

Sustainability at Belle II



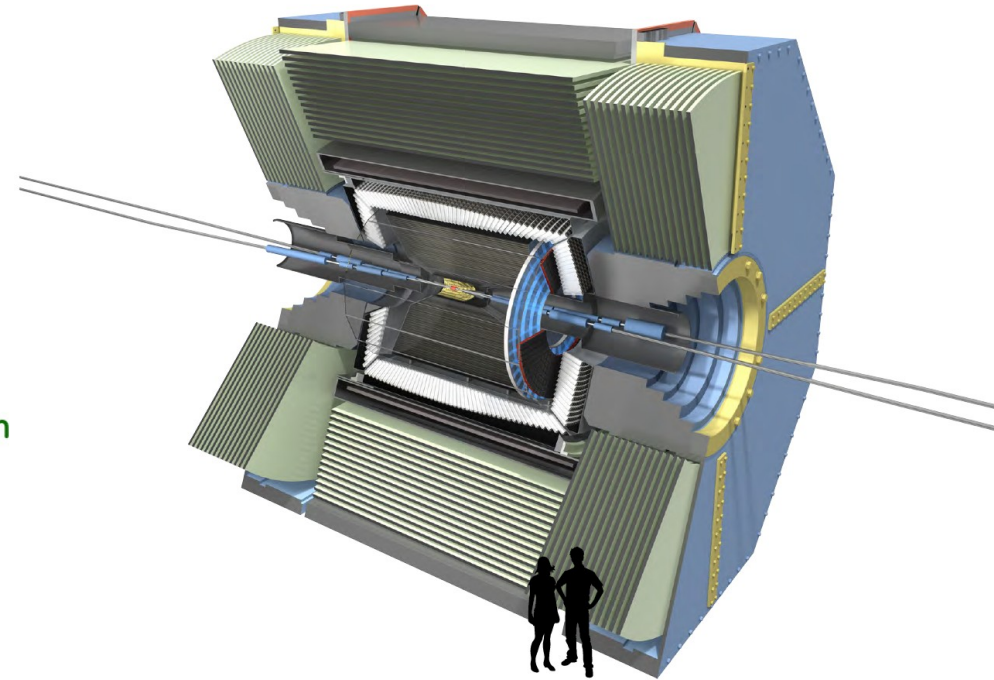
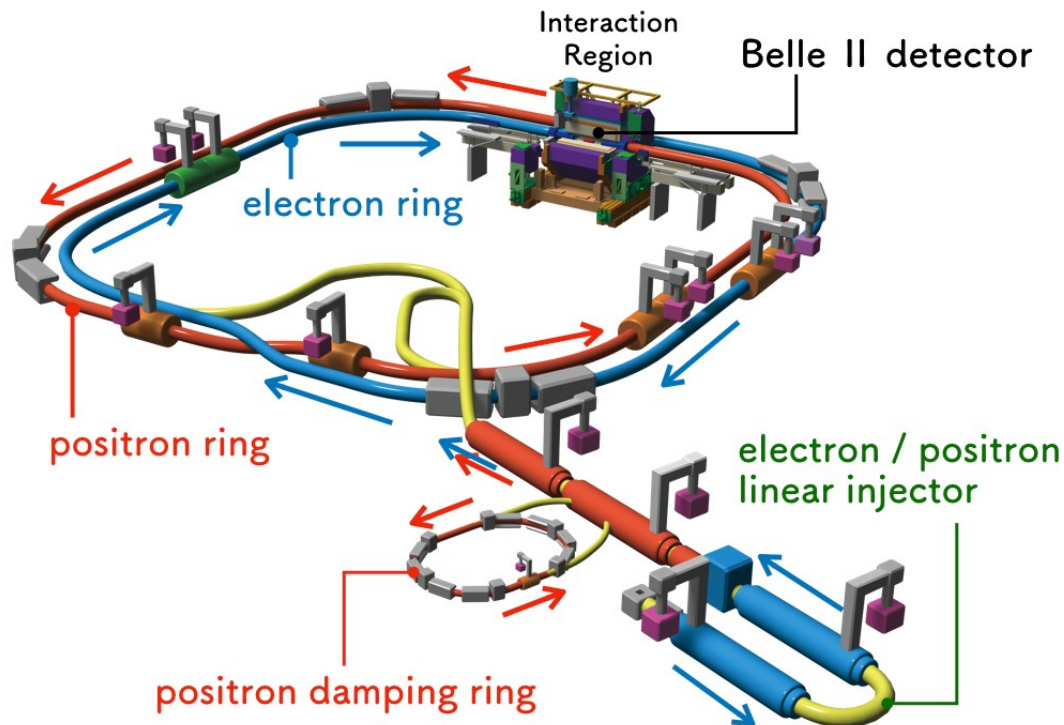
Bundesministerium
für Bildung
und Forschung

Thomas Kuhr, Fabian Becherer,
Andreas Warburton, David Jaffe,
et al.



