Project Deliverable

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RE	Restricted to a group defined by the consortium (including the Commission)	
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Abstract:

The awareness raising activities in Europe and India constitute one of pillars of the EUCLID project and play a crucial role in terms of tangible outcomes. Indeed, the project's success is mainly based on information flows sine qua non condition for detecting EU-India collaboration opportunities in the NMCS field, for promoting what the project has revealed in terms of the EU-India NMCS competences mapping, joint research projects set-up, cooperation models, development of new NMCS applications leading to the acquisition of new common markets, operation of NMCS networks.

This document provides a summary about the **EUCLID** awareness raising and dissemination event (Panel Discussion "Energy and Environmental Challenges in Emerging Regions - Opportunities for Control and Monitoring Technologies") that was organised during the 18th World Congress of the International Federation of Automatic Control (IFAC) in Milan, Italy, on August 31, 2011.

A separate document Deliverable 3.1 provides a summary of the EUCLID round table "Cooperation perspectives between EU and India on monitoring, systems & control science" that took place on August 30, 2011, also during IFAC WC, Milan.

Keywords :

Awareness raising, Networking, Dissemination, Monitoring and Control, EU-India Cooperation

Table of Content

1. Introduction

The EUCLID project was initiated by European and Indian partners and is supported by the European Commission. The aim of the project is to identify **collaboration priorities between India and Europe in the field of Networked Monitoring and Control Systems** (NMCS) technologies and to set-up EU-India partnerships in the NMCS domain.

The awareness raising activities in Europe and India constitute one of project pillars and play a crucial role in terms of tangible outcomes. Indeed, the project's success is mainly based on information flows sine qua non condition for detecting EU-India collaboration opportunities in the NMCS field, for promoting what the project has revealed in terms of the EU-India NMCS competences mapping, joint research projects set-up, cooperation models, development of new NMCS applications leading to the acquisition of new common markets, operation of NMCS networks.

EUCLID project awareness raising and dissemination action strategy in reality covers two campaigns closely interrelated to each other:

– the dissemination campaign and
– the awareness raising campaign

EUCLID project is looking for a large diffusion of information on the EU-India collaboration opportunities in the field of NMCS. The dissemination campaign helps to spread information on the collaboration opportunities between EU and India, about EUCLID project objectives, work scope, outcomes and impacts among a huge number of NMCS actors (including those beyond the NMCS research community). The awareness raising campaign contributes as well to this objective but in a more specific way. Awareness raising strategy represents an important tool for gathering information, ideas, opinions, feedback from the EU-India NMCS community. Acting like a "double way" information pipeline, the awareness raising campaign helps to explore the wider NMCS actors' implications in the project activities.

In this context, the EUCLID project team organized two events in the framework of the 18th World Congress of the International Federation of Automatic Control (IFAC) 2011 Milan:

- **EUCLID Round Table: Cooperation perspectives between EU and India on monitoring, systems & control science on August 30, 2011** and
- **EUCLID Panel Discussion: Energy and Environmental Challenges in Emerging Regions – Opportunities for Control and Monitoring Technologies on August 31, 2011.**

The present document gives an overview of the **EUCLID Panel Discussion: Energy and Environmental Challenges in Emerging Regions – Opportunities for Control and Monitoring Technologies on August 31, 2011.** The summary of the round table is provided in a separate report D3.1.

2. EUCLID Panel Discussion: Energy and Environmental Challenges in Emerging Regions – Opportunities for Control and Monitoring Technologies

2.1. Overview of the Panel

Goal of the panel:

To inform the audience about issues associated with increasing energy use and its environmental impact, with special reference to emerging regions, and to discuss how monitoring, control, and optimization technologies can address these issues.

Abstract:

This panel will review our current understanding of the energy/environment linkage and it will discuss how monitoring and control system technologies can help

A specific focus for the session will be on emerging economies, especially India and China. It is in these geographies that power and energy demand is growing rapidly; clean energy solutions must address priorities there. Recent data on generation mix, power system infrastructure developments, and government policies and priorities will be briefly reviewed. A few imperatives bear special emphasis: reduction and redistribution of energy consumption in homes, buildings, and industries; more reliable transmission and distribution infrastructure; increased penetration of renewable generation; and adjustment of consumption demand in conditions of uncertain and intermittent supply.

The role of control in two critical technology-rich areas will be discussed: energy efficiency and smart grids. Energy efficiency is the obvious first recourse and it is applicable from the generation station to the residential, commercial, or industrial end user. Advanced control and optimization solutions have been successfully deployed, including in emerging regions, and opportunities exist for far greater impact. One challenge that needs to be addressed is that of process-model mismatch over time, resulting in decreasing performance of model-based solutions. Energy efficiency in the transmission and distribution system is a higher priority item in emerging regions than in developed countries (where T&D losses are in single-digit percentages).

The smart grid can be thought of as an overlaying of a communication and control infrastructure on the electricity grid. Control applications are ubiquitous, from generation, to transmission and distribution, to the consumer premises. Control will be crucial for integrating distributed renewable generation and storage technologies with the grid, for broad penetration of electric and plug-in hybrid vehicles, and for overall system reliability. An area of particular importance in emerging markets is microgrid optimization.

