EuPRAXIA @ SPARC_LAB

Project Management
Cost & Schedule TDR & Implementation phase

TDR Review Committee

Antonio Falone, 22/02/2021

Outline

1. External constraints

- ESFRI Roadmap 2021
- Building

2. Organization

- Organization breakdown structure
- Responsibility assignment matrix

3. TDR Project Management Plan

- Work Breakdown Structures
- High level Schedule
- Milestones Schedule
- Detailed Schedule
- R&D Cost
- Management activities

4. Implementation cost estimation

- Cost estimation
- Temporal profile and funding profile
- Management risks assessment

ESFRI 2021 Roadmap

EuPRAXIA@SPARC_LAB is part of a larger initiative that involves 40 Research Institutes and Universities across Europe.
EuPRAXIA has applied to the ESFRI 2021 Roadmap as *Distributed Research Infrastructure.*

Lead country

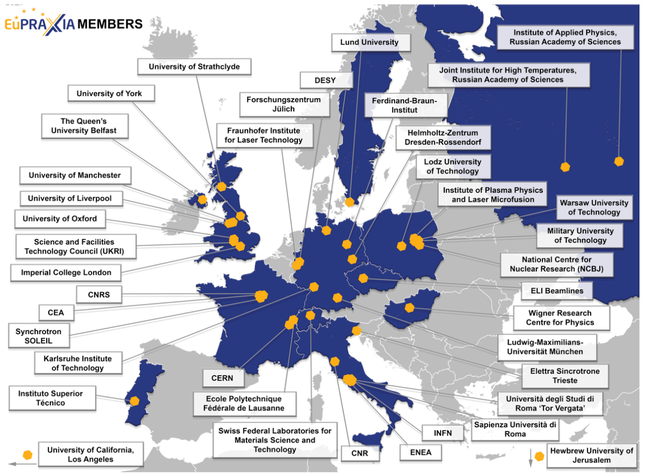
Lead Institute

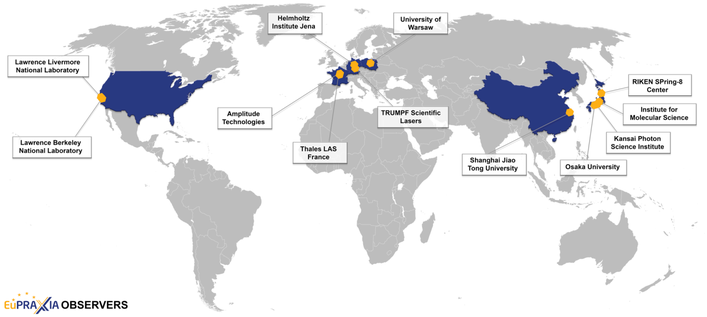
LNF as one of the two pillars

IT UK Czech Republic Portugal Hungary

Political Support

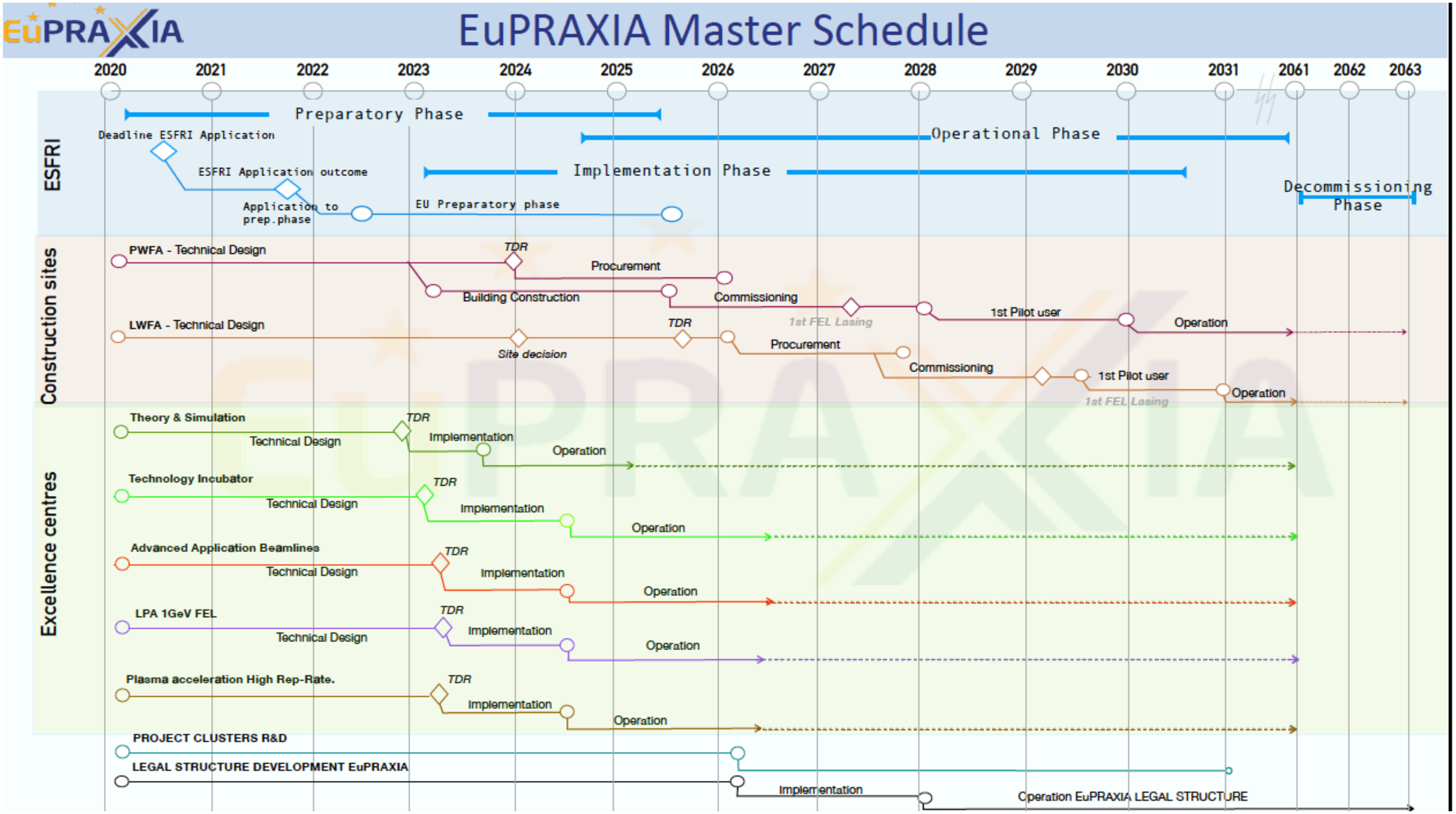
20 Letters of support including TIARA and LEAPS





- Proposal "ELIGIBLE"
- Critical questions & hearings - April/May 2021
- Outcome - September/October 2021

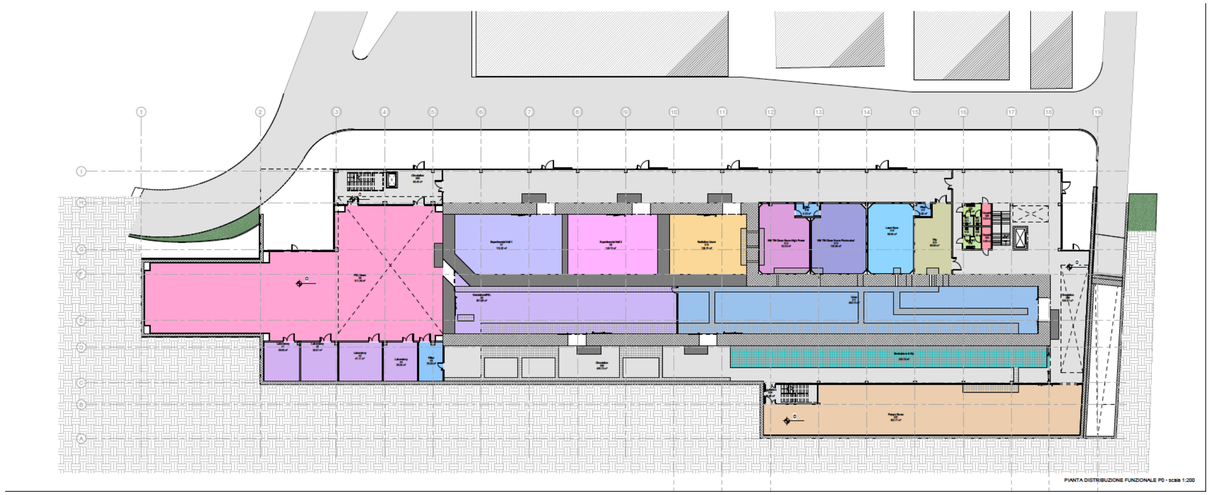
ESFRI 2021 Roadmap



Building

Final and executive design to MYTHOS

Status: Review of the final design. Approval and authorization procedure will start afterwards.