10.06.2024

Belle II @ SuperKEKB



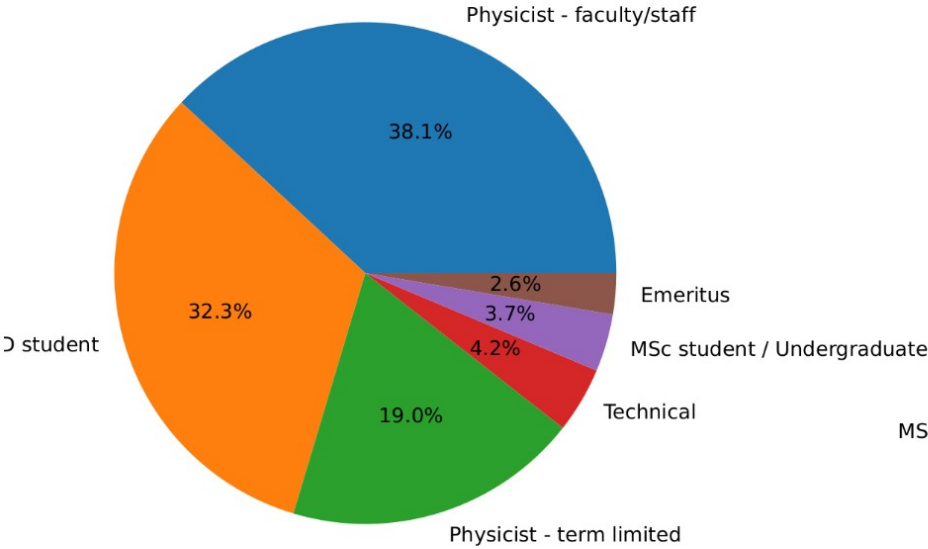
- e^+e^- @ $\sqrt{s} \approx 10.6$ GeV
- Intensity frontier: aim for 50 times more data than Belle
- Study of B mesons, charm hadrons, tau leptons

Sustainability Discussions at Belle II

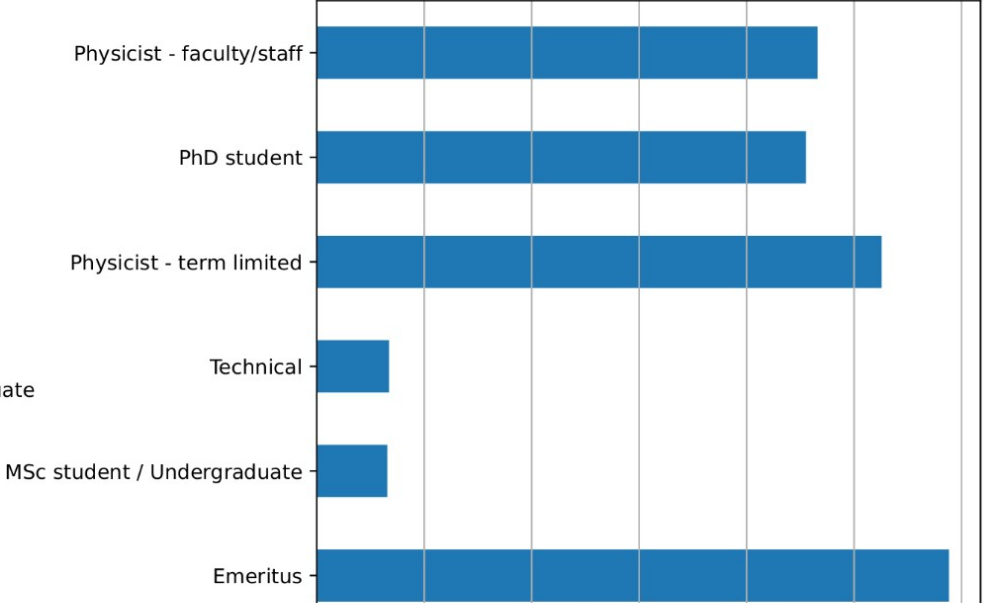
- **23.10.2023**: First discussion in Institutional Board (~Collaboration Board)
- **February 2024**: Survey
- **13.05.2024**: First Belle II Sustainability Meeting
 - virtual at 16:00 JST, 9:00 CEST, 3:00 EDT
 - ~20 participants
- **03.06.2024**: Update at Institutional Board
- **06.06.2024**: Meeting with KEK

189 Survey Participants

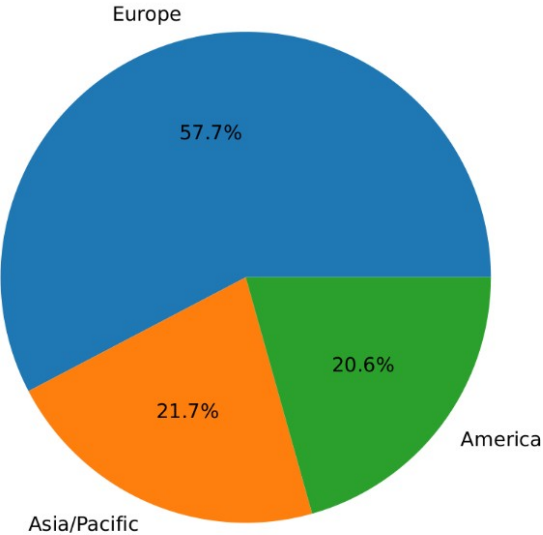
Membership Category



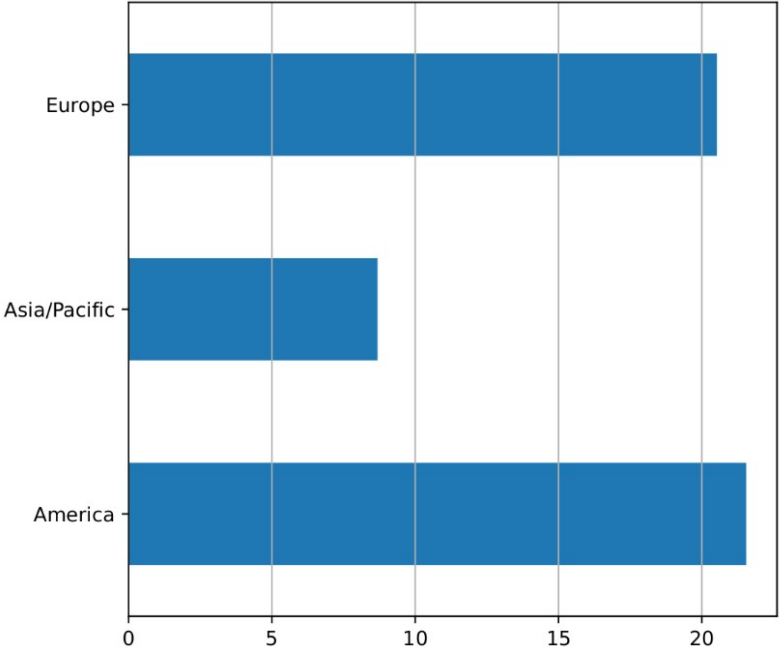
Fraction of active members [%]



