Sustainability and Research Infrastructures

Frédérick Bordry
Former CERN Director for Accelerators and Technology

The National Academies of
SCIENCES · ENGINEERING · MEDICINE

DIVISION ON ENGINEERING AND PHYSICAL SCIENCES
BOARD OF PHYSICS AND ASTRONOMY

Committee on Elementary Particle Physics – Progress and Promise
Meeting No. 3
November 29-30, 2022
NAS Beckman Center, Irvine, California

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

Energy for sustainable science – 1st workshop at ESS (Lund-Sweden) 2011

CERN | ESS EUROPEAN SPALLATION SOURCE | ERF European Association of National Research Facilities Open to International Access

Workshop Energy for Sustainable Science

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 course.

Additional Information & Registration

www.esss.se/energysworkshop

Scientific Organisation

Frédérick Bordry, CERN | Frederick.Bordry@cern.ch
Thomas Parker, ESS | Thomas.Parker@ess.se
Jean-Pierre Caminade, SOLEIL | caminade@synchrotron-soleil.fr
Frank Lehner, DESY | Frank.Lehner@desy.de
Keith Jeffery, STFC | keith.jeffery@stfc.ac.uk

Local Organisation

Monica Nilsson, ESS | monica.nilsson@esss.se

Communications

Marina Giampietro,CERN | marina.giampietro@cern.ch
Roger Eriksson, ESS | roger.eriksson@esss.se

25 talks, 125 participants, mostly from Europe

Beatrix Vierkorn-Rudolph,
Federal Ministry of Education and Research, Germany:
"Increasing energy efficiency is a major goal"

Catherine Cesarsky,
Atomic Energy and Alternative Energies Commission (CEA):
"The Research Infrastructures are very appropriate tools for addressing scientific issues to confront global Climate and Energy challenges"

2nd Workshop
Energy for Sustainable Science
at Research Infrastructures

CERN, GENEVA, SWITZERLAND 23-25 OCTOBER 2013

ENERGY.SUSTAINABLESCIENCE2013@CERN.CH
HTTP://CERN.CH/ENERGY.SUSTAINABLESCIENCE2013

MAIN THEMES

- Energy Management at Research Infrastructures
- Procurement and Financing of Energy
- Energy Efficiency at Research Infrastructures
- Energy Efficiency in Computing Centres
- Sustainable Campus Development and Management
- Energy Quality and Operation
- Green Technologies developed at Research Infrastructures

INTERNATIONAL ORGANIZING COMMITTEE

Mike Ashworth	STFC
Frédérick Bordry	CERN
Frank Lehner	DESY
Carlo Rizzuto	ERF
Thomas Parker	ESS

LOCAL ORGANIZING COMMITTEE

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

CERN – Geneva - Switzerland
23-25 October 2013

51 talks
189 participants
14 countries,
(incl. JP & USA)

