LEAPS League of European Accelerator-based Photon Sources

Research Infrastructures through energy crisis

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PSI/LEAPS

https://leaps-initiative.eu/

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LEAPS

at a glance

LEAPS is the largest consortium of accerator based photon sources world-wide and further expanding its service to an interdisciplinary European user community

19 facilities - **16** institutions - **10** countries

> **300** operating End Stations

> **1.000.000** h beamtime /year

> **5.000** publications/year

> **15** spin off companies

> **35.000** users from all EU & beyond researchers from all research area

Construction and Operation (~ 800 M€/year) through national funding

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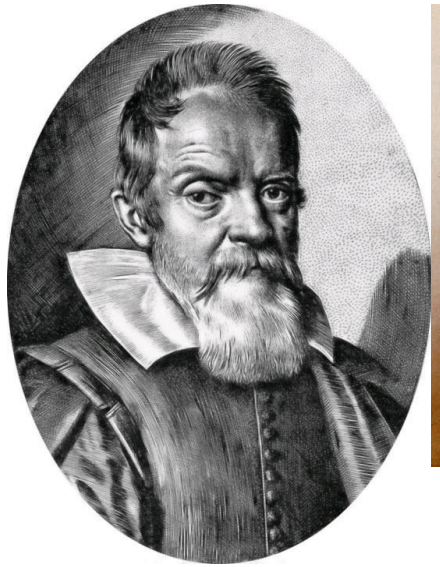
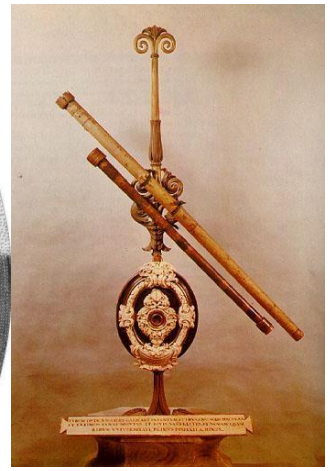
Engines of Discovery

Instruments development: 400 years of discoveries with “telescopes” and “microscopes”



Galileo Galilei



« Le seul véritable voyage … ce ne serait pas d'aller vers de nouveaux paysages, mais d'avoir d'autres yeux, de voir l'univers avec les yeux d'un autre, de cent autres, de voir les cent univers que chacun d'eux voit, que chacun d'eux est. » Marcel Proust

“The real voyage of discovery consists not in seeking new landscapes but in having new eyes” **Marcel Proust**

The First Compound Microscope (circa 1595)

Zacharias Janssen

Accelerator driven applications to meet the needs of society

- Advanced instruments for basic and applied science
- Analysis of physical, chemical and biological materials
- Modification of physical, chemical and biological properties of matter
- Medical: diagnostics, treatment and targeted drug design
- Security: cargo scanning, IT hardware
- Environmental research
- Energy research

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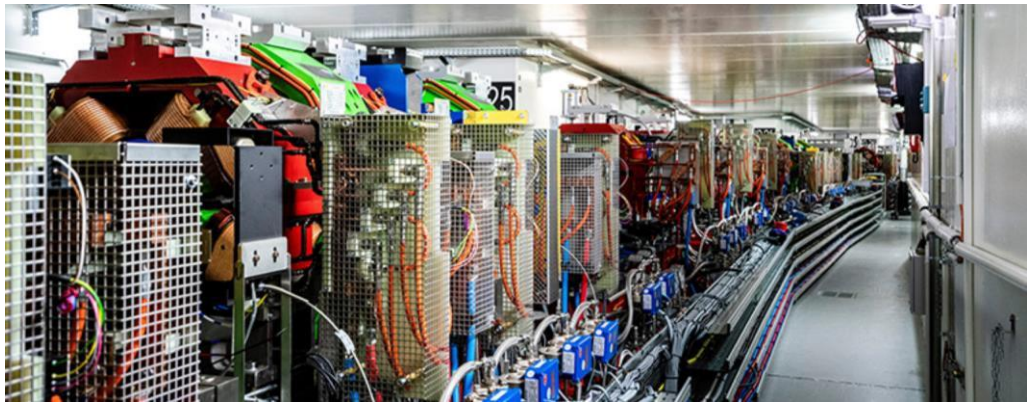
Giant Microscopes

