental policy and CO_2 prices will impact users' technology choices and how GT developers react to user needs. According to the IEA, IGCC CCS has the highest long run marginal cost in 2020 of any forms of base load generation with carbon capture. So how will CO_2 prices affect technology development?

* Will the unfavourable economics of IGCC CCS see a reduced drive to develop GTs that can burn hydrogen?
* How will increasing pressure on emissions drive turbine efficiency?
* Will technology advances jeopardise reliability?
* With users needing to arbitrage between fuel, emissions and electricity production, is there a greater need for a focus on both fuel and operational flexibility? If so, what is being done by the manufacturers?

This second session will look at user requirements, potential GT developments and how GTs can contribute to a clean energy policy.

THE FUTURE OF GAS TURBINE TECHNOLOGY

DAY 1

ETN AFTERNOON, 27 OCTOBER 2010

THE FUTURE OF GAS TURBINE TECHNOLOGY
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	CYCLE EFFICIENCY **Chair:** Jacques Maunand, EDF	CONDITION MONITORING AND INSTRUMENTATION **Chair:** Chris Dagnall, Cogsys	IGCC-CCS **Chair:** Kai Tullius, DG Energy, European Commission
14:00	**Effeciency Monitoring, an Indispensible Tool for O&M** D. Buysse, Laborelec - GDF SUEZ	**Optimizing Gas Turbines' Repair Outages through Condition Monitoring and Diagnostics - case studies** C. Nicol, Turbine Services	**IGCC R&D: An Update on the US DOE Program** J. Strakey, NETL, US Department of Energy
14:30	**Power Generation with Fluid Phase Chemical Looping Combustion** P. Childs, Imperial College London	**Dynamic Simulations for Designing Emergency Procedures for a Gas Turbine Power Plant** K. Takahashi, Hitachi Japan	**Low Emission Gas Turbine Technology for Hydrogen-rich Syngas – H_2-IGCC research project** C. Lappee, Nuon/Vattenfall BG Benelux
15:00	**Flow Field and Heat Transfer Investigations in the Exhaust Nozzle of a Recuperative Aero Engine** D. Missirlis, Aristotle University of Thessaloniki	**Turbine and Combustion Chamber Measurements with a Cooled Unsteady Total Pressure Probe** M. Mersinligil, Von Karman Institute	**When Fuel Flexibility Meets Environmental Requirements** F. Bonzani, Ansaldo Energia
15:30	**Coffee break**		

	COMBUSTION AND FUEL FLEXIBILITY **Chair:** Michaël Deneve, Laborelec - GDF SUEZ	MATERIALS, COATINGS & STRUCTURES **Chair:** Birendra Nath, International Power	MICRO-TURBINES **Chair:** Steve Gillette, Capstone	ASSET MANAGEMENT - METHODOLOGIES **Chair:** Chris Lappee, Nuon/Vattenfall BG Benelux
16:00	**Low NO_x H_2 Combustion for Industrial Gas Turbines of Various Power Ranges** H. Funke, Aachen University of Applied Sciences	**The Challenge for Gas Turbine Materials in Future Power Systems** J. Oakey, Cranfield University	**Technology and Market Status of Small Gas Turbines** A. Mom, Dutch Gas Turbine Association (VGT)	**Asset Management: The Adoption of Value Driven Systematic Maintenance Approaches by Gas Turbine Operators** P. Decoussemaeker, Alstom Power
16:30	**Investigations about Co-firing of Gasified Herbaceous Biomass in an Integrated Gasification Combined Cycle** P. Jansohn, Paul Scherrer Institute (PSI)	**Super Alloys for Solid Shrouds over the last twenty years** T. Nijdam, NLR National Aerospace Laboratory, Chromalloy	**High Efficiency Environmentally friendly Gas Turbine Ceramic Mems of 2 kW Electric Power** A. Soudarev, Boyko Center	**Enhanced Asset Management through Optimisation of Maintenance and Application of Property Risk Assessment Methodology** M. Wärja, Siemens Industrial Turbomachinery
17:00	**Ignition Delay Time Measurements and Validation of Reaction Mechanism for Hydrogen at Gas Turbine Relevant Conditions** A. Keromnes, University of Ireland & German Aerospace Center (DLR)	**Development and Characterisation of Innovative MCrAlY+X Coatings for Gas Turbine Blades and Vanes** A. Bonadei, Ansaldo Energia	**Investigation of the Two-Zone Flow Phenomenon in a Microturbine Centrifugal Compressor Using CFD** A. Javed, Delft University of Technology	**Asset Management of Turbo Machinery Accounting for the Unpredictable, the Predictable and the Controllable** C. Walczuk, Emerson Process Management

