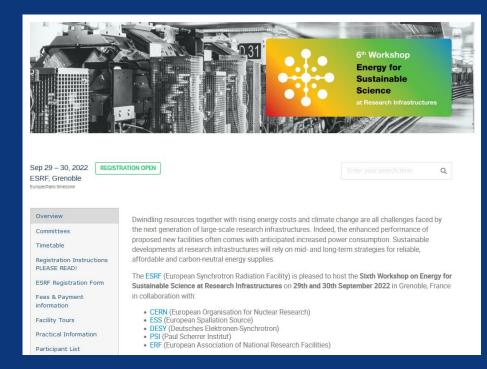
# Introduction & Goals 6th ESSRI workshop

Frédérick Bordry, CERN Mike Seidel, PSI/EPFL 29<sup>th</sup> September 2022







#### **International Organising Committee**

Carlo Bocchetta - ESS
Frederick Bordry - CERN
Serge Claudet - CERN
Andrew Harrison - ERF
Jean-Luc Revol - ESRF
Mike Seidel - PSI
Denise Voelker - DESY

19 meetings = 18 zoom + 1 in person

# In 2010, informal thinking on "Energy at Research Infrastructures"

### **Energy Management**

To share experience between representatives from various research laboratories strategies, goals and institutional practice to advance environmental sustainability at their research facilities and research campus with particular emphasis on energy savings and energy efficiency measures

### **Energy Efficiency, Energy recovery and Energy quality**

Practical examples in different domains: accelerators design and operation, computer centre, buildings, waste energy recovery ...

### Advanced Energy Technologies and Future R&D

What are the technologies which are developed by RI and can be transferred in the domain of energy saving and renewable energy









# Energy for sustainable science – first workshop in Lund/ESS 2011









Energy Management for Large-Scale Research Infrastructures 13-14 October 2011, ESS-LUND, Sweden

CERN, the European Organization for Nuclear Research, ERF, the European Association of National Research Facilities, and ESS, the European Spallation Source, are delighted to invite you to indicate your interest in attending the first joint workshop on Energy Management for large-scale research infrastructures.

Volatile energy costs, a tight budget climate and increasing environmental concerns are all inciting large-scale research facilities across the globe to develop mid- and long-term strategies aimed at achieving for the future a reliable, affordable and sustainable energy supply that is carbon neutral.

The workshop will bring together international experts on energy and representatives from laboratories and future projects all over the world in order to identify the challenges and best practice in respect of energy efficiency and optimization, solutions and implementation as well as to review the challenges represented by potential future technical solutions and the tools for effective collaboration.

Topics for discussion will include

- Technical challenges in availability and quality: efficiency and optimization of energy supply, energy recovery, storage and stability
- Strategic and financial challenges for the future: impact of GRID regulation, investment optimization, procurement strategy
- Challenges for heat recycling systems and water saving: energy conversion, heat recovery, high-temperature cooling loops

#### Costs

Participation is by invitation and free of charge. Participants must cover their own travel and accommodation expenses.

As participation in the Workshop is limited by the availability of accommodation, you are strongly advised to indicate your interest in attending the Workshop as soon as possible.

In order to ensure that the participating research facilities are as broadly represented as possible, the Workshop organizers will issue a formal invitation confirming attendance at the Workshop in due rourse.

Additional Information & Registration www.esss.se/energysworkshop

#### Scientific Organisation

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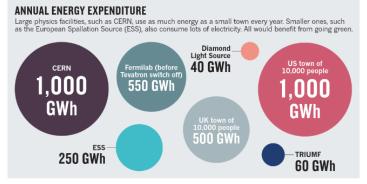
#### **Local Organisation**

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# History of ESSRI workshops



