

WP4: Access to Research Infrastructures for Detectors

EURO-LABS FINE, June 29th, 2026

Marko Mikuž

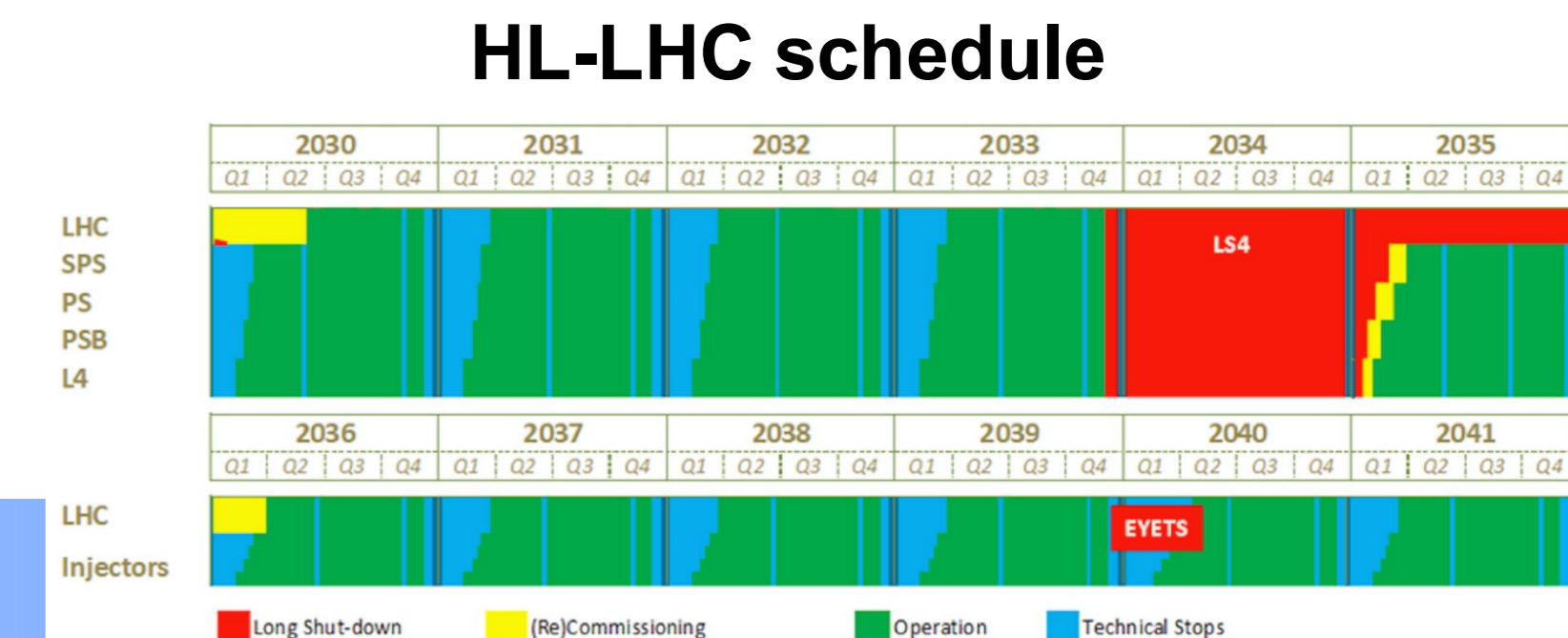
