

The PETRA IV Project Proposal

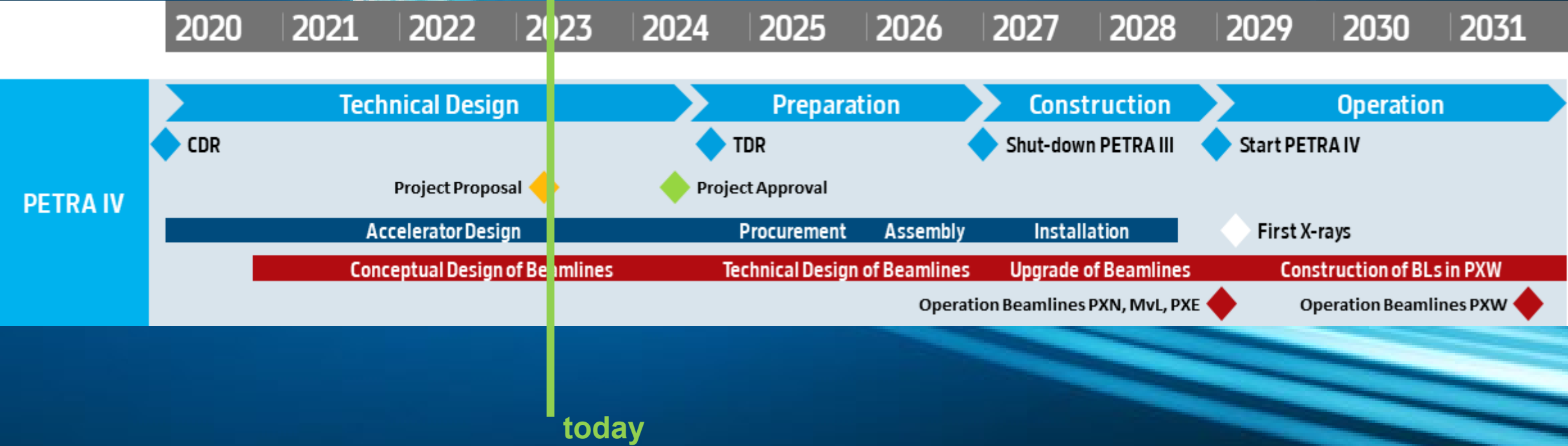
Status and next steps

Progress Review Meeting, 11 May 2023

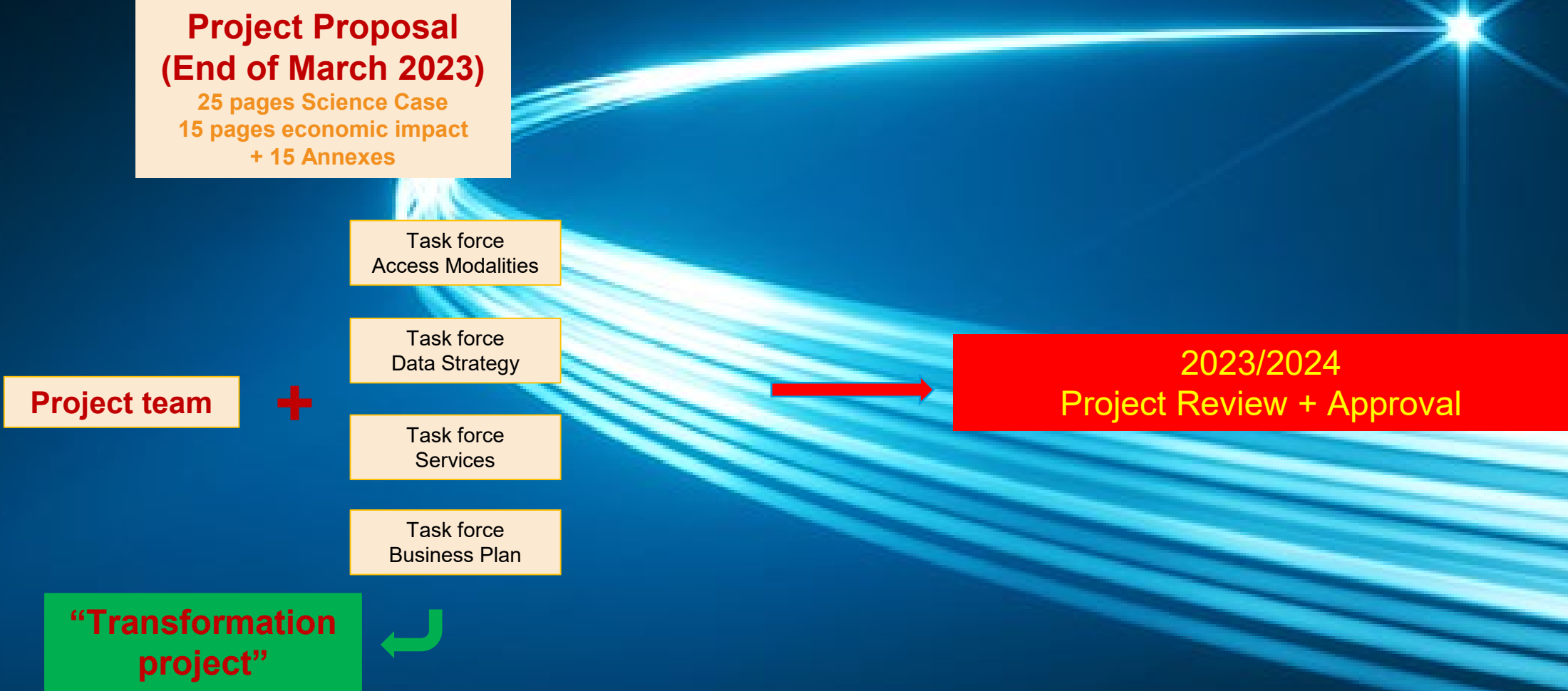
Harald Reichert

Project Leader PETRA IV

PETRA IV Schedule



PETRA IV Schedule



PETRA IV – Project Proposal

Project proposal follows official guidelines from 2016 Roadmap Process

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ca. 1200 pages



Blueprint for TDR

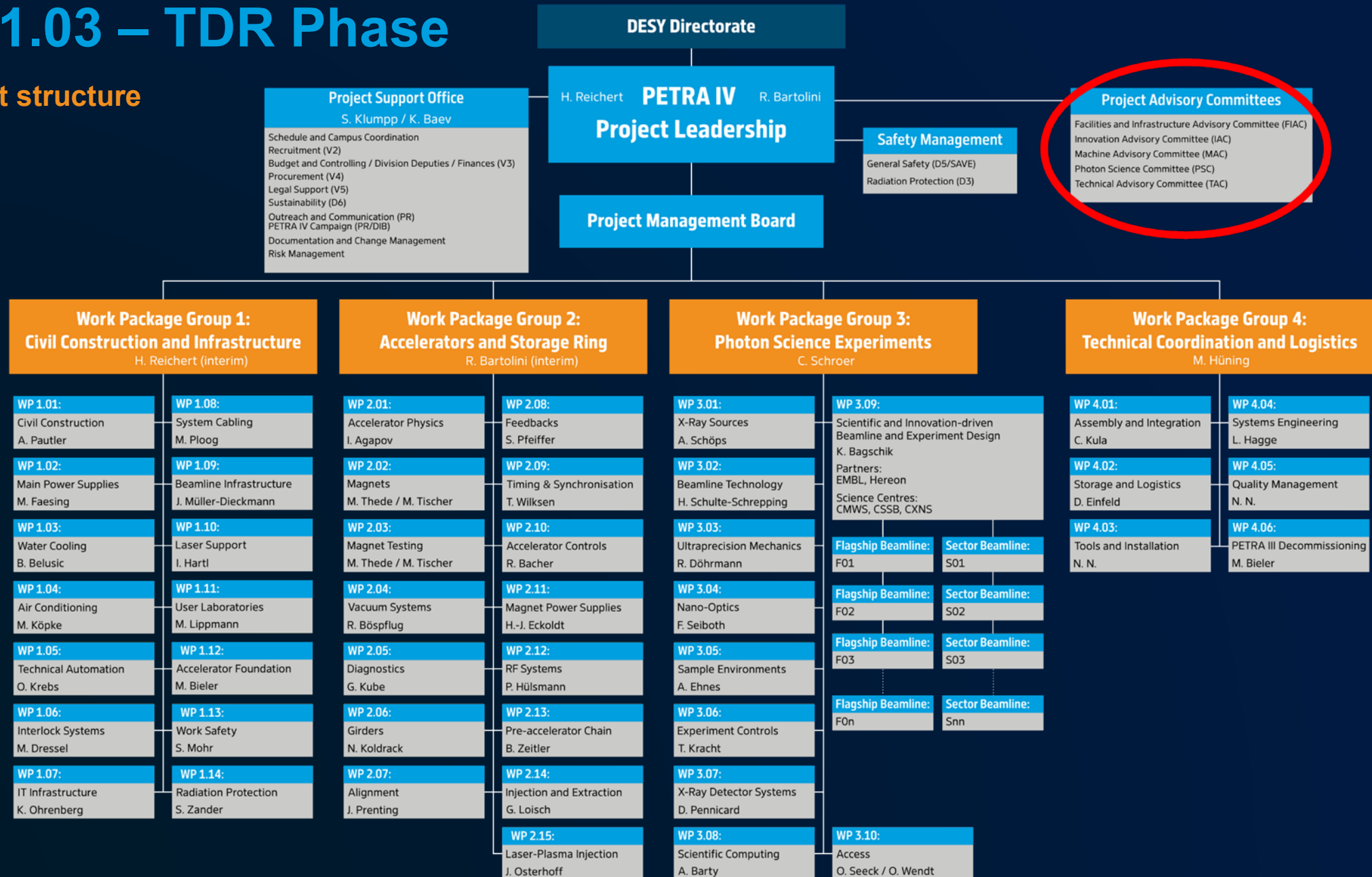
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+ Anlage 15 Nachhaltigkeit