Imaging things on all length and time scales using accelerators,

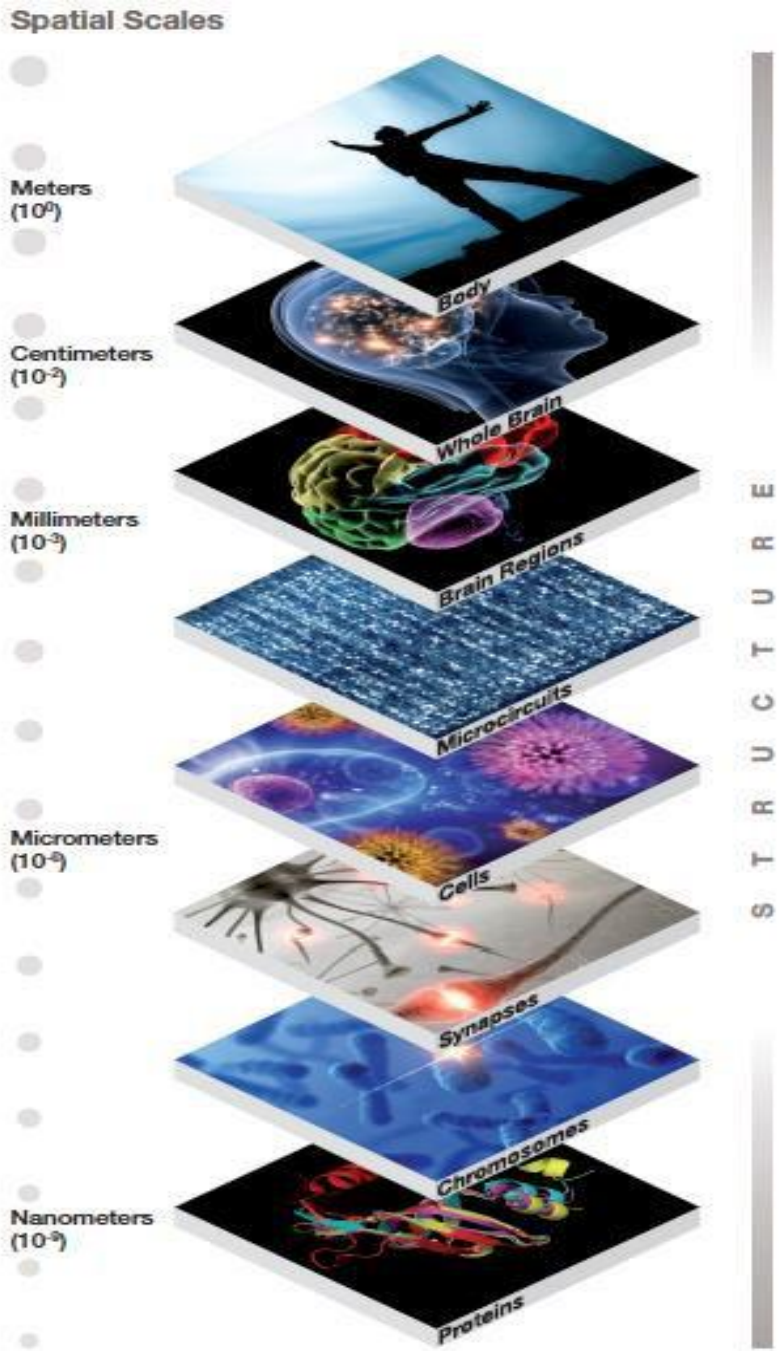
e.g. latest X-Ray and **computational technologies** (developed at accelerators)

ESRF
The European Synchrotron

ESRF-Extremely Bright Source



European Synchrotron Radiation Facility (ESRF)



Caterina Biscari, director of the ALBA synchrotron in Spain told Science|Business the facility's electricity bill has increased by 60% in 2022 compared to 2021. The price hike is despite ALBA negotiating a discount deal with its energy provider.

