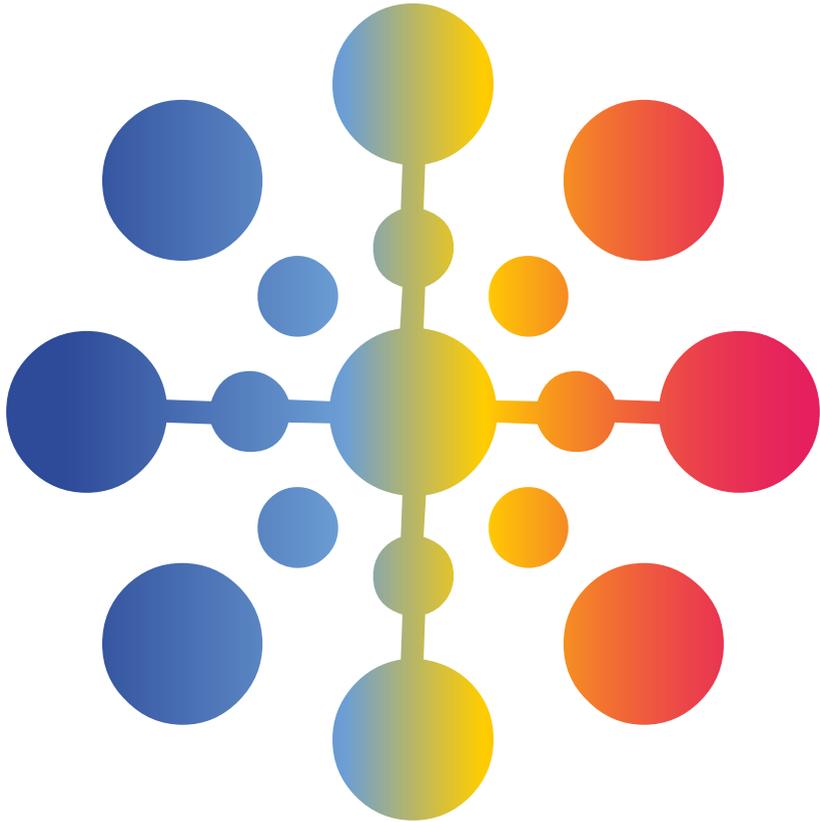


2nd Workshop  
**Energy for  
Sustainable  
Science**  
at Research Infrastructures

CERN, 23-25 October 2013





# 2nd Workshop on Energy for Sustainable Science at Research Infrastructures



CERN, the European Organization for Nuclear Research, ERF, the European Association of National Research Facilities, and ESS, the European Spallation Source organize the second Workshop on Energy for Sustainable Science at Research Infrastructures.

The workshop gathers international experts on energy and representatives from laboratories and future projects worldwide to identify the challenges and best practices in energy efficiency and optimization. Potential technical solutions and tools for effective collaboration will be reviewed.

## Organizing Committees

### **International Organizing Committee**

Mike Ashworth (STFC)  
Frédéric Bordry (CERN)  
Frank Lehner (DESY)  
Carlo Rizzuto (ERF)  
Thomas Parker (ESS)

### **Local Organizing Committee, CERN**

Giovanni Anelli  
Frédéric Bordry (Chairman)  
Helfried Burckhart  
Jean-Paul Burnet  
Fritz Caspers  
Matteo Castoldi  
Enrico Chesta  
Serge Claudet  
Vincent Dore  
François Duval  
Marina Giampietro  
Friedrich Haug  
Tjitske Kehrer  
Philippe Lebrun  
Mauro Nonis

## **\* INTRODUCTION**

**Wednesday 23 October 2013, Main Auditorium, 14:00-15:00**

Prof Rolf-Dieter HEUER, Director-General, CERN

Prof Carlo RIZZUTO, Chair, ERF

Mr Thomas PARKER, Head of Energy Division, ESS

Dr Frédérick BORDRY, Head of Technology Department, CERN

## \* PLENARY SESSIONS

### \* Plenary Session I

**Wednesday 23 October 2013, Main Auditorium, 15:00-18:30**

Chairperson Frédérick BORDRY



15.00 *Main Auditorium*

#### **“Renewable Energy in the present and in the future”**

Mr. Dolf GIELEN (International Renewable Energy Agency)

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Dolf Gielen is the director of the IRENA Innovation and Technology Centre in Bonn since the beginning of 2011. The Centre advises member countries in the area of energy planning, cost and markets and innovation policy frameworks. Prior to his current assignment Mr Gielen worked for the International Energy Agency and the United Nations Industrial Development Organization. Mr Gielen has a PhD from Delft University of Technology in the Netherlands.



15.30 *Main Auditorium*

#### **“EU future strategies and policies”**

Mrs Andreea STRACHINESCU (European Commission, DG Energy)

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Andreea Strachinescu works with the European Commission in the Directorate General for Energy as Head of Unit for new energy technologies, being responsible for the development of the policy and actions on non nuclear energy research and innovation.

Ms. Strachinescu studied mechanical engineering and business administration in Bucharest, Romania and she has a Master of Science in International Economics from H.E.C. Montreal, Canada.

Prior to joining the European Commission, Ms. Strachinescu worked for public administration in Romania and Canada, in the field of economic development and international trade policies and actions.



