5th and Final Project Meeting

Denise Völker (DESY) on behalf of WP11

WP11 Overview

task 1: **Sustainable Concepts for RIs**: networking, workshops on selected topics
deliverable: report

a. System Efficiency of Accelerator Concepts (N.Catalan Lasheras, CERN)
b. Key Technologies and Components for High Efficiency (A.Sunesson [C.Martins], ESS)
c. Cross Linking Accelerator R&D with Industrial Approaches (P.Spiller, GSI)
d. Ecological Concepts (D. Voelker, DESY)

task 2: **High Efficiency Klystron** (N.Catalan-Lasheras CERN, THALES, ULANC)

- deliverable: industrial prototype
- replacing klystrons in LHC

task 3: **Permanent Combined Function Magnets for Light Sources** (B.Shepherd, UKRI, DLS, KYMA, DESY)

- deliverable: magnet prototype, applicable for Diamond upgrade
- several advantages of permanent magnets, not just power consumption

See talks by Nuria

At last IFAST meetings

Efficient RF Systems, Toledo, September 2024 (Nuria Catalan-Lasheras, Igor Syratchev) https://indico.cern.ch/event/1407353/

	TH2167	TH2167HE
Power [kW]	**300**	**350**
Frequency [MHz]	400.8	400.8
Gun microPerveance	1.65	1.65
Beam microPerveance	0.7	0.7
Cathode voltage [kV]	58	58
Anode Voltage [kV]	≤35	≤35
Beam current [A]	**8.5**	**9**
Efficiency [%]	**60**	**≥65**
Gain [dB]	≥37	≥37
Bandwidth [MHz]	**±1**	**±0.7**
Group delay [ns]	**130**	**≤250**

See talk by Ben and Alex

Tomorrow 11.30

The HEPTO Prototype: Final results and outlook

WP11 Task 1a - Efficient RF Sources

- RF power consumption sizable fraction of the total value
- 2 workshops - Parts and system