Region

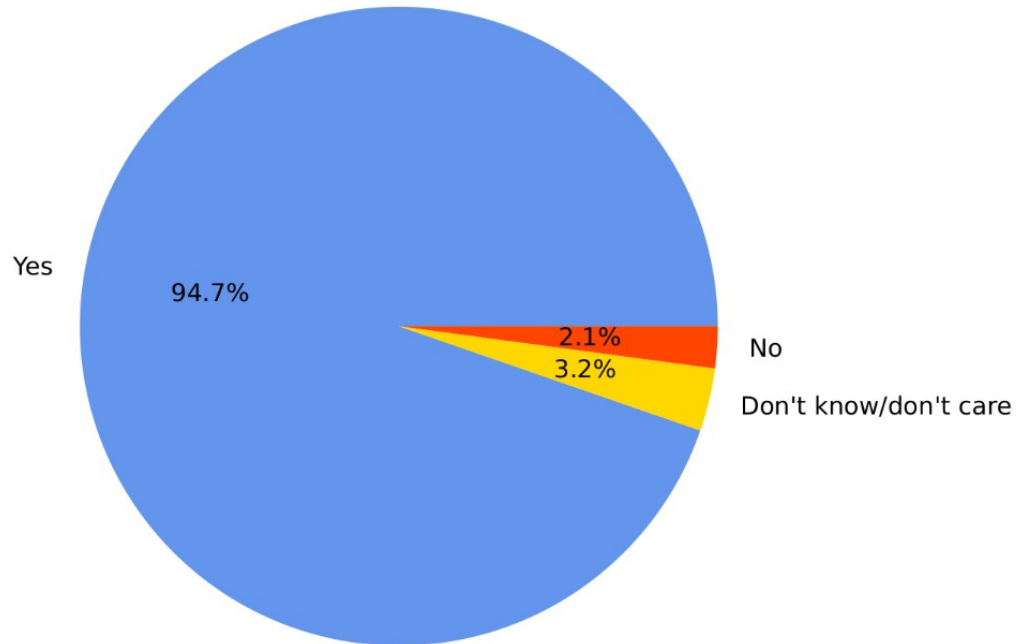


Fraction of active members [%]

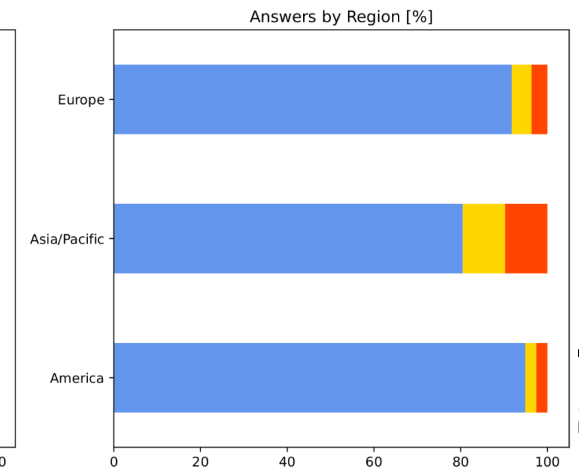
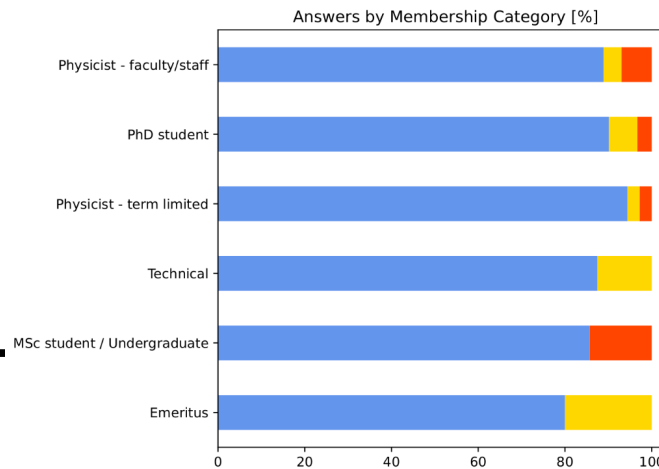
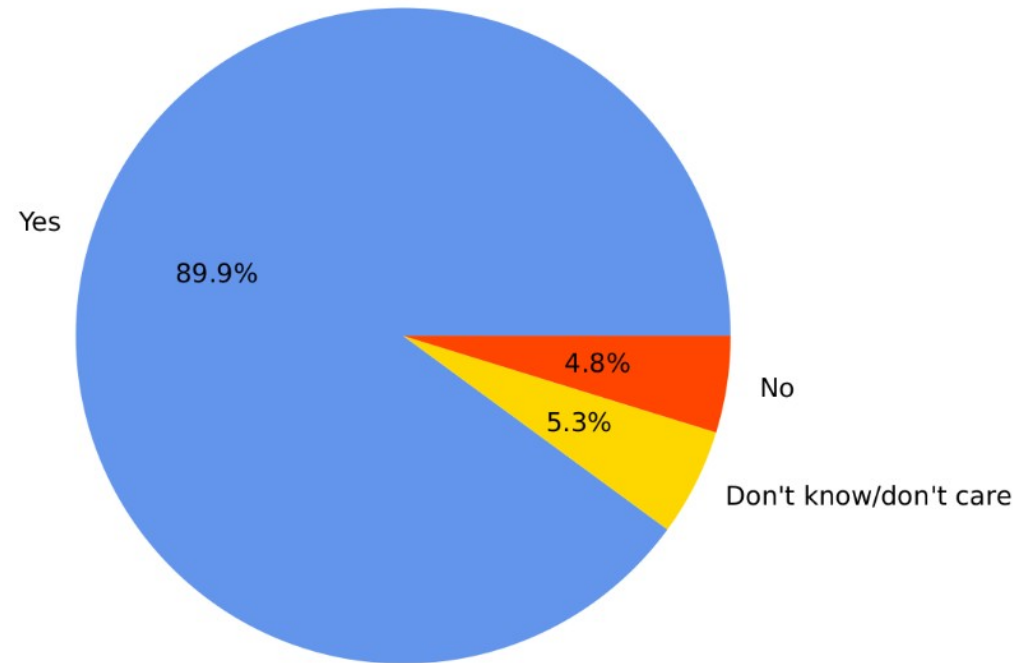