Organization Breakdown Structure

INFN
Istituto Nazionale di Fisica Nucleare

EuPRAXIA

INFN EU

EuPRAXIA @ SPARC_LAB Collaboration Board

PROJECT LEADER
M.Ferrario

LNF- Steering Committee

Chair - *A.Falone*
Project Leader - *M.Ferrrario*
Technical Manager - *A.Ghigo*
Lab.Director *F.Bossi-*
Div.Directors - *A.Gallo, U. Rotundo, P.Gianotti*
Administration - *T. Ferro*
Conventional safety - *S.Vescovi*
Radioprotection - *A.Esposito*
Sparc_Lab - *G.Di Pirro*

Management Team

Scientific Manager
M.Ferrario

Technical Manager
A.Ghigo

Project Management & Integration
A.Falone

***Project Management Office* / PMO**

Working Areas

1. Beam Physics	2. Injector	3. Linac	4. Integration	5. Plasma	6. FEL	7. High Power Laser	8. Users	9. Infrastructures
C.Vaccarezza	*E.Chiadroni*	*D.Alesini*	*B.Buonomo*	*R.Pompili*	*L.Giannessi*	*TBD*	*F.Stellato (Roma2)*	*U.Rotundo*

Work Packages

1. Accelerator Physics *A.Giribono* *A.Mostacci (Univ. La Sapienza)*	5. Secondary part. sources *T.B.D.*	9. Computing *P.Santangelo*	13. Beam Diagnostics *A.Cianchi (Roma2)*	17. Magnets & PS *L.Sabbatini*	21. Cooling & Ventilation *S.Cantarella*
2. Plasma Physics *A.R.Rossi (INFN-MI)*	6. Plasma module *A.Biagioni*	10. Vacuum *A.Liedl*	14. Beam Instrumentation & electronics *A.Stella*	18. Undulators *A.Petralia (ENEA)*	22. Civil engineering *S.Incremona*
3. FEL Physics *V.Petrillo (INFN-MI)*	7. Sparc_Lab TF *R.Pompili*	11. Lasers & Cathodes *M.Anania*	15. LLRF & Synchro *M.Bellaveglia*	19. Mech.Engineering *L.Pellegrino*	23. Radioprotection *A.Esposito*
4. Photon & User Beamlines *F.Villa*	8. RF Gun & Accelerating structures *L.Piersanti*	12. High Power RF & distribution *F.Cardelli*	16. Control system & Interlocks *A.Stecchi*	20. Electrical Installations *R.Ricci*	24. Conventional Safety *S.Vescovi*

Organization Breakdown Structure

Interface Working Areas vs Work-Packages - Responsibility Assignment Matrix

		WA 1	WA 2	WA 3	WA 4	WA 5	WA 6	WA 7	WA 8	WA 9
		Beam Physics	Injector	Linac	Integration	Plasma	FEL	High Power Laser	Users	Infrastructure
WP 1	Accelerator Physics	x	x	x		x	x	x		
WP 2	Plasma Physics	x				x		x		
WP 3	FEL Physics	x					x	x		
WP 4	Photon & User Beamlines	x					x	x	x	
WP 5	Secondary Part.Source							x	x	
WP 6	Plasma module	x				x		x		
WP 7	Sparc_lab TF					x				
WP 8	RF Gun & Acc.Structure	x	x	x						
WP 9	Computing	x								
WP 10	Vacuum		x	x	x	x		x		
WP 11	Laser & Cathodes		x					x		
WP 12	High Power RF & Distribution		x	x	x					
WP 13	Beam Diagnostics	x	x	x	x	x	x		x	
WP 14	Beam Instrumentation & Electronics		x	x	x					
WP 15	LLRF & Synchro		x	x	x					
WP 16	Control system & Interlocks	x	x	x	x	x	x	x	x	x
WP 17	Magnets & PS	x	x	x	x		x			
WP 18	Undulators		x				x			
WP 19	Mech.Engineering		x	x	x					x
WP 20	Electrical Installation				x					x
WP 21	Cooling & Ventilation		x	x	x					x
WP 22	Civil Engineering									x
WP 23	Radioprotection									x
WP 24	Conventional Safety									x

R&D Highlights

INJECTOR

- S-Band RF System (Including LLRF & Synchronization) to improve performances in terms of stability.
- New photocathode laser system
- New RF Gun with load-lock system to develop high QE cathodes

Sparc_Lab

PLASMA

- Development, realization and test on long capillaries
- Plasma density stability and density measurement
- Driver & witness separation
- Vacuum management

Sparc_Lab

R&D Highlights

X-Band RF power system

- Current facility using a CPI klystron from CERN
- 1 Spare to procured asap
- Development with CERN & CPI for a fully compatible (Eupraxia) high efficiency X-Band klystron.
- Reliability and performance studies on the overall X-Band system

TEX

LINAC

- X-Band section prototypes
- Design, development, realization and test of X-Band high power waveguide components.
- Pumping and thermal treatment