Main organisers:

Dr Francoise Lamnabhi-Lagarrigue, CNRS (Centre National de la Recherche Scientifique), Laboratory of Signals and Systems (INSIS & INS2I) & European Embedded Control Institute (EECI), France.

Dr HS Jamadagni, Professor, Centre for Electronics Design and Technology (CEDT), Indian Institute of Science, Bangalore 560 012, India.

Agenda (16.00 – 18.00):

- Tariq Samad, Moderator: 5 min introduction
- 6 panelists: 10-15 min presentation each, including short intro perspective and respond to the questions (total 70 min):

  1) What do you see as some of the key points of differentiation between developed economies and emerging regions with regards to energy and environmental challenges?

  2) This session is focused on the role of monitoring and control technologies, with application to energy efficiency and smart grids. Can you highlight one or two promising avenues for research and development in this broad area that are especially relevant for emerging regions?

  3) What are your thoughts on how we can improve collaboration and coordination between the control communities in the developed economies and emerging regions?

- Panel discussion, including questions from the audience (40 min).

- Tariq Samad, Moderator: 5 min conclusion

2.2. Panelists

The planned panelists includes:

- **Jean-Luc Dormoy, Yello Strom, Director of the EDF Group Programme on Home Technology and Smart Metering, EDF Group, France**. Dr Dormoy joined Yello Strom in January 2009 and uncovers the activities mainly in France – EDF SA – the UK – EDF Energy – and Germany – EnBW and Yello Strom. EDF Group has 40 million customers in Europe. Formerly, Dr Jean-Luc Dormoy was in charge of Programme Strategy for Software and Silicon Architectures at CEA-DRT, from 2003 to 2008. CEA-DRT is a technological research ensemble with more than 3,000 researchers in microelectronics, software and new energy technology. Dr Dormoy contributed to the creation and was a member of the Board of the

ARTEMIS Joint Undertaking on Embedded Systems, a PPP between the European Commission, 20 EU states, and industry and research. He contributed to the creation of new companies, notably in the field on multicore and manycore processors. Dr Dormoy has been part at management level of major industry and research initiatives in France and in Europe: poles de compétitivité MINALOGIC and SYSTEM@TIC, National Research Agency in France, ITEA2 Third Roadmap on Software-Intensive Systems. Formerly, Dr Dormoy worked at EDF R&D as a research engineer, project manager, and advisor for software technology. Dr Dormoy was trained as a mathematician at the Ecole Normale Supérieure de Saint Cloud, and has a PhD in Artificial Intelligence. He is the author of about 40 reviewed scientific papers.

- **S.S. Murthy**, **Professor, Electrical Engineering, IIT Delhi, India**. With nealrly 40 years of experience, Prof Murthy interacted with both Universities and Industry in India and abroad. He has contributed significantly to energy efficiency & conservation, renewable energy for both grid fed and off grid systems, curriculum and lab development. He has published over 220 papers, guided over 100 graduate theses, completed over 80 sponsored research and consultancy projects, dealing with Energy Converters and Energy Systems. His inventions have led to field deployment of renewable energy systems and energy efficient drive systems. He is a Fellow of the prestigious Indian National Academy of Engineering (INAE) and was General Chair of the INAE International conference on "Research Policy for Sustainable Energy" held recently.

- **Régis Hourdouillie, Smart Grid Director - Innovation and Demonstration Projects, Alstom Grid,** has been working in the telecommunications and power utilities sector for 20 years. He has been holding his current position in Alstom Grid (formerly Areva T&D), one of the world leaders in Transmission and Distribution of Electricity, since July 2008. In this capacity, he has the responsibility to define the smart grid strategy and handle smart grid demonstration projects. Régis is an active member of IEC, CENELEC and CIGRE on smart grid standardization. After 2 years with Alcatel in Australia, Régis Hourdouillie joined the R&D Division of French Utility EDF in 1992. He managed several projects and headed a team working on telecommunications solutions for monitoring and control of transmission and distribution power systems. Régis Hourdouillie was an expert in international bodies UCTE, IEC TC57 and UCA Forum on behalf of EDF. In 2000, after taking his MBA, he joined the strategy consulting firm Booz Allen Hamilton (now Booz and Co). He worked on various strategy assignments in the telecommunications and power industry in Europe. From 2004 to 2006, Régis Hourdouillie worked for an international Medium Size Enterprise as Strategic Marketing Director. Cumulating the function of General Manager for Southern Europe, he also performed the restructuring of the French subsidiary. Régis Hourdouillie joined AREVA T&D in 2006 in order to head the Telecommunications Products activity. Régis HOURDOUILLIE holds an Engineering degree from Ecole Centrale de Lyon (France), a Master of Electrical Engineering from Cornell University (USA), a Master of Telecommunications Engineering from Ecole Nationale des Télécommunications (Paris) and a Master of Business Administration from HEC (France).