Cause and Urgency

Do you think there is a human caused climate change?

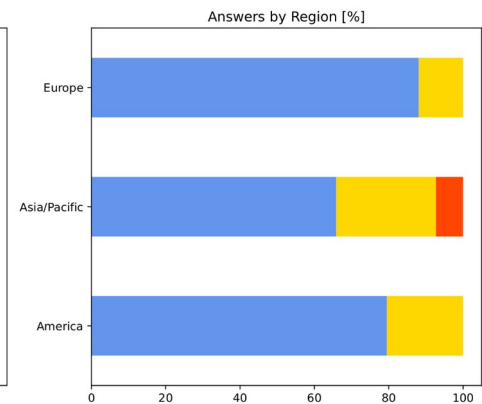
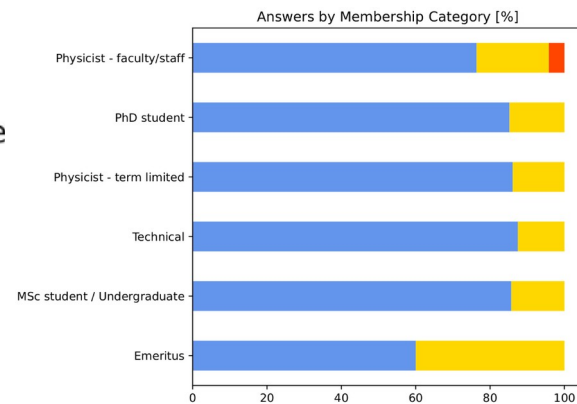
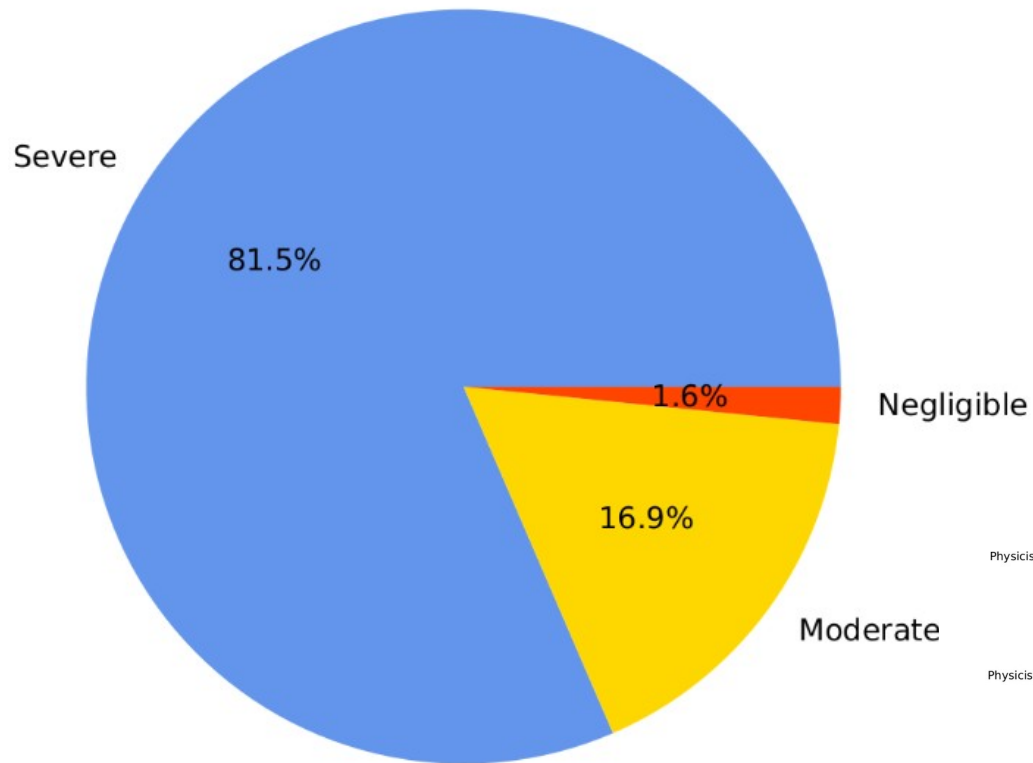


Do you think it is urgent to do something about climate change?