18:15	**Meeting point** at the Conrad Hotel Reception and bus transfer to the Gala Dinner
19:00	**Cocktail Reception** and **Dinner** at the Chalet Robinson - Theme: Creativity and Innovation
23:00	Bus transfer to the Conrad Hotel

THE FUTURE OF GAS TURBINE TECHNOLOGY

DAY 2

ETN MORNING, 28 OCTOBER 2010

THE FUTURE OF GAS TURBINE TECHNOLOGY
5th INTERNATIONAL GAS TURBINE CONFERENCE

08:00	**Networking coffee**
08:30	Opening and introduction
08:35	**CREATIVITY, INNOVATION AND DESIGN IN GAS TURBINE TECHNOLOGY** **Chair:** Klaus-Dieter Broichhausen, Professor Doctor, Schuh Complexity Management **Opportunities and Ideas for Future Gas Turbine Technology with a Medium to Long Term Perspective (2030-2050)** Peter Childs, Professorial Lead in Engineering Design, Imperial College London Interactive discussions
10:35	**Coffee break**

CREATIVITY, INNOVATION AND DESIGN IN GAS TURBINE TECHNOLOGY

Creativity is a highly prized personal and commercial attribute and an essential element of the design process. Some creative ideas are astonishing and brilliant, while others are simple practical ideas previously not thought of.

Creativity is the most important leadership quality, according to CEOs as reported in the Capitalizing in Complexity- Insights from the 2010 IBM Global CEO Survey report. Creativity, for many engineers, is however viewed as a nebulous activity that rests uneasily with the precise quantitative processes normally associated with engineering practice. There is a tension between risk in a safety critical and capital intensive industry and business opportunities.

There are many validated creative methods available which can be used to enhance and provoke our generative activity but professionals tend to restrict their attention to very few methods.

This session will embrace the use of creativity tools to generate ideas relevant to the future of gas turbine technology with a medium to long term perspective (2030-2050).

	COMBUSTION AND FUEL FLEXIBILITY **Chair:** Catherine Goy, E.ON UK	CYCLE EFFICIENCY **Chair:** Jacques Maunand, EDF	MATERIALS, COATINGS & STRUCTURES **Chair:** Daniel Mack, Research Center Jülich	ASSET MANAGEMENT - OPTIMIZATION ALGORITHMS **Chair:** Pascal Decoussemaeker, Alstom Power
11:05	**Fuel Flexibility for Heavy Duty and Aeroderivative Gas Turbine** M. Moliere & B. Naidu, GE Oil & Gas	**The Topspool Cycle - Development Program of a Novel Gas Turbine Cycle** J. Jacoby, Vattenfall	**Analytical Estimation of Microslip Damping in Bladed-Disks** J. Rao, Altair Engineering India	**Power Plant Selection and Deployment - the TERA (Techno-Economic Environmental Risk Analysis)** V. Sethi, Cranfield University
11:35	**Application of Automating the Process of Combustion Tuning on Large Industrial Gas Turbines** R. Casanta, Gas Turbine Efficiency Sweden	**Operational Plant Efficiency and Flexibility with Siemens H-Class Technology** A. Heilos, Siemens Energy	**Fatigue Resistance of Stationary Gas Turbine Blade Metal in View of Service Life Extension Tasks** S. Ivanov, Close Co. "IPMB&E"	**Product Optimisation of a Pool of Power Plants based on a Neural Model** G. Cerri, University of Roma TRE
12:05	**Stable Dry Low Emissions with Fuel Flexibility in Industrial Gas Turbines** J. Larfeldt, Siemens Industrial Turbomachinery	**Middle East Based V94.2 SwirlFlash Power Augmentation** C. Payet & K. Meijer, Stork Thermeq	**The Impact of Flow Inlet Conditions on the Two Phase Flow Pattern and the Heat Transfer in a Scavenge Pipe of an Aero Engine Bearing Chamber Sealed with Brush Seals** S. Kanarachos, Frederick University	**The Challenge of Management and Interpretation of CMMS Information** R. Acosta, Alstom Power
12:30	**Lunch**			