16.00 Main Auditorium

## **“Energy management in Japan. Consequences for RIs”**

Prof Masakazu YOSHIOKA (KEK)

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Japan is eager to host the ILC, the International Linear Collider Project. One of the issues in realizing such a large accelerator facility in Japan would be assuring a satisfactory supply of electrical power. As is well known, after the Tohoku - Pacific Ocean Earthquake in March 11, 2011, most Japanese nuclear power plants have been off-line. Prior to that, up to 30% of the demand on the electrical grid was supplied by nuclear power. While there is no prospect for resumption of reactor operations, a rapid increase of the generation capacity of fossil fuel plants has allowed Japanese industries and domestic life to survive without major disruption, though it has worsened the trade imbalance. In any case, we must be realistic in preparing an energy management plan for our Research Institutes where large-scale energy consumers are. Already for many years laboratories such as TRISTAN, KEKB and J-PARC have scheduled their operations so that they could contract to draw minimal power during the summer cooling season which causes the peak demand on the system. However, it is still crucial to continue systematic efforts to (1) improve the overall design in order to get better “luminosity/unit power consumption” and to (2) improve the power efficiency of all accelerator components. For a third attack on the problem, energy recovery from the cooling water system should be studied, in spite of its relatively-low energy density. In my talk I will summarize the current Japanese electrical power condition and an energy management plan for the Japanese Research Institutes and finally our efforts in advancing large scale Research Institutes for their spin-off benefits to the whole of Japanese civil society.

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Name: Masakazu Yoshioka

Birth date: June 3, 1946, in Japan

Final academic background

1975: Complete Kyoto

University Graduate School

1978: Doctor of Science, Kyoto University

Professional career

1976–1989 Institute for Nuclear Study,  
University of Tokyo

1989–2012 KEK

2012– Professor emeritus of KEK

2013– Guest professor of Tohoku  
University and Iwate University

Main research history

Coordinator of TRISTAN  
experiment (1989–1994)

Construction management of KEKB  
and J-PARC accelerator (1994–2010)

R&Ds for Linear collider for  
many years

Development of accelerator based BNCT  
(boron neutron capture therapy) (2010–)  
facility



17.00 Main Auditorium

## **“Research, Education and Innovation Bundling Forces towards a Sustainable European Energy Future”**

**Dr Karl-Friedrich ZIEGAHN**

(Karlsruhe Institute of Technology, Chief Science Officer KIC InnoEnergy SE, Chairman of the Supervisory Board)

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New technologies and applied innovation in the field of sustainable energy are needed in order to achieve a competitive and climate neutral Europe. As one of the first three Knowledge and Innovation Communities (KIC) of the European Institute of Innovation and Technology (EIT), KIC InnoEnergy invests in innovation projects and new educational programmes and provides business creation service with the purpose of delivering the disruptive technologies and innovations that Europe requires to meet this ambitious goal. Its stakeholders are top European players in the industry, research institutes, universities and business schools. Six regionally bundled European hubs – Barcelona/Lisbon, Grenoble, Eindhoven, Karlsruhe, Stockholm and Krakow - lead one thematic field each in sustainable energy. The thematic fields addressed range from Intelligent “Energy-efficient Residential Buildings and Cities” over “Energy from Chemical Fuels”, “Renewable Energies”, “Clean Coal Technologies” to “European Smart Electric Grid and Electric storage” as well as “Sustainable Nuclear and Renewable Energy Convergence”. Since the start of KIC InnoEnergy in 2010, a wealth of ventures were nurtured, new technology products and services for the energy value chain were created and participants in the educational programmes were trained to become the game changers in sustainable energy. KIC InnoEnergy has the vision to become the leading engine for innovation and entrepreneurship in sustainable energy in Europe.

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Dr.-Ing. Karl-Friedrich Ziegahn, born in 1952, studied physics at the Technical University of Karlsruhe and received a doctoral degree in mechanical engineering in 1987. Until 2006, he held leading positions at the Fraunhofer Institute for Chemical Technology (ICT) before he was appointed program director for non-nuclear energy and environment research at the Research Center Karlsruhe that merged in 2009 with the University of Karlsruhe to the Karlsruhe Institute of Technology (KIT). KIT is the largest research and education institution in Germany with a total of 9.200 employees and a budget of € 730 Mio. In 2011, he was appointed Chief Science Officer and became a Member of the Executive Board of the KIT. In this function, he is responsible for the departments of Civil Engineering, Geo and Environmental Sciences as well as Architecture, and for Helmholtz Research Programs in energy and environment. He serves as president of the German Society for Environmental Engineering (GUS) and is past president of the Confederation of European Environmental Engineering Societies (CEEES). He was one of the founders of the European KIC InnoEnergy ([www.kic-innoenergy.com](http://www.kic-innoenergy.com)) and serves as chairman of the KIC SE supervisory board, a cutting edge venture of some 30 partners in 6 European regions managing an annual budget of 130 Mio € (2013) under the umbrella of the European Institute for Innovation and Technology (EIT).



17.30 *Main Auditorium*

## **“Sustaining networks: technologies and people towards new paradigms”**

**Prof Fiorenzo GALLI**

(National Museum of Science and Technology Milan)

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The world undergoes constant changes that take place more and more quickly and at a global scale. In Europe, the economic crisis and a new widespread understanding of sustainability pose key questions about development models emerging from industrial revolutions and in the post-industrial era. The subject of energy, and of resources in general, is at the centre of a collective reflection that looks at prospects where sustainability, technology, innovation and participation are interconnected: it is the “Smart System” vision. The “Smart System” vision aims at reconciling the global and local dimension, promoting systemic and relational perspectives. It offers a horizontal integration between systems that were previously unconnected, it involves technological and social aspects, and it finds its main enabling factor in networking technologies - energy grids and communication networks. It is difficult to predict the speed, pervasiveness and revolutionary outcomes of the on-going transition towards new paradigms. Technological innovation plays a key role, not as an end in itself but as the means for a wider cultural transformation. In this scenario, technical and scientific museums are performers, observers and custodians acting through their single institutional work, the synergy of networks such as ECSITE, and the relationships created in contexts such as the STS Forum.