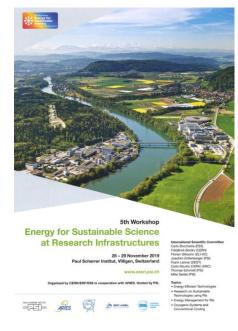
#### 2013: CERN Geneva Switzerland



2015: DESY – Hamburg - Germany



2017: ELI-NP - Bucarest - Romania



2019: PSI Villigen - Switzerland



#### Community Activities on Sustainability

2014-17: EUCARD-2, WP Energy Efficient Accelerator Technologies

https://www.psi.ch/enefficient

2017–21: ARIES, Work Package Efficient Energy Management

https://www.psi.ch/aries-eem

**2021–25: I.FAST**, Work Package Sustainable Concepts

https://www.psi.ch/scat



→ consult websites for link collection to workshops and documentation

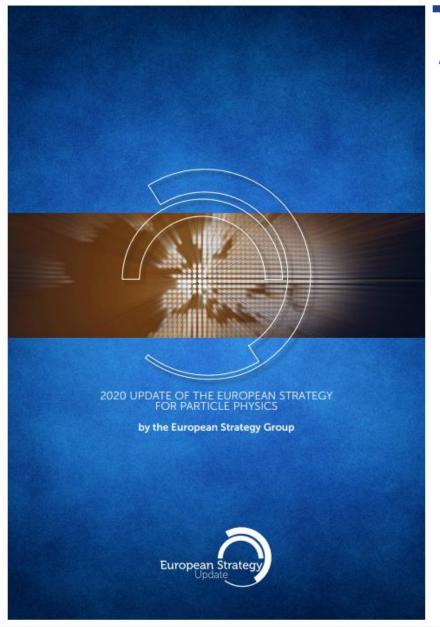
#### Thanks to Mike Seidel





- ICFA panel on sustainable accelerators, chair: Thomas Roser (BNL)
- https://icfa.hep.net/icfa-panel-on-sustainable-accelerators-and-colliders/







# **Environmental and societal impact**

- A. The energy efficiency of present and future accelerators, and of computing facilities, is and should remain an area requiring constant attention. Travel also represents an environmental challenge, due to the international nature of the field. The environmental impact of particle physics activities should continue to be carefully studied and minimised. A detailed plan for the minimisation of environmental impact and for the saving and re-use of energy should be part of the approval process for any major project. Alternatives to travel should be explored and encouraged.
- B. Particle physics, with its fundamental questions and technological innovations, attracts bright young minds. Their education and training are crucial for the needs of the field and of society at large. For early-career researchers to thrive, the particle physics community should place strong emphasis on their supervision and training. Additional measures should be taken in large collaborations to increase the recognition of individuals developing and maintaining experiments, computing and software. The particle physics community commits to placing the principles of equality, diversity and inclusion at the heart of all its activities.
- C. Particle physics has contributed to advances in many fields that have brought great benefits to society. Awareness of knowledge and technology transfer and the associated societal impact is important at all phases of particle physics projects. Particle physics research centres should promote knowledge and technology transfer and support their researchers in enabling it. The particle physics community should engage with industry to facilitate knowledge transfer and technological development.
- D. Exploring the fundamental properties of nature inspires and excites. It is part of the duty of researchers to share the excitement of scientific achievements with all stakeholders and the public. The concepts of the Standard Model, a well-established theory for elementary particles, are an integral part of culture. Public engagement, education and communication in particle physics should continue to be recognised as important components of the scientific activity and receive adequate support. Particle physicists should work with the broad community of scientists to intensify engagement between scientific disciplines. The particle physics community should work with educators and relevant authorities to explore the adoption of basic knowledge of elementary particles and their interactions in the regular school curriculum.