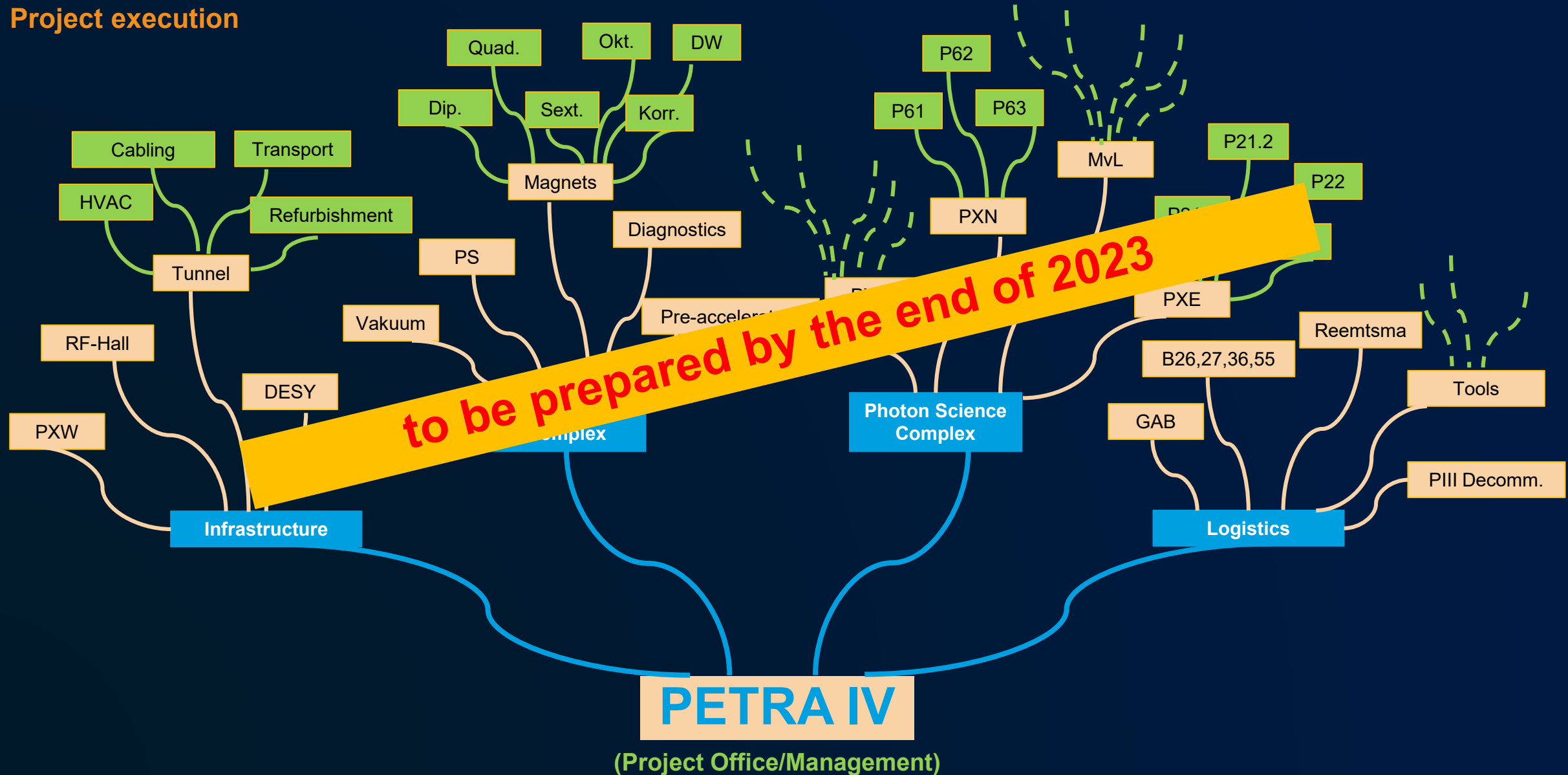
WP1.03 – TDR Phase

Project structure



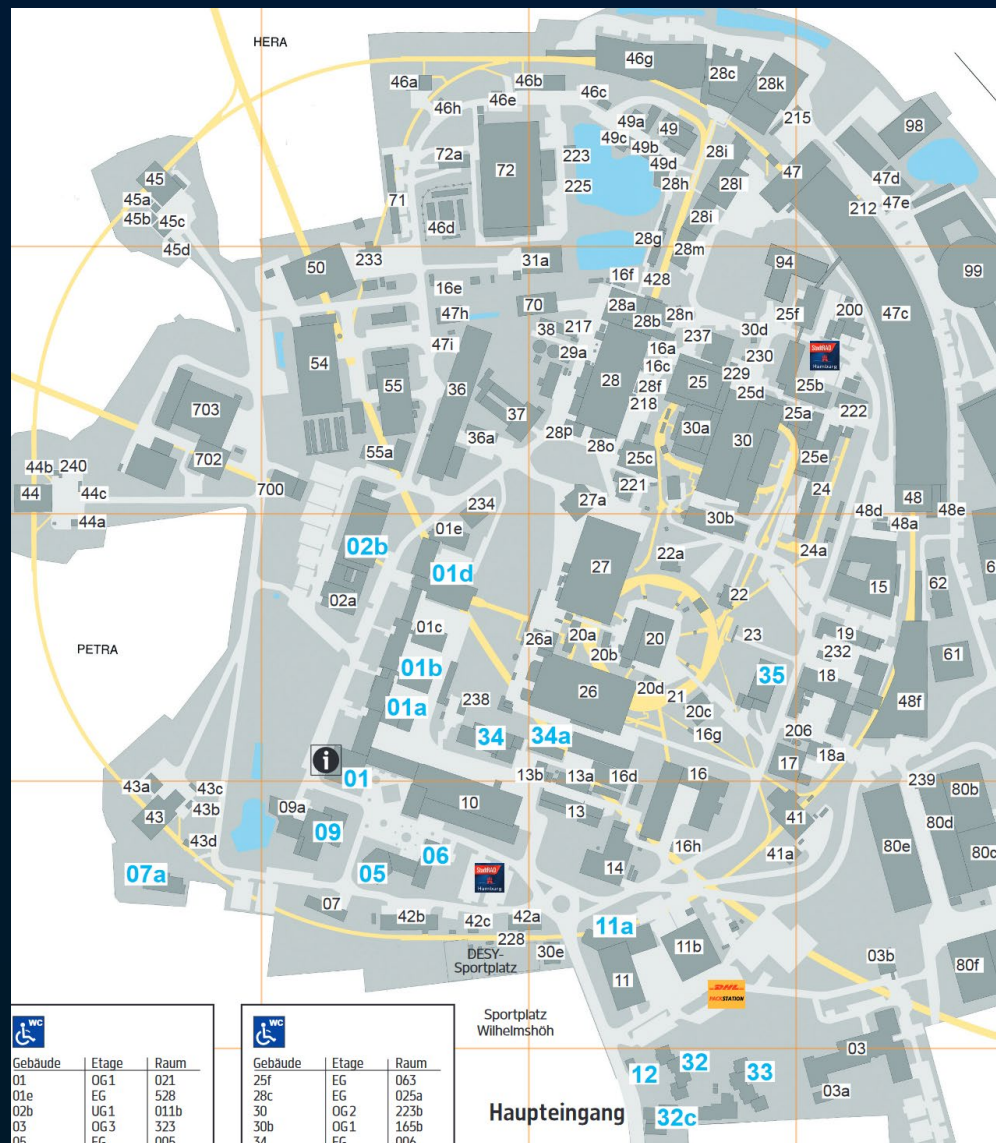
WP1.03 – Project Phase

Project execution



to be prepared by the end of 2023

PETRA IV – Infrastructure



PETRA IV – Infrastructure

Civil construction programme

organised in 7 packages

- **GAB**
- **PXW, Tunnel NWN, RF Sector**
- **DESY Complex**
- **Supply Buildings**
- **Building Refurbishments**
- **Tunnel refurbishment (old sections)**
- **Underground Networks (Heating, Cooling, IT, etc.)**

+ Works under the responsibility of the FHH

- Relocation of the biotopes
- Replacement of sports facilities
- Reconstruction Lise-Meitner-Park