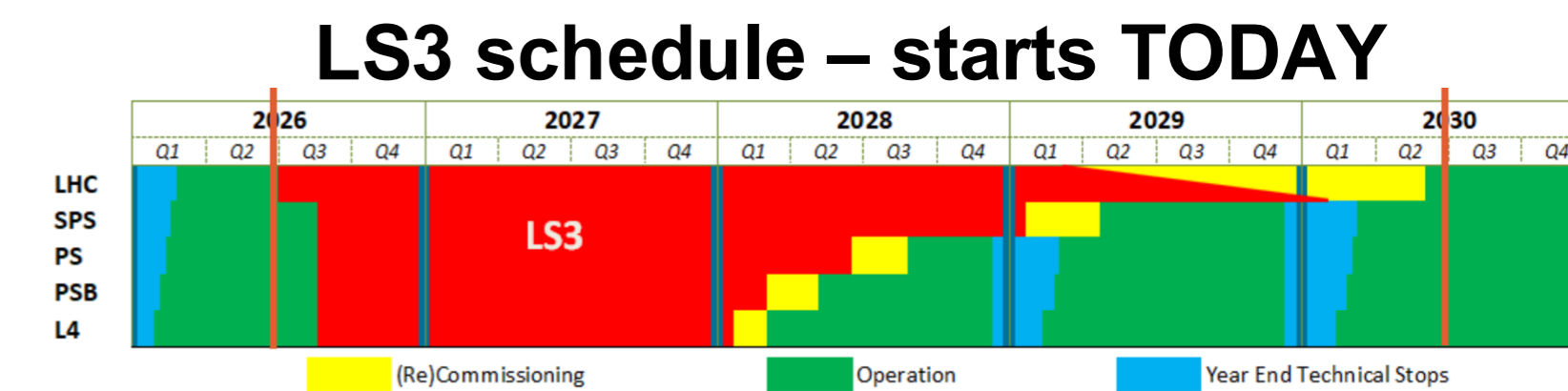
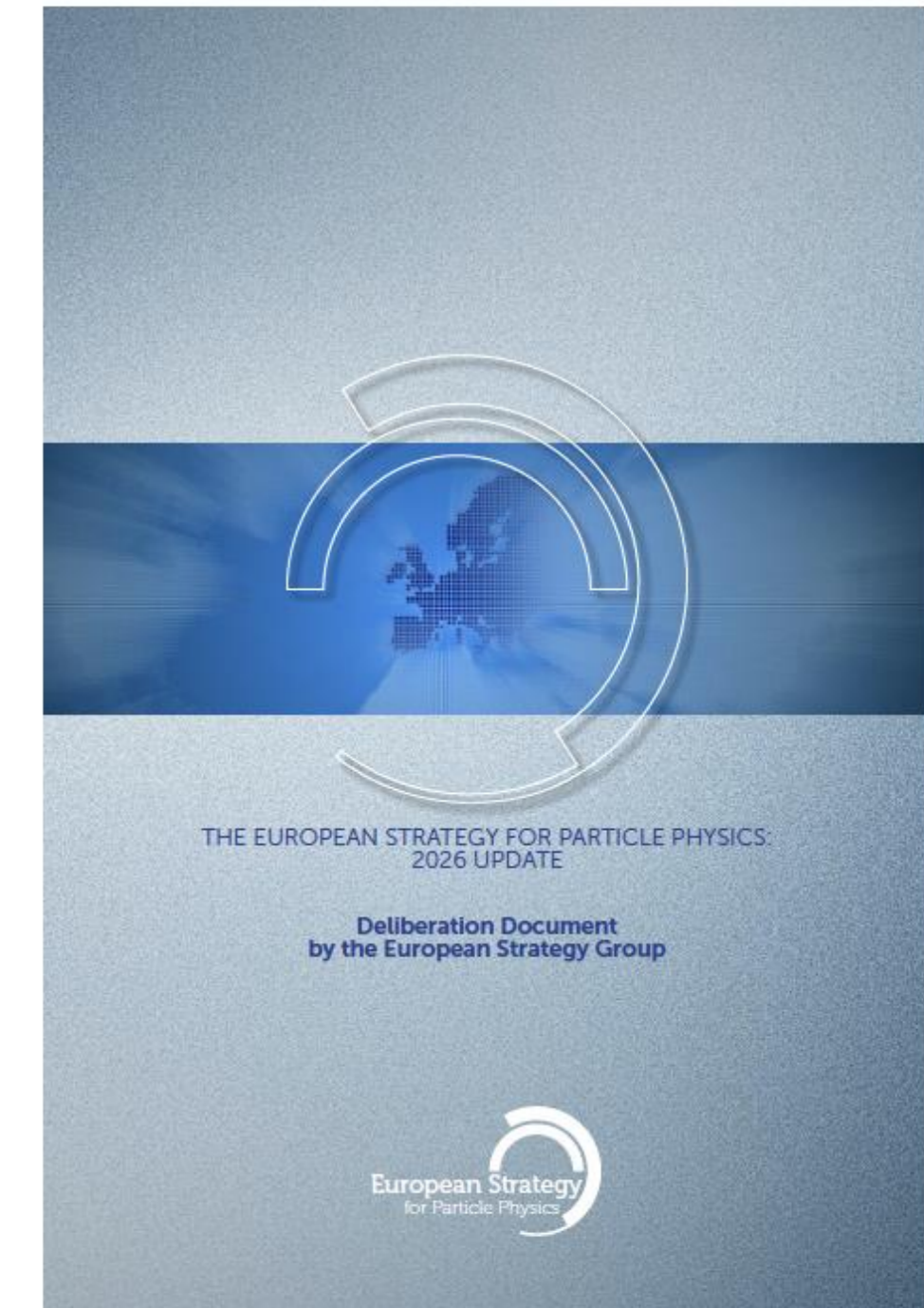
University of Ljubljana and Jožef Stefan Institute, Ljubljana, Slovenia