History of ESSRI workshops 2013 to 2019

Stabilization of participants ~ 120-150

All continents: Europe, Japan, China, USA, Canada, Brazil,… Sesame, EU…

More focus on achievements, …. , realism

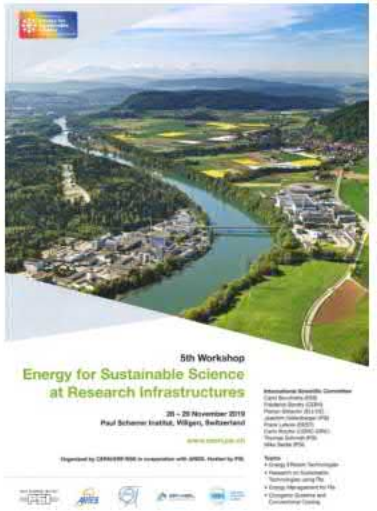
Established series of workshops

2011: ESS
Lund - Sweden

2013: CERN
Geneva - Switzerland

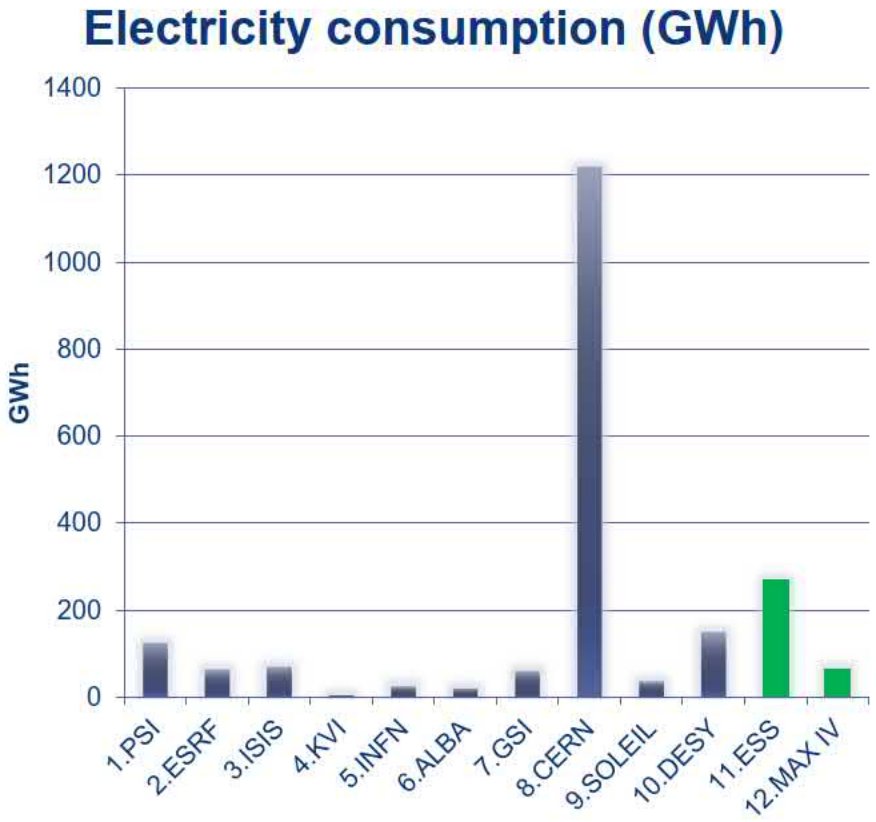
2015: DESY –
Hamburg - Germany

2017: ELI-NP -
Bucharest - Romania



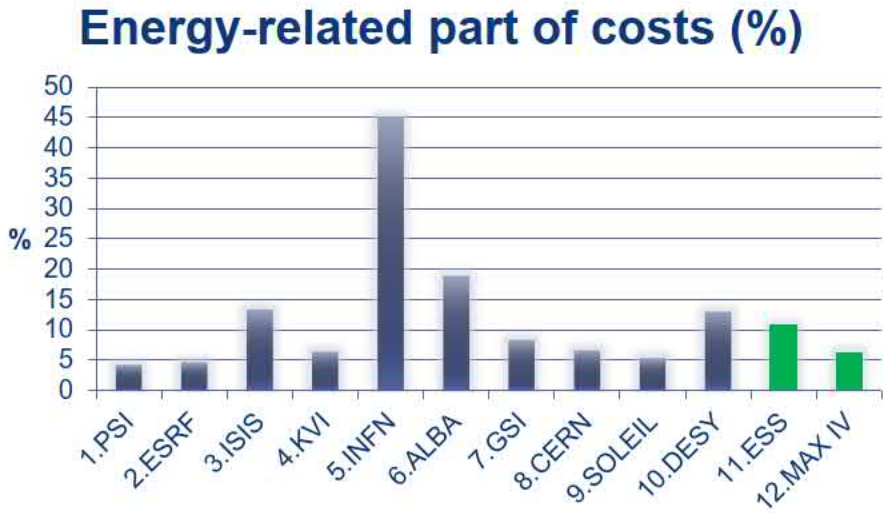
2019: PSI
Villigen - Switzerland

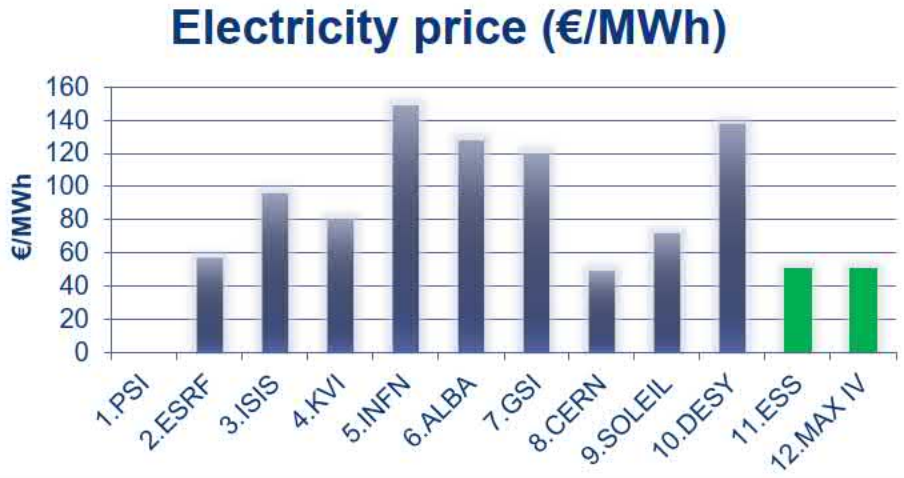
Laboratory Survey: Energy Consumption and Energy Cost



EuCARD²

Mike Seidel, 2014





PSI example

Building Infrastructure of PSI Campus

Building Infrastructure and condition, casing and insulation

- Age from 0 to 50 years
- Office, laboratories and functional buildings with high internal heat loads
- Some huts as permanent interim arrangements
- Closed but still legal «research atomic reactor buildings»
- Buildings to be removed but ever and ever used

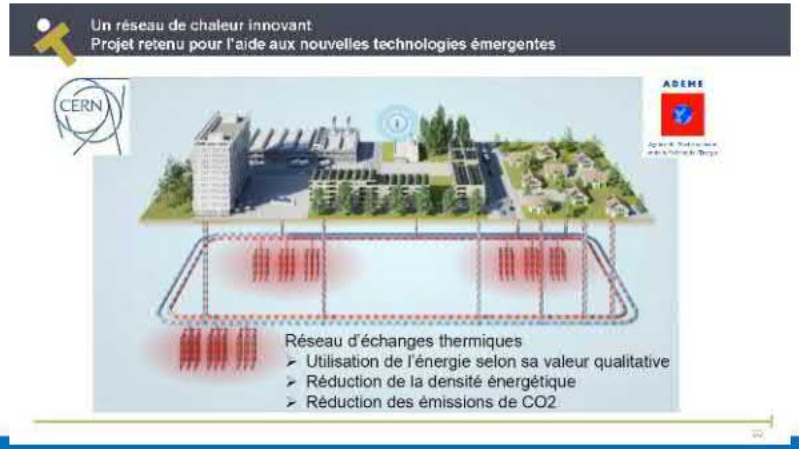
It is more efficient to channel the heat through the windows than isolating old buildings !!!

(For large sites, heat pump to heating network)

- Reduction of heat consumption by passive insulation less effective than waste heat recycling but very costly!

CERN Heat recovery projects (1/2)

Heat recovery from CERN-P8 to be injected in a local “anergie” loop
(ZAC Ferney-Voltaire innovation)



Scan of all possible synergies done on French & Swiss territories, P8 confirmed with P2 to follow in medium term future

All equipment on CERN site installed during LS2, including 10 MW heat exchangers, no impact on LHC activities

2km "link" to local community to be installed in 2022, while LHC is in operation

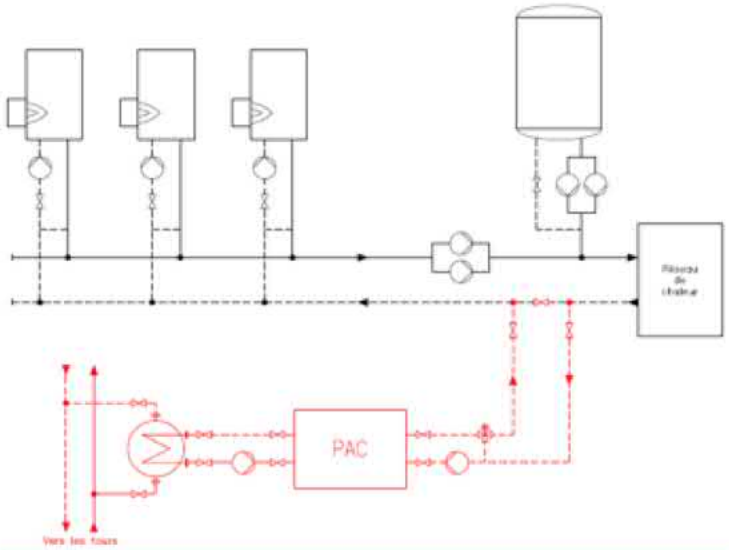
New entity established Nov'21 to operate the new network from 2024 onwards

CERN Heat recovery projects (1/2)

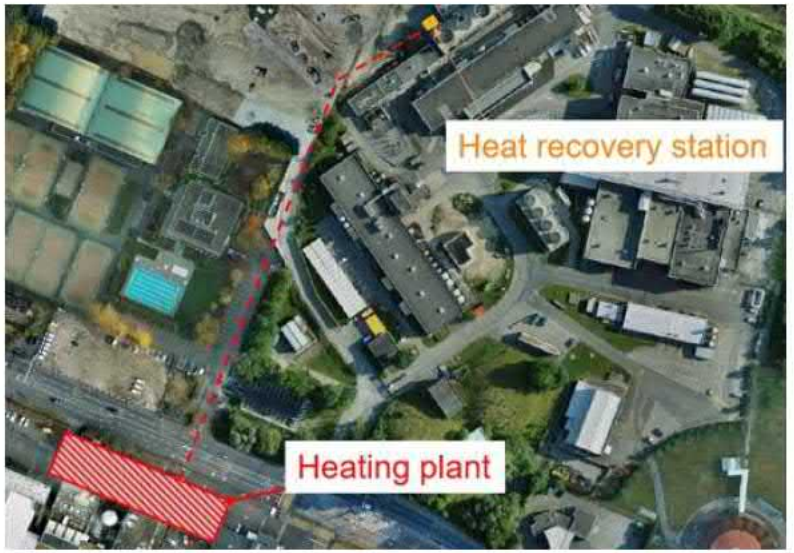
Refurbishment of the Prevessin heating plant (F) including heat recovery from the new Computing Centre (PCC) planned to heat buildings of the site as of 2024 – reducing emissions from the gas heating plant located on the site (~1900 tCO_2e/y).