Draft of the new development plan Bahrenfeld 71/Lurup 69

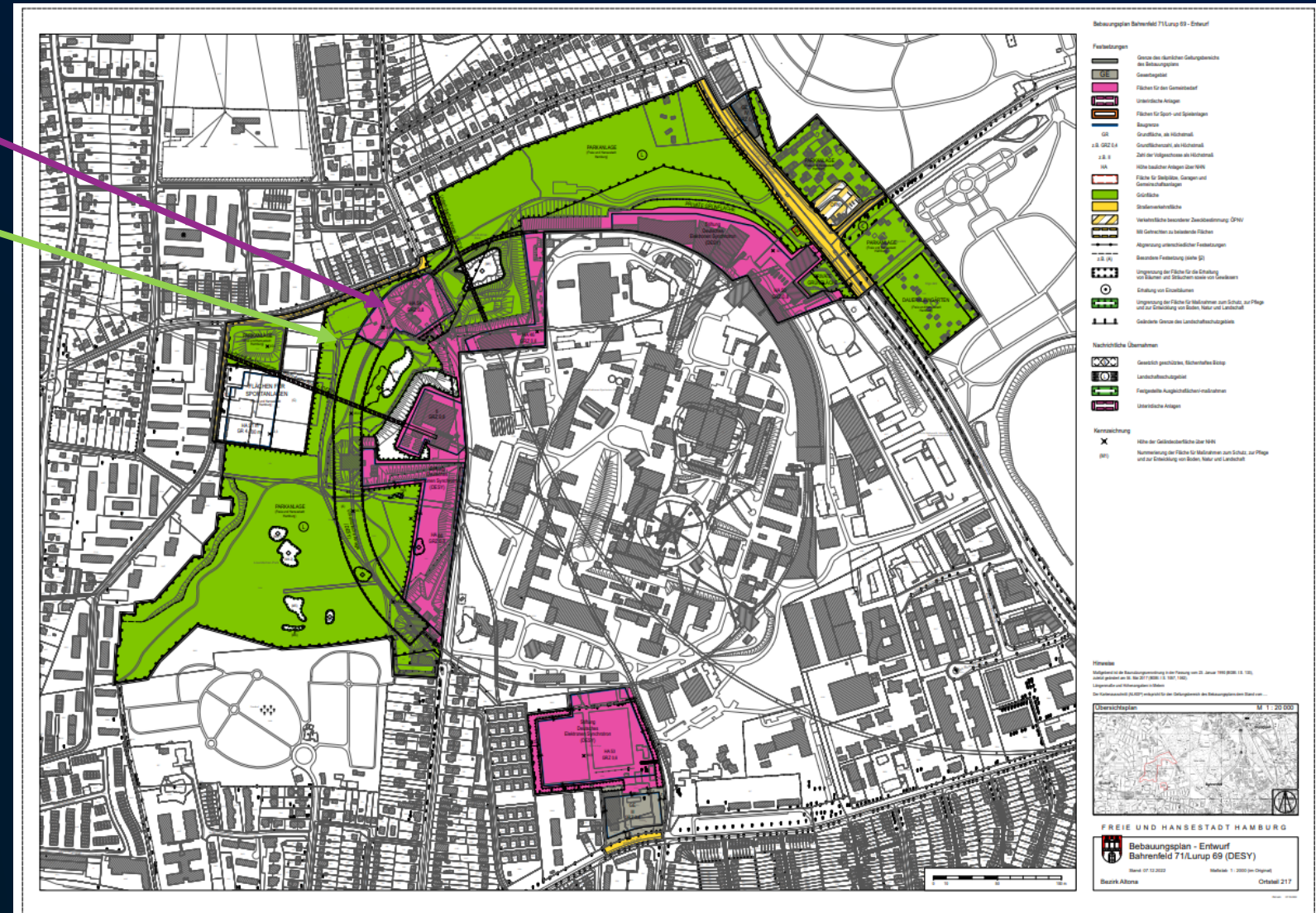
DESY premises

Lise-Meitner-Park

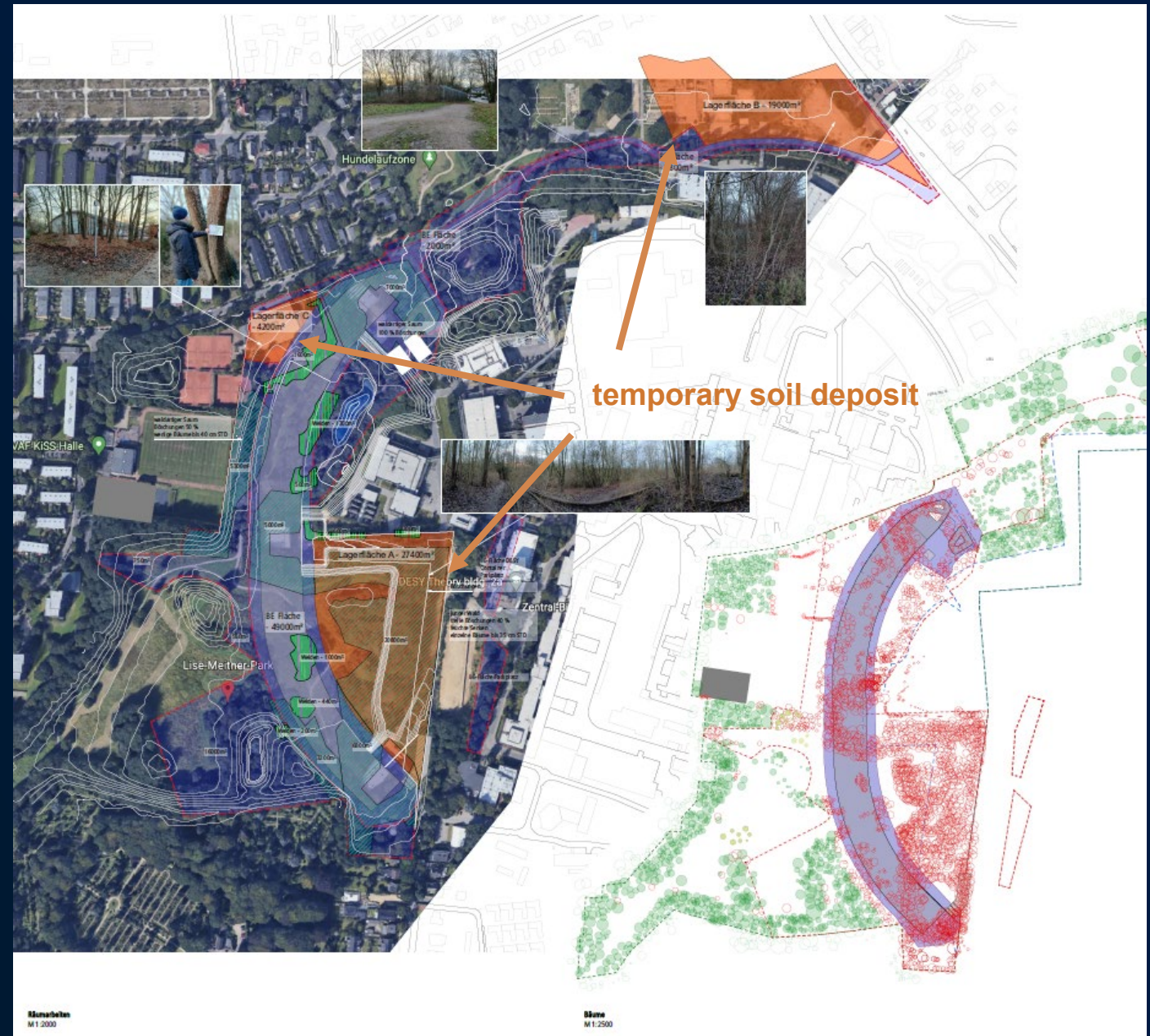
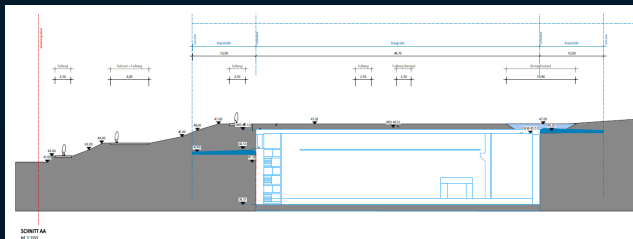
Includes

- relocation of biotopes
- concept for sports facilities
- path network for cycling and pedestrians

**PETRA IV is well integrated
into urban planning**