# Categories of Sustainability for RI's

energy related research

energy procurement

research infrastructure system efficiency

grid energy consumption and quality

heating & waste heat recycling

water consumption

waste management & recycling

use of materials and resources

office/lab energy consumption

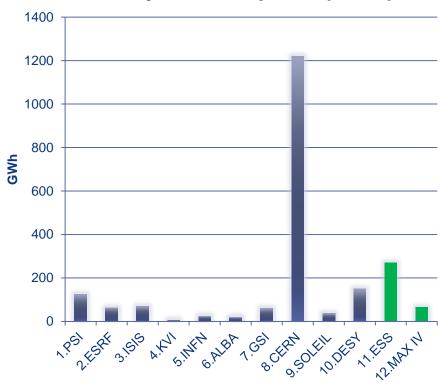
mobility & business travel

efficient technologies



## Laboratory Survey: Energy Consumption and Energy Cost

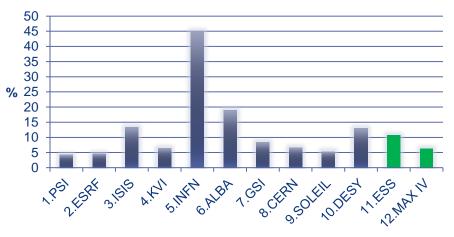
#### **Electricity consumption (GWh)**



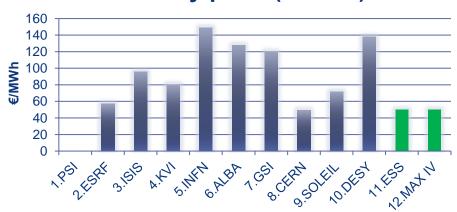


Mike Seidel, 2014

#### **Energy-related part of costs (%)**



#### **Electricity price (€/MWh)**





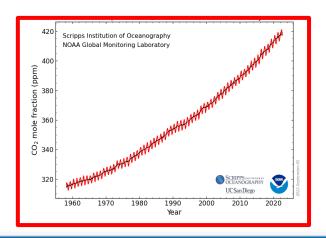
# Past tow years even more pressing challenges ...

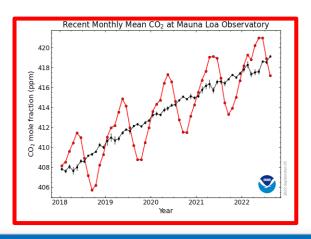
 Practical experience of climate change due to record temperatures, long drought periods, forest fires, floods in many parts of the world, e.g. China, US, Europe ...





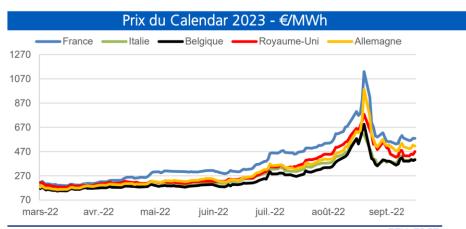






# Past tow years even more pressing challenges ...

- Practical experience of climate change due to record temperatures, long drought periods, forest fires, floods in many parts of the world, e.g. China, US, Europe ...
- General inflation triggered through COVID and the Ukraine invasion
- Unpredictable fluctuations on the energy trading exchange





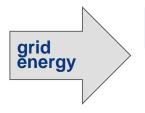
Spotmarktpreise (Day-Ahead Fixing) Schweiz

Mittlere tägliche Spotpreise (CH)

sources : EEX, EDFT

www.bricklebrit.de

#### Accelerator driven Research Infrastructures (RI)



accelerator

primary beam

auxiliary systems

primary beam production

- electrons
- protons
- ions

- conversion target
- undulators/magnets
- colliding beam insertion
- ...

conversion to specific secondary radiation



- X-rays
- · neutrons, muons, neutrinos
- exotic particles

High level goal science output:

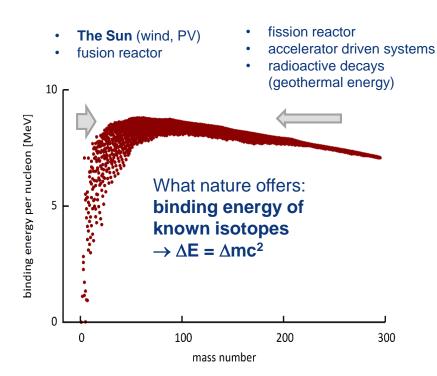
- per operating/investment cost
- per grid energy,



- Energy per luminosity delivered (GWh/fb<sup>-1</sup>)
- Expected energy per luminosity delivered (GWh/fb<sup>-1</sup>)
- LHC energy consumption (GWh)
- Expected LHC energy consumption (GWh)



### Can we contribute to energy production?



With accelerator driven systems (ADS) nuclear power can be made safe and more sustainable (burning Actinides).