Ongoing studies to recover waste heat from CERN cooling tower units at LHC Point 1 to heat buildings on the Meyrin site (CH) – reducing emissions from the gas heating plant located on the site (~2000 tCO_2e/y).

New Prevessin (FR)
Computing Center



Heat pump to boost existing heating plant



Meyrin (CH) - LHC P1
Heat recovery studies

Courtesy Serge Claudet

CERN Improved efficiency, recent cases

Facility upgrades: East Area Renovation (done during recent LS2)

Powering energy:
From 11 GWh/year to around 0.6 GWh/year
(> 90% reduction)

New equipment (Cryogenic Refrigerators for HL-LHC)

Compressor station
of LHC 18 kW@ 4.5 K helium refrigerator

LHC 18 kW @ 4.5 K helium cryoplants
33 kW @ 50 K to 75 K, 23 kW @ 4.6 K to 20 K, 41 g/s liquefaction

Diameter: 4 m
Length: 20 m
Weigth: 100 tons
600 Input/Output signals

A set of requirements (performance, technology) to allow industry to provide the optimum for a given scenario
Adjudication: CAPEX + OPEX (10 years)

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

EuCARD² Enhanced European Coordination for Accelerator Research & Development

ARIES ACCELERATOR RESEARCH AND INNOVATION FOR EUROPEAN SCIENCE AND SOCIETY

iFAST Innovation Fostering in Accelerator Science and Technology

→ consult websites for link collection to workshops and documentation

ICFA

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

CERN Council Open Symposium on the Update of

European Strategy for Particle Physics

13-16 May 2019 - Granada, Spain

Physics Preparatory Group

Halina Abramowicz (Chair)
Shoji Asai
Stan Bentvelsen
Caterina Biscari
Marcela Carena
Jorgen D'Hondt
Keith Ellis
Belen Gavela
Gian Giudice
Beate Heinemann
Xinchou Lou
Krzysztof Redlich
Leonid Rivkin
Paris Sphicas
Brigitte Vachon
Marco Zito
Antonio Zoccoli

Local Organizing Committee

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Alberto Casas
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Juan José Hernández
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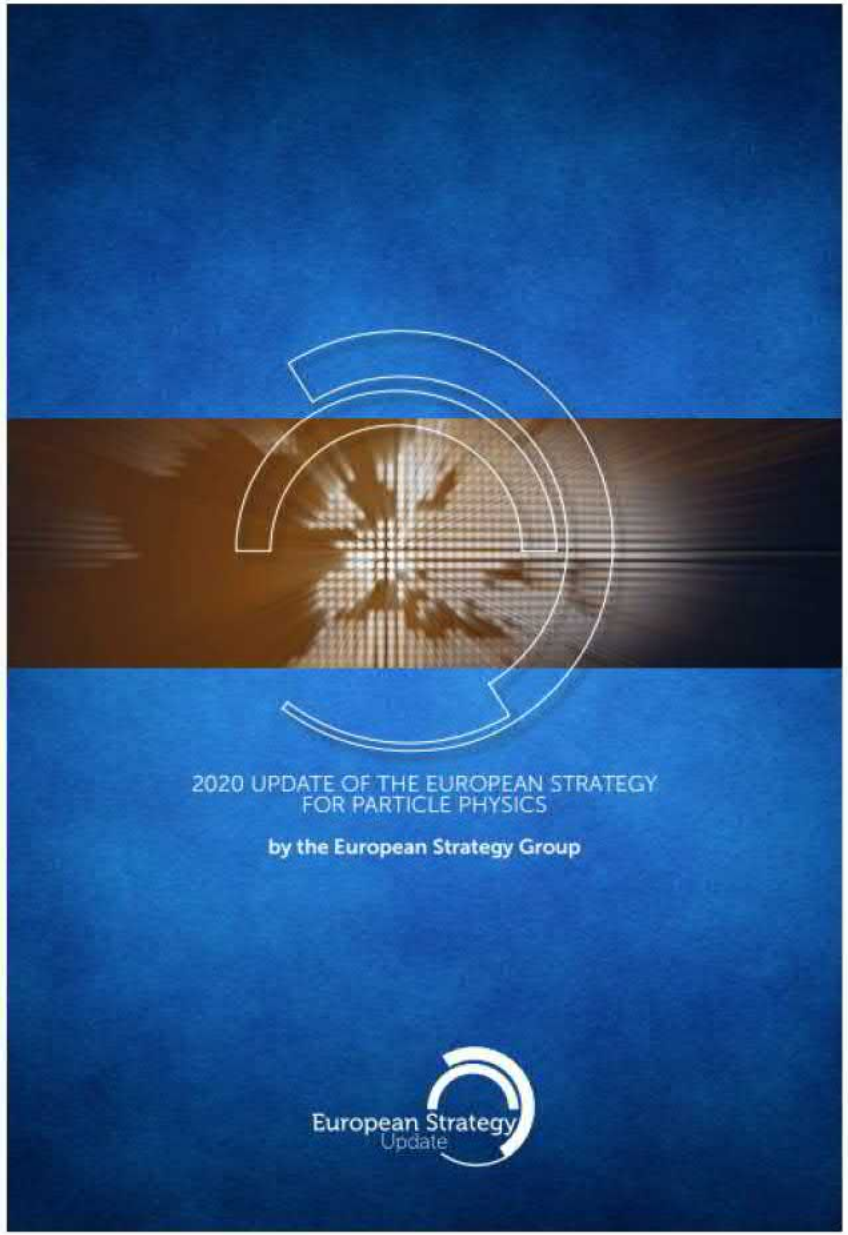
José Santiago

https://cafpe.ugr.es/eppsu2019/

eppsu2019@pcgr.org

Sponsored by:

CERN Council Open Symposium on the Update of
European Strategy for Particle Physics
13-16 May 2019 - Granada, Spain



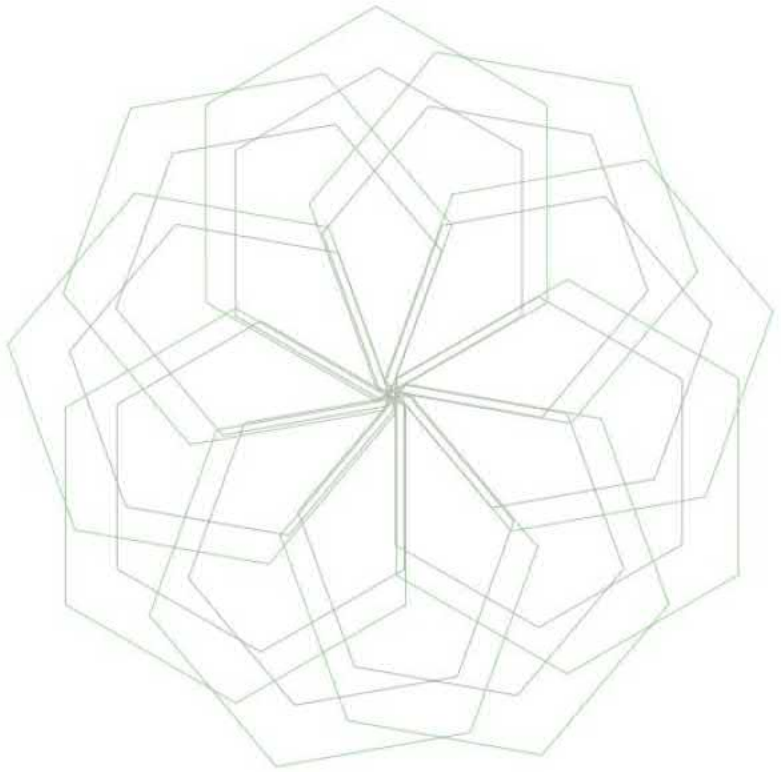
7 Environmental and societal impact

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.***



Environment Report

2017 - 2018

About CERN

>17 900 people

CERN employs around **3600** people and some **12 500** scientists from around the world use the Laboratory's facilities. The remainder is largely made up of associates and students *(page 8)*.