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Born in Milan in 1955, Fiorenzo Galli holds a degree in Political Economics and Finance from the Università degli Studi - Milan. Two sons, officer of the Italian Alpine troops, he has a 20 year entrepreneurial experience in the electromechanic sector with his family business. He is General Director of the National Museum of Science and Technology Leonardo da Vinci since 2001. He is Professor of Museology and Preservation of the Cultural Heritage at Università degli Studi - Milan and he holds other courses and Masters in different Universities. He has held different roles in Confindustria and Assolombarda, and was a member of the Executive Board and of the Presidential Committee and President of the lobby “Giovani Industriali” (Young Industrialists), nowadays is member of the Committee and of the Board of the “Probiviri” of Assolombarda. He is member of the Scientific Committee for the Diffusion of Scientific Culture of the Ministry of University and Research. He is member of the Kuratorium of the Deutsches Museum in Munich and of many other Scientific Committees. He has been awarded with large merits and rewards in cultural field.



18.00 *Main Auditorium*

## **“Design and efficiency of Data Centres”**

**Mr Liam NEWCOMBE** (CTO Romonet Ltd)

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Liam will provide an overview of the current state of data center technology including practical guidance on how best to operate what you already have and how differently you should build new capacity based on recent changes in technology and knowledge. The way data centers are built and operated has changed fundamentally in the last 5 years which has resulted in substantial changes to the construction and operational costs for those able to take advantage of these changes. This is particularly true for high performance compute type facilities where many of the expensive traditional elements may be discarded by the well-informed operator. The presentation will discuss key changes in data center technology and practices such as IT environmental controls and answer the question, do you need to go to Iceland to get rid of mechanical cooling? The discussion will include practical measures for operators to implement as well as identifying the relevant standards and free guidance such as the EU Code of Conduct for Data Centers Energy Efficiency.

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Liam is a co-founder of Romonet Ltd and is recognised as a thought leader in the data center arena. Liam readily challenges convention to stimulate debate and collaboration to drive innovation. Liam has been a leading industry contributor to the European Commission’s European Code of Conduct for Data Centers (launched 19th Nov 2008), and used to chair the Best Practice Working Group.

In 2011 Liam won the prestigious DatacenterDynamics ‘Outstanding Contribution to the Industry’ Award, the first non-American to do so.

## PARALLEL SESSIONS

**Thursday 24 October 2013**

### **Energy Management at Research Infrastructures A1** *Main Auditorium – 09:00 - 10:30*

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#### **Energy management at KEK, strategy on energy management, efficiency, sustainability**

Speaker: Dr. Atsuto Suzuki (KEK)

Under inflating project- and budget-sizes in accelerator science programs, it is indispensable to save, utilize and eventually manage energies in total throughout a project. Given this backdrop, my presentation is comprised of (1) Current Activities on Energy Management at KEK, (2) A Possible Trial for Saving Energy in Accelerator Component, and (3) A Possible Idea to Save and Utilize Energy in the ILC.

#### **Energy management at Fermilab, strategy on energy management, efficiency, sustainability**

Speaker: Mr Stephen Krstulovich (FNAL)

Since the transfer of most research at the “Energy Frontier” to CERN, Fermilab has shifted to the Intensity and Cosmic Frontiers with new projects in the coming decades that depend on much higher beam intensities. So Fermilab is once again pioneering the development of new technologies, like high Q Superconducting RF cavities, higher efficiency RF sources, and more efficient Energy Recovery Linacs to help offset the growth of power needs. Operational strategies to compliment this include facility consolidations, environmental management, alternative financing, and a portfolio approach to sustainably to support these new initiatives.

### **Energy Efficiency Examples B1** *Council Chamber – 09:00 - 10:30*

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#### **Boosting accelerator electrical efficiency at the ESRF**

Speaker: Mr. Jean-François Bouteille (ESRF)

The ESRF produces very intense Hard Xray beams for the scientific community and is preparing the renewal of equipment inside the storage ring. This has motivated us to carry out a careful analysis of the energy efficiency over the life time of this large instrument. Taking into account the initial design of 1986 when electrical energy was cheap, uncertain future conditions are the key elements in the changes to technology needed for the preparation of this upgrade. Some examples of the consequences on the global cost calculation over the lifetime estimated of the future storage ring will be presented.

#### **Valorization of low-grade waste heat**

Speaker: Prof Felix Ziegler (TU Berlin)

Low-grade heat is available everywhere and sometimes in large quantities; consequently, the valorization of this heat seems to be attractive in terms of economics.

We will discuss the issue first from a theoretical point of view; then some examples will be given, namely using waste heat from engines for intake air cooling, the Honigmann process for storing and conversion of low-grade heat, and recent developments of absorption chillers.

## **Energy Management at Research Infrastructures A1**

**Main Auditorium** – 09:00 - 10:30

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### **Energy management at BNL, strategy on energy management, efficiency, sustainability**

Speaker: Dr Edward Murphy (BNL)

Brookhaven National Laboratory (BNL), located on Long Island, New York, USA, has maintained robust energy management and sustainability programs since the first energy crisis in the early 1970's. Our presentation will overview BNL's science mission; physical plant infrastructure; energy and carbon footprints; and past energy and sustainability accomplishments. We will also highlight some notable features of BNL's sustainability program including the 32MW Long Island Solar Farm at BNL; use of renewable hydroelectric power; chilled water thermal storage; LEED-certified research facilities and investment strategies. Finally, we will touch on BNL's Site Sustainability Plan, including our goals and future vision.

### **Energy management at DESY: strategy on energy management, efficiency, sustainability**

Speaker: Prof Helmut Dosch (DESY)

DESY is an internationally renowned centre for the investigation of the structure and function of matter and builds, operates and scientifically exploits brilliant X-ray sources for photon science and detectors and observatories for particle/astroparticle physics. Volatile energy costs, tight operation budgets and increasing environmental concerns require sustainable solutions for instance for energy savings at research facilities and on campus. The current status of the DESY sustainability concept, first implementations and future goals are presented.