Also for **fusion reactors** we have synergetic technologies in the field of accelerators, like RF power generation, superconducting magnet, power conversion, vacuum technology,...

# 6th Workshop: Energy for Sustainable Science at Research Infrastructure

#### Goals:

- Identify and share good practices on energy management, energy efficiency, storage,...
- Identify potential future technological solutions
- Stimulate initiatives, cooperation amongst institutes
- Communication to policymakers





Sep 29 – 30, 2022 REGISTRATION OPEN ESRE Grenoble

Q



essri2022-loc@esrf.fr

Dwindling resources together with rising energy costs and climate change are all challenges faced by the next generation of large-scale research infrastructures. Indeed, the enhanced performance of proposed new facilities often comes with anticipated increased power consumption. Sustainable developments at research infrastructures will rely on mid- and long-term strategies for reliable, affordable and carbon-neutral energy supplies.

The ESRF (European Synchrotron Radiation Facility) is pleased to host the Sixth Workshop on Energy for Sustainable Science at Research Infrastructures on 29th and 30th September 2022 in Grenoble, France in collaboration with

- . CERN (European Organisation for Nuclear Research)
- ESS (European Spallation Source)
- . DESY (Deutsches Elektronen-Synchrotron) PSI (Paul Scherrer Institut)
- ERF (European Association of National Research Facilities)

The workshop is supported by I.FAST (Innovation Fostering in Accelerator Science and Technology). It will be held in person on the EPS Campus site (sanitary crisis permitting).

ESSRI 2022 will bring together international sustainability experts, stakeholders and representatives from research facilities and future research infrastructure projects worldwide, with the purpose of identifying the challenges, best practices and policies to develop and implement sustainable solutions at research infrastructures. This includes the increase of energy efficiencies, energy system optimizations, storage and savings, implementation and management issues as well as the review of challenges represented by potential future technological solutions and the tools for effective collaboration

The workshop series 'Energy for Sustainable Science at Research Infrastructures' is a biannual event organised by CERN, ERF and ESS in various locations. Exceptionally, the sixth edition of the series has been selected as one of the key events of 'Grenoble: European Green Capital 2022' to enhance Grenoble's engagement in sustainability.

The first ESSRI workshop was held at ESS, Sweden on 13-14 October 2011, the second at CERN, Switzerland on 23-25 October 2013, the third at DESY, Germany on 29-30 October 2015, the fourth at ELI-NP, Romania on 23-24 November 2017 and the fifth one at PSI, Switzerland on 28-29 November 2019.













## Energy: a Duty and an Opportunity

#### **Duties**

To be aware of energy use (sobriety) and energy efficiency

To monitor and plan energy use (Energy forecast and management )

To design and use energy-efficient equipment (integrated loss)

To recover fatal energy

#### Opportunities:

Savings in operational cost.

Policymaker and public acceptance

Research infrastructures do not want to represent an energy issue for society. But wish to contribute to good practices and solutions for the future!

There will be no future large-scale science project without an energy management component, an incentive for energy efficiency and energy recovery among the major objectives.



SF4 CH4 N2O NF3 HFC5 PFC









15/09/2022

Year of Environmental Awareness: communication campaign



# Have a fruitful ESSRI workshop





The year will help highlight the crucial role of basic sciences for sustainable development, and emphasize their contributions to the implementation of the 2030 Agenda and achievement of the Sustainable Development Goals (SDGs).

These aims are strongly aligned with the International Science Council's mission to increase evidence-informed decision-making on urgent global challenges, and its vision of science as a global public good. The IYBSSD would complement nicely the ISC initiatives to support the 2030 Agenda.

The proposal for the Year was developed by the International Union of Pure and Applied Physics (IUPAP), with the encouragement and support of the ISC and its many members, partner institutions and UNESCO.