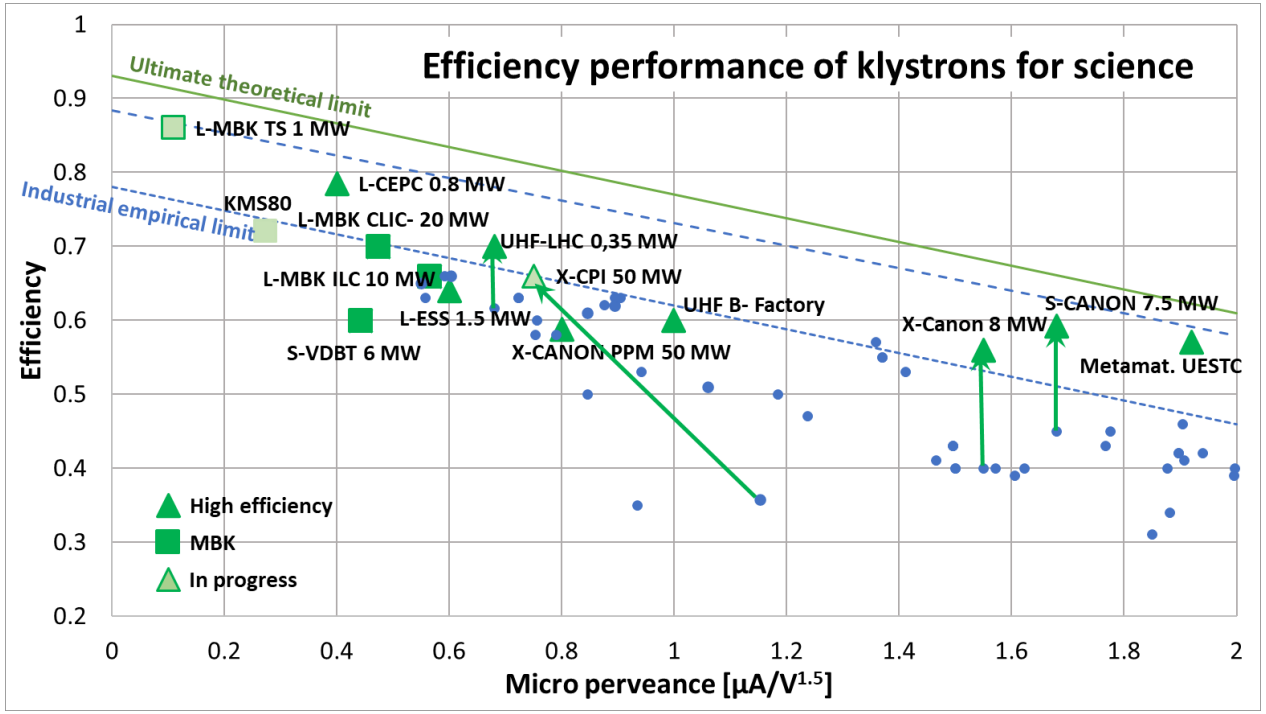


Figure 1: Beam power to RF efficiency of klystrons used for science against their microperveance. Traditional tubes are shown as blue points while new designs focusing on high efficiency are shown in green, Light green filled symbols represent prototypes still in production

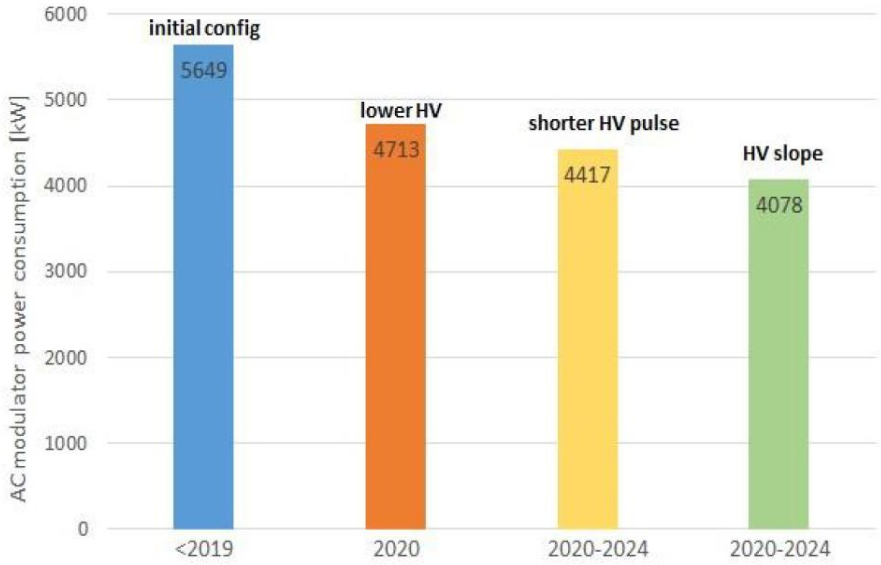


Figure 2: AC consumption of RF stations in kW in XFEL after several improvements in operation

WP11 Task 1b – Power Conversion

As estimates show, saving up to 500 MWh per year is possible for 10 MW installed peak power.