## **Energy Efficiency Examples B1 Council Chamber** – 09:00 - 10:30

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### **From eV to TeV: the Green ILC**

Speaker: Denis Perret-Gallix  
(Centre National de la Recherche Scientifique (FR))

Large particle accelerator/collider facilities are probably the most power hungry fundamental research undertakings. It may prove to be a roadblock in the progress of this research at least in the public view. On the other hand, they can be used as a life-size workbench to develop new energy saving and generation technologies and to improve the reliability, maintainability and flexibility of sustainable energies sources. The ILC project proposed to be hosted in Japan provide a major opportunity to embed a Center for Energy Research involving from design to operation the contribution of a wide variety of energy scientists. From eV to TeV the green ILC could be seen as an energy transformer. We will overview some of the collider equipment which could be partially or fully powered by alternative energy sources and what would imply to engage in this endeavour.

### **Use of electricity at high-field magnet laboratories**

Speaker: Prof Geert Rikken (LNCMI)

## **Energy Management at Research Infrastructures A2**

***Main Auditorium*** – 11:00 - 12:30

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### **Energy management at CERN, strategy on energy management, efficiency, sustainability strategy**

Speaker: Dr. Helfried Burckhart (CERN)

The European Laboratory for High Energy Physics CERN in Geneva, Switzerland, is a major consumer of energy with almost 90% of the electric energy being used for the operation of the accelerators. Efforts are being made to further increase the energy efficiency and to reduce the consumption. Practical work concentrates on 3 areas: the CERN campus, the accelerator chain, and re-use of waste heat. A coherent energy concept is implemented for major renovations and when constructing new buildings. Equipment and cycles of the accelerators are dynamically switched on/off according to needs. Most of the electric energy is finally disposed in cooling towers as low grade waste heat, which can possibly be re-used for heating buildings.

## **Energy Efficiency at Research Infrastructures B2**

***Council Chamber*** – 11:00 - 12:30

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### **Energy efficiency of particle accelerators – a network in the European program EUCARD-2**

Speaker: Dr. Mike Seidel (PSI)

Eucard-2 (Enhanced European Coordination for Accelerator Research and Development) is an on-going project for integrating research and development activities in the context of particle accelerators. EnEfficient (Energy Efficiency of Particle Accelerators) is one of six networking activities within the Eucard-2 program. Networks will primarily organize workshops and bring together the activities of research institutions and universities in specific areas.

The ever growing requirements for beam energy and intensity typically resulted in increased power consumption of accelerator facilities. On the other hand resources become scarce and the cost of energy is rising. The focus of EnEfficient is the efficient and cost effective utilization of electrical power in particle accelerators. Within the work package five tasks were defined that deal either with subsystems of accelerators or with general aspects related to power consumption. After motivating the relevance of EnEfficient, the talk will describe the individual tasks and plans for the next years. Additional participants are sought and are welcome in this activity.

## **Energy Management at Research Infrastructures A2**

**Main Auditorium** – 11:00 - 12:30

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### **Energy management at ESS, strategy on energy management, efficiency, sustainability strategy**

Speaker: Mr. Thomas Parker  
(European Spallation Source ESS AB)

ESS will be a long-pulse neutron source powered by a 5MW accelerator. Full operation starts in 2025, first neutrons in 2019.

Site decision was made in May 2009, three contenders, “Scandinavia” spiced their winning bid with a “sustainable research facility” applying an energy strategy of “Responsible, Renewable, Recyclable”. This is now a written commitment from the host government that the facility will be energy efficient, use only renewable power, and recycled its surplus heat. Full delivery on the energy strategy is viewed as a top-level requirement at ESS.

The energy strategy is built on local opportunities, and caters to local expectations. It is therefore not universally applicable, but, together with other progress in the field, contributes to setting a threshold for future facilities.

## **Energy Efficiency at Research Infrastructures B2**

**Council Chamber** – 11:00 - 12:30

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### **Cryogenic waste heat utilization for DESY and European XFEL**

Speaker: Mr. Jens-Peter Jensen (DESY)

High energy research facilities like DESY and European XFEL have considerable power consumption. 85 % of the power consumption is electricity and 15 % heating. Electricity is used for the accelerator subsystems like rf power, cryogenic plant, magnets and cold water production. They produce waste heat which is often blown into the atmosphere without using it for heating and air conditioning. The rising energy costs and the energy turnaround make it necessary to look after the whole energy budget. The often asked question is how to reuse the waste heat from accelerators and feed it into a heating system.

Since 20 years DESY reuses a part of the waste heat from the HERA cryogenic plant. The waste heat from the oil cooler is feed into the DESY heating network. 2 of 3 helium liquefaction lines will supply the XFEL injector and the linac tunnel. Over a long time data have been collected from the cryogenics group MKS and the energy supply group MKK. For this investigation of feeding the heat into the DESY heating network a simulation in Matlab/Simulink is developed. The results show that there is a good potential for using waste heat of a cryogenic plant for heat utilization.

## **Energy Management at Research Infrastructures A2**

**Main Auditorium** – 11:00 - 12:30

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### **Heat Recycling at PSI, a project to cover up to 75% of the campus's heat consumption**

Speaker: Mr. David Reinhard (PSI)

PSI has started a project recycling heat out of existing and future cooling circuits. The recycled heat will cover 75% of the PSI need by 2017. The heat will be to the greatest extent recycled directly from radio frequency cooling loops of relatively high temperature. Since the yearly power consumption of the institute is a factor 10 higher than the heat consumption, a further increase of the heat recycling would be possible but - depending on the current and unknown future boundary conditions - not necessarily sustainable. A relevant boundary condition for the economy of the project is the existence of a district heating cycle. But it is designed for 120°C, far higher than the temperature of the heat sources. Decreasing the operating temperature is the most cost intensive measure to achieve compatibility between heat source and consumers. However, the leverage of heat recycling is much higher than the most common method of reducing the heat consumption by passive insulation of buildings. At PSI, these buildings have a wide range of conditions and characteristics.