- **Andrew D Paice,** Head of R&D Controls, Schindler**.** Dr Andrew Paice completed a BSC(Hons) in Applied Mathematics and PhD in Systems Engineering in Australia. After some time as a PostDoctoral Fellow at the University of Bremen, Germany, he moved in 1997 to the ABB Research Center, Dättwil, Switzerland, as a Scientist. In this position he worked on the modeling, simulation and control of power plants and railway networks. Subsequently he transferred to the Business Unit Power Plant Automation, where he built up a group that developed, sold and delivered high fidelity training simulators for combined cycle power plants. From 2003 he was development department manager and ultimately also responsible for product management. From April 2006 to beginning of this year he was department manager at the ABB research center in Dättwil. Here Dr Paice is active in the area of Smart Grids. He contributed to the definition and negotiation of the EU FP7 project ADDRESS - Active Distribution network with full integration of Demand and distributed energy RESourceS, where he was Workpackage Leader for Communication and a member of the technical and management boards. He is also member of a number of advisory boards in the area of smart grids.

- **Tariq Samad, Corporate Fellow, Honeywell Automation and Control Solutions, US**. Dr Samad has been with Honeywell 24 years and during the last several years he has led or is leading R&D initiatives on energy efficiency, clean power generation, fuel-efficient engines, and smart grids. He is a member of the governing board of the U.S.Smart Grid Interoperability Panel, a member of the steering committee of IEEE Smart Grid, and a representative to the Global Carbon Capture and Storage Institute. He has given several keynote and plenary presentations and invited talks discussing the role of automation and control in mitigating greenhouse gas emissions through energy management. He is the general chair for the 2012 American Control Conference. Dr. Samad is an IEEE Fellow, Past President of IEEE Control Systems Society, and former editor-in-chief of IEEE Control Systems Magazine.

- **Yuanzhang Sun, Dean, School of Electrical Engineering, Wuhan University, China**. He got his Ph.D. degree from Tsinghua University in June, 1988. He is a Specially Appointed Professor of “Chang Jiang Scholars Program” organized by Chinese Ministry of Education. Currently he is the member of “Research on Cutting-Edge Science and Strategic High-Tech issues” of NNSF (National Natural Science Foundation) long-term development of science and technology plan. He is the sinner member of IEEE and CSEE, Editor-in-chief of the two international journals named “Journal of Electromagnetic Analysis and Applications” and “Smart Grid and Renewable Energy”, Assistant Editor-in-chief of the international journal “Control Engineering Practice”, and Distinguished Editor of “Chinese Science Bulletin”. In 2000, he was Expert Member and Project Assistant Chief of Major State Basic Research Development Program (973) “Sudden Change Prevention and Cure and Economic Operation of Large Power System”. He was supported by NNSF for Distinguished Young Scholar in 1999 and Oversea Cooperation Funds for Young Scholar in 2000. He was Expert Member and Assistant Chief Scientist of Major State Basic Research Development Program (973) “Basic Research on Improving Reliability of Large Interconnected Power System” and presided over major program of NNSF of China “Research on Basic Theory and Key Technology of Power System Wide-area Security Defense System” in 2004. He has published over 100 papers and eight monographs in Chinese or English.

- **Maren Kuschke**, **Research Assistant and PhD student**, Sustainable Electric Networks and Sources of Energy (SENSE) Lab, Technische Universität Berlin , Germany. She studied Electrical Engineering with focus on Electrical Drives, Photovoltaics, and Electric Energy Systems at TU Berlin and KTH Stockholm, Sweden. She graduated with the Dipl.-Ing. degree from TU Berlin in 2008. For her outstanding study performance Maren Kuschke received the VDI Award in 2009 and the IEEE PES German Chapter Best Master Thesis Award in 2010. Her research is concerned with tidal energy conversion systems and power grid control. Her work is supported by the Reiner Lemoine foundation. Her supervisor, **Kai Strunz, Technische Universität Berlin, Germany,** is a Professor for sustainable electric networks and sources of energy at Technische Universität Berlin in Germany. Dr. Strunz is vice chairman of the IEEE Power & Energy Society Subcommittee on Distributed Generation and Energy Storage. He is the secretary of the IEEE Power & Energy Society Subcommittee on Research in Education. Prof. Strunz received the Dr.-Eduard-Martin Award from the University of Saarland in 2002, the National Science Foundation (NSF) CAREER Award in 2003, and the Outstanding Teaching Award from the Department of Electrical Engineering of the University of Washington in 2004. He will take part in the panel with.

- **Paul van den Bosch, Professor Control Systems in Electrical Engineering, Eindhoven University of Technology, Netherlands (had to cancel his participation but provided contributions thatw ere discussed at the panel)**. With nearly 40 years of experience in cooperation among industries, research agencies and universities he has explored and implemented many novel control ideas in applications ranging from advanced wafer scanners in the lithographic industry with accuracies of nanometers to large scale connected power systems in Europe. He published over 200 scientific papers, supervised about 50 Phd students and more than 500 Master students and has been project leader of tenths of research projects funded by industry and the EU. Past years he had refocused his interests on the overwhelming complex problems of future power systems, arising from the massive introduction of renewables, market liberalization and increasingly more active consumers. As present control arrangements cannot cope with these challenges, new, distributed incentives-based control approaches have been proposed, which can unleash in real-time the considerable contribution of active consumers and producers in keeping a power balance. These distributed controllers can guarantee, even with only information from their neighbours in the power system, a solution with minimal costs, satisfying all tie-line constraints. These ideas are currently being implemented is several Dutch and European research projects.