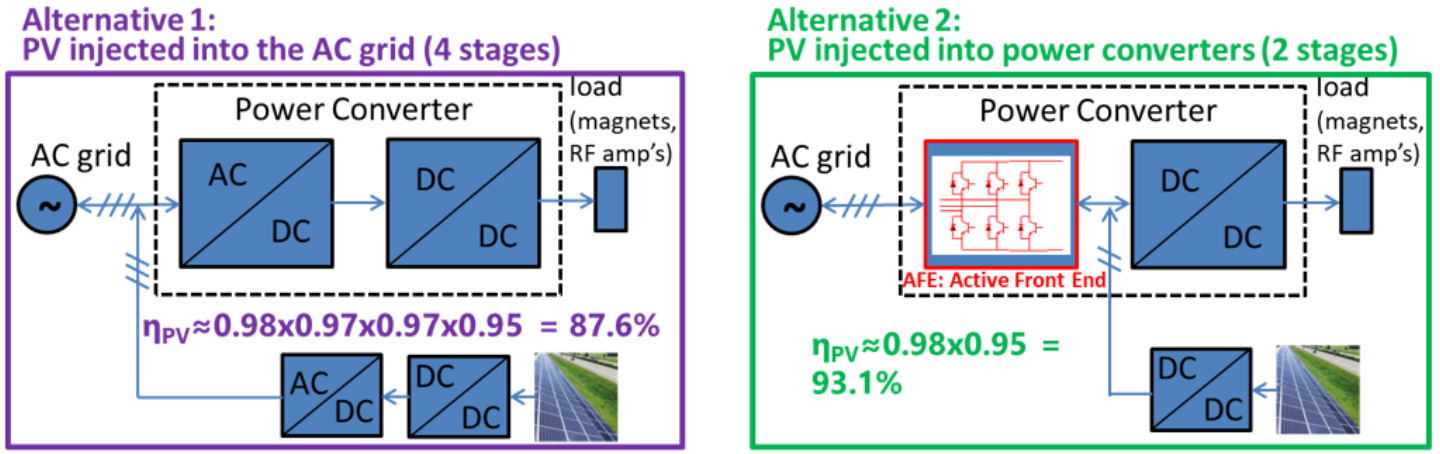
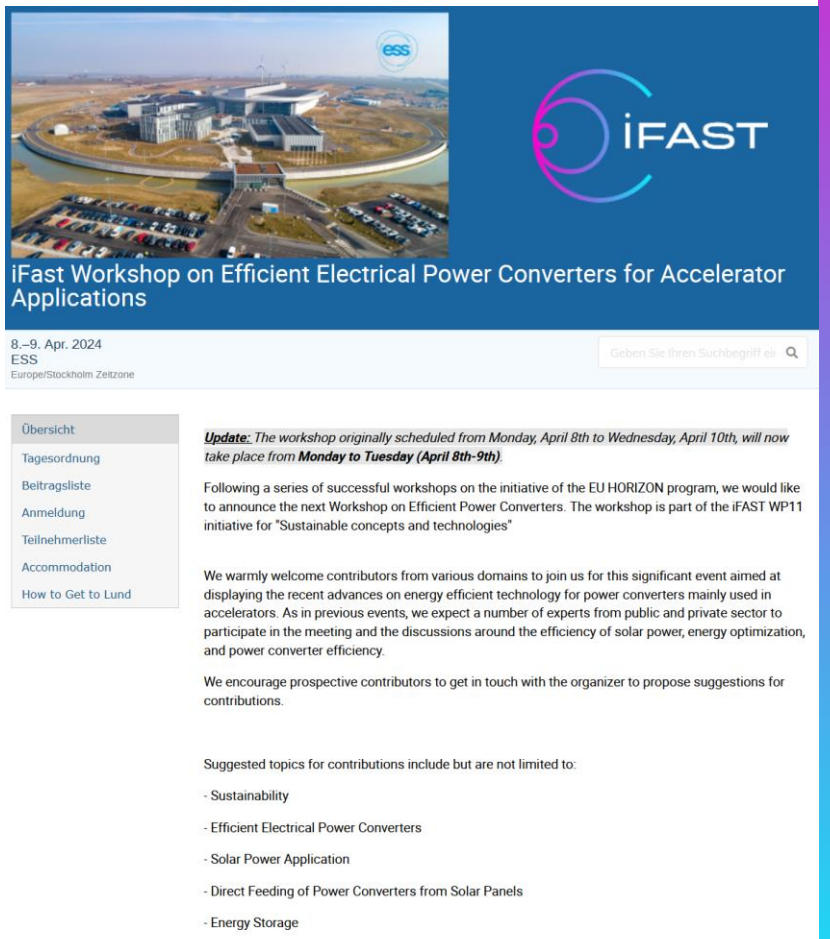


Figure 9: Example of how PV direct injection could save power (for example [4], Sunesson et al)



Conversion:

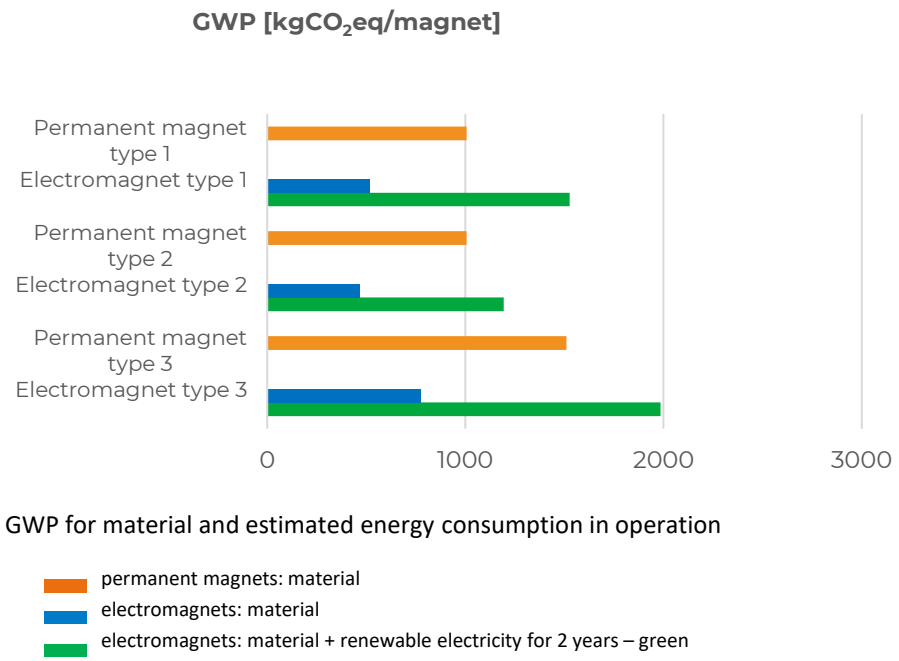
- PV – AC/DC
- Waste Heat
- ….

WP11 task 1c – Superconductivity with focus on industry

- development of high-tech products requires long-term cooperation and the early involvement of industry
- suitable adjustments to the legal framework conditions are useful
- → working group of the I.FAST program

WP11 task 1d – Permanent Magnets and the question of Rare Earth Elements (REE)

Permanent magnets in PETRA IV will save **2,87 GWh/year**



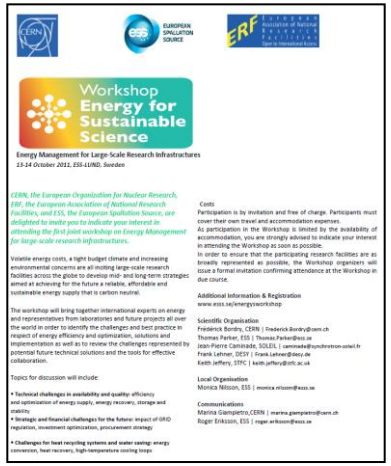
Rare Earth mining and processing

Workshop at DESY
6th-8th February 2023

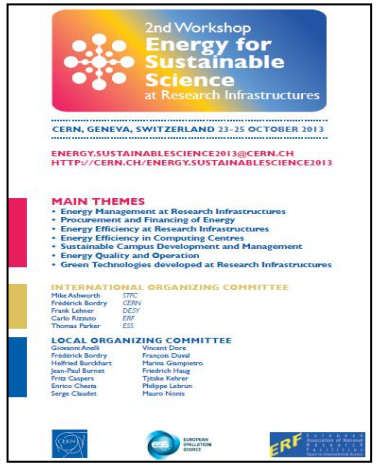
WP11 Task 1 - other

Goals:

- Energy management,
- Stimulate initiatives, coop amongst institutes
- Identify and share good practices,
- Energy efficiency, Storage and savings
- Identify technologies developed by RI and transferable in the field of energy and sustainability