The SwissFEL research facility, which is currently being built, will be of high efficiency through its basic design. Important elements of an efficient infrastructure, in addition to high temperature heat recycling out of RF, will be a cooling system based on optimized use of ground water, an efficient ventilation design and the application of A-class infrastructure components.

## **Energy Efficiency at Research Infrastructures B2**

**Council Chamber** – 11:00 - 12:30

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### **Development of high-power IOTs as an efficient alternative to klystrons**

Speaker: Dr. Morten Jensen (ESS)

The European Spallation Source ESS is a 2 GeV, 5 MW proton accelerator being designed with the start of construction planned for 2014 in Lund, Sweden.

ESS is to provide a sustainable large-scale research facility. As such, ESS is focusing on reducing energy consumption by the use of high efficiency devices and by recovering waste heat. The largest section of the ESS linac, the high beta section requires 88 RF sources with a pulsed power requirement of around 1.1 MW plus a power overhead for cavity field regulation. Traditionally, at the ESS frequency of 704 MHz, the typical choice would be to use large klystrons. However the use of IOTs will deliver certain advantages to the operation of ESS including higher efficiency at the operating point, cheaper modulators and a more compact design and layout. This talk will describe a proposed multi-beam 1.2 MW IOT development to be sponsored and supported by ESS in collaboration with CERN.

## **Energy Management at Research Infrastructures A2**

**Main Auditorium** – 11:00 - 12:30

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### **Energy management at GSI and FAIR, strategy on energy management, efficiency, sustainability strategy**

Speaker: Mr. Jan Lindenberg (GSI)

GSI Helmholtzzentrum für Schwerionenforschung GmbH operates a unique large-scale accelerator for heavy ions. In the coming years the new international accelerator facility FAIR, one of the largest research projects worldwide, will be built at GSI. In the final extension FAIR consists of several heavy ion accelerator rings, experiment storage rings with up to 1,100 meters in circumference, two linear accelerators and about 3.5 kilometers high energy beam transfer lines as well as several experiment caves.

In the context of rising energy prices and the responsible use of resources, GSI has taken the task to develop concepts for efficient use of energy. Actual work includes the introduction of a broad collection and analysis of energy consumption data and the development of the high efficient data center “Green IT Cube” and technologies such as load based cooling of accelerator components.

The final intention of this work is to provide a modern and efficient research facility at reasonable energy costs and sustainable use of energy.

## **Energy Efficiency at Research Infrastructures B2**

**Council Chamber** – 11:00 - 12:30

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### **Energy reduction: example of a test facility upgrade with pulsed magnets instead of DC magnets, saving 90% of energy consumption**

Speaker: Mr. Jean-Paul Burnet (CERN)

CERN has many experimental areas connected to three synchrotrons PSB, PS and SPS. A supercycle is managing all users and each facility receives beams when its cycle is played. For example, the PS East area is the destination of the beam for 7 cycles over 42 of the supercycle. This facility is powered in DC. If we compare the time of the beam presence in the area to the powering time of the magnet, the ratio is less than 5%. By powering this facility in pulsed operation, the energy consumption could be reduced by 95%. The talk will present the project of upgrading the EAST area to pulsed operation and how this upgrade could be financed by energy saving.

## **Energy Efficiency in Computing Centres A3**

**Main Auditorium** – 14:00 - 15:30

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### **A Comprehensive Approach to Energy Efficiency in Data Centers for High-Performance Computing**

Speaker: Prof. Thomas C. Schultness(CSCS)

High-performance computing (HPC) data centers are here to deliver simulation capabilities as tools for scientific discovery. Supercomputers comprise the most capital-intensive part of this infrastructure and are thus receiving most of the attention. However, with power consumption of these systems jumping from the typical hundred kilowatts a decade ago to several megawatts in recent years, and with projected future increases to tens of megawatts, the energy cost of HPC data centers has become a major concern for the scientific community. In this presentation I will give an overview of how we have been containing growth of energy costs within the Swiss initiative for HPC and Networking (HPCN). The initiative began in 2009 with a three-pronged strategy: (1) develop a new data center for CSCS in Lugano with particularly innovative cooling technology; (2) buildup of new supercomputing systems that employ novel and efficient architectures; and (3) invest in a Swiss network of competence in algorithm and application software development. Four years into this initiative, we have promising results in all three areas that I will summarize in a quantitative report from a energy efficiency point of view.

## **Sustainable Campus Development and Management B3 Council Chamber** – 14:00 - 15:30

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### **Sustainability on Campus: Overview, Implementation and Outlook**

Speaker: Dr. Oliver Opel (Leuphana University)

Sustainability implementation affects all parts of an institution. Research institutes typically have high energy demands and traffic / mobility emissions, but buildings, paper, office supply, waste, the canteen and other segments are also of great importance. Energy savings and reduction of mobility emissions surely are key factors and need custom-tailored solutions. However, sustainability means more than reducing direct emissions. To reach all parts of an institution, high level decisions are needed to cover all parts of the institution, and a management and reporting scheme, best case with external auditing, is necessary to ensure long-term progress and sustained efforts to reach sustainability goals. Last but not least dedicated staff is needed to introduce sustainability guidelines and support.

## **Energy Efficiency in Computing Centres A3**

**Main Auditorium** – 14:00 - 15:30

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### **Exploiting mobile phone technology to build energy efficient supercomputers: the Mont Blanc project**

Speaker: Dr. Simon McIntosh-Smith  
(University of Bristol)

Energy efficiency is becoming the limiting factor in large-scale high performance computing systems. Today's fastest machines already use megawatts of power and cost millions of dollars a year to run. By the end of this decade, the fastest machines are predicted to require over 20 megawatts of power, making them considerably more expensive to run than today's machines, and limiting the number of sites that can support such installations. To address this issue, the Mont Blanc project is investigating whether technologies being driven by the mobile markets may help address the energy efficiency crisis in HPC. This talk will describe the prototype machines which have been built using mobile processors, and present the results so far.