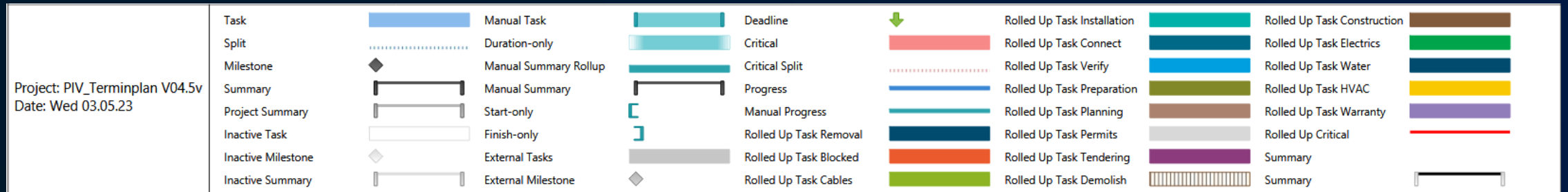
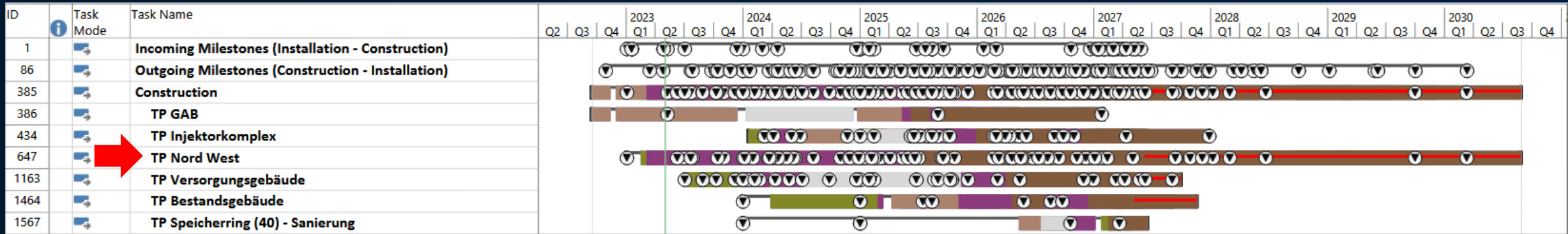


Construction site preparation



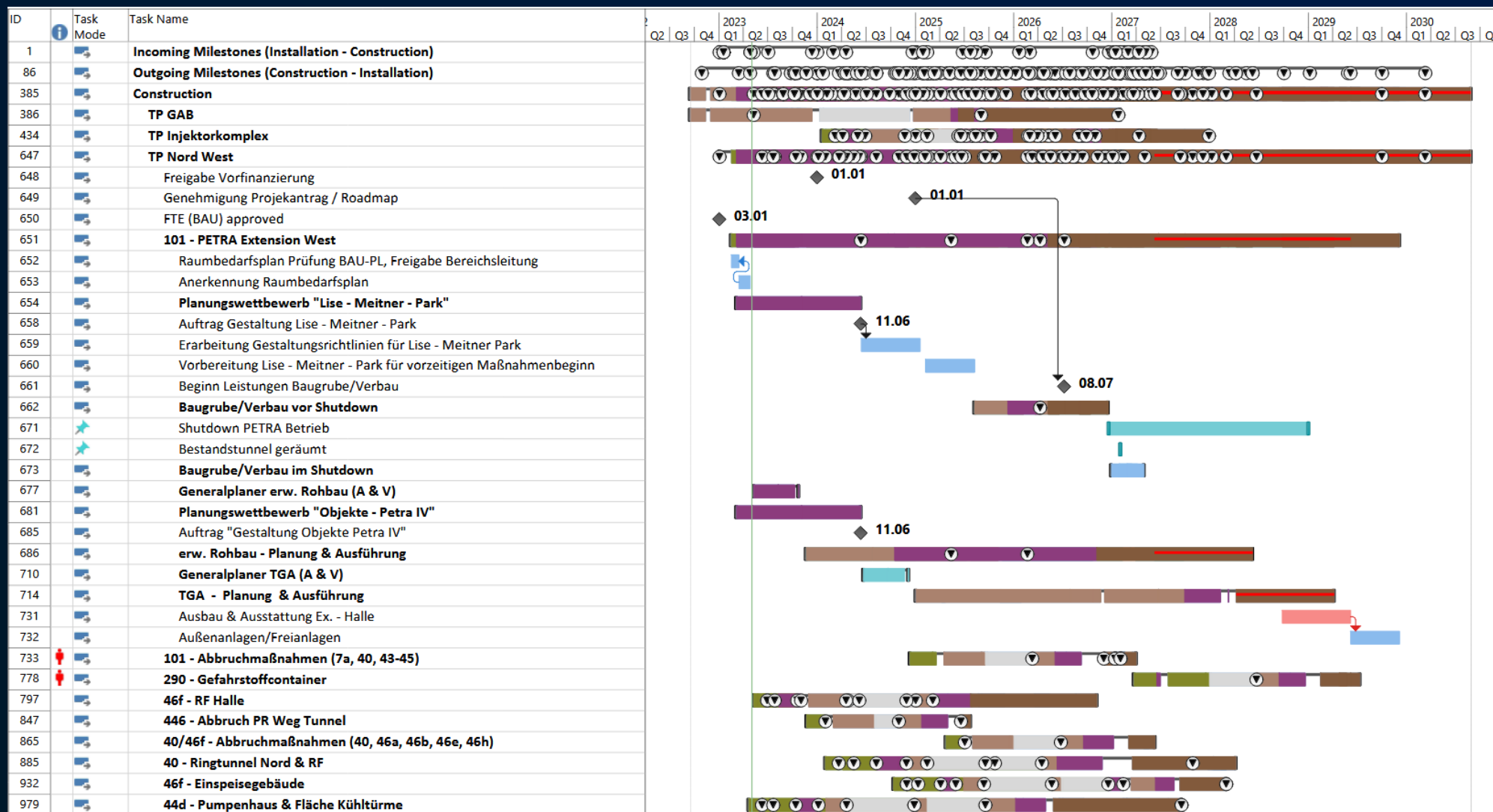
PETRA IV – Schedule / Planning

High-level planning with milestones



PETRA IV – Schedule / Planning

Relocation / Renewal of 5 110 kV main power lines (Stromnetz Hamburg – SNH)