2.3. Summary of the panel discussion

1) Differentiation between developed economies and emerging regions with regards to energy and environmental challenges

2) Avenues for research and development in monitoring and control technologies, with application to energy efficiency and smart grids relevant for emerging regions

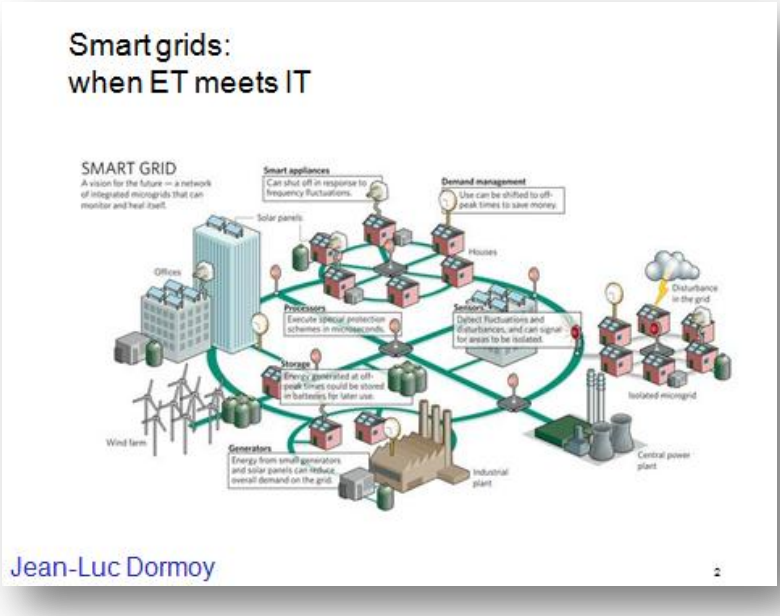
3) Thoughts on how we can improve collaboration and coordination between the control communities in the developed and emerging economies

- **Dr. Tariq SAMAD, member of the EUCLID Expert Group,** opened the panel session, presenting the EUCLID project, with its main tasks and objectives, and the panelists. He invited participants to make their presentations to introduce the panel discussion.

❖ **Dr Jean-Luc Dormoy (EDF Group, France)**

Currently, there are deep changes, following the smart systems development. Information about grids is asymmetric and knowledge on what is concretely happening is limited.
One of the main differences with regards to energy and environmental challenges between the developed and emerging economies today is in the energy needs. Basic needs in energy (as in other aspects) are huge in emerging countries, whereas developed countries see themselves as "developed", and so more in a maintenance scheme. However, the changes in basic energy technology, connected to the massive application of IT to the electrical system, often coined "smart grids", will change things in the same directions in both types of countries. More and more, the downstream side, i.e. the customers, the people, will play a key role in these changes, and in the future management and business models of electricity generation, delivery and consumption. If the economic level on the downstream side is most different between developed and emerging countries, the basic behaviour and requirements for customer involvement are eventually similar. In particular, the explosive development of IT in developed as well as emerging countries – 70% homes connected to the web, vs. 70% cell phone subscribers – provides similar opportunities for this "bottom-up" reconstruction of the energy system. Basically, one needs cognisant people, mastering IT and the basics of energy usage, which is the case on both sides.

Today GRIDs market is more B to B oriented, but an innovative approach should develop the Downstream to Upstream Reconstruction. The Upstream-Downstream Optimization through Demand response should be developed. The new trend should follow the path from the customer to the system. Another new trend could be the in-home intelligence: a huge new world, covering green construction.



[1]There are different avenues for collaboration in diverse areas. Scientists and technologists from both regions like to tackle complex problems. One is mathematical or engineering depth, either theoretical or on the application side. However, the possibility to implement control at a very large scale on billions of

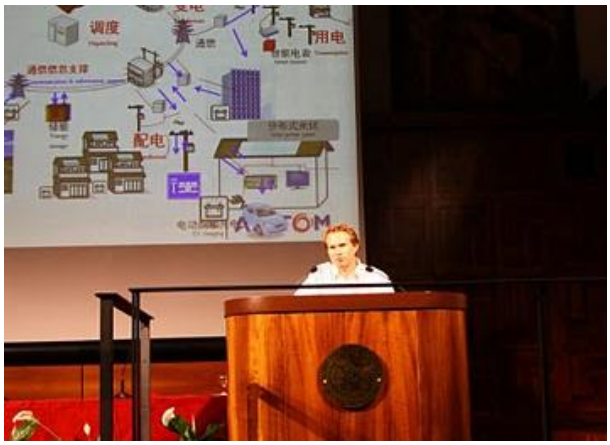
[1]Extract of the presentation of Jean-Luc Dormoy, given during the EUCLID Panel Discussion

devices for billions of people open the door to two new dimensions of complexity: to the versatility of "control" solutions, as there will be no "one-size-fits-all" solution, e.g. in energy efficiency for so many different people; and to the understanding of such a hugely distributed system, first of all in the domain of modelling and simulation. [2]

In this respect, people will have to be put in the design and modelling loop, which control people know how to do when application domain involves a professional environment, such as driving an aircraft or an industrial plant, but which is more difficult when it comes to "ordinary" people. Here, the experience e.g. in the automotive industry with control and embedded system could be very useful. These new technologies can be applied in India: India is a huge country, with a large demand, they know how to manipulate these systems; they want these energy solutions; the market is growing in constant development. They are willing to put on the market better products, which are smarter and less expensive. The future of control is to design for the consumers, taking into consideration the demand.