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

Sustainability

Facility	Energy [GWh/year]	Operating time reduction
CERN LHC	1300 (2200 with FCC)	- 20% in 2022, 2023 (C-free energy)
DESY	153	
PSI	125	- 20%
~ all LEAPS RIs	~ 1050	

Total: 510'000
SNCF: 7'000

Total: 277'000
RENFE: 2'600

Total: 58'000
SBB: 3'000

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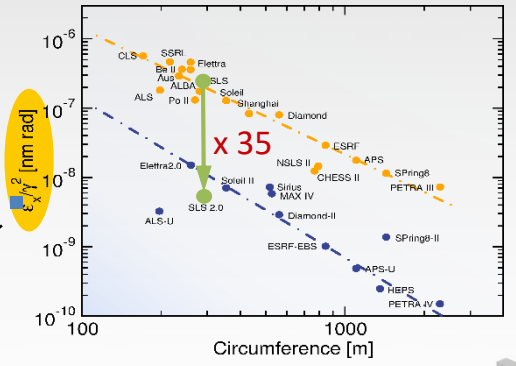
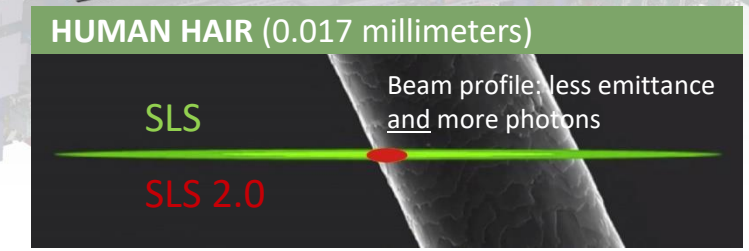
PAUL SCHERRER INSTITUT

SLS 2.0: upscaling Swiss Light Source

$$\mathcal{B} = \frac{\text{flux}}{\text{emittance}}$$

Brilliance





2021 2022 2023 2024 2025 2026

DECEMBER 2020

Swiss Parliament agrees on the Swiss Dispatch on Promotion of ERI.

OCTOBER 2023

Start of construction. Dark period 15 months

JULY 2025

Restart of User Operation

During darktime SLS building roof will be refurbished

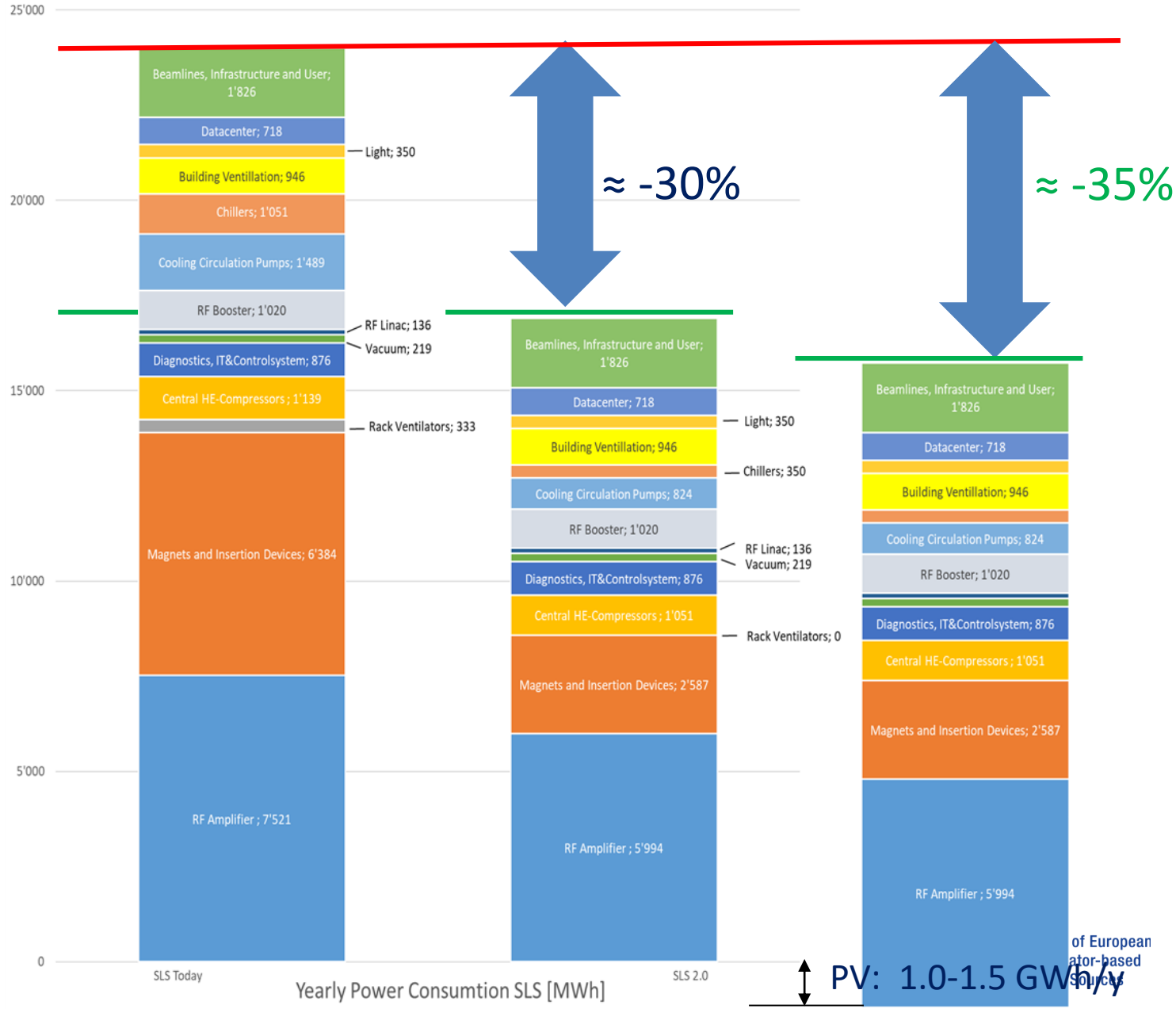
Power economy SLS2.0 vs. SLS incl. PV roof