This project has received funding from the European Union's Horizon Europe Research and Innovation programme under Grant Agreement No 101057511.

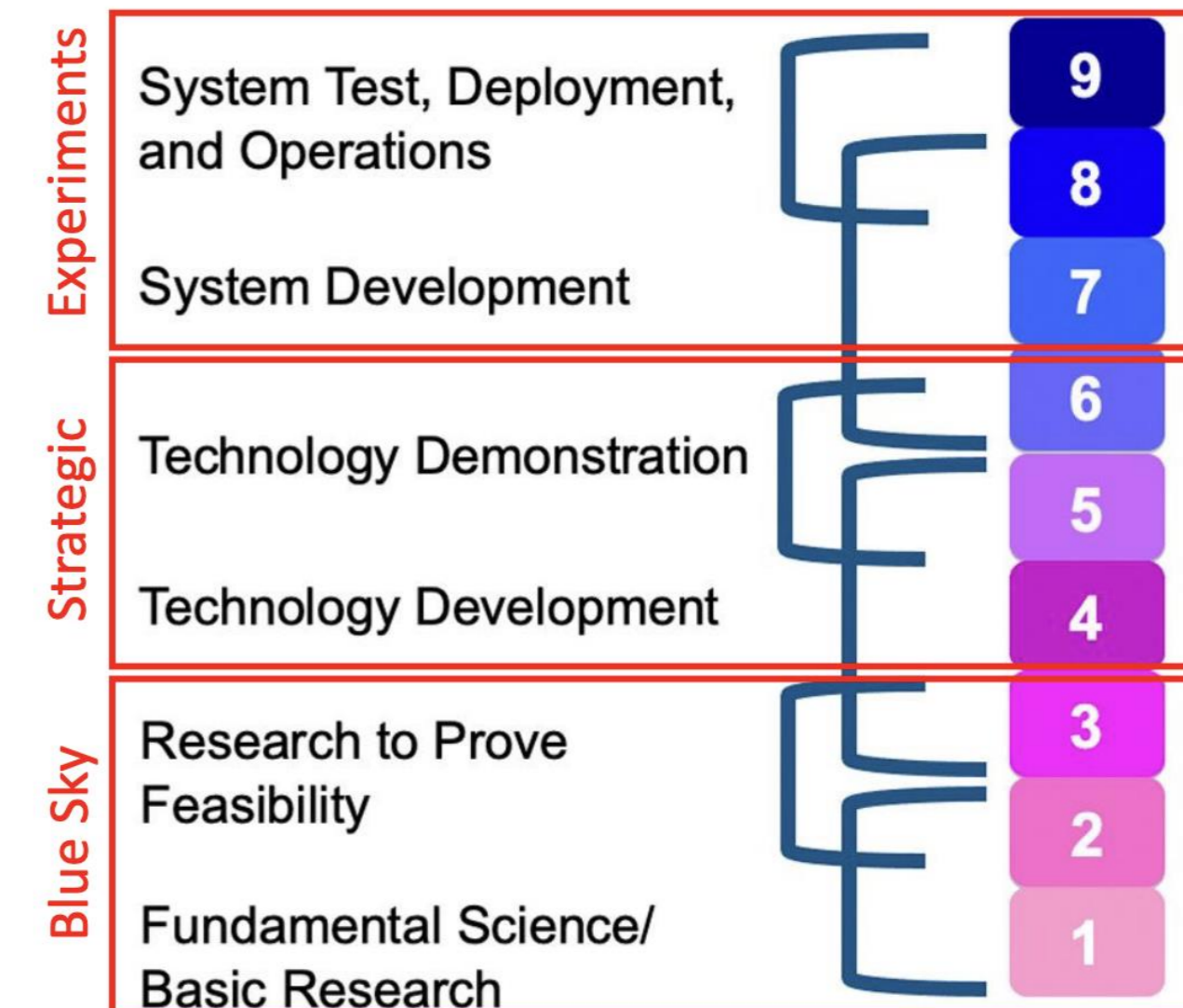
Placing of WP4 in European Detector R&D (present)

- Core detectors endeavour in HEP today - construction of upgraded detectors for operation at the **HL-LHC** at CERN
 - In line with the stipulations of the **2026 Update of the European Strategy for Particle Physics** (ESPP) deliberations – “*The full exploitation of the physics potential of the LHC and the HL-LHC and the completion of the high-luminosity upgrade remain the highest priorities of European particle physics.*”
 - Associated detector R&D almost entirely finished, large orders placed, construction activities are well under way with persistent schedule pressure
 - Expected load on WP4 – very few remaining parts of late R&D, like bPOL reprocessing
 - Main load driven by sensor QA activities to monitor production quality – not serviced by EURO-LABS
 - Production Readiness Review adopted as the dividing line – allow QA of preproduction (~5%)
- Exception to the grand picture - inner tracker part of ATLAS and CMS
 - No solution found to survive the entire HL-LHC lifetime
 - Replace the inner pixel detector at mid-point after ~2/ab of integrated luminosity, though no appropriate Long Shutdown in the current schedule
 - Existing detector solution could serve as a viable replacement, but R&D for technologically more advanced detectors are being pursued vigorously
- LHCb and ALICE - major upgrades in LS4
 - Radiation load to LHCb detectors - close to the inner parts of ATLAS&CMS trackers; their R&D in obvious need of EURO-LABS WP4 RI's.
 - ALICE Inner Tracker System – design closest to FCC-ee vertexing specs