TEX

Work Breakdown Structure

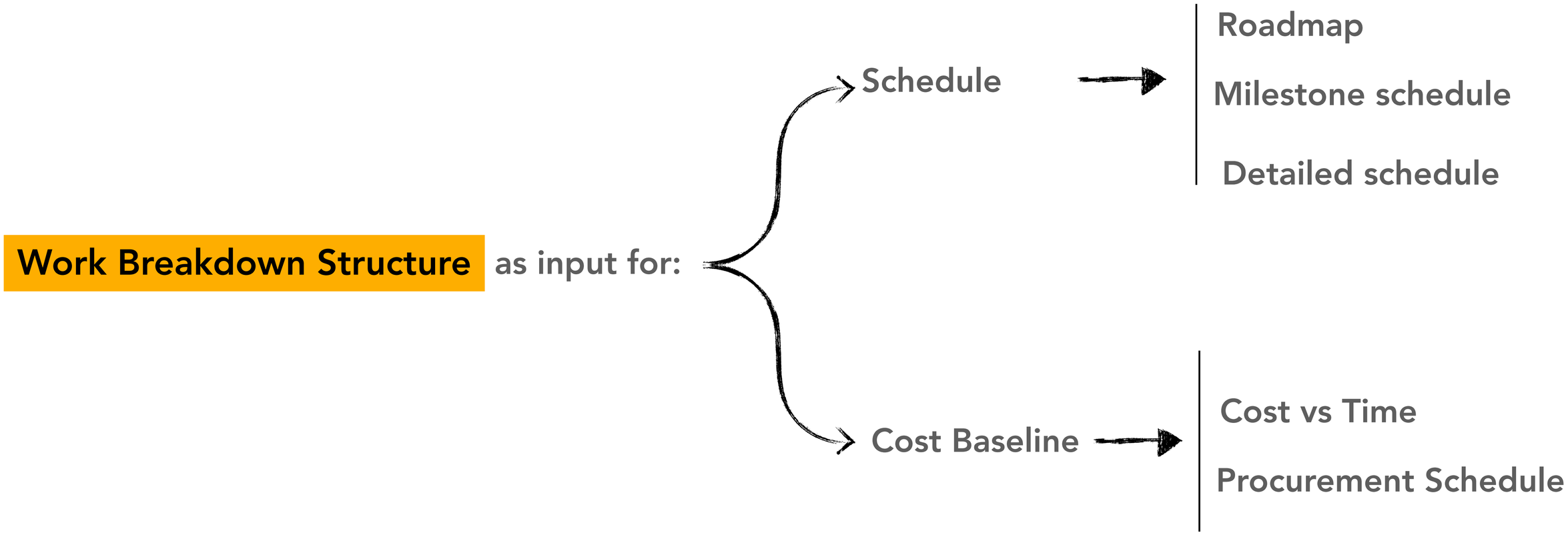
Applicability: **Technical Design Report**

Milestones and deliverable have been set up for each WA and for each WP (Bottom up approach)

Feature and guideline for the WBS

- Consistency and completeness
- Deliverable measurable and defined.
- Deliverable Report to be approved through a dedicated review process.
- Activities cross-correlated
- R&D Costs (where applicable) are part of the WBS itself.
- Resources (assignment but not leveling).
- Time frame: TDR to be concluded in 2024

Work Breakdown Structure



Work Breakdown Structure

S2E Simulations

WA	WP	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
WA1	**S2E Simulations**		**640 g**	**ven 01/01/21**	**gio 15/06/23**		**205.000,00 €**
WA1.0	WP.09	Setting up computing cluster	12 mes	ven 01/01/21	gio 02/12/21		205.000,00 €
WA1.01	WP.01	Number & types of ondulators	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA1.02	WP.01	Number & types of transfer line	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA1.03	WP.01	Spectrometers line	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA1.04	WP.04	5 GeV Plasma accelerator line	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA1.05	WP.17	First magnet specs	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA1.06	WP.01	Nominal working point	6 mes	ven 18/06/21	gio 02/12/21	4	0,00 €
WA1.07		Machine layout optimization	6 mes	ven 18/06/21	gio 02/12/21	4	0,00 €
WA1.08		Virtual measurement	7 mes	ven 03/12/21	gio 16/06/22	9	0,00 €
WA1.09		Diagnostics	7 mes	ven 03/12/21	gio 16/06/22	9	0,00 €
WA1.100		Functional check high level SW	7 mes	ven 03/12/21	gio 16/06/22	9	0,00 €
WA1.110		Lattice robustness	6 mes	gio 30/06/22	mer 14/12/22		0,00 €
WA1.120		Jitter and alignment sensitivity	6 mes	gio 30/06/22	mer 14/12/22		0,00 €
WA1.130		Commissioning strategy	7 mes	ven 01/07/22	gio 12/01/23		0,00 €
WA1.150		TDR redaction	6 mes	dom 01/01/23	gio 15/06/23		0,00 €
WA1.M1		Preliminary machine baseline approved	0 g	ven 18/06/21	ven 18/06/21	4;7	0,00 €
WA1.M2		Intermediate machine baseline approved	0 g	ven 03/12/21	ven 03/12/21	9	0,00 €
WA1.M3		Final layout and beam parameters ready	0 g	ven 04/11/22	ven 04/11/22	18FI+12 mes	0,00 €