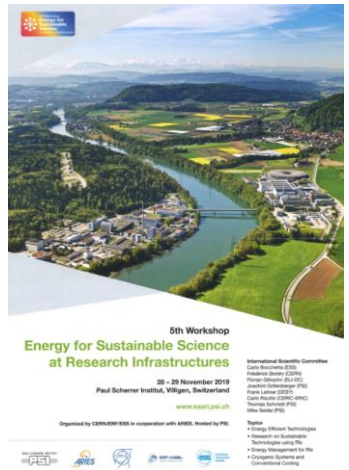
2011: ESS
Lund - Sweden



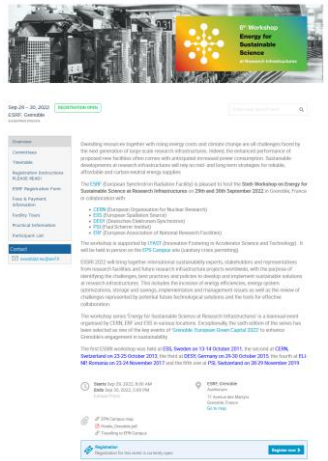
2013: CERN
Geneva - Switzerland

2015: DESY –
Hamburg - Germany

2017: ELI-NP
Bucharest - Romania

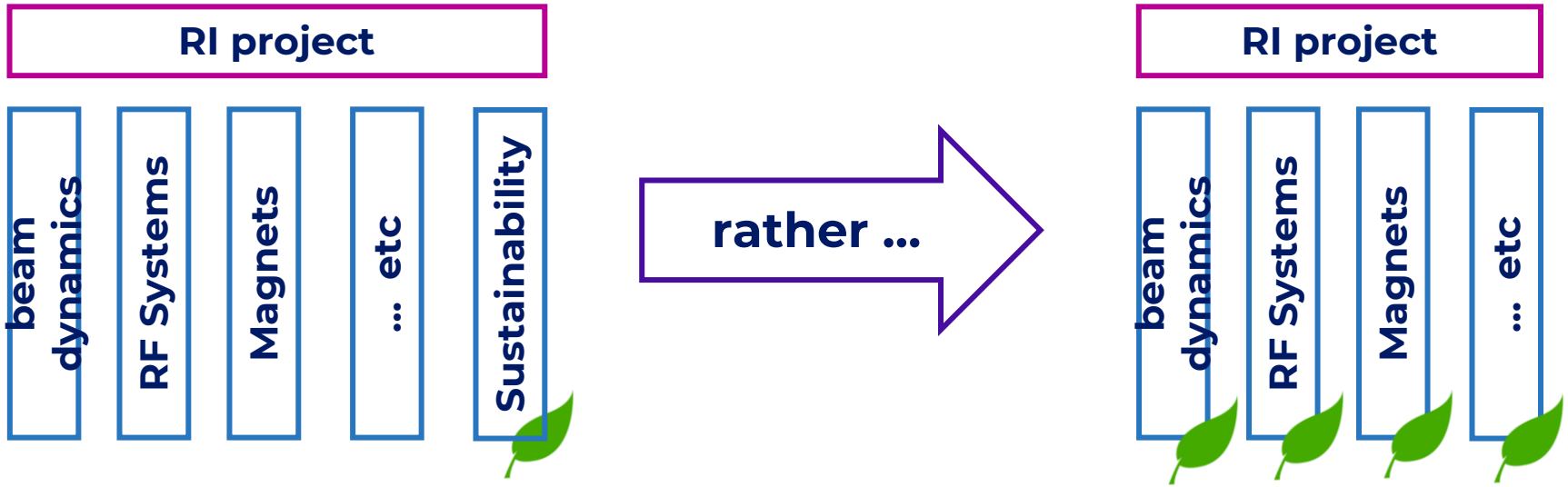


2019: PSI
Villigen - Switzerland



2022: ESRF
Grenoble - France

Integrating Sustainability



Competences specific to accelerators must be used to improve efficiency and other sustainability aspects. The accelerator community **will not solve societal challenges such as low-carbon concrete or energy production**.

For RI's, science quality and quantity must remain paramount. Sustainability needs to be balanced against cost and operational complexity. Synergies are welcome, e.g. energy = cost.

Sustainability Outlook «Footprinting»

- many evaluations and agreed motivation to develop these approaches further and to design science specific methods

to be agreed upon:

- Assessment of materials: Scope? What is relevant?
- What kind of assessment? (footprint vs. lifecycle, GHG vs. environmental vs. social)
- Which metrics to use? (databases, software, conversion) also: LDG WG colliders
- Available data? Assumptions to be made?
- Standards: Greenhouse gas protocol vs. DIN norm vs. EMAS?