Energy

1251 GWh

CERN consumed **1251 GWh** of electricity and **64.4 GWh** of fossil fuel. The Laboratory commits to limiting rises in electricity consumption to **5%** up to the end of **2024**, while delivering significantly **increased performance** of its facilities *(page 12)*.

Emissions

223 800 tCO_2e

CERN's direct greenhouse gas emissions were **192 100 tonnes of CO_2 equivalent, tCO_2e**. Indirect emissions arising from electricity consumption were **31 700 tCO_2e**. CERN's immediate target is to reduce direct emissions by **28%** by the end of **2024** *(page 14)*.

Ionising Radiation

< 0.02 mSv

People living in the vicinity of CERN received an effective dose of between 0.7 and 0.8 milliSieverts, mSv, from natural sources. CERN's activities added under **0.02 mSv** to this, less than **3%** of the naturally occurring background *(page 16)*.

Waste

56% recycled

CERN eliminated **5808 tonnes** of non-hazardous waste, of which **56%** was recycled, and **1358 tonnes** of hazardous waste. CERN's objective is to increase the current recycling rate *(page 18)*

AT A GLANCE

CERN AND THE ENVIRONMENT IN 2018

Noise

70 dB(A)

CERN has invested resources to keep noise at its perimeters below **70 dB(A)** during the day and **60 dB(A)** at night. This corresponds to the level of conversational speech *(page 17)*.

Environmental Compliance

146 monitoring stations

CERN has a state-of-the-art environmental monitoring system consisting of **146 monitoring stations**. The Organization reports **quarterly** on environmental issues to Host State authorities. **No serious** environmental **incidents** were recorded **in 2018** *(page 23)*.

Biodiversity

15 species of orchids

There are **15 species** of orchids growing on CERN's sites. CERN land includes **258 hectares** of cultivated fields and meadows, **136 hectares** of forest and three wetlands *(page 22)*.

Water and Effluents

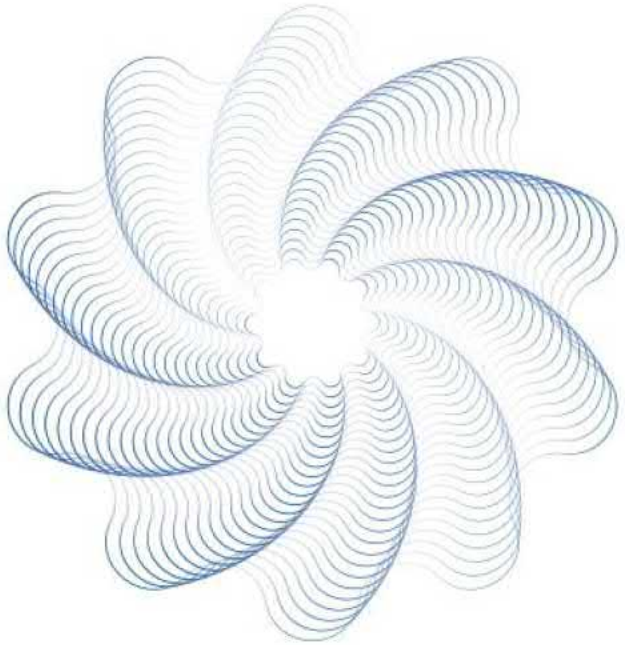
3477 megalitres

CERN drew **3477 megalitres** of water, mostly from Lake Geneva. The Laboratory commits to keeping its increase in water consumption **below 5%** up to the end of **2024**, despite a growing demand for water cooling of upgraded facilities *(page 20)*.

Knowledge Transfer

18 domains

CERN's 18 technology domains have several environmental applications including reducing air and water pollution, environmental monitoring, and more efficient energy distribution using superconducting technology *(page 24)*.



Environment Report

2019 - 2020

CERN

HIGHLIGHTS

CERN AND THE ENVIRONMENT IN 2019

During the period covered by this report, 2019-2020, CERN's accelerator complex was in its second long shutdown. Due to this shutdown, several environmental indicators show a different pattern from the previous reporting time frame of 2017-2018. These highlights only include 2019 indicators, given that 2020, with the COVID-19 pandemic, was not representative of a normal year.

Energy

428 GWh

In 2019, CERN consumed **428 GWh** of electricity and **68 GWh** of fossil fuel. CERN's electricity consumption during the period was about 64% lower than when the accelerator complex is running.

The Laboratory is committed to **limiting rises in electricity consumption to 5%** up to the end of 2024 (baseline year: 2018), while delivering significantly increased performance of its facilities. CERN is also committed to increase energy re-use.

Waste

57% recycled

In 2019, CERN eliminated 6589 tonnes of non-hazardous waste, of which **57% was recycled**. The Laboratory also eliminated 1868 tonnes of hazardous waste.

CERN's objective is to increase the current recycling rate.

Emissions

78 169 tCO_2e

In 2019, CERN's direct greenhouse gas emissions (scope 1) were **78 169 tonnes of CO_2 equivalent** (tCO_2e), which is less than half of the amount emitted annually over the period 2017-2018 when the accelerators were running.

Indirect emissions arising from electricity consumption (scope 2) were **10 672 tCO_2e**. In addition, indirect emissions from water purification, waste treatment, business travel, personnel commutes and catering (scope 3) were **12 098 tCO_2e.**

CERN's immediate target is to **reduce direct emissions by 28%** by the end of 2024 (baseline year: 2018).

Water

2006 ML

In 2019, CERN drew **2006 megalitres (ML)** of water, mostly from Lake Geneva. This is about 47% less than in operational years.

The Laboratory is committed to **keeping its increase in water consumption below 5%** up to the end of 2024 (baseline year: 2018), despite a growing demand for water cooling of upgraded facilities.

Biodiversity

16 species of orchids

In 2019, a new species of orchid was discovered on CERN's sites, bringing the total to **16 species**. CERN land includes **258 hectares** of cultivated fields and meadows, **136 hectares** of forest and three wetlands.

When you think of Environment at CERN, what is the first word that comes to mind?

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
ESRF, Grenoble
Europe/Paris timezone

https://indico.esrf.fr/event/2/

Overview
Committees
Timetable
Registration Instructions PLEASE READ!
ESRF Registration Form
Fees & Payment information
Facility Tours
Practical Information
Participant List
Contact
essri2022-ioc@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.