Injector

WA2	Injector		501 g	ven 01/01/21	ven 02/12/22		2.045.000,00 €
WA2.010	WP.15	3D Design photoinjector & LBTL	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA2.011	WP.11	Load-lock system decision	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA2.012	WP.08	Commissioning new RF-Gun at Sparc_lab	6 mes	gio 01/07/21	mer 15/12/21		0,00 €
WA2.013	WP.08	RF Gun design	221 g	lun 01/03/21	sab 01/01/22		0,00 €
WA2.014	WP.08	RF Gun manufactured & tested	12 mes	lun 03/01/22	ven 02/12/22	25	180.000,00 €
WA2.015	all	Injector optimization & final design	12 mes	sab 01/01/22	gio 01/12/22		0,00 €
WA2.020	WP.11	R&D on transverse homogeneity	12 mes	ven 01/01/21	gio 02/12/21		415.000,00 €
WA2.021	WP.11	Laser diagnostics specifications	6 mes	gio 01/07/21	mer 15/12/21		0,00 €
WA2.022	WP.11	Photocathode laser developed	12 mes	gio 16/12/21	mer 16/11/22	29	700.000,00 €
WA2.030	WP.08	Experimental studies on RF jitters	12 mes	sab 01/01/22	gio 01/12/22		0,00 €
WA2.031	WP.15	Upgrade LLRF	6 mes	mar 01/06/21	lun 15/11/21		100.000,00 €
WA2.032	WP.15	Upgrade Synchronization system	6 mes	mar 01/06/21	lun 15/11/21		100.000,00 €
WA2.033	WP.12	Solid State S-Band modulator.	12 mes	sab 01/01/22	gio 01/12/22		550.000,00 €
WA2.M1		RF GUN prototype ready	0 g	lun 05/12/22	lun 05/12/22	26	0,00 €
WA2.M2		Injector designed	0 g	ven 02/12/22	ven 02/12/22	27	0,00 €
WA2.M3		PC Laser developed & designed	0 g	gio 17/11/22	gio 17/11/22	30	0,00 €
WA2.M4		LLRF & Synchronization system designed	0 g	mar 03/05/22	mar 03/05/22	32;33;34	0,00 €