In order to improve collaboration between the control communities in EU and India some Instruments are absolutely necessary, and these issues have to be solved, using all the experience from both sides on how to deal with them. However, to motivate the decision makers some "semantics" has to be put forward, namely very appealing projects and ideas. What is said above on IT and control (e.g. for energy efficiency, or local generation) can provide the ground for such fascinating projects. It is sure that academic and industry on both sides – Europe and India – already have experience in this. Promoting common projects in this area, in a comparative way, would certainly bring light on yet unforeseen commonalities, and could certainly provide a ground for passion for young scientists and technologists on both sides. Really good projects always find a way to be funded.

- **Dr Regis Hourdouillie (Alstom Grid)**

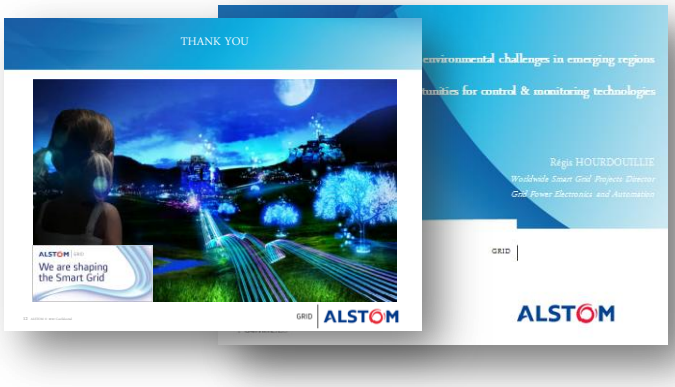


The global key drivers for Smart Grids are CO2 reduction and environmental issues to be addressed. Developments and improvement is needed in the field of C02 free energy and environmental impacts, Energy efficiency and Grid reliability and stability. The short term goals for emerging countries are: a) to increase generation of renewable energy b) to use renewable energy sources c) control and monitoring of grid and distributed resources.

Smart Grid is everywhere in the world. However emerging countries can directly install the new technologies whereas developed countries need investment to replace the ageing infrastructure, already available. There is a difference is the situation

that exists today, in the different regions, which means that there are different challenges and priorities. This changes the vision for smart grids development according to the region.

Short term focus for emerging countries should be given on their high potential. India targets 20GW of renewable energy by 2020; China will spent 10 billion/year US dollars to modernize its grid infrastructure by 2020. The changes needed concern the integration of renewable power, reinforcement of the grid and energy efficiency. The main challenges address the micro grid, provoking interest in Concept of cities etc could be explored and developed.



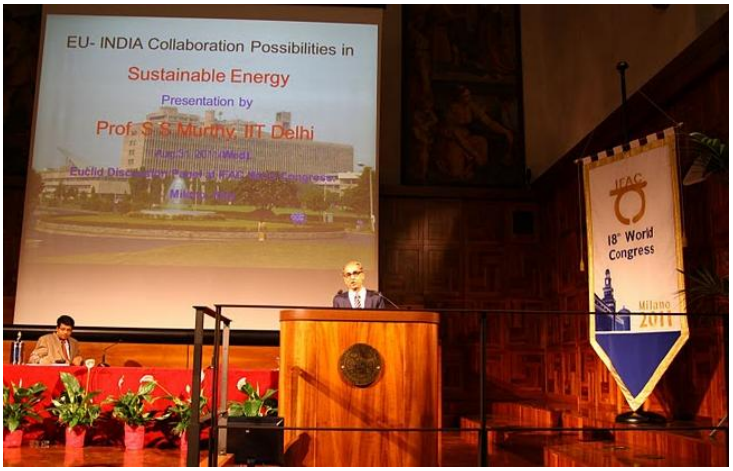
EU and maybe very interesting to be integrated in India, China and other emerging economies. The main advantage is that it is well adapted to both new cities and remote villages as well.

The ALSTOM R&D programs cover the following: a) Control room IT, b) Grid power electronics c) Substation Automation; smart territories such as campus,

❖ **Prof. S. S. Murthy (IIT Delhi, India)**

Similarly to the industrial revolution, there is a need of energy revolution. India is willing to work hand in hand with EU in this revolution. The main question is how to reduce CO2 in all sections. In India the emission per capita/anum is lower than in other big countries, such as USA, China etc and India has different sources of energy. Despite the fact that India has all sources of energy, on the Indian power scene much challenges exist, some villages miss electricity or it is not available all the time despite the multiple plans for electrification. The dispersed population in India, which has a vast population in remote, rural and dispersed pattern, makes that the Grid-off system is preferred in India. Currently, there are Grid Fed and Off Grid: The Grid connected electrical network is mandatory in EU but not fully realized in India. A great opportunity for cooperation could be found in the transport sector where EU experience on public and high speed transport can be a boon to India with proper cooperation for both road and rail transport.