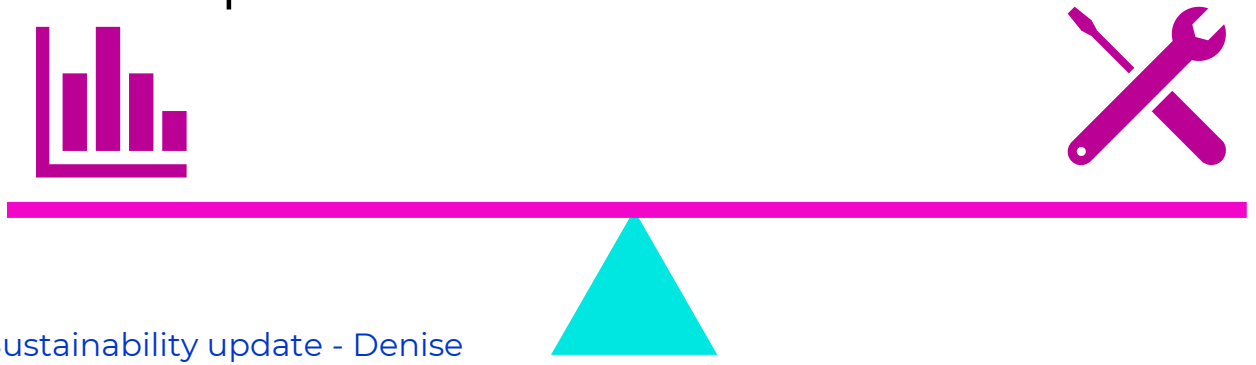
- careful interpretation of results
- Balancing with other criteria