More radiated X-ray power for users
Less electricity consumption

	SLS → SLS2.0
E_{e^-}	2.4 GeV → 2.7 GeV
P_{SR}	310 kW → 365 kW
W_{elec}/y	24 GWh → 17 GWh
W_{elec}-W_{PV}/	17 GWh → 15.5 GWh

Key savings:

- **Electromagnets → permanent magnets**
- **Klystrons → solid state amplifiers**
- **Standard pumps → regulated pumps for cooling**
- **Tar paper roof → PV cladded roof**



Example: LEAPS Facilities Investment Plans 2022-2026

- **Given the initial investment, cutting operation time, we give up on our primary task of being the engine of innovation and progress**
- **Do we re-balance the weight of science and what it contributes to society?**
  RIs are integral part of the solution for the challenges ahead

Activity (2022-2026)	Approximate numbers
No. of new beamlines being constructed or refurbished	70
Yearly/Total operational budget	800/4000 M€
Budget for investments	450 M€
Budget for the upgrade programs (partly already funded)	550 M€

Larger investments foreseen for the period 2027-2030

Our instruments are oversubscribed: delays and cost increases due to supply chain problems, inflation etc. will result in cancellation of projects, harming careers of PhDs and early career researchers

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Solutions needed urgently

WHAT SHOULD BE DONE?

Stabilize the energy supply: RIs need long-term planning

- ✓Sustainable, affordable, predictable
- ✓Regulated tariff mechanism?
- ✓Fluctuations in energy cost makes the planning unrealistic and hampers the scientific progress on challenges the society is facing, including energy production

Energy crisis is starting to hit Europe's big science labs

20 Sep 2022 | News

Research infrastructures are worried about the rising cost of running large scientific experiments and are looking for help with paying sky-high electricity bills. One lab has seen a 60% increase in its tariff this year

By Florin Zubașcu

ALBA synchrotron. Photo: albasynchrotron / Facebook

Leonid Rivkin, chair of LEAPS, said member organisations are still debating a course of action but they would welcome the European Commission becoming part of the talks. "The energy prices situation is too volatile for a longer-term planning, but it of course would be useful to discuss with the Commission an inclusive solution," said Rivkin.

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League of European Accelerator-based Photon Sources

Tool for European inclusiveness

"The strength of LEAPS lies in its staff and users, hailing from all European countries, beyond those which host the facilities."