Prof. Murthy recommended R&D cooperation with EU to be strengthened. He highlighted that one of the most important points is to encourage cooperation pilot projects of importance for the society, e.g. demonstrate the use of grids. Prof. Murthy mentioned that exchange of personnel (Student and faculty members) between the universities could enhance the cooperation. Projects should be co-funded by both India and EU. India has a National Energy Fund (NEF) set up with a cess of 0.1% of turnover of all Energy producing Companies. He discussed as well the role of NEF which should commission and Fund R&D and provide R&D funding in support of applications, innovation of new ideas, and fundamental research to researchers in Institutions, Universities and even individuals. In addition, according to Prof. Murthy the bureaucratic hurdles have to be reduced, the policy guidelines should be prepared as they represent an important barrier for the establishment of cooperation. The use of EU-India collaboration through successfully deployed field should be demonstrated.



The Role of science and engineering is to deal with Conventional energy sustainability and renewable energy availability. Therefore R&D areas on sustainable energy relevant to India are listed below broadly aimed at making Conventional Energy Sustainable and Renewable Energy Available: Conventional-Grid fed (Clean Coal Technologies, Carbon Capture-sequestration, Nuclear- Security/safety, France Experience); Renewable - Grid Fed (Wind Energy, Solar) and Renewable-Off Grid (Micro-Grid, Smart Grid Systems, Hybrid energy systems using a combination of sources, Small Hydro, Roof top Wind Mills and Solar systems, Bio gas Engine generator and control, Applications in IT, Communications- Telecom Tower Power supplies).

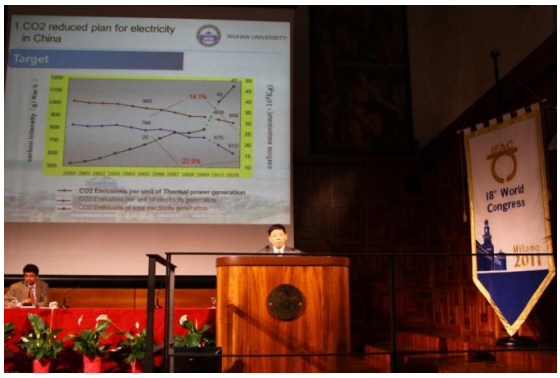
- **Dr Andrew Paice (Schindler, Switzerland)**

Smart grids have been developing for the last years in EU, as EU is adapting to the currently existing situation. Helping to the built environment, building is developing fast; Countries like China are constructing very rapidly. Concerning India there are differences in the environment and the energy fields. The energy systems have a role to play here. The smart grids offer more actions by the increased measurement and information flow they allow. Topics could be classified as generation, grid operations and consumption. Regarding the smart grids and their use in the emerging economies it was mentioned that there are differences in terms of the importance in metering, of the new network concepts at the various levels – HV, MV, LV, site building. In addition, there are differences in the availability of communications, in the integration with existing infrastructures and the possibility and need for change.

Some of the avenues for research are in the field of power smart grids, revolution in installations, and maintenance of the existing installations. Furthermore, the research could address overall decision on grid architecture (Robust decentralised control of microgrids, Integration of intermittent power sources into a weak grid), new technologies & products (Engineering simple, robust systems: Plug'n'power, Low power electronics and remotely monitored systems with intermittent communications). Finally, other paths for research could be the proving of new ICT arch concepts (The Greenfield advance).
In EU this is a challenge that has to be addressed. In this case the avenues for research should be driven by the Demand response. The Demand should be considered for the whole ICT sector.

In order to contribute to improvement of cooperation between India and EU, Andrew Paice suggested the Exchange of people, project collaboration, coaching on the local context & strengths and facilitation in finding synergies / complementarities as possible actions.

- **Prof. Yuanzhang Sun (School of Electrical Engineering, Wuhan University, China)**



Coal is a major source of electricity in China (80%) and consequently the CO2 emissions are huge. The current trend is to reduce the coal energy and developing renewable energy. In this context, the following technologies could find application in China: Developing large capacity generator, energy with wind power, Building smart grid distribution network: improve the reliability of users, efficiency of electricity etc…etc. Monitoring and control technologies could be imported in China. One of the important challenges: custom power technology, a Self healing control and distribution network. Other axes are to build energy saving in generation plants (with super critical and ultra-super critical pressure).The Energy saving in transmission side meets the following challenges: a) need of long distance and large scale transmission by UHV b) reversed distribution between energy resources and load demand.

- **Maren Kuschke, TU Berlin, Germany**

Maren made a presentation on tidal energy systems. Tidal is one of the current resources in EU. EU-OEA EU ocean energy potential is 15% of the EU energy demand. According to MNRE INDIA, more than 8000 MW energy can be developed through tidal and three main regions are identified. Tidal energy conversion systems exploit kinetic energy from sea currents to produce energy. The Limit is that the maximum velocity is reached only during high tide (15 days). In tidal power generation, horizontal axis turbines are mostly used. One of the main advantage of tidal plants is benefit of normal mode of operation - tidal resources can be well predicted as compared to wind which helps in power scheduling. Maren presented the topic in more details.