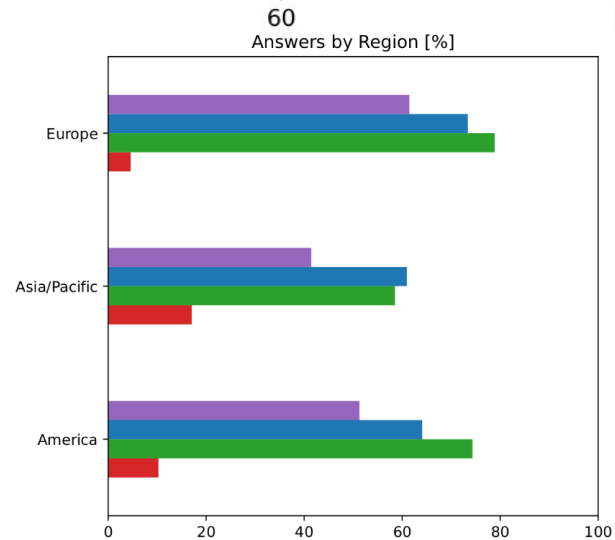
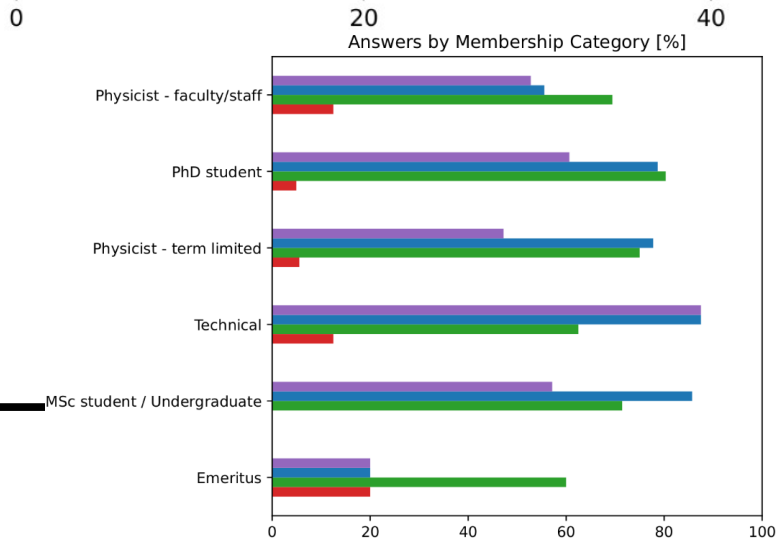
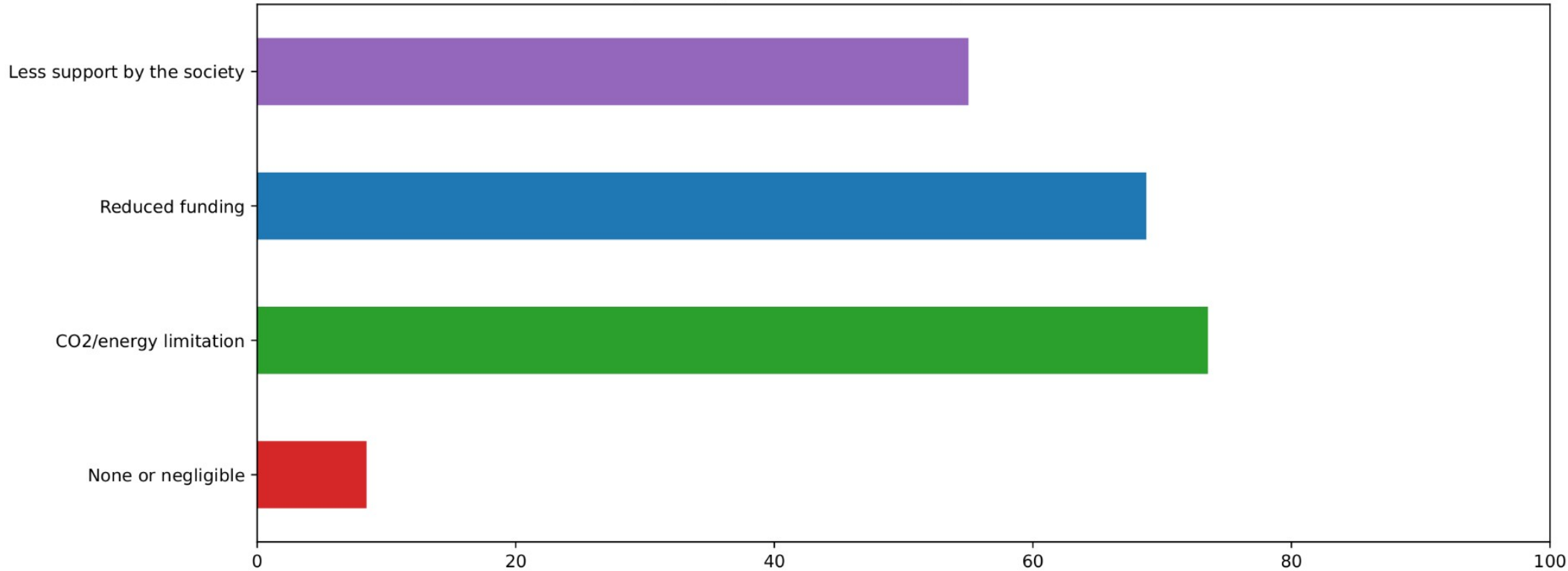
Impact in General

How large do you expect the impact of climate change to be in general?