Tak

Tack

Thanks

Bedankt

Danke

Dziękuję

Merci

Grazie

Gracias

@leaps_initiative

@LEAPSinitiative

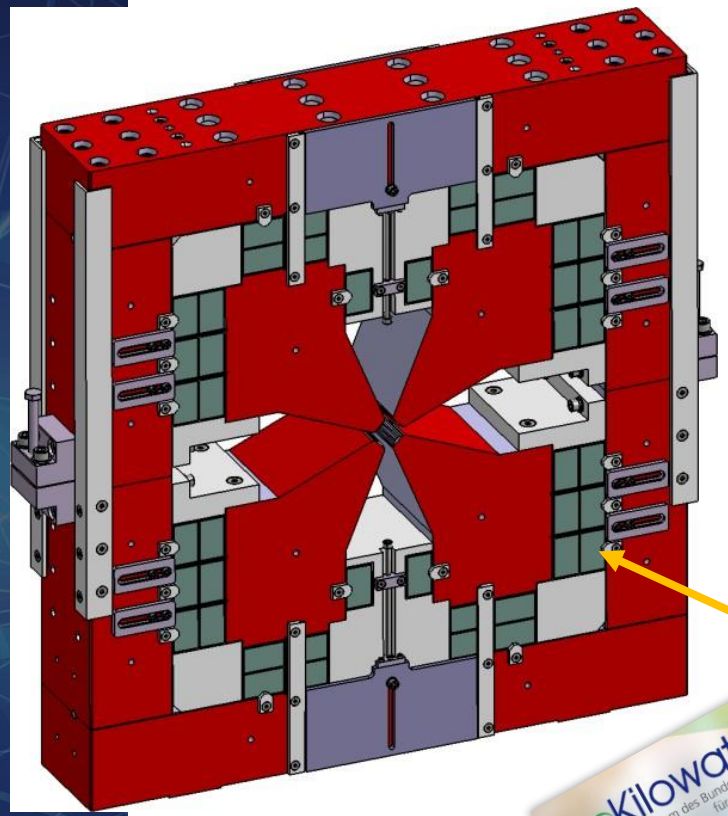
https://leaps-initiative.eu

Innovation – Permanentmagnete für SLS 2.0

permanent magnet technology results
in 425kW power savings of SLS 2.0 vs. SLS

2.9GWh/y = 2.3% of PSI

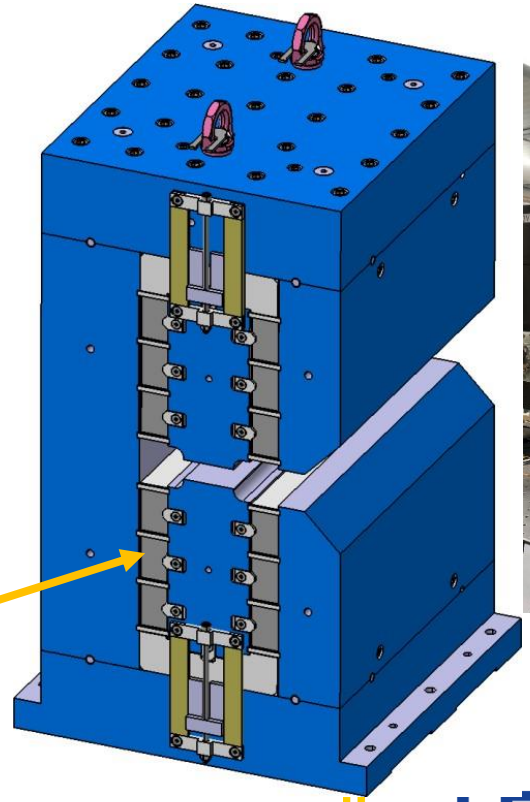
quadrupole



+ zero power consumption
+ compact design
+ no cooling, no vibrations
- no remote tunability