## **Sustainable Campus Development and Management B3**

**Council Chamber** – 14:00 - 15:30

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### **The Green Campus project at University of Copenhagen**

Speaker: Mr. Tomas Refslund Poulsen  
(University Copenhagen)

University of Copenhagen has via the Green Campus project invested considerable money and efforts in reducing CO<sub>2</sub>-emissions and energyconsumption. The project has been characterized by strong management support, short term ambitious targets, focused approach, willingness to invest and considerable communication activities.

By 2012 UCPH had reduced CO<sub>2</sub>-emissions by 24.1 % pr. staff/student and energy consumption by 18.3 % per staff/student compared to 2006 levels. The reductions has been achieved particularly via considerable investments in energy efficiency, improved energy management and change to more energy efficient behaviour via the Green Action campaign.

The Green Action campaign combines top down communication and awareness building, simple advice on key energy issues to address and 250 green ambassadors among the staff taking local action. The campaign has saved approx. 4 % of the energy consumption equalling annual savings of € 1 million annually. Repeated campaigns and ongoing efforts to engage green ambassadors have established consistent energy efficient behaviour among university staff.

Read more:  
[http://climate.ku.dk/green\\_campus/](http://climate.ku.dk/green_campus/)

## **Energy Efficiency in Computing Centres A3**

**Main Auditorium** – 14:00 - 15:30

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### **Roadmap towards Ultimately-Efficient Datacenters**

Speaker: Dr. Bruno Michel (IBM)

Chip microscale liquid-cooling reduces thermal resistance and improves datacenter efficiency with higher coolant temperatures by eliminating chillers and allowing thermal energy re-use in cold climates. This concept has been successfully demonstrated three years ago in a one rack prototype and scaled up to a 10'000 server system. Liquid cooling enables an unprecedented density in future computers to a level similar to a human brain. This is mediated by a dense 3D architecture for interconnects, fluid cooling, and power delivery of energetic chemical compounds transported in the same fluid. Vertical integration improves memory proximity and electrochemical power delivery creating valuable space for communication. This strongly improves large system efficiency thereby allowing computers to grow beyond exa-scale.

### **Energy Savings in CERN main Data Centre**

Speaker: Mr. Wayne Salter (CERN)

Over the past few years, CERN has been working to improve the efficiency of its main Data Centre that was built in the early 70s. Most of the equipment hosted in the Centre relies on an air-cooling infrastructure that was designed and installed many years ago. By applying small changes to the existing, and ageing, cooling infrastructure, CERN has significantly improved the energy efficiency of the Data Centre. This has permitted to cool more equipment with the existing infrastructure and to make important energy savings. This presentation reports on the most important steps taken to improve the cooling efficiency in the Data Centre and on the corresponding achieved savings.

## **Sustainable Campus Development and Management B3**

**Council Chamber** – 14:00 - 15:30

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### **Experience in Implementing and installing co-generation and energy-saving schemes**

Speaker: Dr. Piterà (Studio Vio)

### **CERN campus: mapping of the building versus energy consumption and an example of design and construction of a green building**

Speaker: Dr. Luigi Scibile (CERN)

The CERN campus differentiates those facilities linked to the life at CERN with respect to those areas linked to the accelerators and experiments. In this context, the CERN campus comprises work facilities (offices, labs, workshops, etc.), social facilities (restaurants, hostels, banking services, post office, clubs and a kinder garden) and visitor facilities. To address the issues related to the reduction of energy consumption, the application of the applicable norms and an eventual re-use of waste process energy, a model describing the estimated energy consumption of the building stock in the Meyrin site has been setup. This model has been used to analyze the current situation, it is now used as a support for the CERN consolidation and it will be used for future urban developments. An example showing the energy concepts of a building under construction at CERN is presented.

## **Energy Quality and Operation A4** *Main Auditorium* – 16:00 - 17:30

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### **High temperature cooling of cryoplant and klystrons**

Speaker: Mr. John Jurns (ESS)

The European Spallation Source (ESS) neutron spallation project has committed to an energy management strategy that minimizes cost, lowers environmental impact, and factors out variability in energy. The ESS energy management strategy is based on four pillars: Responsible, Renewable, Recyclable, and Reliable. Recycling waste heat from the facility plays a major role in meeting the ESS energy management strategy. We discuss the overall waste heat recovery strategy, cryoplant and klystron waste heat contributions, risks and challenges, and plans to optimize recovery of heat from these systems.

### **Three years of operation of the Elettra tri-generation plant**

Speaker: Dr. Roberto Visintini  
(Elettra - Sincrotrone Trieste)

The first tri-generation plant (TGP1) has started its operations in June 2010 on the FEL light source, FERMI.

In 2011 the critical loads of the storage ring, Elettra, have been connected to TGP1, prior the start of the next phase of the new on-site co-generation project at the Elettra Research Center.

The immediate beneficial effects of the increased availability of power from UPS on the operation of the Elettra light source are presented, using, in particular, the super conducting 3rd harmonic cavity (SC-3HC) as case study.

## **Green Technologies developed at Research Infrastructures B4** *Council Chamber* – 16:00 - 17:30

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### **Superconducting Links for the LHC machine**

Speaker: Dr. Amalia Balarino (CERN)

In the framework of the upgrade of the LHC machine, new Superconducting Links are being developed for the feeding of the LHC superconducting magnets. The electrical lines, which are made from High Temperature Superconductors, contain tens of cables feeding different electrical circuits and transfer all together DC currents of more than 150 kA. The required length of the cables and the current ratings would make electrical transmission via conventional cables unaffordable.