Starts Sep 29, 2022, 8:00 AM
Ends Sep 30, 2022, 5:00 PM
Europe/Paris

ESRF, Grenoble
Auditorium
71 Avenue des Martyrs
Grenoble, France
Go to map

EPN Campus map
Hotels_Grenoble.pdf
Travelling to EPN Campus

Registration
Registration for this event is currently open.
Register now

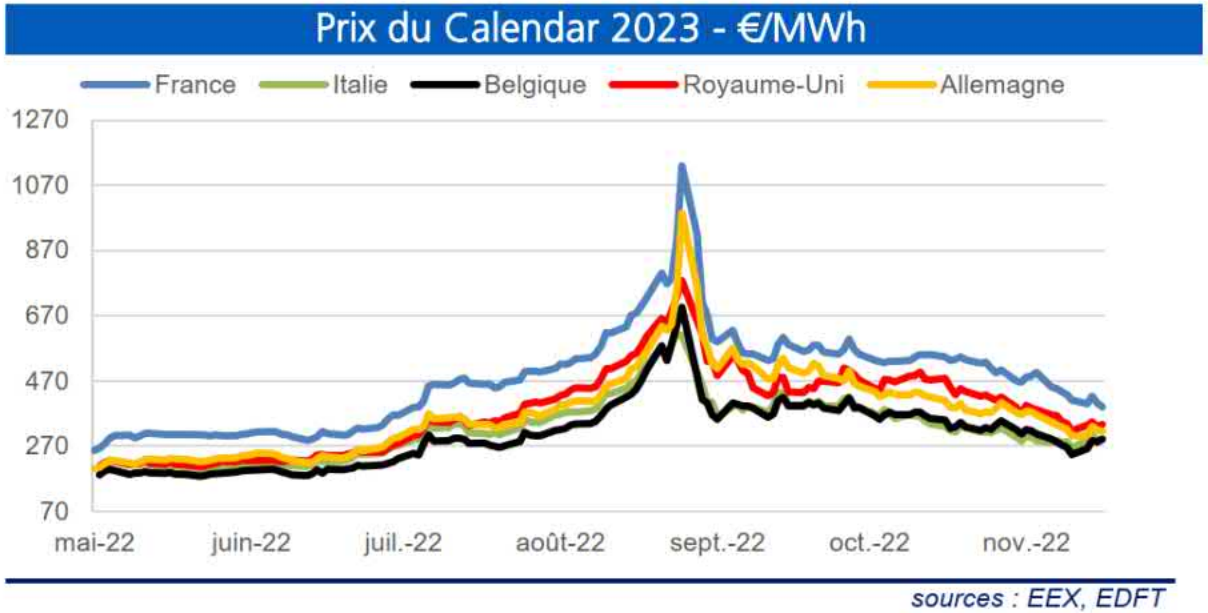
International Organising Committee

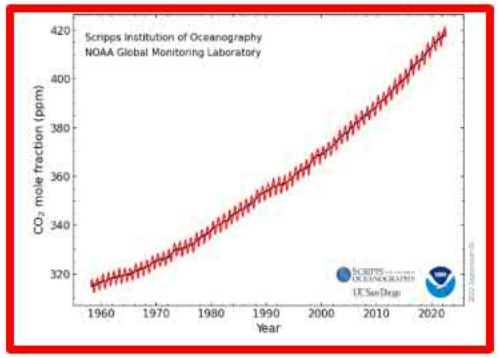
Carlo Bocchetta - ESS
Frederick Bordry - CERN
Serge Claudet - CERN
Andrew Harrison - ERF
Jean-Luc Revol - ESRF
Mike Seidel - PSI
Denise Voelker - DESY

19 meetings
18 zoom + 1 in person

Past two years even more pressing challenges …

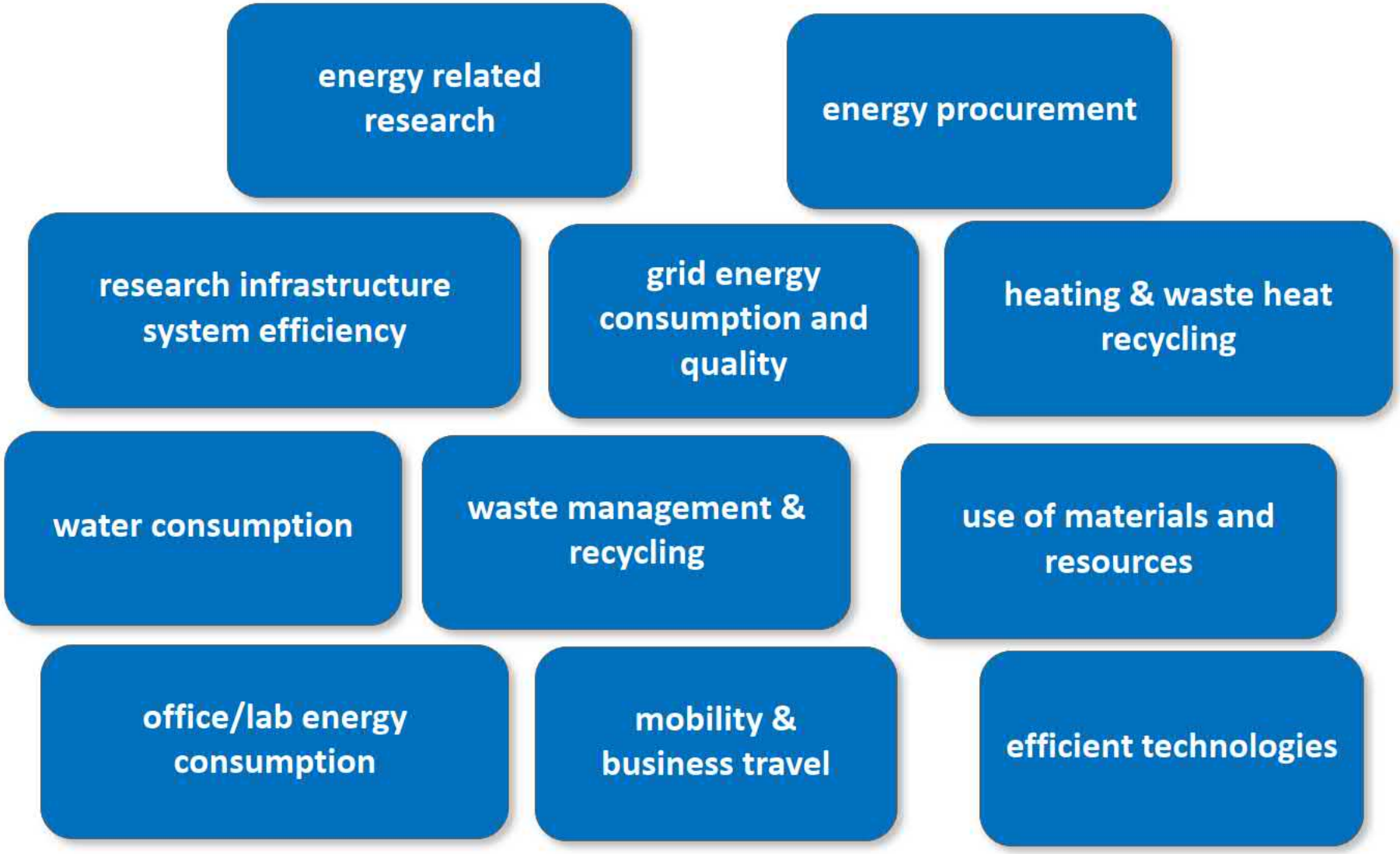
- Practical experience of climate change due to record temperatures, long drought periods, forest fires, floods in many parts of the world, e.g. China, US, Europe ...
- General inflation triggered through COVID and the Ukraine invasion
- Unpredictable fluctuations on the energy trading exchange