THE FUTURE OF GAS TURBINE TECHNOLOGY

DAY 2

ETN AFTERNOON, 28 OCTOBER 2010

THE FUTURE OF GAS TURBINE TECHNOLOGY
5th INTERNATIONAL GAS TURBINE CONFERENCE

	FUEL FLEXIBILITY IN HARSH ENVIRONMENT **Chair:** Jonathan Clarke, Shell	COMMON R&D BETWEEN AERO & INDUSTRIAL GTS **Chair:** Jos van Buijtenen, Delft University	COMPRESSOR FOULING **Chair:** Bernard Quoix, Total
13:30	**Gas Turbine Durability in Harsh Environments** C. J. Etheridge, Solar Turbines	**Laser Additive Manufacturing (LAM) of Ti-6Al-4V and Inconel 718** G. Kool, National Aerospace Laboratory (NLR)	**Inlet Air Filtration and Compressor Cleaning for Gas Turbines** P. De Jong, KEMA
14:00	**Characterization of a Generic, Fuel Flexible Reheat Combustor** J.Fleck, German Aerospace Center (DLR)	**Numerical Simulation of Windback Seals used in Aero Engine Bearing Chambers** M. Flouros, MTU Aero Engines	**Aerodynamic Implications of Blade Fouling on an Axial Compressor Stage** P. Pilidis, Cranfield University
14:25	**Coffee break**		
14:45	**MEETING THE CHALLENGES IN FUTURE MARKETS** **Chair:** Peter Childs, Professorial Lead in Engineering Design, Imperial College London **Managing Growth in Challenging Future Markets** Klaus-Dieter Broichhausen, Professor Doctor, Schuh Complexity Management		
15:45-16:00	**Summary and closing remarks** Bernard Quoix, President of ETN		

MANAGING GROWTH IN CHALLENGING FUTURE MARKETS

The political impact on the gas turbine industry and the influence of the future energy market have been covered in previous keynote sessions and in the technical sessions appropriate examples of technical solutions, the progress of industry and research have also been presented. Nevertheless, when we address future needs it is also necessary to look at the basic global drivers for these markets. This presentation intends to reveal the increasing degrees of complexity in our future environment:

* What are the general trends driving the markets of the future?
* What are the cross correlations and interactions?
* How do these trends influence the markets of energy?
* What are the emerging technologies and how can they influence the energy markets?
* How can we develop potential scenarios and evaluate if they are reasonable?

For any stakeholder in these markets – be it in the research field, in the industry as a producer of gas turbines or as an energy provider and distributor- it is mandatory to develop a strategy for coping with these complex and changing boundary conditions. In the face of these challenges, meeting the described requirements of future markets and creating sustainable growth opportunities require major generic leverages:

* How we can develop customer perceived value in changing market environments?
* How technology and research can be streamlined as early as possible to the needs of the future markets?
* What elements are needed to phase market or technology driven creativity into a stringent program management?
* Where can we find an optimum with respect to life cycle cost and customer satisfaction?

The main drivers of generating growth through innovation will be demonstrated by examples, giving participants from research and industry a new set of ideas for their future business.

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H_2IGCC
Energy without CO_2

H_2-IGCC

RESEARCH PROJECT

Low Emissions Gas Turbine Technology for Hydrogen-rich Syngas

To pave the way for commercial deployment of efficient, clean, flexible and reliable IGCC plants with CCS by 2020

Project under the European Union's Seventh Framework Programme for Research and Technological Development

The overall objective of the H_2-IGCC project is to provide and demonstrate technical solutions which will allow the use of state-of-the-art highly efficient, reliable gas turbines (GTs) in the next generation of Integrated Gasification Combined Cycle (IGCC) plants. The goal is to enable combustion of undiluted hydrogen-rich syngas with low NO_x emissions and also allowing for high fuel flexibility. The challenge is to operate a stable and controllable GT on hydrogen-rich syngas with emissions and processes similar to current state-of-the-art natural GT engines. The H_2-IGCC project aims to tackle this challenge as well as fuel flexibility, by enabling the burning of back-up fuels, such as natural gas, without adversely affecting the reliability and availability.

The technical challenges being addressed by the H_2-IGCC project are divided into 4 Subprojects: Combustion, Materials, Turbomachinery, System Analysis.

Acronym: **H_2-IGCC**
Collaborative Project: FP7-239349
Duration: 4 years (2009-2013)
Budget: 17.8 M Euro (11.3 M Euro EU co-funding)
Coordinator: European Turbine Network
Website: www.h2-igcc.eu

The 5th International Gas Turbine Conference serves as a dissemination platform for the H_2-IGCC project.

For more information please visit our project stand at the EXPO.

ETN

promoting environmentally sound gas turbine technology with reliable and low cost operation

* Cycle Efficiency
* Fuel Flexibility & Emissions
* Materials Degradation
* Condition Monitoring
* Instrumentation & Control
* Asset Management
* Project Coordination
* International Cooperation

Bringing technical solutions to the market through technology watch, technical committees, working groups and R&D projects

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