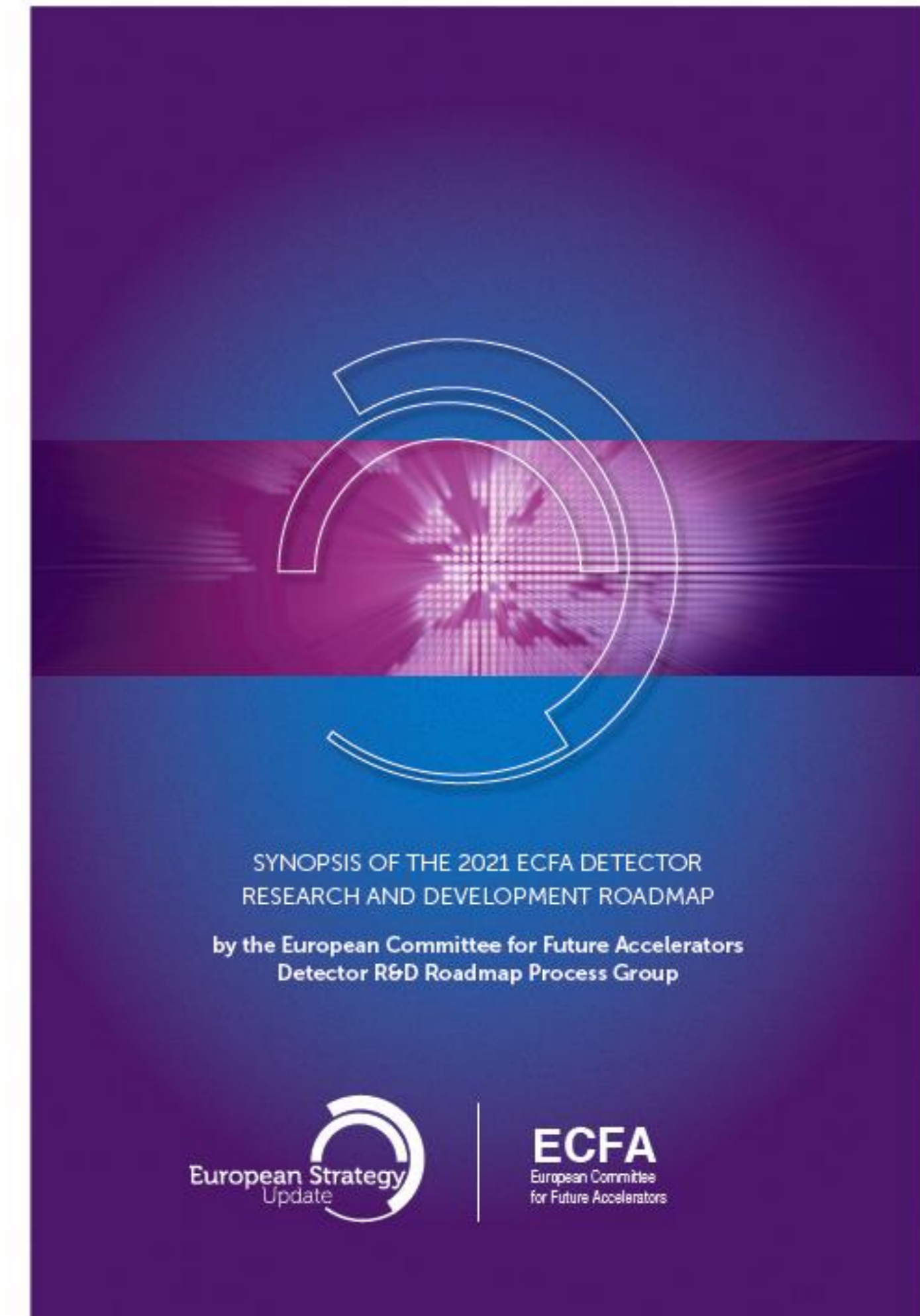
Placing of WP4 in European Detector R&D (future)