An overview of the R&D activity that is being performed CERN is presented, with a special attention to the advantages that the use of Superconducting Links brings to accelerator technology. The results of the tests performed on prototype links are discussed. Plans for future activities are presented, together with a timeline for a potential future integration in the LHC machine.

### **ORC process for reducing power consumption at the energy recovering electron cooler system for FAIR**

Speaker: Dr. Kurt Aulenbacher  
(Johannes Gutenberg-University Mainz)

In collaboration with Forschungszentrum Jülich (FZJ) the Helmholtzinstitut Mainz (HIM) pursues the design of an 8MV electron cooler. In the present concept, about 1 MW of electrical power would be needed to drive the compressor system for turbogenerators which use the insulating gas (sulphur hexafluoride, SF<sub>6</sub>) as medium. We propose to generate the necessary flow of pressurized SF<sub>6</sub> by an ORC process in order to reduce the power consumption considerably.

## **Energy Quality and Operation A4**

**Main Auditorium** – 16:00 - 17:30

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### **SMES usage and power grid applications at RIs**

Speaker: Mr. Hans-Joerg Eckholdt (DESY)

The on-going increase of regenerative energies with the strong meteorological fluctuation, leads to high strain for the stability of the 50 Hz grid frequency. To keep the 50 Hz stable the transmission system operators use the primary control for fast acting. This primary control has to be active for the first 15 min till other regulations take over. Short-time energy storages can be used for this purpose. Although only a comparably small amount of energy can be stored, they are able to provide high power for this period of time. They can be charged and discharged rapidly and have a high degree of efficiency. Superconducting magnet energy storages (SMES) belong to this group of short-time storages and a frequency stabilisation is possible. Due to the high investment, this technology is not used nowadays. However, in the long term operation no further wear and tear occurs, which keeps the maintenance costs low. Particle accelerator sites have already a large amount of assets that may reduce the cost for the operation of a SMES. These are on one side soft skills like the knowledge of the operation of superconducting magnets structures with the corresponding protection, the power electronics, regulation and control technology. Additionally, there is hardware available such as powerful high voltage connections to the mains, reactive power compensation, cryo plant, etc. At DESY a study was done to check the use of a SMES for the primary control. For dimensioning a potential SMES, parameters of existing plants were taken as e.g. LHC or ITER. The technical functionality with power supply, regulation and protection was simulated. Additionally, the regulation behaviour with real frequency data of the mains of 2012 was investigated. Finally, the German reserve market was analysed to check a possible amortization of such a plant.

## **Green Technologies developed**

**at Research Infrastructures B4**

**Council Chamber** – 16:00 - 17:30

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### **Development of new high slew-put and high energy-efficient power supplies for J-Parc upgrade**

Speaker: Dr. Yoshinori Kurimoto (J-PARC)

In J-PARC Main Ring (MR), the upgrade toward megawatt beam intensity is scheduled. To achieve megawatt beam, we need to increase the repetition rate of the accelerator from 0.42 Hz to 1 Hz. In this case, the total power variation in main grid is up to 100 MVA. This is because the magnets in MR should be driven much faster in 1 Hz operation. However, such power variation is not allowed by the electricity company. Therefore, we are planning to replace the current power supply of the magnets in MR for the new one with large capacitor energy storage. The capacitors used for such application must survive after 108 cycles of charging and discharging, which corresponds to 10 years operation. We have developed the capacitors whose lifetimes are longer than 10 years with a manufacturer. In this talk, we will present about not only the capacitors but also the power supply under development.

## **Energy Quality and Operation A4**

**Main Auditorium** – 16:00 - 17:30

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### **Advanced Simulation tools in support of the design of the Power System architecture of the European Spallation Source (ESS)**

Speaker: Prof. Antonello Monti (RWTH Aachen)

Advanced laboratories such as ESS are a challenging infrastructure from the energy perspective both for the internal energy management and for the impact on the overall energy grid.

In a project developed in collaboration between ESS, Lunds Energi, E.ON and RWTH a complete model of the ESS Lab and of the surrounding energy grids has been developed in order to have realistic predictions on the static and dynamic characteristics of this future laboratory. Models are used both to internally optimize energy consumption and to study the interaction with the Distribution and Transmission Grid. The models have been implemented in a very advanced simulation infrastructure available in RWTH Aachen able to support the execution also in real time without compromising on the accuracy of the modeling itself. In particular, given that we are dealing with a system that will be inserted in the grid in a few years from now, different studies have been performed to incorporate the elements of uncertainty given by the lack of knowledge about how the electrical network will look in the future.

The presentation will illustrate the main concepts adopted during the modeling process and some of the most interesting results obtained in the analysis phase.

## **Green Technologies developed at Research Infrastructures B4**

**Council Chamber** – 16:00 - 17:30

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### **The High Efficiency SRB Solar Thermal Collector: A by-product of the CERN Accelerator Technologies**

Speaker: Prof. Cristoforo Benvenuti (SRB Energy)

Vacuum is the best thermal insulator made available by Nature. Thanks to the reduced thermal losses provided by vacuum, the SRB solar thermal collector may reach temperatures up to 400°C without the help of light focussing mirrors. This is a very important feature for Central Europe, where diffuse light, which cannot be focused, may exceed 50% of the available solar power.

The vacuum inside the collector is maintained by a Getter pump powered by sun. Getter pumping, in the form of a getter ribbon subtended along 23 km of the machine, was adopted for the first time for the Large Electron Positron collider (LEP) at CERN. Later a Getter film, coating the internal walls of the room temperature vacuum chambers, was developed and adopted for the CERN Large Hadron Collider (LHC).