LINAC

WA	WP	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
WA3	**Linac**		**728 g**	**ven 01/01/21**	**mar 17/10/23**		**1.365.000,00 €**
WA3		**Magnets**	**369 g**	**ven 01/01/21**	**mer 01/06/22**		**210.000,00 €**
WA3.010	WP.01	Module elements position	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA3.011	WP.17	1st Quadrupole design	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA3.012	WP.17	Magnetic lab upgrade	12 mes	gio 01/07/21	mer 01/06/22		130.000,00 €
WA3.013	WP.17	Quadrupole prototype	10 mes	ven 18/06/21	gio 24/03/22	43	80.000,00 €
WA3		**Diagnostics**	**608 g**	**ven 01/01/21**	**mar 02/05/23**		**230.000,00 €**
WA3.014	WP.13	High precision charge measurement (x2)	6 mes	gio 01/07/21	mer 15/12/21		80.000,00 €
WA3.015	WP.13	Compact diagnostic chamber design	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA3.016	WP.13	Manufacturing & Test on Compact Diag.Chamber	6 mes	ven 03/12/21	gio 19/05/22	48	60.000,00 €
WA3.017	WP.13	BPM Design	6 mes	mar 01/06/21	lun 15/11/21		0,00 €
WA3.018	WP.13	Manufacturing & Test on BPM	6 mes	mar 16/11/21	lun 02/05/22	50	60.000,00 €
WA3.019	WP.13	BLM Design	6 mes	mer 01/06/22	mar 15/11/22		0,00 €
WA3.020	WP.13	Manufacturing & Test on BLM	6 mes	mer 16/11/22	mar 02/05/23	52	30.000,00 €
WA3		**Vacuum**	**500 g**	**ven 01/01/21**	**gio 01/12/22**		**105.000,00 €**
WA3.030	WP.10	Vacuum pressure distribution	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA3.031	WP.10	Test of different pumps&gauges	6 mes	gio 01/07/21	mer 15/12/21		40.000,00 €
WA3.032	WP.10	Design & procurement heat treatment chamber	6 mes	gio 01/07/21	mer 15/12/21		55.000,00 €
WA3.033	WP.10	Vacuum layout	6 mes	ven 03/12/21	gio 19/05/22	55	0,00 €
WA3.034	WP.10	Design local heater for circular WG	6 mes	sab 01/01/22	gio 16/06/22		0,00 €
WA3.035	WP.10	Prototype & test on local heater	6 mes	ven 17/06/22	gio 01/12/22	59	10.000,00 €
WA3.036		Layout RF Modules development	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA3		**Waveguide system**	**728 g**	**ven 01/01/21**	**mar 17/10/23**		**480.000,00 €**
WA3.040	WP.12	WG attenuation estimation	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA3.041	WP.12	Validation Asymetric distribution	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA3.042	WP.12	RF Deflector WG Line	6 mes	mar 01/06/21	lun 15/11/21		0,00 €
WA3.043	WP.12	WG vacuum pressure	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA3.044	WP.12	Design WG Circular mode converter	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA3.045	WP.12	Procurement WG Circular mode converter	6 mes	ven 03/12/21	gio 19/05/22	67	80.000,00 €
WA3.046	WP.12	Procurement HP WG X-Band component	6 mes	sab 01/01/22	gio 16/06/22		200.000,00 €
WA3.047	WP.12	HP Waveguide components test	6 mes	mer 03/05/23	mar 17/10/23	69	0,00 €
WA3.048	WP.12	BOC Design	12 mes	sab 01/01/22	gio 01/12/22		0,00 €
WA3.049	WP.12	BOC manufacturing & Test	6 mes	ven 02/12/22	gio 18/05/23	71	200.000,00 €
WA3		**X-Band Section**	**660 g**	**ven 01/01/21**	**gio 13/07/23**		**340.000,00 €**
WA3.050	WP.08	X-Band Mech Prototype design	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA3.051	WP.08	Manufacturing X-Band Mech Prototype design	6 mes	ven 18/06/21	gio 02/12/21	74	60.000,00 €
WA3.052	WP.08	X-Band RF prototype Design	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA3.053	WP.08	Manufacturing X-Band RF Prototype	6 mes	ven 18/06/21	gio 02/12/21	76	80.000,00 €
WA3.054	WP.08	Full prototype design	6 mes	sab 01/01/22	gio 16/06/22		0,00 €
WA3.055	WP.08	Manufacturing Full prototype (x2)	6 mes	ven 17/06/22	gio 01/12/22	78	200.000,00 €
WA3.056	WP.08	Full prototype HP test	6 mes	ven 02/12/22	gio 18/05/23	79	0,00 €
WA3.057	WP.08	Dark Current studies.	2 mes	ven 19/05/23	gio 13/07/23	80	0,00 €
WA3.M1		Layout RF Module completed	0 g	ven 03/12/21	ven 03/12/21	61	0,00 €
WA3.M2		Waveguide Layout ready	0 g	mer 01/06/22	mer 01/06/22		0,00 €
WA3.M3		HP Test on X-Band WG System finalised	0 g	ven 19/05/23	ven 19/05/23	72	0,00 €
WA3.M4		X-Band Accelerating sections validated	0 g	ven 19/05/23	ven 19/05/23	80	0,00 €

Work Breakdown Structure

RF&Power Supplies

WA	WP	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
WA4	**Integration RF & Power Supplies**		**880 g**	**ven 01/01/21**	**gio 16/05/24**		**1.500.000,00 €**
WA4		**RF Stations**	**880 g**	**ven 01/01/21**	**gio 16/05/24**		**1.500.000,00 €**
WA4.010	WP.01	Number & Type of RF Station	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA4.011	WP.12	Procurement 2nd X-Band klystron	6 mes	mar 01/06/21	lun 15/11/21		750.000,00 €
WA4.012	WP.12	Acquisition 2nd X-Band klystron	12 mes	mar 16/11/21	lun 17/10/22	90	0,00 €
WA4.013	WP.12	Procurement full specs X-Band Klystron	6 mes	dom 01/01/23	gio 15/06/23		750.000,00 €
WA4.015	WP.12	Acquisition full specs X-Band klystron	12 mes	ven 16/06/23	gio 16/05/24	92	0,00 €
WA4.016	WP.01;WP.08;WP.15	Final Specs Modulators	6 mes	dom 01/01/23	gio 15/06/23		0,00 €
WA4.017	WP.01;WP.08;WP.15	Quality acceptance test definition	6 mes	dom 01/01/23	gio 15/06/23		0,00 €
WA4		**Power supplies**	**760 g**	**ven 01/01/21**	**gio 30/11/23**		**0,00 €**
WA4.020	WP.17	First Layout power supply room	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA4.021	WP.17	Power supply specifications and utilities requirements	6 mes	ven 18/06/21	gio 02/12/21	97	0,00 €
WA4.022	WP.17	Integration modulators and PS	6 mes	ven 03/12/21	gio 19/05/22	98	0,00 €
WA4.023	WP.17	Installation & commissioning strategy	6 mes	ven 16/06/23	gio 30/11/23	94	0,00 €
WA4.M1		2nd X-Band Klystron tested	0 g	mar 18/10/22	mar 18/10/22	91	0,00 €
WA4.M2		Full Specs Klystron tested	0 g	ven 03/11/23	ven 03/11/23	93	0,00 €
WA4.M3		Modulator room layout and utilities	0 g	ven 16/06/23	ven 16/06/23	94	0,00 €