NdFeB
+ NiFe wrapping

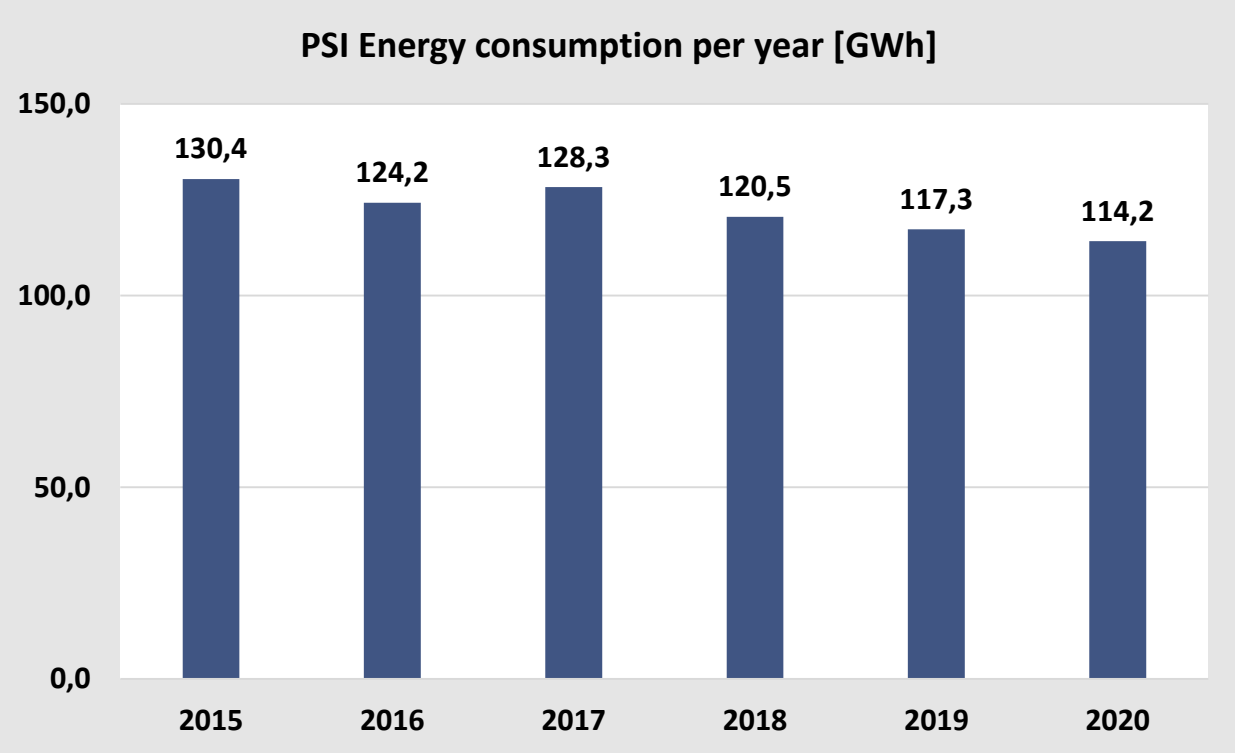
dipole



Unterstützt durch Pro-Kilowatt

Grid Energy demand at PSI is high but falling

PSI's energy consumption is dominated by the operation of the large-scale research facilities. The PSI accelerators are already among the most efficient in the world.



Peak power: 22.5 MW (all hydro power)