Low-level planning for individual construction projects

DESY/PETRA IV – Power Supply

Relocation / Renewal of 5 110 kV main power lines (Stromnetz Hamburg – SNH)

2 power lines passing through the DESY campus

**Potential relocation into the Lise-Meitner-Park
bypassing the DESY campus
(following the bicycle path)**

3 power lines supplying the DESY campus

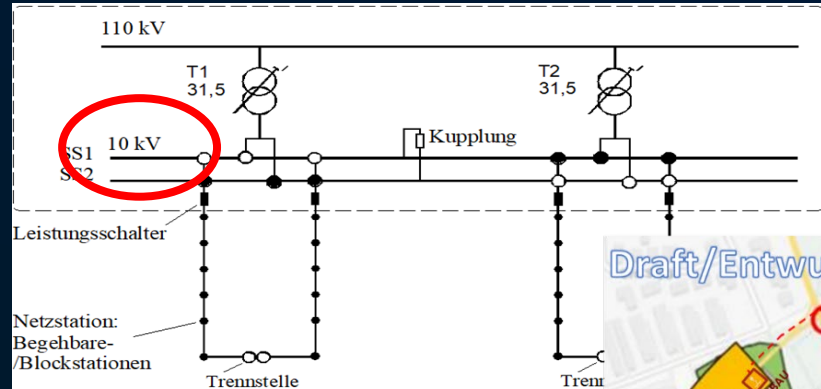
Needs to be integrated into the overall planning



PETRA IV – Power Supply

Main power lines

Three 110 kV power lines supply power to DESY



PETRA IV / PXW Erschließung/ development

HST A Geb. 16 110/10kV-Hauptstation
HST B Geb. 16a 110/10kV-Hauptstation
HST C Geb. 16b 110/10kV-Hauptstation

Unterstationen „PETRA IV 10kV-Ring“

— 10 kV Kabeltrasse
— 10 kV Kabeltrasse (PXW-Ringversorgung)
- - 10 kV Kabeltrasse im Tunnel
— 0,4 kV Kabeltrasse

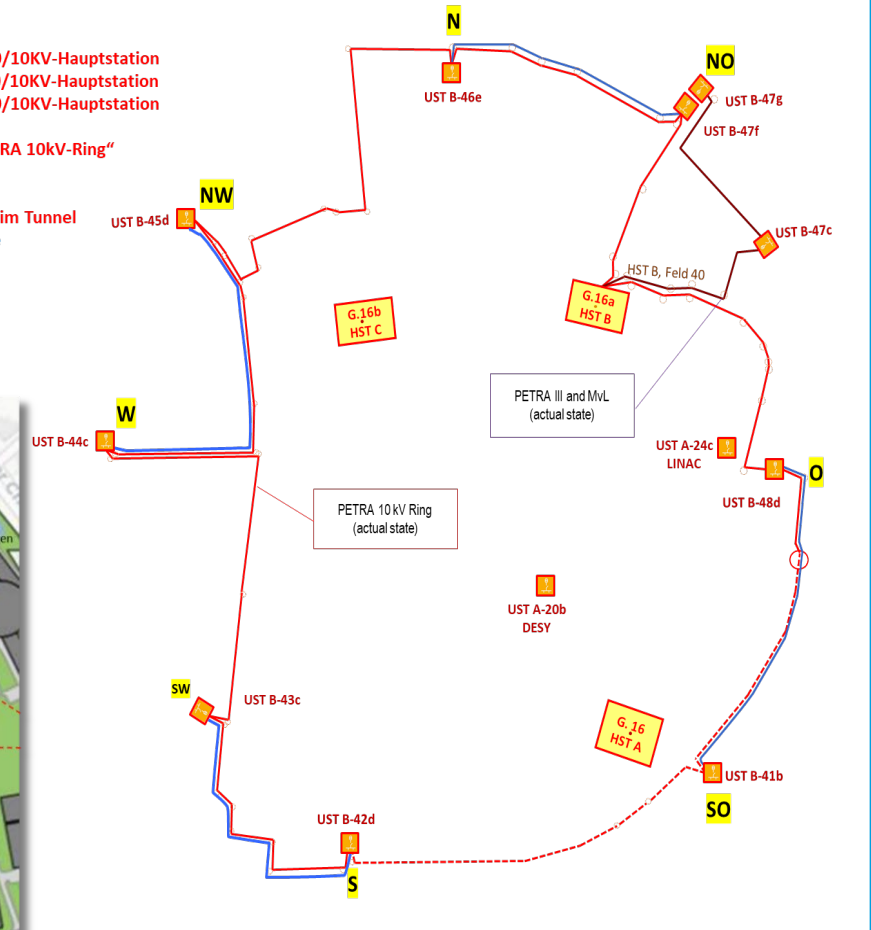
Main voltage distribution via 10 kV ring grid

Legende

HST A Geb. 16 110/10kV-Hauptstation
HST B Geb. 16a 110/10kV-Hauptstation
HST C Geb. 16b 110/10kV-Hauptstation

Unterstationen „PETRA 10kV-Ring“

— 10 kV Kabeltrasse
- - 10 kV Kabeltrasse im Tunnel
— 0,4 kV Kabeltrasse



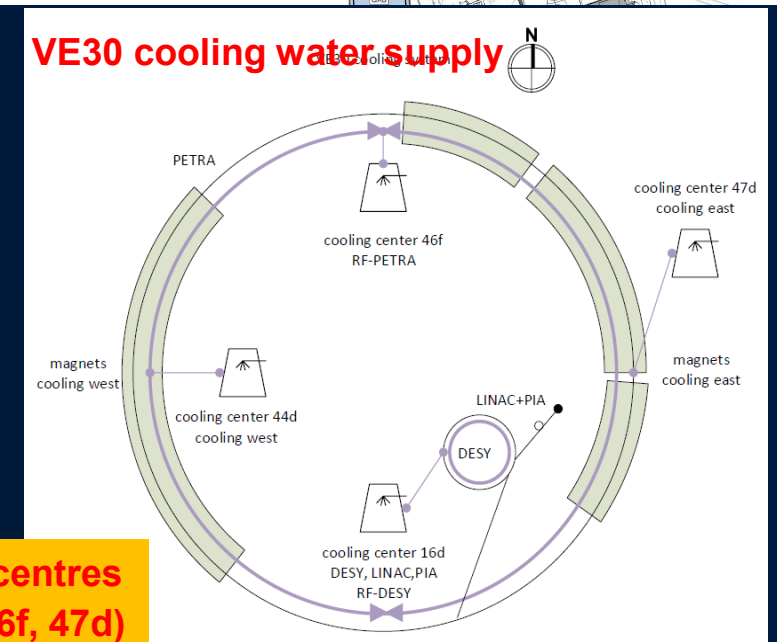
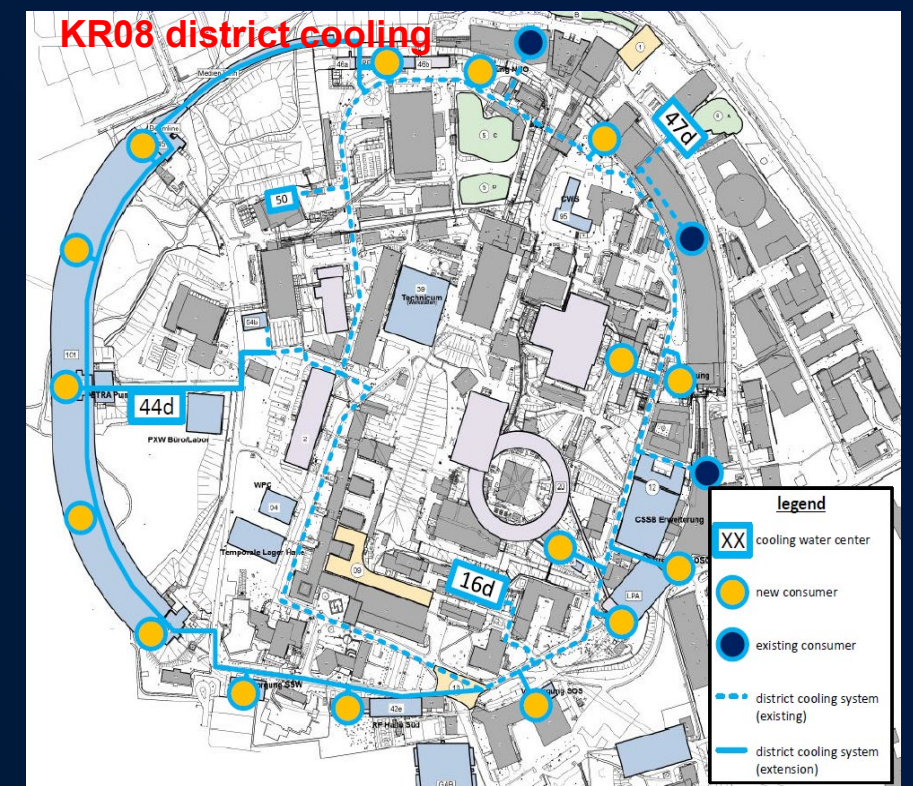
Main supply areas