Sustainablity Outlook

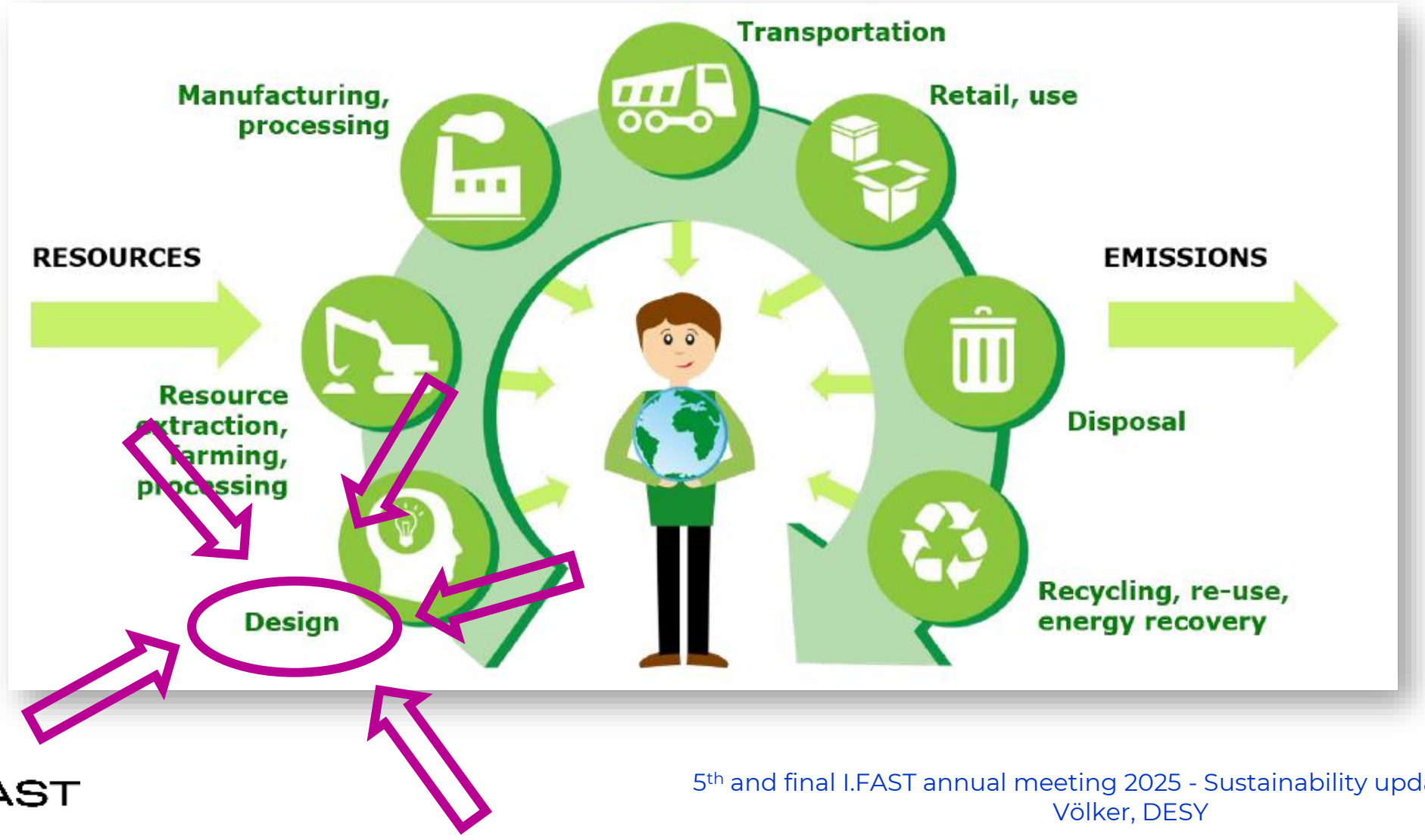
Balanced and pragmatic approach

- “Footprinting” of relevant aspects

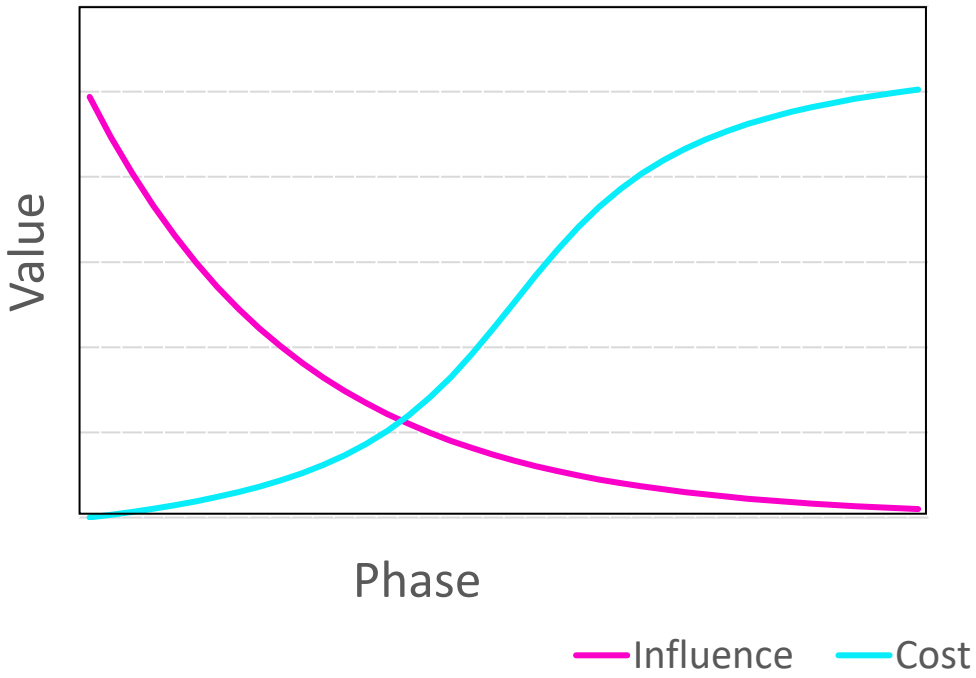
- Design for Sustainability (footprint, repairability, recyclability)
  - best practices technology
  - Integrated system-wide view
  - technology transfer, industrial production