- The **2026 ESPP Update** pin-points the next flagship project at CERN
 - ***“The electron–positron Future Circular Collider (FCC-ee) is recommended as the preferred option for the next flagship collider at CERN.”***
 - For the longer term: ***“The FCC-ee would also pave the way towards a hadron collider reusing the tunnel and much of the infrastructure, providing direct discovery reach well beyond the 10 TeV parton energy scale, in line with the community’s ambition for exploration at the highest achievable energy.”***
 - Keynote talk by Paris Sphicas on Tuesday afternoon
 - Detector R&D for these two goals worked out in the **EFCA Detector R&D Roadmap** executed by **CERN DRD collaborations**.
 - Unlucky enough no EC funded detector R&D project, AIDAInnova finished
- Development cycle towards the use of a new technology in detectors spans over 10 to 20 years.
 - **prospective** detector R&D (“Blue Sky” research) – TRL 1
 - **strategic** detector R&D, according to known needs of future projects – TRL 2-5
 - **focussed** detector R&D of approved experiments – TRL 5-7
- These detector development phases - supplemented by providing access to the RI’s of EURO-LABS WP4

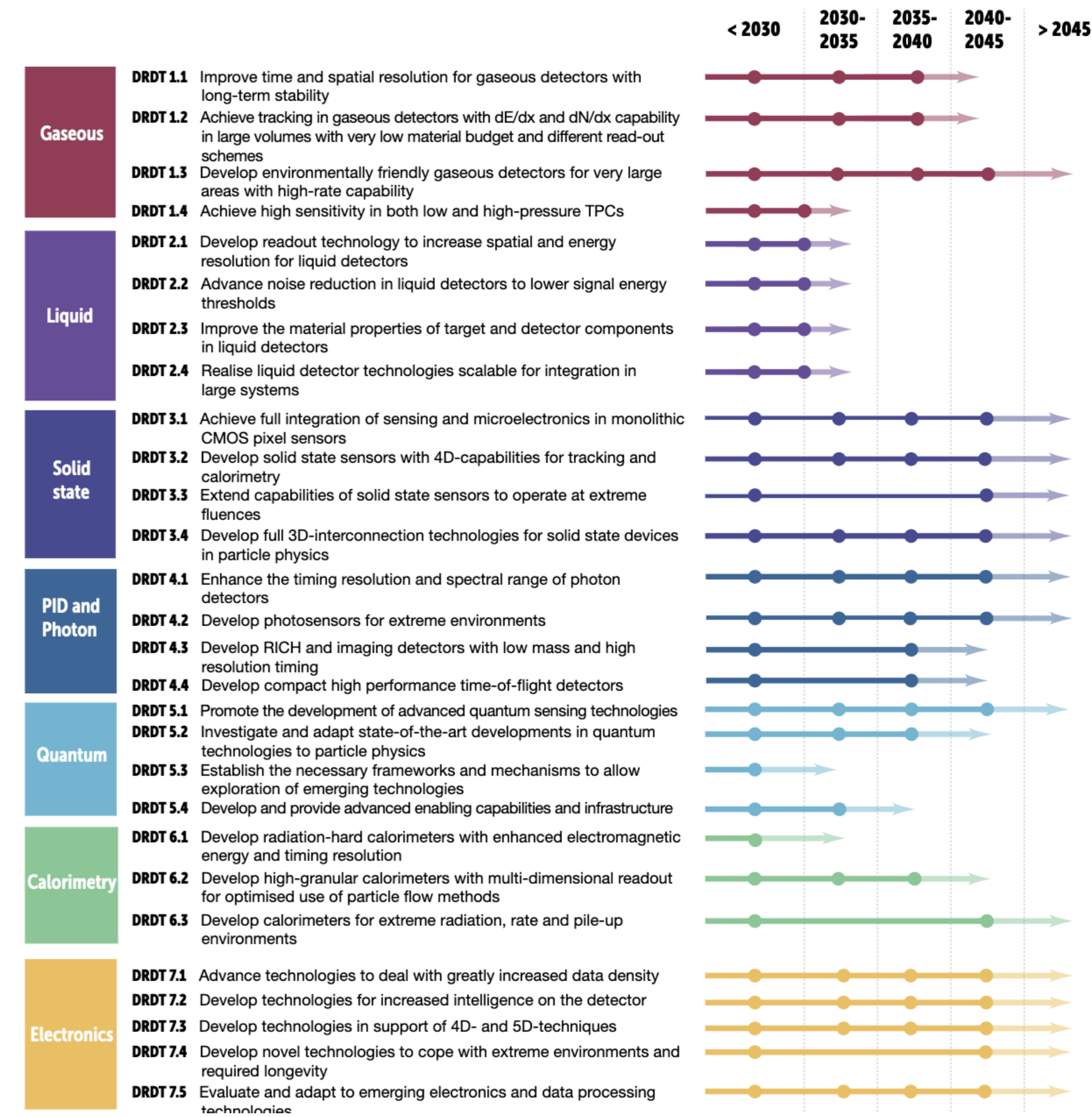


Placing of WP4 in European Detector R&D (future)