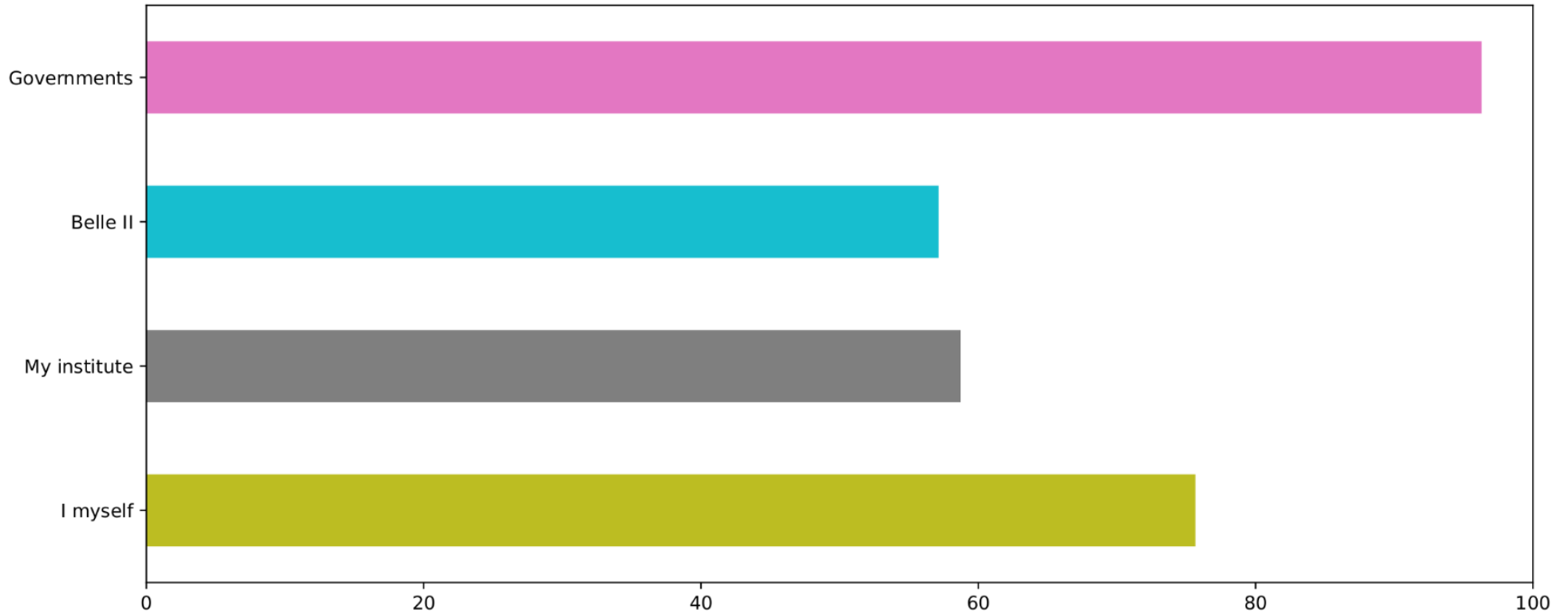
Impact on Belle II

What impact do you think climate change could have on Belle II? [%]

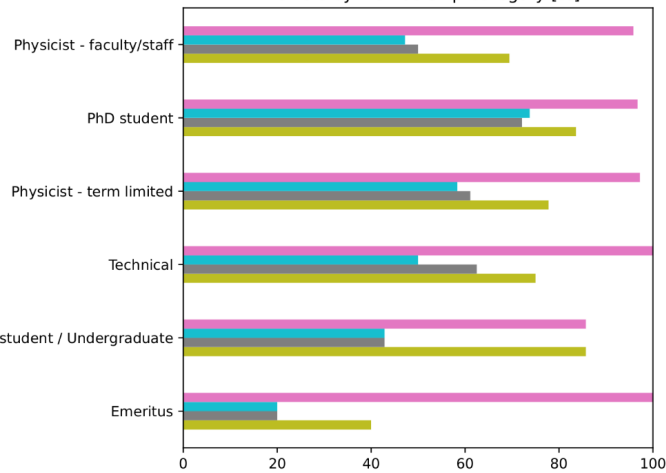


Responsibility to Act

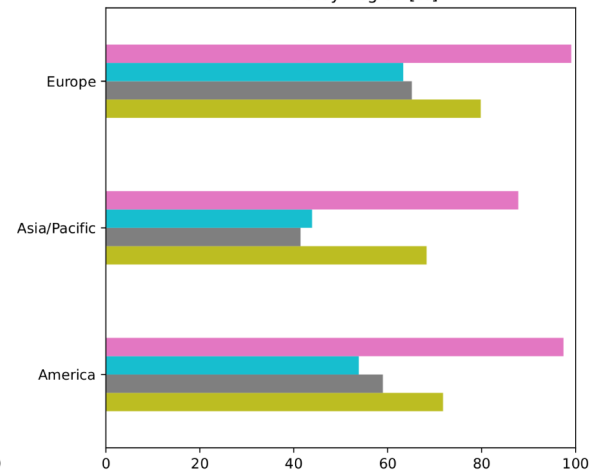
Who should do something against climate change? [%]



Answers by Membership Category [%]



Answers by Region [%]



Survey Summary

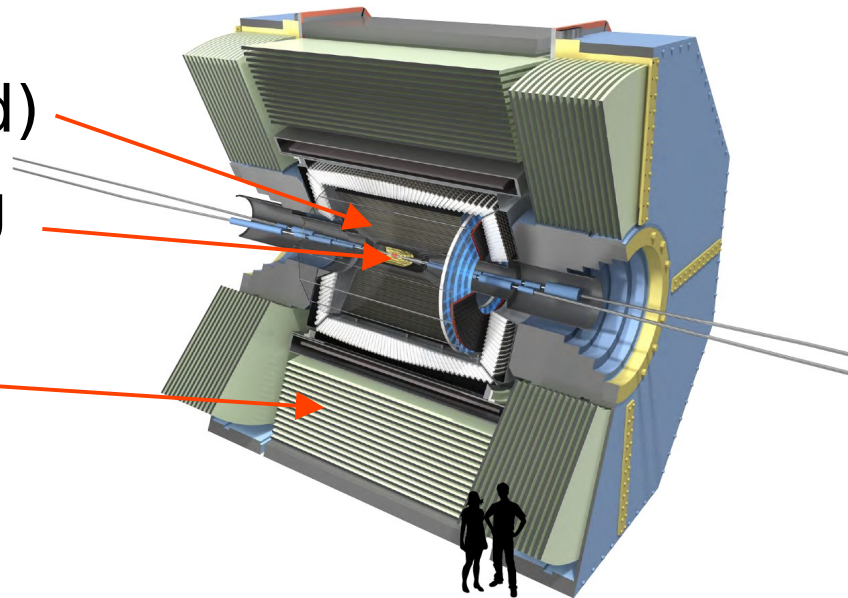
- Good participation
- 51 additional free text comments
- Climate change is a topic in the Belle II collaboration
- Negative impact in general and on Belle II expected
- Main responsibility seen as governments', slight majority sees need for Belle II to act as well