The thin film getter coating technology was also adopted for the SRB collector, which is now produced industrially in Spain, close to Valencia. The collector is particularly suited to produce process heat for Industry at temperature from 80°C to 250°C in Central Europe, but also for district heating, cooling, air conditioning and water desalination. Recently a roof of the Geneva Airport has been equipped with about 300 collectors (total solar field surface area about 1200 m<sup>2</sup>) for heating during winter and air conditioning during summer.

## ❁ Plenary Session 2

**Friday 25 Oct 2013 Main Auditorium, 09:00 – 10:00**

**Chairperson:** Prof. Carlo RIZZUTO



9.00 Main Auditorium

### **“Sustainability and Energy Efficiency in the Automotive Sector”**

**Prof Dr Georg Stephan BARFUß**

(Technische Hochschule Ingolstadt)

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Since this year there can be no doubt that “sustainability” has become the top issue in the automotive sector. Volkswagen’s CEO Prof. Dr. Martin Winterkorn attacked incumbents like BMW Group (so far the “most sustainable car manufacturer” for the 8th consecutive year) or Toyota (producer of the famous “Prius”) head-on by boldly stating to become “the most profitable and most sustainable car manufacturer worldwide by 2018” . This announcement clearly shows that “sustainability” and “profitability” no longer are considered as conflicting targets. On the contrary, to Prof. Dr. Winterkorn : “climate protection is a driver for economic growth”. To prime discussions, the plenary talk will give a brief overview of the entire range of energy efficiency in the automotive sector: based on the multiple drivers behind energy efficiency, practical examples are presented along the entire life-cycle of cars (R&D, production, usage and recycling). These “cases” include big automobile producers as well as their respective suppliers.

Common to all efforts is the strategic tirade “prevent”, “reduce” and “compensate” of energy usage and its CO2 emissions respectively.

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Professor at the Technische Hochschule Ingolstadt & Sustainability

Manager at the Dräxlmaier Group (automotive industry)

2000 – 2009 finance/controlling positions in the (automotive)

industry (a.o. FIAT Group, Bosch Siemens Hausgeräte B/S/H)

2009 – 2013 MBA Sustainability Management at Leuphana University

2004 – 2007 Dr. rer. nat. at the University of Augsburg

1995 – 1999 International Economics Studies at Maastricht University

Interests and fields of study:

Corporate Social Responsibility

Sustainability Management

Responsible and Sustainable Leadership

Internationales Controlling

Green Controlling/Sustainability Controlling

Sustainable Economics: measuring our welfare beyond the gross domestic product



9.30 Main Auditorium

## **“Use of cooling-temperature heat for sustainable food production”**

Prof Anders KIESSLING (Swedish University of Agricultural Sciences)

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Food production and energy are undoubtedly interlinked. However, at present food production depends almost exclusively on direct use of stored energy sources, may they be nuclear-, petroleum- or bio-based. Furthermore, non-storage based “renewable” energy systems, like wind and solar, need development before being able to contribute at a significant level. This presentation will point towards surplus heat as a way to bridge the gap between today’s food systems and truly sustainable ones, suitable to be performed in urban and peri-urban areas. Considering that arable land and fresh water resources are the base for our present food systems, but are limited, in combination with continued urbanisation, such solutions are urgently needed. By combining the use of surplus energy with harvest of society’s organic side flows, like e.g. food waste and aquatic based cash crops, truly sustainable and urban close food systems are possible at a level of significance also for global food security. In order to bring this work forward a site and scale specific optimisation model is needed and will be discussed at the presentation. ESS with its expertise in physics and system analysis and located in the middle of Scandinavia’s most expansive urbanisation and its most productive bread basket area is a most interesting place to also host a centre of expertise in the interconnection between surplus energy and nutrient recycling. A centre with the ultimate aim to produce knowledge allowing implementation of healthy and environmentally friendly food systems not dependent on large areas of arable land and huge quantities of fresh water, suitable also for urban and peri-urban locations. ESS will require approximately 250 GWh of power per year to operate, power that ultimately is converted to heat. With innovative cooling solutions, a third of the captured heat will be high-temperature and can be sold as district heating, supplying a significant portion of the heating needs in the City of Lund. Further innovation is required for the remaining two thirds of the heat produced. This heat could be augmented with heat pumps, but at the price of a significantly increased use of electricity. This presentation will bring forward an alternative food production cooling chain, involving fermentation, aquaculture and greenhouse horticulture including both use of low grade surplus heat and recycle societies organic waste as animal feed and manure based fertilizers. The development of such system will demand trans-disciplinary collaboration between physics and biology. The presentation will show the biological processes involved.

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Professor Anders Kiessling has more than 30 years of experience in research and teaching in aquaculture in Sweden, Canada and Norway. He’s present science focus new sustainable animal feed sources, with special focus on microbial sources. Also use of closed farming system and use of surplus heat in recycling nutrients from waste to food again are part of his present interest. From 2010 he has a professorship in aquaculture at the Swedish University of Agricultural Sciences. His former activity has target salmonid fishes in the area of nutrition, product quality and welfare. He has participated in research projects and teaching development both at national, Nordic and EU –level. He has been member, vice-chair and chair of three pan European Cost networks in fish nutrition, meat and fish quality and welfare of farmed fish and is presently the Swedish delegate in the Food and Agricultural domain committee of Cost. He has published close to 100 articles in peer-reviewed journals and has several international assignments within the area of aquaculture.

## \* Plenary Session 3

**Friday 25 Oct 2013, Main Auditorium, 10:30 – 12:30**

10:00 - 10:30 Reports on parallel session A1 and A2

11:00 - 12:00 Reports on Parallel Sessions A3-A4, B1-B2, B3 and B4

12:00 - 12:30 Joint conclusions

## Industrial Exhibition

An industrial exhibition is organized during the workshop to encourage contacts and possible collaboration between industry and research infrastructures in the field of energy efficiency and optimization.

Exhibitors will showcase their best practices and latest technologies in CERN's "Salle des Pas Perdus".



**BIOS IT**