PLASMA

WA	WP	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
WA5	**Plasma**		**960 g**	**ven 01/01/21**	**gio 05/09/24**		**800.000,00 €**
WA5.010	WP.06	Instability studies	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA5.020	WP.06	Different gas options	12 mes	mar 01/06/21	lun 02/05/22		0,00 €
WA5.030	WP.06	Long capillary design	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA5.040	WP.06	Realization long capillary	6 mes	ven 03/12/21	gio 19/05/22	108	400.000,00 €
WA5.050	WP.06	Plasma generation & characterization	6 mes	ven 20/05/22	gio 03/11/22	109	0,00 €
WA5.060	WP.06	Long capillary alignment w.r.t beam	6 mes	ven 20/05/22	gio 03/11/22		0,00 €
WA5.070	WP.06	Realization 2nd long capillary layout	12 mes	ven 04/11/22	gio 05/10/23	111	400.000,00 €
WA5.080	WP.06	Integration with matching optics	6 mes	ven 06/10/23	gio 21/03/24	112	0,00 €
WA5.090	WP.06	Final plasma design	6 mes	ven 22/03/24	gio 05/09/24	113	0,00 €
WA5.M1	WP.06	Long Capillary plasma characterization	0 g	ven 04/11/22	ven 04/11/22	110	0,00 €
WA5.M2	WP.06	Plasma section final design	0 g	ven 06/09/24	ven 06/09/24	114	0,00 €