Intergovernmental Panel on Climate Change

Categories of Sustainability for Research Infrastructures



Stanford
ENERGY SYSTEM
INNOVATIONS

6th Workshop
Energy for Sustainable Science
at Research Infrastructures

Making Energy Sustainability Innovation Real

Lincoln Bleveans | ESSRI 2022 | Grenoble | 29 September 2022

Energy Operations
Facilities Energy Management
Water Resources & Civil Infrastructure
Office of Sustainability
Waste Management
Operational & Industrial Safety
Emergency Preparedness & Response

Lucile Packard Children's Hospital Stanford
Stanford School of Humanities & Sciences
Residential & Dining Enterprises
Stanford University
Creating a Culture of Excellence
Stanford EARTH
Stanford LawSchool
Stanford HEALTH CARE
SLAC National Accelerator Laboratory
Stanford GRADUATE SCHOOL OF EDUCATION
Stanford | Redwood City
Stanford | Doerr School of Sustainability
STANFORD ATHLETICS
Stanford ENGINEERING
STANFORD BUSINESS
Stanford | MEDICINE

MARCH 24, 2022

Stanford transitions to 100 percent renewable electricity as second solar plant goes online

Stanford completes the university's transition to 100 percent renewable electricity as Solar Generating Station #2 begins commercial operation.

BY CHELCEY ADAMI

Stanford's second solar generating plant went online this month, completing the university's years-long transition to 100 percent renewable electricity and marking a major milestone in its larger journey to reach net zero carbon emissions on campus.

Stanford Solar Generating Station #2 (SSGS2), Stanford's portion of a larger solar and energy storage project called Slate, began commercial operation in mid-March. The 63-megawatt solar photovoltaic plant sits on approximately 420 acres in Central California, near Lemoore.

The station serves as the final component in the Stanford Energy System Innovations (SESI), a complete redesign and transition of Stanford University's energy system from a 100 percent fossil fuel-based, combined heat and power plant to grid-sourced electricity and a more efficient electric heat recovery system.

Stanford Solar Generating Station #2 (SSGS2), Stanford's portion of a larger solar and energy storage project called Slate, began commercial operation in mid-March.
(Image credit: Goldman Sachs Renewable Energy)

Sustainability at Fermilab and the PIP-II Project

Tiffany Price

6th ESSRI Workshop

29 September 2022

Sustainability within PIP-II

PIP-II Workshop

- Established five goals for the project
- Brainstorming sessions to identify and explore strategies, review lessons learned, and to develop specific, executable plans to improve sustainability features for PIP-II

1. Energy management at accelerator facilities and resulting experience
2. Energy efficient technologies
3. Campus and building management
4. Energy recovery
5. Waste heat recovery

Sustainability and Research Infrastructures
Frédérick Bordry
National Academies of Sciences – Engineering – Medicine , Committee EPP 2024
30th November 2022

PIP-II

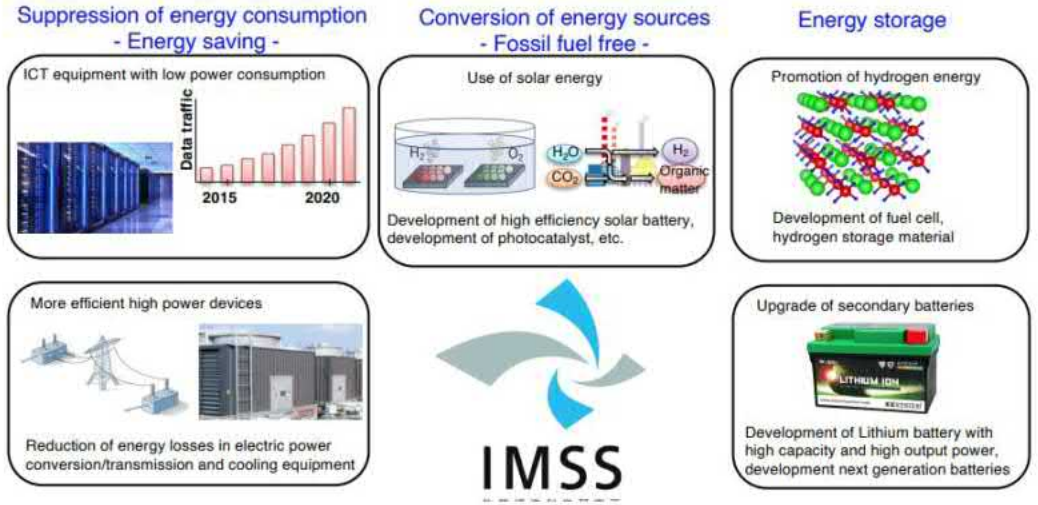
The 6th ESSIR workshop
Sep. 31, 2022

Efforts to save energy consumption in KEK accelerator facilities

Tadashi Koseki

Accelerator Laboratory, KEK

KEK IMSS (Institute of Materials Structure Science) is contributing low-carbon technology developments by research using multi-probe with four beams; neutron and muon beams at MLF, SR beams at PF/PF-AR and slow positron beams at SPF.