- Major support of EURO-LABS WP4 for **FCC-ee** detectors
 - Test Beams (WP4.1) and Detector Characterization (WP4.2) tasks
 - Radiation load is relatively small
 - Still testing at low levels of radiation & checking for single event effects
- Detector studies aimed at **FCC-hh**
 - Detectors at **FCC-hh** - highest radiation levels (after 30/ab)
 - Forward calorimeters : 5000 MGy and $5 \times 10^{18} n_{eq}/cm^2$
 - Innermost layer of the barrel vertex detectors $\sim 1 \times 10^{18} n_{eq}/cm^2$
 - Need fluences in excess of at least $1 \times 10^{17} n_{eq}/cm^2$
 - Benchmark for a yearly exchange of inner layers
- EURO-LABS WP4 provided access to these conditions, even up to $1 \times 10^{18} n_{eq}/cm^2$
 - RI's in the Irradiations task WP4.3
- End of 2021 the *ECFA Detector R&D Roadmap* was approved by the CERN Council
 - Long term HEP Detector R&D strategic goals defined
 - Implementation strategy approved in September 2022



- Detector R&D Themes tackled by DRD Collaborations
 - DRD1 Gaseous Detectors
 - DRD2 Liquid Detectors
 - DRD3 Solid State Detectors
 - DRD4 Particle ID and Photon Detectors
 - DRD5 Quantum and Emerging Technologies
 - DRD6 Calorimetry
 - DRD7 Electronics
- Process overseen by CERN's DRD Committee
- Collaborations approved in 2024
- Nowadays our predominant customers



WP4 Tasks and Budget

Task name	WP label	EC + CH + UK	EC
Test Beams	WP4.1	1,033,300	855,175
Detector Characterization	WP4.2	236,420	236,420
Irradiations	WP4.3	1,074,713	908,263
Service Improvements	WP4.4	740,675	606,800
Total Budget	WP4	3,085,108	2,606,658

Task overviews:

Talk by Marcel Stanitzki Tue 15:05

Talk by Igor Mandić Tue 15:05

Talk by myself Tue 9:50

- EC allocation 2.6 MEUR
- ✓ Supplemented by CH and UK contributions from their national funds

WP4.1-3 Sub-Tasks and Deliverables

- Each RI delivers **Access Units** (~beam hours) allocated to **Projects** with **Users**
- Two access modalities: physical/remote access
 - *Physical*: users at RI (user support)
 - *Remote*: users send samples to RI (handling, shipment)

Task	WP name	Institute	Facility	Access Units	Users	Projects	User support
Test Beams	WP4.1.1	CERN	PS & SPS	8736	504	56	yes
	WP4.1.2	DESY	TESTBEAM	8640	120	30	yes
	WP4.1.3	PSI	PiM1/UCN	5376	136	32	yes
Detector Characterization	WP4.2.1	RBI	RBI-AF	504	24	12	yes
	WP4.2.2	ITAINNOVA	EMCLab	800	56	14	yes
Irradiations	WP4.3.1	CERN	IRRAD	4000	65	16	yes/remote
	WP4.3.2	CERN	GIF++	4060	74	14	yes
	WP4.3.3	JSI	TRIGA	700	150	50	remote
	WP4.3.4	IFJ-PAN	AIC-144	800	140	28	yes/remote
	WP4.3.5	UCL	HIF/LIF/NIF	100	20	10	yes
	WP4.3.6	UoB	MC40	300	36	12	remote