Additionally, Maren provided answers to the questions discussed at the panel:

1) *What do you see as some of the key points of differentiation between developed economies and emerging regions with regards to energy and environmental challenges?*

Regarding energy and environmental challenges in developed economies and emerging regions, differences are concerned with the following three categories:

(1) Access to energy and water
(2) Policy and legislation
(3) Industry (as a main driver)

The first point is a crucial factor regarding the economic growth in general. There is still shortage of energy supply in some parts of early-emerging regions. In these parts, people still rely on biomass, such as wood and dung, for their most basic needs, such as cooking, heating and lighting. Environmental impacts do arise, firstly due to the clearing of forests and secondly due to the gases that are released when burning wood and waste. In further developed emerging economies, China being an example, the energy demand has dramatically increased during the last years. In order to meet the increased demand, a large number of coal fired power plants has been built. This results in air pollution, which can in turn lead to acid rain. In the so-called developed countries, an area-wide good energy infrastructure as well as a high degree of reliability of supply can be found. Water and air pollution are to a lesser extent an issue compared with green-house gas emissions.

The efficiency of use of primary energy is higher as the degree of development rises. Since a reliable infrastructure is already established in developed economies, priority is given to energy efficiency and reduction of green-house gas emissions. Therefore, in developed regions, the legislation over the past ten years specifically tried to enforce research and installation of renewable energy sources. This is seen as a means to reduce greenhouse gas emissions and strengthen the autonomy from exhaustible primary energy sources. A good example in this respect is the German renewable energy act ('EEG'), which guarantees relatively high feed-in tariffs for energy from renewable sources to encourage an increasing contribution from renewables. As a consequence, investors have been attracted, and renewable energy plant development has been boosted.

Legislation usually addresses the most pressing issues. In emerging economies, first priority is given to improving economic conditions since the industry and economy determine the living standard. To have a growing economy and thus higher living standard, the access to energy is of prime importance. The energy supply must therefore be 'unlimited' and of course as cheap as possible. To keep the industry cost-competitive is therefore most important. While the industry in developed economies is already concerned with efficiency and sustainability, the emerging regions are primarily concerned with growth, while environmental long-term consequences and side-effects of this rapid development often come second.

2) *This session is focused on the role of monitoring and control technologies, with application to energy efficiency and smart grids. Can you highlight one or two promising avenues for research and development in this broad area that are especially relevant for emerging regions?*

A very promising avenue of research relates to microgrids. The power infrastructure needs to be developed, since a significant part of the population in emerging regions still has no access to reliable electric power. This is where microgrids can come in as a solution. Microgrids are small grids that can be connected to the main grid or operate autonomously. If the main grid is weak or there is none nearby, a microgrid can be suitable and provide reliable electric power. Power is mainly produced by renewable

energies. Electricity consumption and generation may be balanced by a small fossil fuel generator or a battery. When installing the microgrid, the individual weather conditions on-site are considered in order to achieve reliable and cost-effective supply.

How to design the microgrid that makes best usage of localized potential? New technologies such as river in-stream turbines may be combined with wind turbines, solar power and biomass. Therefore, an individual control strategy has to be developed ensuring a most efficient operation. How could this control strategy be easily adapted for other locations? Moreover, when it comes to energy efficiency, a smart grid can improve it to certain extend. Smart technologies are especially useful in microgrids since demand side management can play an important and significant role. Enabling demand side management, a higher overall efficiency could be achieved since less fossil fuel for balancing has to be used or the battery can be dimensioned smaller. Reducing investment and operation costs including maintenance and repair is the main driver for a successful operation.

3) *What are your thoughts on how we can improve collaboration and coordination between the control communities in the developed economies and emerging regions?*

The communities should meet and identify a common team that is of mutual interest and would benefit from bringing in competences from both communities. An example for such a team may be “Smart grid in developed and emerging regions”. The communities should then team up with energy engineers, electrical and mechanical engineers with interest in the power and energy sectors to strengthen the breadth of the knowledge. By providing diversity in that both researchers from developed and emerging regions and researchers from cross-cutting disciplines are involved, a good and promising seed of cooperation is established.

Tariq Samad presented the point of view of **Prof. Paul van der Bosch (NL**), who had to cancel his participation in the panel at the last moment, but communicated with the EUCLID team his statements:

1: **Considerable differences between developed and emerging countries are wealth, liberalization and transparency**.

Wealth: If prices for political and social reasons are not allowed to match costs, investments are not possible and the reliability of the power system cannot match the increasing demands. With many people in a surviving mode, any price incentive will fail. Market liberalization cannot easy be implemented as transparency lacks. Government plays and has to play an important role in supplying basic facilities. Environment is initially less important than just surviving. Subsidies can prevent or deteriorates proper developments of markets and the power systems.

Also in The Netherlands, government subsidized photo-voltaic devices at homes. It deteriorated the market, high costs, few results. Now the subsidy is stopped, the market flourishes as the rules are now transparent and can be predicted by all market participants.

When the economy develops, transparency and some liberalization are required to stimulate a proper development of the power system, also allowing satisfying environmental constraints by strict and enforced governmental regulation.

2: **Promising avenues for R&D** are studying the local problems as they arise from (changing) governmental regulation, environmental issues and technical challenges and solutions. Control is always a small, but extremely valuable, capability to master uncertainty in dynamical systems. But not the control technology should dominate the selecting of research but the problem to be solved. In emerging countries other factors are more important: unreliable infrastructure (stimulating smart local grids), changing governmental subsidies and regulation (difficult to anticipate/copy with), lack of incentives for investment and lack of incentives for influencing consumer behavior. So, difficult to predict which topics inside the control area are most needed. But certainly there is no lack of advanced control or advanced mathematics. Countries benefit more from transparent, predictable government regulation which can stimulate required developments. Showing this and convincing government is a major contribution.