Detector

- Power consumption: ~ 3 GWh/a \rightarrow 1400 tCO₂e/a assuming 0.47 kgCO₂e per kWh for energy mix in Japan

Used gases:

- CDC: ethane gas (mostly circulated)
- VXD cooling: CO₂ (circulated during operation, evacuated at shutdown)
- KLM: C₂H₂F₄ \rightarrow ~ 2000 tCO₂e/a



Discussed ideas:

- Monitor impact of gas leaks, investigate recirculation
- Consider greenhouse gas footprint of upgrades

Computing

- Assuming 500 W per kHS06
→ ~1 GWh/a
(ATLAS+CMS: ~35 GWh/a)

Discussed ideas:

- CO₂ footprint in yearly computing accounting
- Footprint report for user jobs
- Option to consider site energy mix in job scheduling
- Systematic software optimization

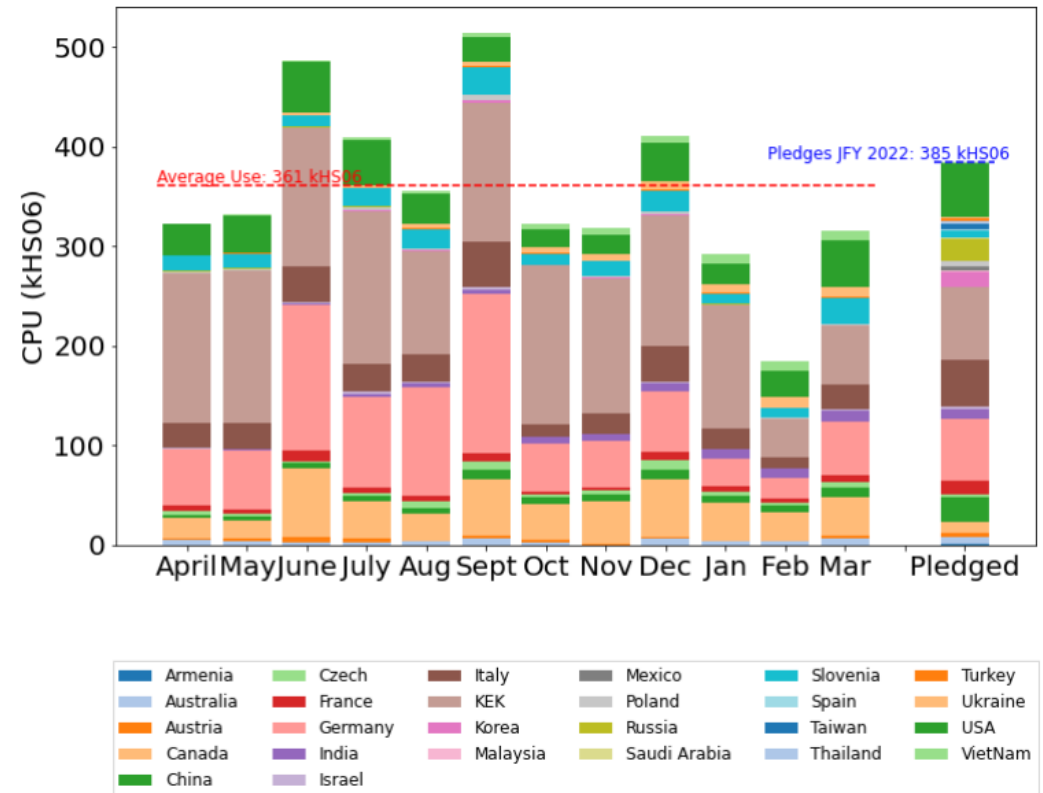
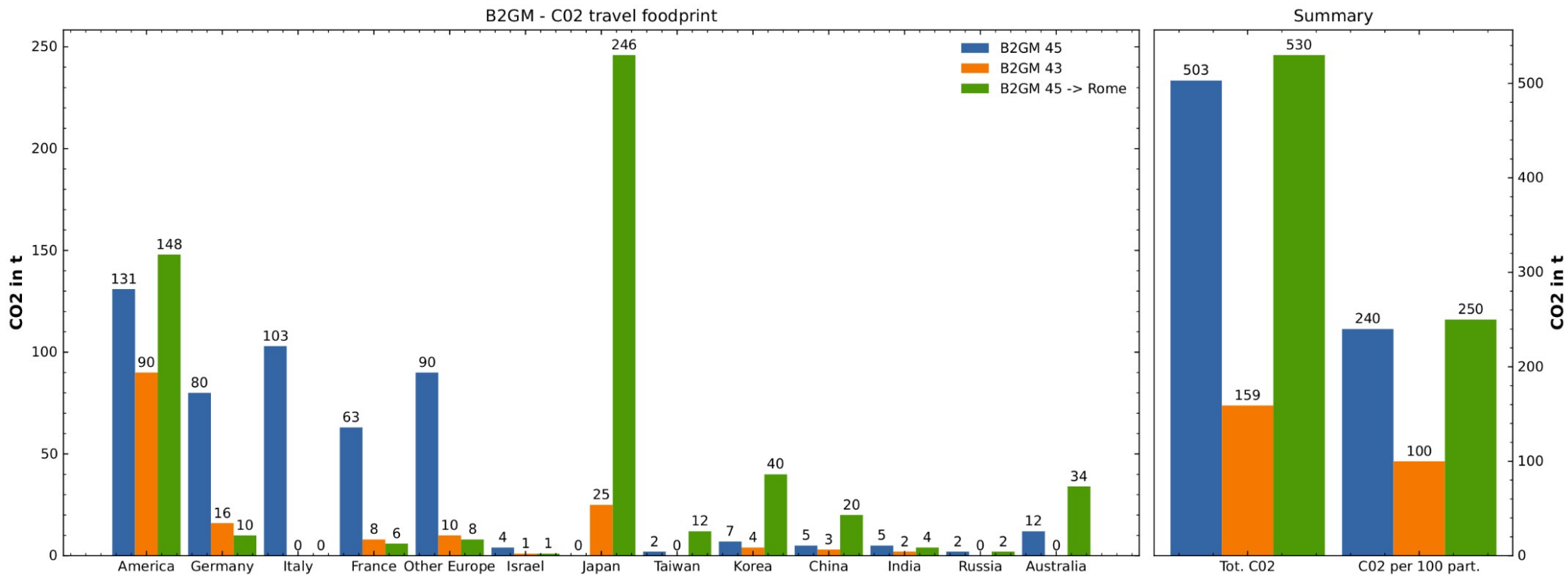