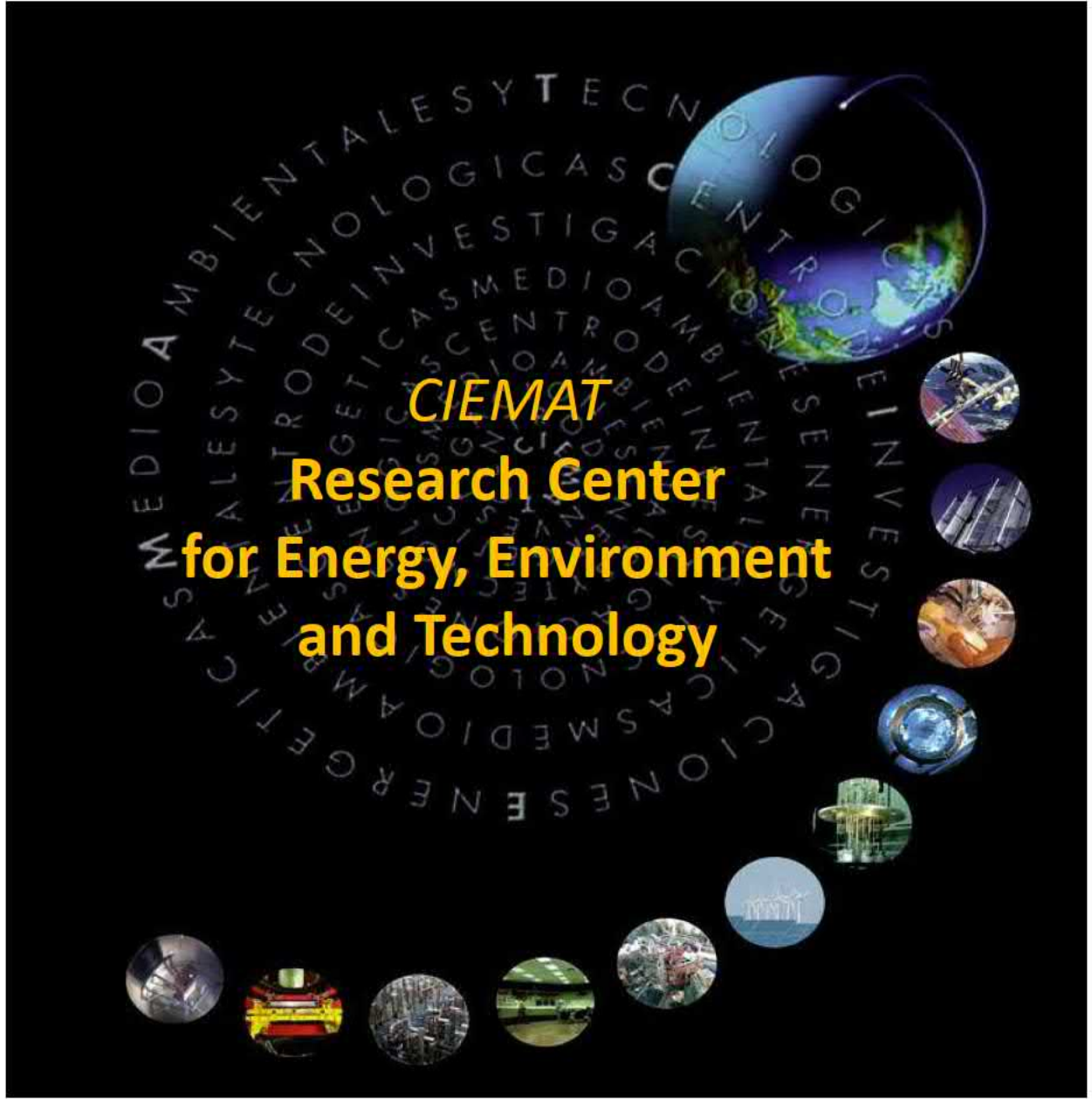


IMSS continues to study of the various materials to solve these issues using multi-probes.

KEK reinforces challenges for sustainable society

- Research and developments on low carbon technologies
- Efforts for energy saving in accelerator facilities
- Cooperation with academic, industrial and areal communities

Booklet:
" KEK efforts toward carbon neutral"



Workshop
Energy for
Sustainable
Science

7th Workshop Energy for Sustainable Science at Research Infrastructures

Autumn 2024 at CIEMAT in Madrid

GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN

Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Goals of the workshops

To create a sustainable forum for open exchange of practices and policies on energy management in RIs *(Energy and sustainability awareness)*

To share best practices on energy efficiency, recovery, storage and global optimization

(Energy coordinator forum ?)

To define energy and sustainability strategies, policies and management at research infrastructures for

- the core infrastructures (accelerators, experiments,…)
- the computer centres
- the tertiary buildings and the campus, including aspects of mobility
- Green procurement

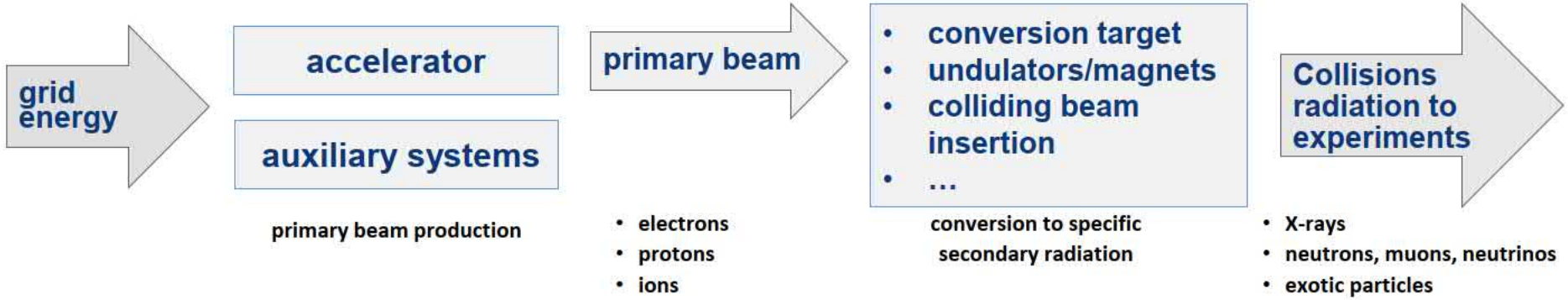
To identify and share experience on energy procurement methods *(grouped procurement ?),* innovative financing (construction costs % operation costs) and on governmental legislation *(tax exemptions,…).*

To encourage more cooperation in joint approaches, initiatives, projects and training.

To develop jointly programs to train researchers, operators and managers to face the upcoming energy challenges *(dedicated school?)*

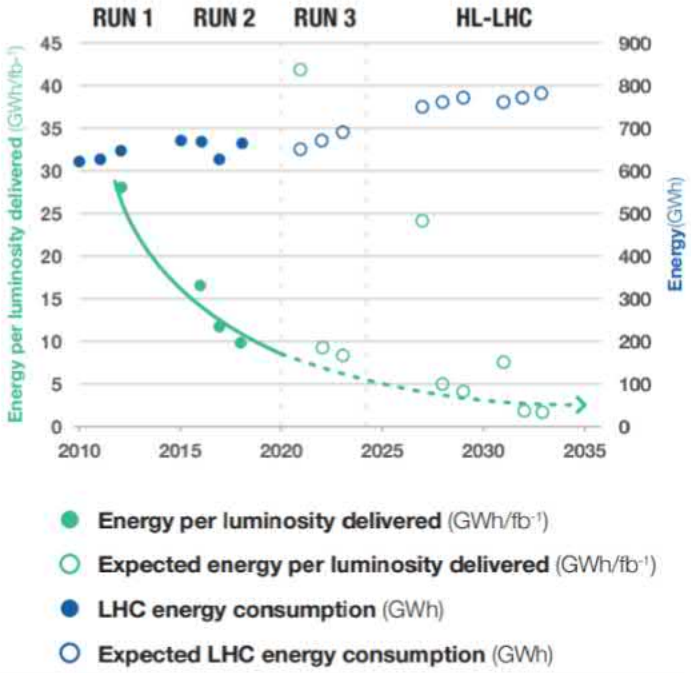
To offer an opportunity for government (especially the EU) to develop and set up a coordinated and supportive action program to deal with energy management and sustainability for large-scale RIs

Accelerator driven Research Infrastructures (RI)



High level goal science output :