Pledged deliverables

Task WP4.4: Service Improvements

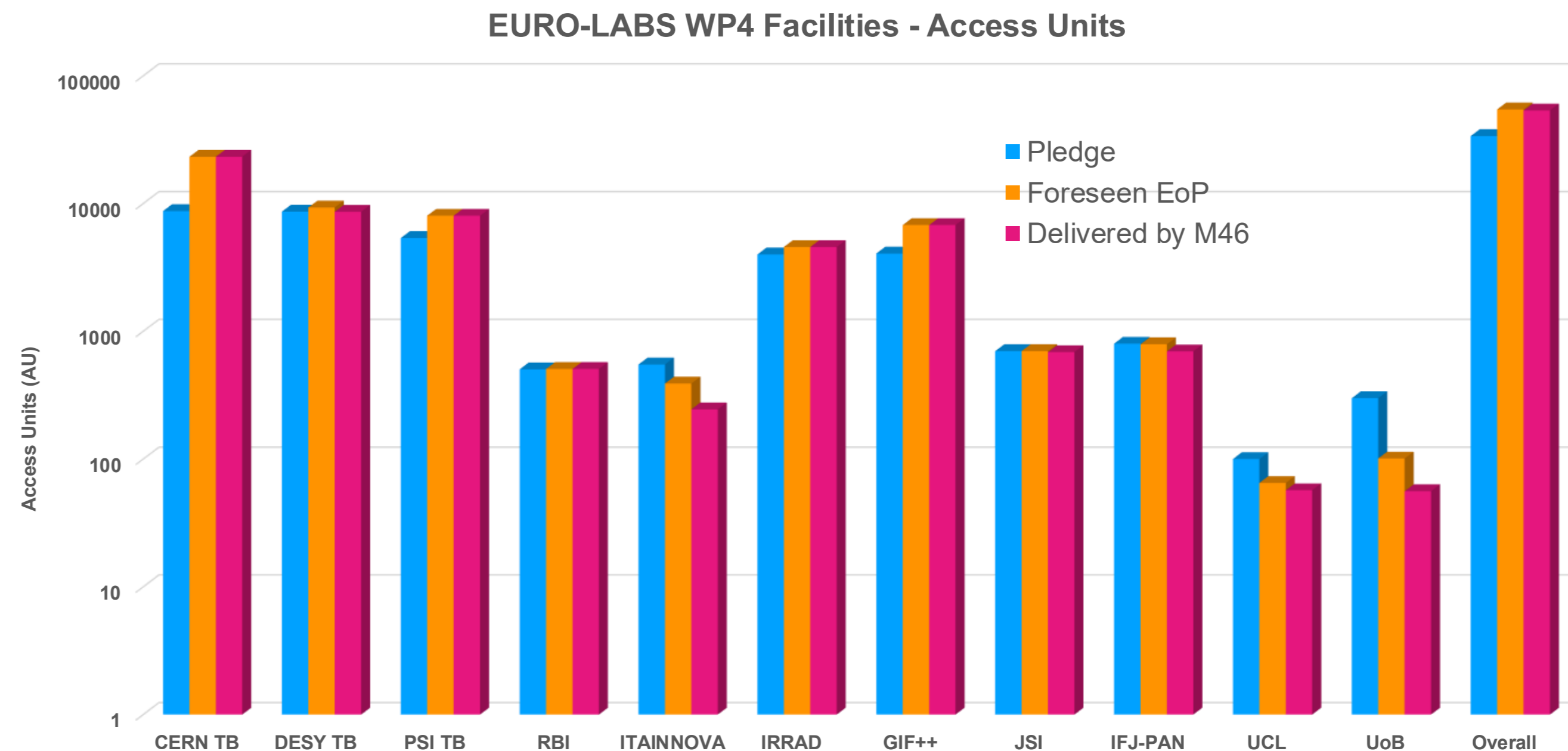
- Aimed at improving user access to RI for EURO-LABS
 - Each RI proposed improvements to maximize impact on user access
 - Resulted in 10 sub-tasks, some serving multiple RIs
 - Improvements had to be ready in Y3 of the project, preferably by Y2
 - All 10 associated milestones delivered in 2024
 - EC contributions are matched by RI's own funding, typically exceeding EC
 - Budget adjustment of EC part: equipment - > consumables, manpower

CERN TB, IRRAD & GIF++	Data base handling of beam time and irradiation requests
DESY Test Beams	Precision motion stages for large detector setups
PSI Test Beams	Beam monitor
RBI-AF	Ion beam focusing lens
ITAINNOVA	Cooling System and Graphical User Interface for EMC test station
CERN IRRAD	Beam profile monitor
JSI TRIGA	Cadmium shielding in the tangential channel
IFJ PAN AIC-144	2-D scanning table for irradiation
UCL CRC	Test chamber for the heavy ion irradiation facility
UoB MC40	Scanning system upgrade for high fluence delivery