Das Diagramm zeigt die elektrische Trennung zwischen dem Normal-Netz (NN) und dem Netz-Geräten-Netz (GN). Oben sind die Hauptverteilungsschalttafeln (UST B-456 bis B-470) dargestellt, die über einen Bus (HST B) verbunden sind. Unten sind die Verbraucherschalttafeln (PKW-NW, PKW-W, PKW-SW, S, SO, O) zu sehen. Die Verdrahtung ist so ausgeführt, dass das GN über separate Leitungen vom Bus gespeist wird, während das NN über andere Leitungen versorgt wird. Die Trennung ist durch rote gestrichelte Linien und die Beschriftung 'Normal-Netz (NN)' und 'Netz-Geräten-Netz (GN)' verdeutlicht.

PETRA IV – Water Cooling

Supply of 6 different cooling water qualities

water type acronym	consumer stakeholder	temperature (inlet)	water quality	pipng materials
cooling water VE30	magnets, RF, magnet power supplies, vacuum system	30 °C	deionized water electr. conductance: < 1 µS/cm BTGA 3.003	stainless steel copper red brass
chilled water ALU25	Undulators	25 °C	deionized water electr. conductance: < 1 µS/cm BTGA 3.003	stainless steel aluminum
chilled water KW20	server racks	20 °C	BTGA 3.003	stainless steel copper red brass
chilled water VE20	laboratories experiments	20 °C	deionized water electr. conductance: < 1 µS/cm BTGA 3.003	stainless steel copper red brass
chilled water RLT KW09	AC units	9 °C	BTGA 3.003	stainless steel copper red brass
district cooling KR08	district cooling/ campus distribution	8 °C	BTGA 3.003	carbon steel copper red brass



**4 separate centres
(16d, 44d, 46f, 47d)**

PETRA IV – HVAC

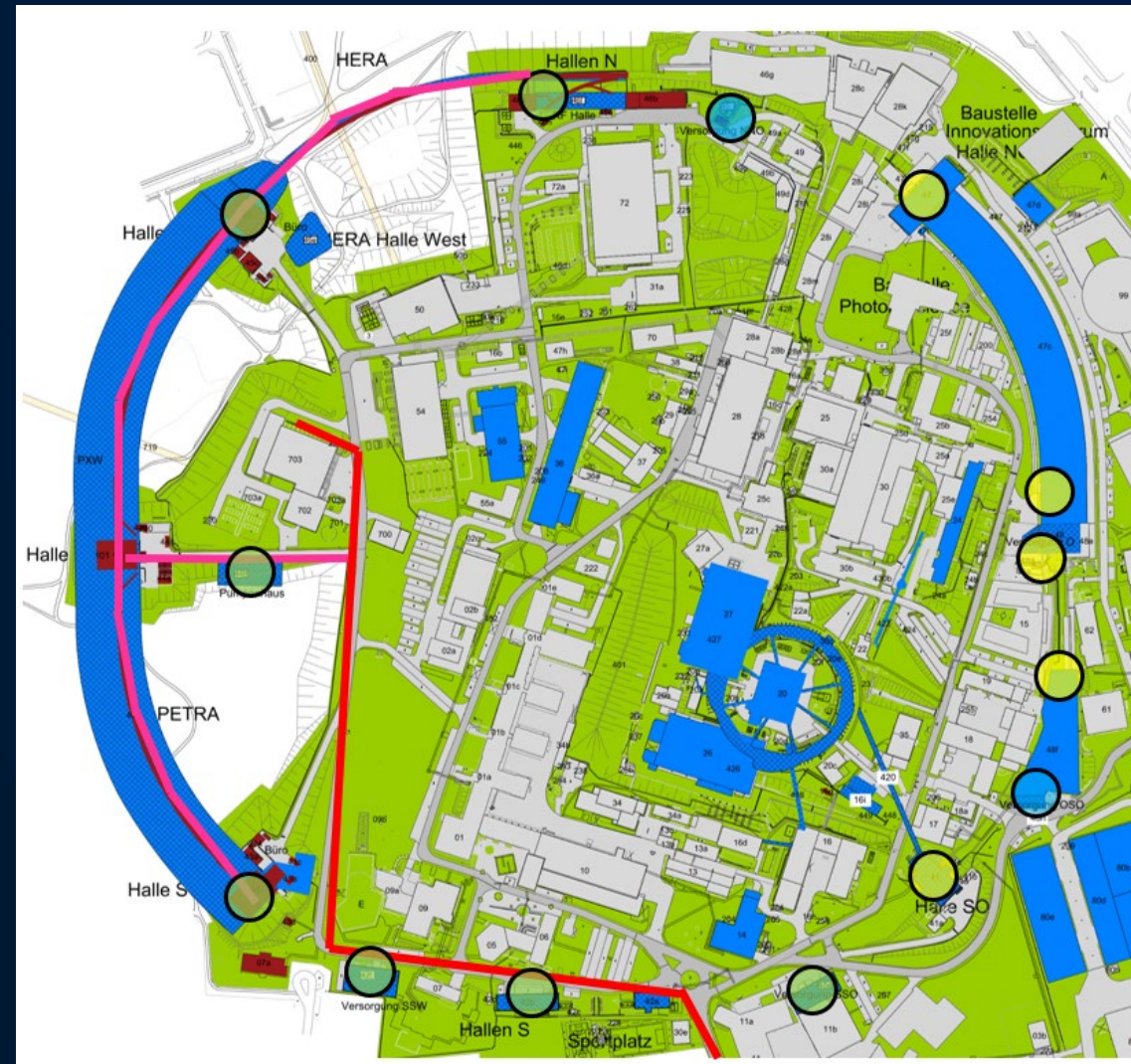
Heating distribution network

Connection to external district heating (up to 135 °C)

DESY heating distribution networks

- Primary district heating circuit (55 to 105 °C)
- Secondary heating circuits (50 °C)

- Existing underground district heating stations usable for PETRA IV
- New underground district heating connections for PETRA IV (low-T)
- New underground district heating connections for PETRA IV ()
- PETRA IV addition to low-T piping system
- Underground district heating system from XFEL to Campus South