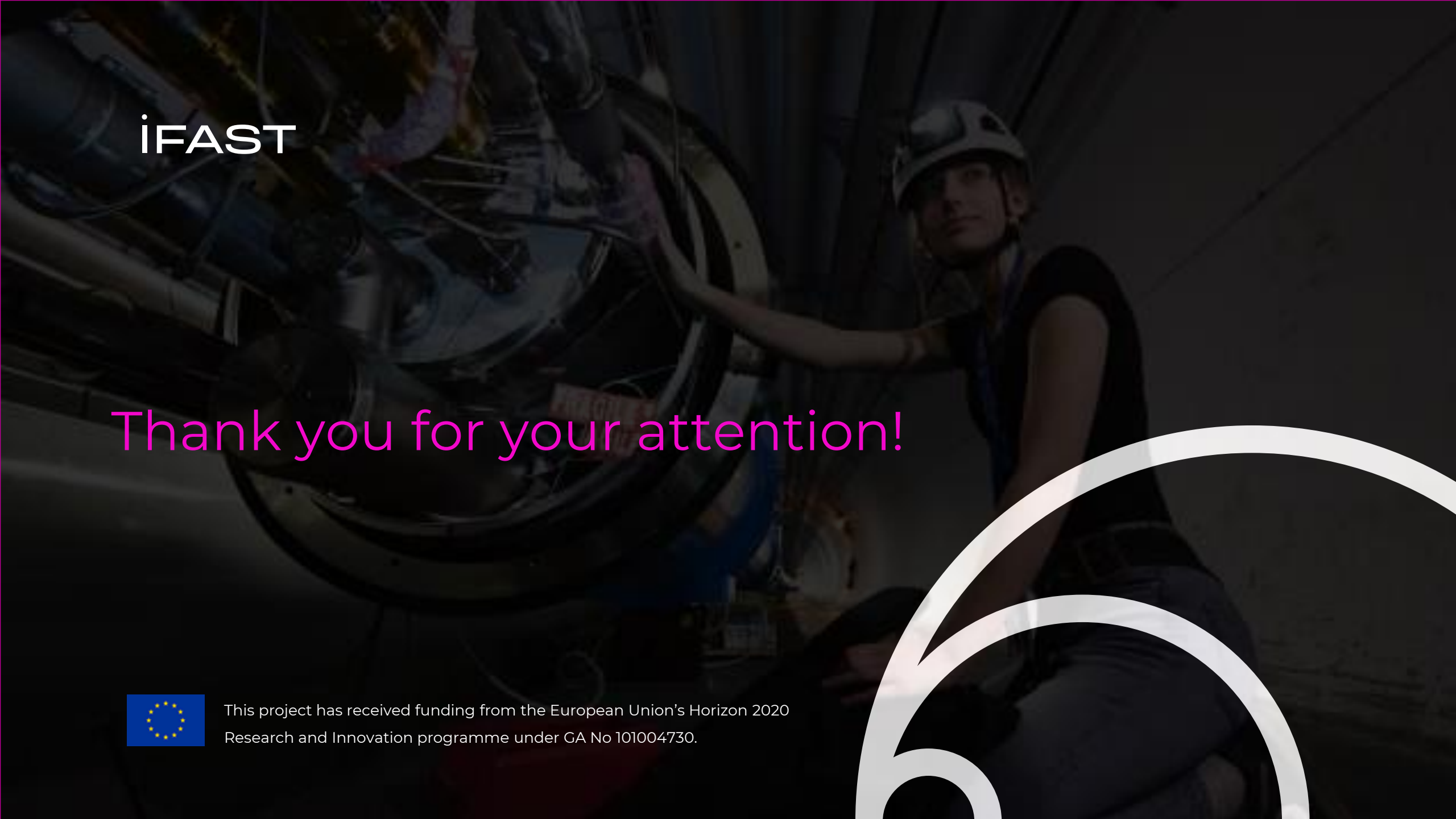
Assess the complete life cycle



Every life cycle starts with the first idea



TOGETHER WE ARE SUSTAIN ABLE.



Thank you for your attention!

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