3: **The major contribution of control,** either in developed or emerging countries, is NOT solving a control problem, but in formulating for a given situation a clear and well-defined, relevant problem. Control is one, but a very valuable approach as it can cope with uncertainty, for solving these problems. So focus the majority of time on the problem formulation, not on its mathematical solution.
Collaboration and coordination is easiest been done by exchanging ideas and people. The least are publications and conferences. Discussions are about solutions of mathematical problems. Better are visits, co-supervision of students, participation in advisory boards, where the problem formulation is part of the discussions. The best approach is likely to focus on the local problems, search for solutions and formulations that are both relevant and solvable and try to contribute of that topic.

Then the participants took part in the discussion moderated by Dr Tariq Samad. Below are examples of the discussed issues:

- There are considerable differences in the different geographic regions translated in terms of wealth, liberalization and transparency. India with 1.3 b. population is densely populated in most parts with mostly rural centric in contrast to EU with smaller population and population density mostly urban centric. The country has vast population in remote, rural and dispersed pattern, many in hilly regions and forests and vast tribal population. India has low per capita annual energy consumption even less than world average compared to EU needing heavy expansion of installed capacity of power plants mostly through coal based thermal plants causing emission. Per capita emission level of India is also low compared to EU. This impacts on the development of the new technologies and consequently on Smart Grids.
- Smart Grids development is a costly process, which has an unavoidable impact on prices. However, in some countries the standard of living does not allow too high prices, because of the lack of customers. The issue is that the costs of new technologies are high enough and if the prices do not follow costs, investment is not possible, as there will be no return on investment. This is one of the differing patterns between EU and India. In addition, in order to attract investment a liberalized market is needed. However, market liberalization depends on transparency, which is often limited in the emerging countries.

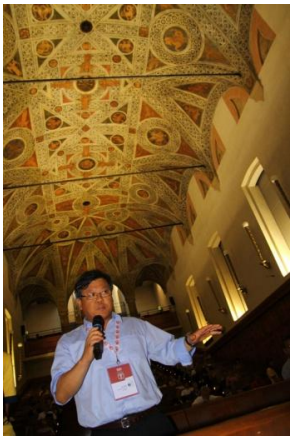
- Governments have and have to play an important role in supplying basic facilities: subsidies can prevent proper developments of markets and of the power systems. In addition government need to plan co-funding with EU for Smart Grid projects in order to stimulate research.
- Energy efficiency research in India can be applied in the following domains:

    - Smart Buildings- Sensor technology
    - Smart meters
    - Energy Management Systems
    - Transport sector-Rail-Road, Hybrid Electric Vehicles
    - Irrigation, Agriculture
    - Process Industries
    - Commercial complexes, IT sector, HVAC systems..

- Collaboration and coordination between the control communities in the developed economies and emerging regions can be improved by exchange of people, working in the field of M&C research. Furthermore, cooperation could be enhanced by launching of pilot projects of relevance to societal problems to be addressed in the specific region. Last, but not least the policy guidelines, concerning the facilitation of international cooperation in the emerging regions, should be improved, with simplified procedures and bureaucratic barriers.

Dr Tariq Samad summarized the promising paths for future development of control technologies and concluded that control have to address and study local problems. He explained that control brings capability and allows the major contribution in formulating a relevant problem. Dr Samad summarized that collaboration in the field of control can be done only by exchanging ideas by people.





Several questions have been discussed. Some examples are below:

1. *Qualified specialists are needed to operate the smart grid solution. The question is to know who will be able to operate these solutions. The social structure in a country/region has to be seen as a whole. Is there any technology spreading the technologies from big cities to other areas?*

- There are systems which are working in India. Water campaign from underground sources technology and this technology is operated and maintained. There is a governmental help to maintain these technologies.

2. *Is there any research area which is always repeated?*

The frequently mentioned areas are the following:

- Smart grid and systems;
- Multi-power generators;
- Electric cars;
- Carbon capture solutions (CCS): there are large plants to develop CCS and the production is boosted for more green technologies.

3. *What is the importance of the Control in nuclear energy?*

After the Japan experience, awareness about the monitoring of the nuclear sector is even more important as people became more conscious of the danger that nuclear plants present. This represents an opportunity for emerging regions. Nuclear energy is very important to provide basis, but it is recommended that research looks for energy mixtures.

Dr Tariq Samad summarized the discussion and highlighted the importance of cooperation between monitoring and control systems communities. The suggestions of the panelists will be used for the development of recommendations for EU-Indian cooperation in monitoring and control.

3. EECI European PhD award on Embedded Systems and Networked Control

At the EUCLID panel, Prof. Sebastian ENGELL, Vice-President of European Embedded Control Institute, announced the winner of the EECI European PhD award on Embedded Systems and Networked Control. The award was given to Ulrich Münz, working on "Delay Robustness in Cooperative Control", under the supervision of Dr F. Allgöwer.