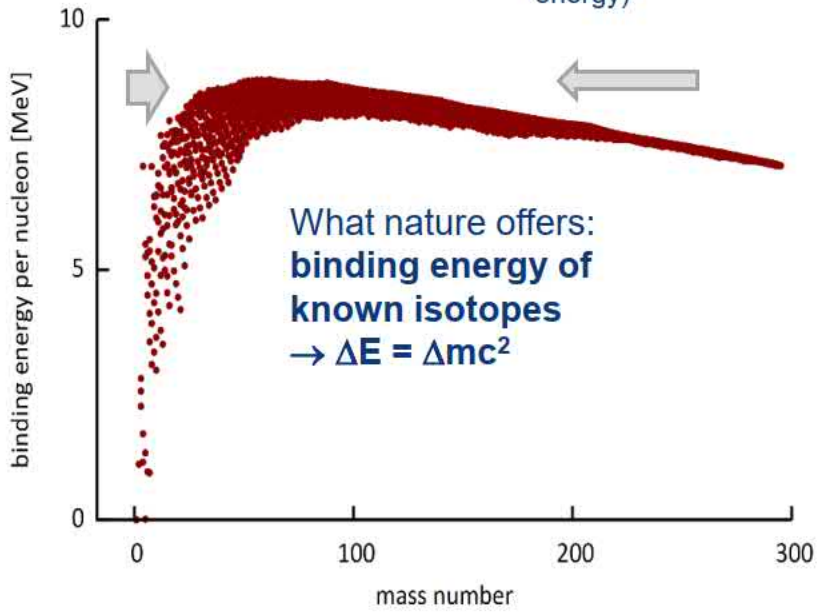
- per operating/investment cost
- per grid energy,



Can we contribute to energy production?

- **The Sun** (wind, PV)
- fusion reactor

- fission reactor
- accelerator driven systems
- radioactive decays (geothermal energy)



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,…

Low loss energy transport (superconductivity)

….

Oct. 31 – Nov. 1, 2022
Washington, D.C., USA

Thematic Tables 2022

The **Thematic Tables** were hosted by organizations/foundations and brought together participants for networking and informed discussion on a specific topic. The tables took place during the extended lunch break on the first day of the conference. The outcome of the tables were used in the further course of the conference and fed into the closing session.

Research Infrastructures and sustainable developments

Large-scale research infrastructures are faced with rising energy costs, resource scarcity, growing environmental concerns and climate change. These major challenges have prompted research facilities to work on sustainable solutions for their operations and to design sustainable development strategies for both existing facilities and future projects. There will be no more new research facilities without a strong environmental commitment as a main objective.
Research organisations need to act responsibly on energy consumption (reduction in consumption, energy efficiency and recovery, ...) on environmental impact and on the transfer of technology towards society in the broad field of sustainability. In this context, it is important to show the relevance of our research and at the same time show that the technologies developed are useful to society.
In Europe, the current energy crisis and price shock will further aggravate the situation and may require immediate action but a medium- and long-term vision is compulsory. In this Thematic Lunch Table, we will reflect on the current situation, include the results of the recent 6th workshop on Energy for Sustainable Science in Large Research Infrastructures and discuss the need for more international cooperation in this area.

Fermilab

CERN

Co-Host: **Lia Merminga**
FNAL

Co-Host: **Frederick Bordry**
CERN

Thematic Lunch Table on Research Infrastructures and Sustainable Development

THE TRANSATLANTIC BIG SCIENCE CONFERENCE

Table participants: Lia Merminga FNAL, Frederick Bordry CERN
Frederic Le Pimpec CLS, Rick Stevens ANL, Jens Dilling ORNL, Ana Asnselmo HZB, UFZ , Elizabeth Austin

Research infrastructures are faced with rising energy costs, resource scarcity, growing environmental concerns and climate change. These major challenges have prompted research facilities to work on sustainable solutions for their operations and to design sustainable development strategies for both existing facilities and future projects. There will be no more new research facilities without a strong environmental commitment as a main objective.

In Europe, several interesting initiatives (HZB, DESY, CERN, ...) and a forum : Energy for Sustainable Science in Research Infrastructures (biannual since 2011, last event at ESRF in Oct. 2022, next one in CIEMAT in fall 2024)
Main pillars: Energy management, Energy efficiency and quality, Heat recovery and Technologies transfer from RIs to society in the large domain of the sustainability

Historically, U.S. and Canada facilities have been less focused on sustainability and efficiency, given relatively low costs of energy
However, there is an increasing necessity for more responsible approaches to energy use, especially in new machines
- Four DOE labs participate in the “Net Zero Lab” pilot program

Thematic Lunch Table on Research Infrastructures and Sustainable Development

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Policy changes are needed to enable broader use of "green" energy sources and sustainable practices

- **For example, approving increased costs of green offsets for travel**
- **Factoring sustainability, local energy sources into siting of new facilities**

Discussion on the production of energy by RIs (PV, Wind,....SMR,..) or to have long-term contracts with energy providers or decentralized production (SESAME example)

% of the total energy ? Can we produce more of our own energy? ORNL investigating SMR – ≈20 MWe (technology transfer and pilot installation)

More and more RIs have a carbon footprint evaluation (direct and indirect emissions Scope 1 and Scope 2; Scope 3: travels and procurement (large source of CO_2): how to go to green procurement ?

Thematic Lunch Table on Research Infrastructures and Sustainable Development

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Sustainability issues extend beyond machines to infrastructure

- Much of basic facility infrastructure (HVAC, etc) is fairly primitive
- Sustainable technologies such as heat recovery limited by existing infrastructure – but can and should be included in new facilities
- DESY is working with local universities to set up Ph.D. projects to create new generation of infrastructure

Water use, water infrastructure increasingly posing sustainability issues as well.
Helium sustainability

Need to persuade government sponsors that investing in sustainable infrastructure makes sense ?
Fundamental question: How should large facilities balance need for sustainability against increased costs for science?
Research infrastructures do not want to represent an energy issue for society. However, wish to contribute to good practices and solutions for the future!
If we as scientists are not at the forefront of sustainability and fighting climate change, who will be?

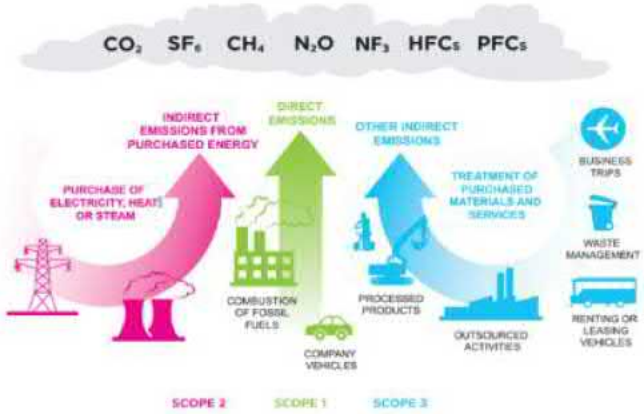
Thematic Lunch Table on Research Infrastructures and Sustainable Development

THE TRANSATLANTIC BIG SCIENCE CONFERENCE

Create a global forum to share experiences, talk about ways to persuade sponsors that increased investments in sustainability are wise and urgently necessary

- What can we do to improve sustainability at large science facilities?
- Compare lab policies for energy – actions we are currently taking, or that we want to take
- More coordination currently in Europe than U.S. /Canada
- Include energy sustainability as a KPP for new research infrastructure projects (already exists in HPC)
- Compare and share strategies for energy efficiency and successful initiatives
- Sustainability must be considered in the same way as safety in the design and operation of research infrastructures.

Energy and sustainability : 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, carbon footprint)

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.
More generally, a solid demonstration of the minimisation of environmental impact.
An assessment of the technologies that will be developed for the project and that can be transferred to society in the field of energy and sustainability.

IYBSSD2022

International Year
of Basic Sciences
for Sustainable Development

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.