Figure 1: CPU power per month (in kHEPSpec06) used in different countries during 2022, including both grid and local resource usage.

Travel

- Estimate of footprint of air travel to Belle II collaboration meetings (B2GM) assuming direct flights from home countries and using calculation from www.myclimate.org
- B2GM 45 in June 2023 in Tsukuba, Japan,
B2GM 43 in October 2022 in Rome, Italy,
Assuming participants of B2GM 45 travel to Rome



Travel

Discussed ideas:

- Consider one B2GM per year abroad
- In general more consciousness about reasons for travel and efficient use of in-person meeting time
- Collect (air) travel information at B2GM registration
- Estimate impact of travel for shifts and conferences before considering more detailed data collection
- Give preference (e.g. earlier opening of shift booking) to those who stay longer at KEK for shifts

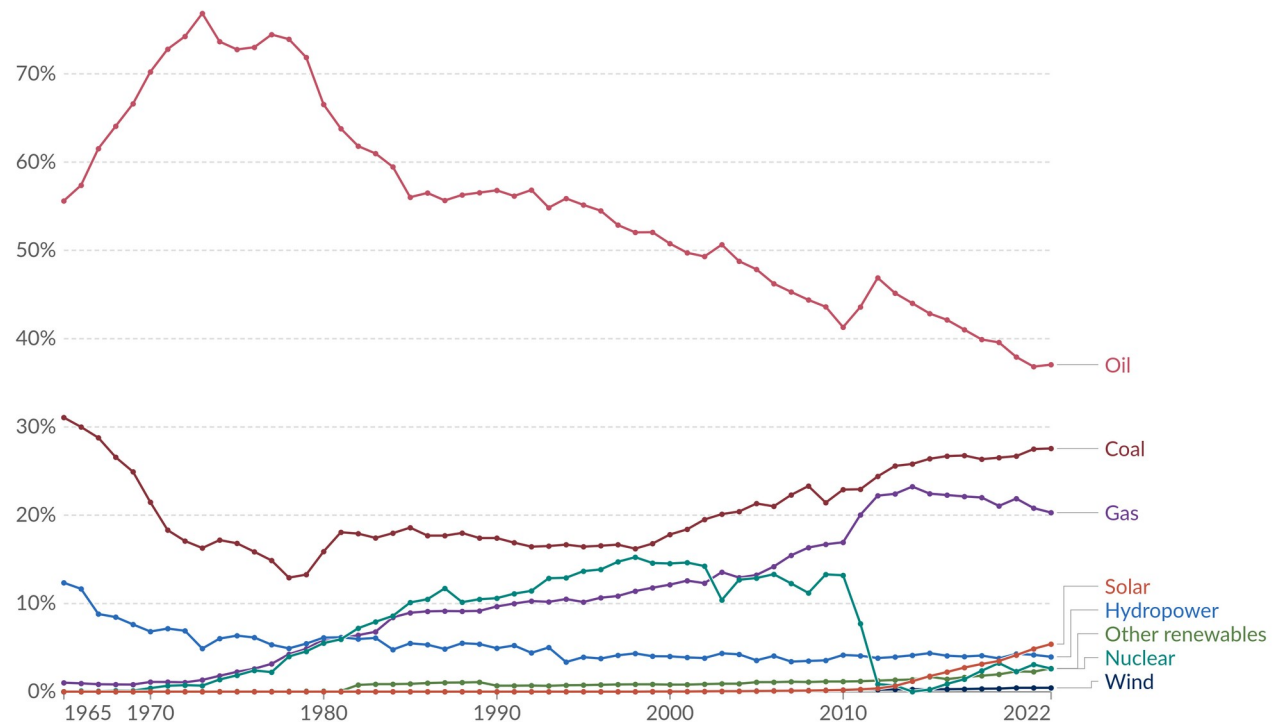
Accelerator / KEK

- Main impact from power consumption
- Several measures, e.g. solar panels on site and reuse of heat, are considered
- Japan wants to be carbon neutral by 2050

Share of energy consumption by source, Japan

Measured as a percentage of primary energy¹, using the substitution method².

Our World
in Data



Data source: Energy Institute - Statistical Review of World Energy (2023)

OurWorldInData.org/energy | CC BY

- Increasing interest in sustainability in the Belle II collaboration
- Grassroots initiative started
- Several ideas collected
- Organizational structure being discussed
- Looking forward to exchange and collaboration with corresponding initiatives at other experiments