Europe	Research
CERN	1300 GWh
DESY (D)	175 GWh
PSI (CH)	125 GWh
ISIS (UK)	70 GWh

CH Govt.	
SBB	1600 GWh
Swisscom	450 GWh

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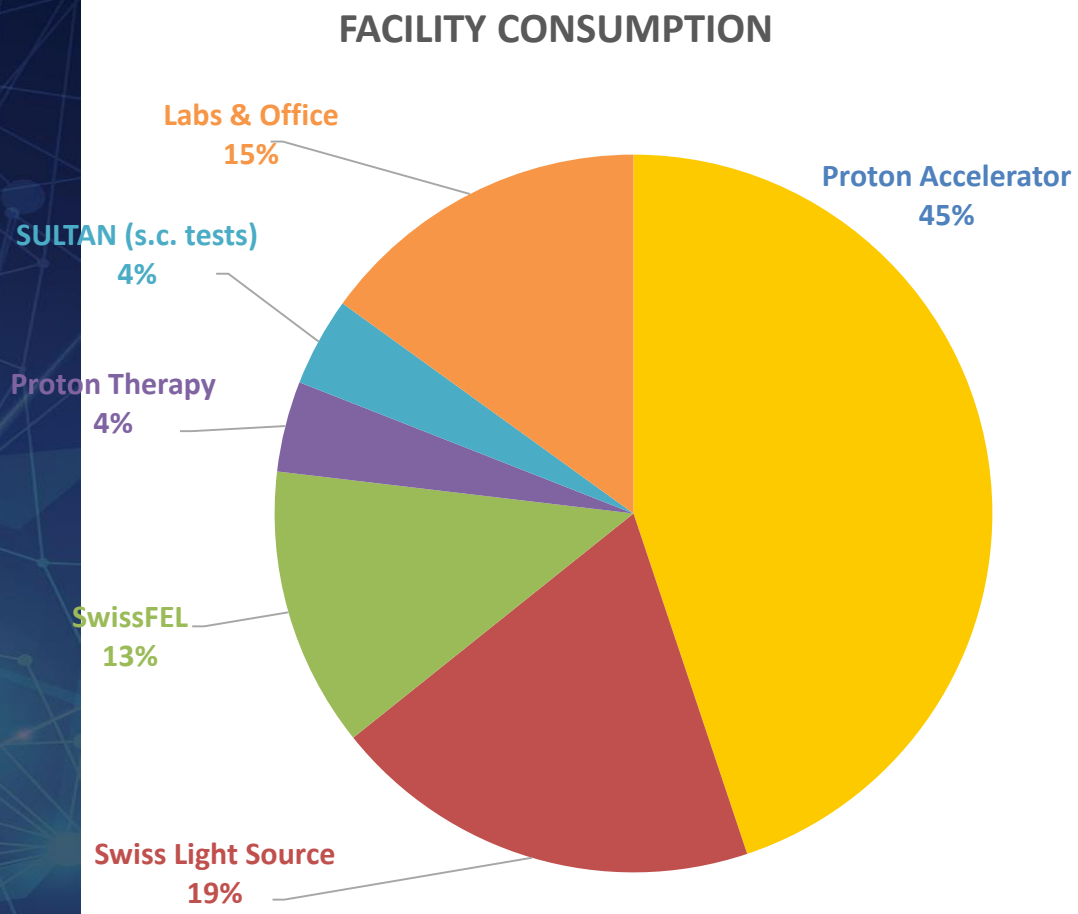
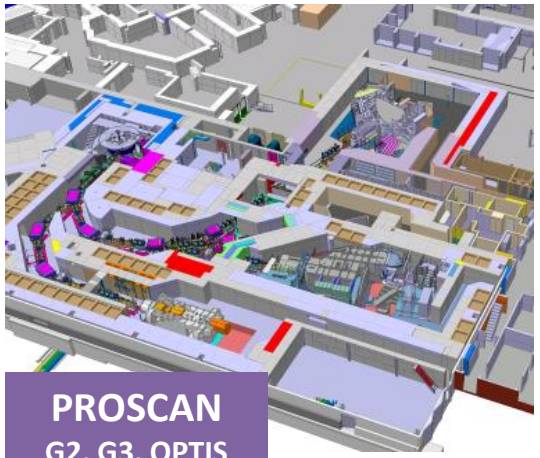
Energy Consumption PSI



total: ≈ 125 GWh/y

HIPA
SμS, SINQ, CHRISP



PROSCAN
G2, G3, OPTIS

SLS
16 beamports

SwissFEL
ARAMIS, ATHOS

Innovation – Photovoltaik & Wärmerückgewinnung

Photovoltaik (aktuell 5‘500 m^2)	
installed peak power entire PSI	580 kW
energy generated	0.56 GWh
fraction of PSI consumption	0.4 %

Potential: + 40’000 m^2, + 4.5 MW peak, + 3.5 %
10 Mio CHF investment

Wärmerückgewinnung	
total heating energy PSI	12.9 GWh/y
recovered heat from facilities	6.5 GWh/y
= fraction of needed energy	50 %
energy cost saved	415 kCHF/y

solar panels on a lab building @ PSI

HIPA cooling circuit with recovery