WP4 Performance by End of Project

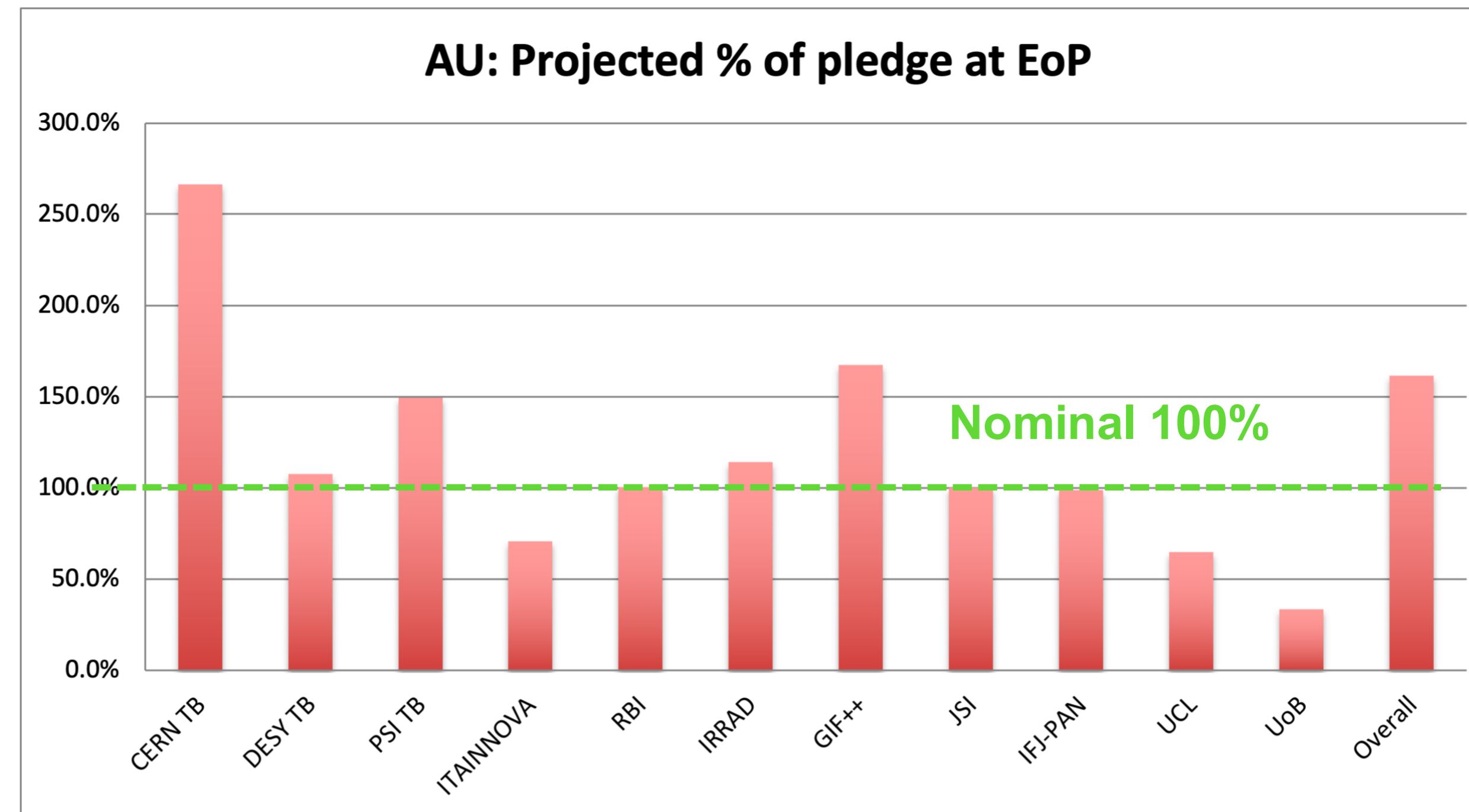
- Taking overall number of AU (the only deliverable!) projected to be granted to users by EoP, WP4 is doing extremely well with **>160%** of total AU delivered
- In fact, performance could be more balanced
 - Overall figure dominated by CERN
 - CERN beams also in 2026 (until today !), not initially planned
 - All RIs finally took off...

Research Infrastr.	% of pledge	AU pledged	AU EoP
CERN TB	266.3%	8736	23264
DESY TB	107.8%	8640	9312
PSI TB	149.3%	5376	8028
ITAINNOVA	70.9%	550	390
RBI	100.6%	504	507
IRRAD	114.2%	4000	4567
GIF++	167.3%	4060	6792
JSI	100.0%	700	700
IFJ-PAN	99.0%	800	792
UCL	65.0%	100	65
UoB	33.7%	300	101
Overall	161.5%	33766	54518



WP4 Performance by EoP - details

- 3 RIs grossly overperforming (>150%)
 - CERN TB even above 250%
 - Followed by GIF++ and PSI
- 5 did their job well (>95% of nominal)
 - DESY, RBI, IRRAD, JSI, IFJ-PAN
- 3 underperforming
 - ITTAINNOVA, UCLouvain, UoB
 - ITTAINNOVA & UCL made it to ~2/3 of their pledge
 - UoB did not catch up, trouble with the facility
- On task level
 - WP4.1 and WP4.3 both overperforming
 - WP4.2 modestly underperforming



- With WP4 EURO-LABS is providing transnational access to top level European Research Infrastructures for European Detector R&D
 - Started as TA complement to AIDAInnova, now a workhorse for DRD collaborations
- Access to RIs free of charge
 - Well matched to detector R&D where dedicated funding is often a problem
- Covers 3 types of research infrastructures, grouped into tasks
 - WP4.1: Test Beams (3 facilities)
 - WP4.2: Detector Characterization (2 facilities)
 - WP4.3: Irradiations (6 facilities)
- Service Improvements at each RI to improve access
- Close to End of Project: overall performance excellent
 - A few RIs remained below their pledge though