PETRA IV – Project Budget

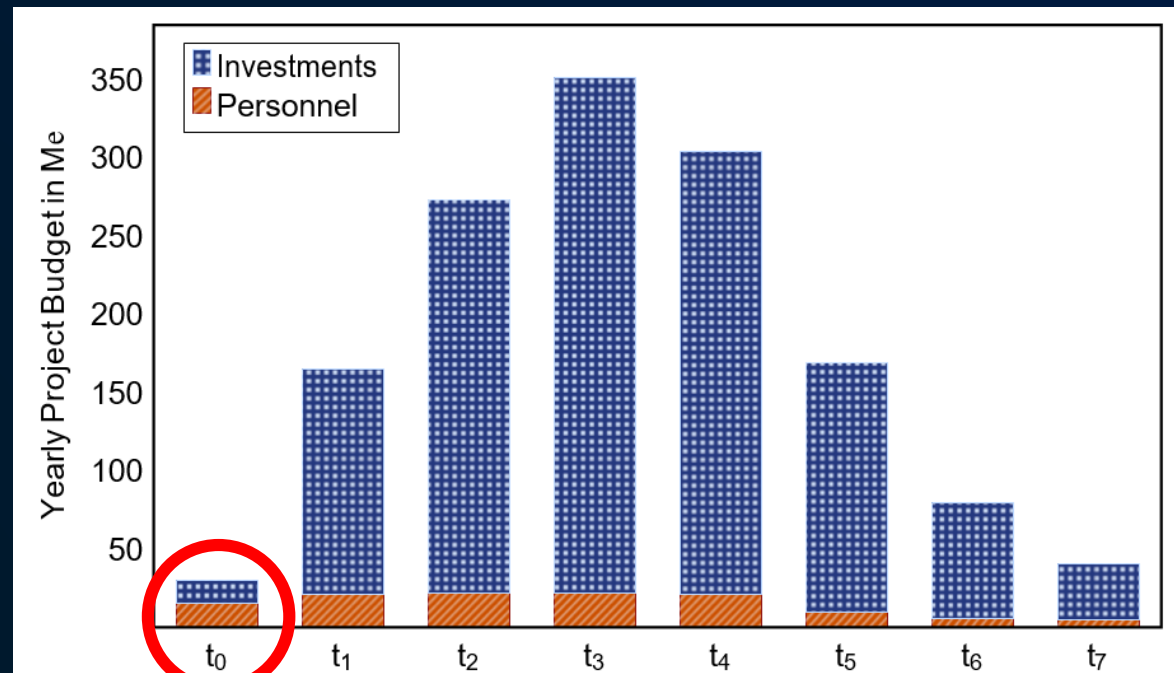
Overview (price index end of 2022)

PETRA IV	DESY's Own Contribution			Third Party Funding			Sum
	Personnel		Investments	Personnel		Investments	
	PY	Mio.€	Mio.€	PY	Mio.€	Mio.€	Mio.€
Accelerators	580	52.8	40.0 *	344	31.4	328.1	452.3
Experiments	634	57.7		365	33.3	223.5	314.5
Logistics	22	2.0		180	16.2	13.2	31.4
Infrastructure	109	9.9		185	16.9	665.8	692.6
Safety	19	1.7		24	2.4	20.0	24.1
Management	52	4.7		219	19.8	2.4	26.9
Sum in Mio.€		128.8	40.0		120.0	1,253.0	1,541.8

* incl. Helmholtz contribution from LK-II funding PETRA III 2027/2028

PETRA IV – Spending Profile

Values in Me	Spending Profile of the Project								
Categories	t ₀	t ₁	t ₂	t ₃	t ₄	t ₅	t ₆	t ₇	Sum
Investments	14.6	144.6	251.4	329.8	282.8	159.1	74.4	36.3	1,293.0
Personnel Budget	15.3	20.6	22.0	21.7	21.0	9.8	5.3	4.3	120.0
PETRA IV Project	29.9	165.2	273.4	351.5	303.8	168.9	79.7	40.6	1,413.0



Financing:

- 90% Federal

- 10% State

Problem: slow project start → pre-financing!

PETRA IV – Operation Budget

Operation budget PETRA IV (without contribution from partners – EMBL, Hereon, KIT, MPG, ...)

Operation Budget in M€	PETRA III	PETRA IV
Personnel	37.6	51.3
Accelerator operation	108 FTE	139 FTE
Experiments	145 FTE	206 FTE
Recurrent	14.8	20.3
Electricity (2022 price)	10 M€	13.3 M€
consumption	74.3 GWh	98.4 GWh
other recurrent costs	4.8 M€	7.0 M€
Invest	8.4	21.3
Total	60.8	92.9

+ 32%

Personnel in the Divisions M & FS (LK-II funding)

M – Division in FTE			FS – Division in FTE		
Group Name	PETRA III 2022	PETRA IV 2029	Group Name	PETRA III 2022	PETRA IV 2029
M & MR (mngt.)	1.3	3.0	PETRA-D	46.4	60.0
D3	2.0	3.0	PETRA-S	34.1	41.7
MBB	1.8	2.0	PETRA-USG	2.9	24.0
MCS	11.2	17.0	FS-BT	16.3	19.0
MDI	11.3	12.0	FS-EC	10.0	17.0
MEA	6.9	7.0	FS-TI	13.8	17.0
MHF	10.1	10.0	FS-US	10.4	12.0
MIN	12.3	14.0	FS-SC	11.2	16.0
MKK	10.2	20.0			
MPC	12.8	15.0			
MPE & MPY	5.8	7.0			
MPS	4.2	5.0			
MSK	6.8	9.0			
MSL	0.6	0			
MVS	10.4	13.0			
MLS	0	2.0			
Total	107.7	139.0		145.1	206.7

+ 37%

PETRA IV – Operation Budget

Operation budget PETRA IV (without contribution from partners – EMBL, Hereon, KIT, MPG, ...)

Operation Budget in M€		PETRA III	PETRA IV
Personnel		37.6	51.3
Accelerator operation	108 FTE		139 FTE
Experiments	145 FTE		206 FTE
Recurrent		14.8	20.3
Electricity (2022 price)	10 M€		13.3 M€
consumption	74.3 GWh		98.4 GWh
other recurrent costs	4.8 M€		7.0 M€
Invest		8.4	21.3
Total		60.8	92.9

Δ = 32.1 M€
i.e. 53%

Accelerator operation:

+ 4.7 M€ Personnel
+ 0.5 M€ Consumables
+ 1.9 M€ Invest

Δ = 7.1 M€

Beamline operation:

+ 4.7 M€ Personnel
+ 0.8 M€ Consumables
+ 3.0 M€ Invest

Δ = 8.5 M€

New services:

+ 4.5 M€ Personnel
+ 0.8 M€ Consumables
+ 7.9 M€ Invest

Δ = 13.2 M€

Electricity:

+ 3.3 M€ Consumables

Δ = 3.3 M€

PETRA IV – Power Consumption

... and the challenge to reduce it

PETRA III (reference year 2021) in GW h		PETRA IV (full operation) in GW h		
LINAC / DESY II	11.5	LINAC / DESY IV	11.5	- X LPA
PETRA III	45.7	PETRA IV	44.3	
		RF	21.5	+ 5.2
		Magnets	22.8	
Air handling	-	Air handling	5.2	+ 16.3
Water cooling	11.7	Water cooling	28.0	
Experimental halls	5.4	Experimental halls	9.4	
PXN, <u>MvL</u> , PXE	5.4	PXN, <u>MvL</u> , PXE	4.4	
		PXW	5.0	+ 5.0
Total	74.3		98.4	

Explore further potential for reduction

PETRA IV – Power Consumption

... and the challenge to reduce it

PETRA III (reference year 2021) in GW h		PETRA IV (full operation) in GW h	
LINAC / DESY II	11.5	LINAC / DESY IV	11.5
PETRA III	45.7	PETRA IV	44.3
		RF	21.5
		Magnets	22.8
Air handling	-	Air handling	5.2
Water cooling	11.7	Water cooling	28.0
Experimental halls	5.4	Experimental halls	9.4
PXN, MyL, PXE	5.4	PXN, MyL, PXE	4.4
		PXW	5.0
Total	74.3		98.4

+ 32%

Reduction of total power capacity for water cooling:

14 MW → 11.8 MW

28 GWh/a → 25 GWh/a

+ 28.4%

January 2023

Dedicated workshops for individual trades with users from all WPGs:

- Power supply
- (H)VAC
- Water cooling

PETRA IV – Remaining TDR Phase

Next steps

We have a robust baseline design for PETRA IV

... and more than one year for further optimisation

- **Reduction of energy consumption**
- **Lower material consumption**
- **.....**



Increased sustainability

PETRA IV – Remaining TDR Phase

Next steps

Get the project funded (including pre-financing for 2024)

... in the meantime: continue with planning

- **Work out detailed schedule including all infrastructure**
- **Identify dependencies and items on the critical path**
- **Continue discussion with public administrations**
- **.....**

PETRA IV – Remaining TDR Phase

Next steps

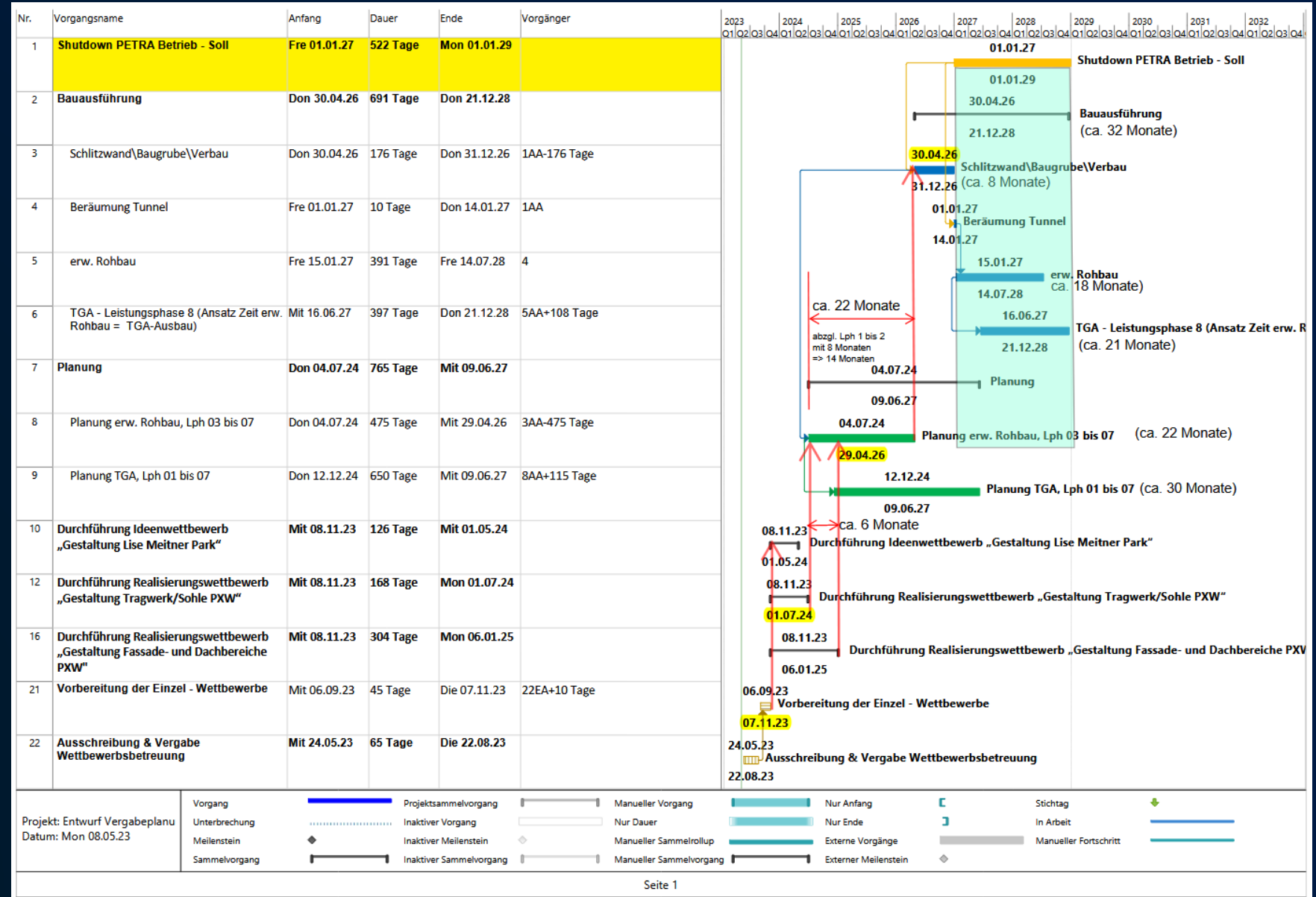
Project logistics



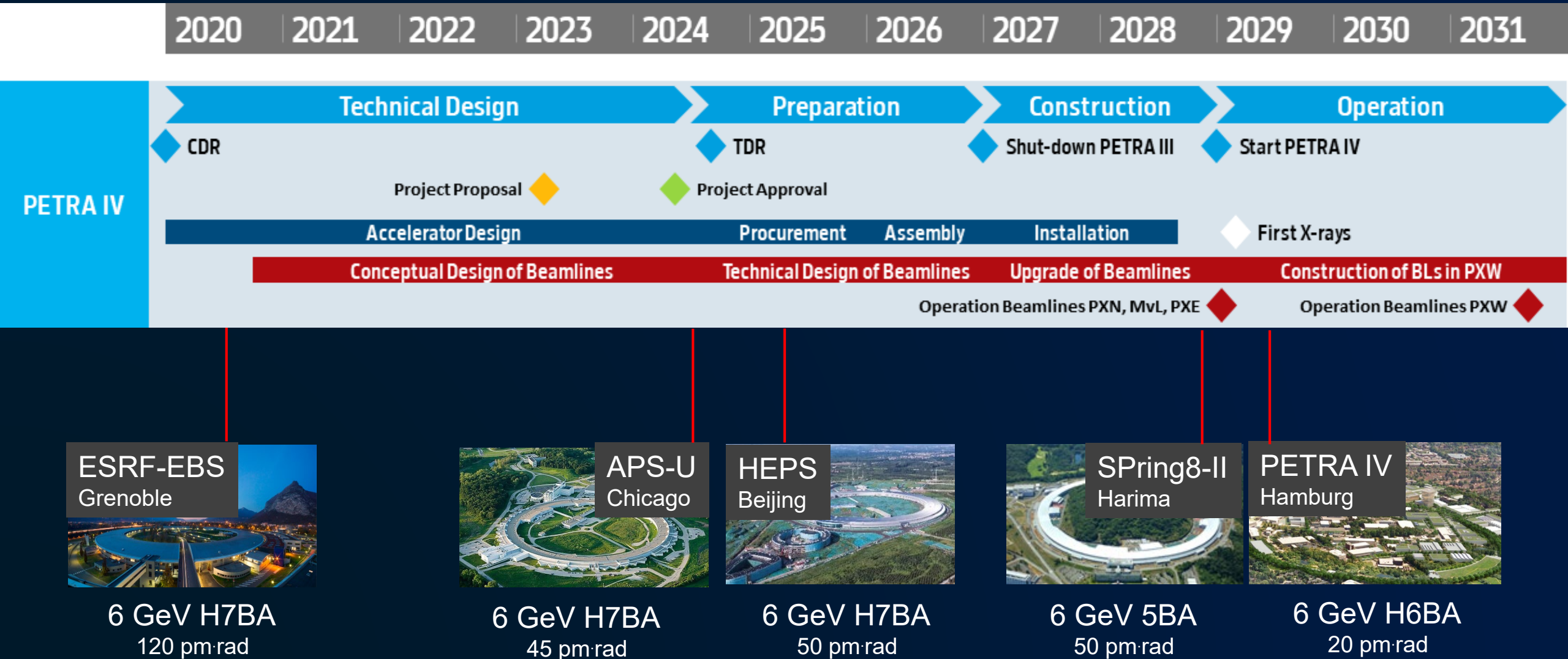
Integration of
civil construction



Integration of TGA



PETRA IV – the clock is ticking.....



The PETRA IV Project Proposal

Status and next steps

Progress Review Meeting, 11 May 2023

With a very big thanks to all of you supporting the project