FEL

WA	WP	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
WA6	**FEL**		**760 g**	**ven 01/01/21**	**gio 30/11/23**		**200.000,00 €**
WA6.010		**Studio Configurazione 14 nm (SPARC)**	**760 g**	**ven 01/01/21**	**gio 30/11/23**		**0,00 €**
WA6.011	WP.18	Definizione parametri SCU prototipo - opzione	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA6.012	WP.18	Simulazione di riferimento parametri ondulatore	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA6.013	WP.18	Simulazioni s2E	12 mes	ven 18/06/21	gio 19/05/22	120	0,00 €
WA6.014	WP.18	Analisi tolleranze	8 mes	ven 20/05/22	gio 29/12/22	122	0,00 €
WA6.015	WP.18	Definizione specifiche	8 mes	ven 20/05/22	gio 29/12/22	122	0,00 €
WA6.016	WP.13	Definizione diagnostiche intraondulatore	8 mes	ven 20/05/22	gio 29/12/22	122	0,00 €
WA6.017	WP.18	Progettazione	12 mes	ven 30/12/22	gio 30/11/23	125	0,00 €
WA6.0200		**Studio Configurazione Seeded 50-180 nm**	**740 g**	**ven 01/01/21**	**gio 02/11/23**		**0,00 €**
WA6.0201	WP.18	Condizioni seed potenza - intervallo di operazione	7 mes	ven 01/01/21	gio 15/07/21		0,00 €
WA6.0202	WP.18	Definizione parametri ondulatore	7 mes	ven 01/01/21	gio 15/07/21		0,00 €
WA6.0203	WP.18	Simulazioni Varie configurazioni – parametri	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA6.0204	WP.18	Simulazioni Varie configurazioni – s2e	6 mes	ven 03/12/21	gio 19/05/22	130	0,00 €
WA6.0205	WP.18	Studio Tolleranze	6 mes	ven 20/05/22	gio 03/11/22	131	0,00 €
WA6.0206	WP.18	Definizione specifiche ondulatori	6 mes	ven 20/05/22	gio 03/11/22	131	0,00 €
WA6.0207	WP.13	Definizione diagnostica intraondulatori	7 mes	ven 04/11/22	gio 18/05/23	133	0,00 €
WA6.0208	WP.04	Sistema laser - Trasporto radiazione e diagnostiche	7 mes	ven 04/11/22	gio 18/05/23	133	0,00 €
WA6.0209	WP.04	Optical beamlines	6 mes	ven 19/05/23	gio 02/11/23	135	0,00 €
WA6.0210	WP.18	Progettazione	6 mes	ven 19/05/23	gio 02/11/23	135	0,00 €
WA6.0300		**Configurazione 3 nm**	**760 g**	**ven 01/01/21**	**gio 30/11/23**		**200.000,00 €**
WA6.0301	WP.18	Definizione opzioni ondulatore	6 mes	ven 01/01/21	gio 17/06/21		0,00 €
WA6.0302	WP.18	Studio preliminare di apple X (Sabina like) – periodo 16	7 mes	ven 18/06/21	gio 30/12/21	139	100.000,00 €
WA6.0303	WP.18	Definizione parametri SCU elicoidale	7 mes	ven 18/06/21	gio 30/12/21	139	0,00 €
WA6.0304	WP.18	Simulazioni Varie configurazioni – parametri	7 mes	ven 18/06/21	gio 30/12/21	139	0,00 €
WA6.0305	WP.18	Simulazioni Varie configurazioni – s2e	6 mes	ven 31/12/21	gio 16/06/22	142	0,00 €
WA6.0306	WP.18	Studio Tolleranze	7 mes	ven 17/06/22	gio 29/12/22	143	0,00 €
WA6.0307	WP.18	Definizione specifiche ondulatori	6 mes	ven 30/12/22	gio 15/06/23	144	0,00 €
WA6.0308	WP.13	Definizione diagnostica intraondulatori	6 mes	ven 30/12/22	gio 15/06/23	144	100.000,00 €
WA6.0309	WP.04	Studio linee ottiche	6 mes	ven 16/06/23	gio 30/11/23	145	0,00 €
WA6.0310	WP.18	Progettazione	6 mes	ven 16/06/23	gio 30/11/23	145	0,00 €
WA6.0400		**Configurazione 30-180 nm**	**240 g**	**ven 20/05/22**	**gio 20/04/23**		**0,00 €**
WA6.0401	WP.18	Incremento numero ondulatori (+1)	6 mes	ven 20/05/22	gio 03/11/22	131	0,00 €
WA6.0402	WP.18	Progettazione	6 mes	ven 04/11/22	gio 20/04/23	150	0,00 €
WA6.M1	WP.18	Design 14 nm option	0 g	ven 21/04/23	ven 21/04/23	126	0,00 €
WA6.M2	WP.18	Design 50-180 nm option	0 g	ven 06/10/23	ven 06/10/23	137	0,00 €
WA6.M3	WP.18	Design 3nm option	0 g	ven 06/10/23	ven 06/10/23	148	0,00 €
WA6.M4	WP.18	Design 30-180nm option	0 g	ven 21/04/23	ven 21/04/23	151	0,00 €

Work Breakdown Structure

USERS

WA	WP	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
WA8	**USER**		**720 g**	**ven 01/01/21**	**gio 05/10/23**		**225.000,00 €**
WA8.010	WP.04	Scientific case @3nm	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA8.011	WP.04	Evaluation scientific case @ other wavelengths	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA8.012	WP.04	Beam Transport & Optical elements simulations	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA8.013	WP.04	Optical elements design	12 mes	ven 01/01/21	gio 02/12/21		0,00 €
WA8.014	WP.04	Detector test	12 mes	ven 03/12/21	gio 03/11/22	161	0,00 €
WA8.015	WP.04	Mechanical components design	12 mes	ven 03/12/21	gio 03/11/22		225.000,00 €
WA8.016	WP.04	Sample delivery system test	6 mes	ven 04/11/22	gio 20/04/23	163	0,00 €
WA8.017	WP.04	Final design user end station	6 mes	ven 21/04/23	gio 05/10/23	164	0,00 €
WA8.M1	WP.04	Design optical elements	0 g	ven 03/12/21	ven 03/12/21	161	0,00 €
WA8.M2	WP.04	Final design use end station	0 g	ven 06/10/23	ven 06/10/23	165	0,00 €

INFRASTRUCTURES

WA9	Infrastructures		380 g	ven 01/01/21	gio 16/06/22		100.000,00 €
WA9.010	WP.20	Harmonic rejection filters studies	6 mes	gio 01/07/21	mer 15/12/21		0,00 €
WA9.011	WP.8	High stability cooling skids studies	6 mes	sab 01/01/22	gio 16/06/22		50.000,00 €
WA9.012	WP.23	Radioprotection studies	18 mes	ven 01/01/21	gio 19/05/22		50.000,00 €

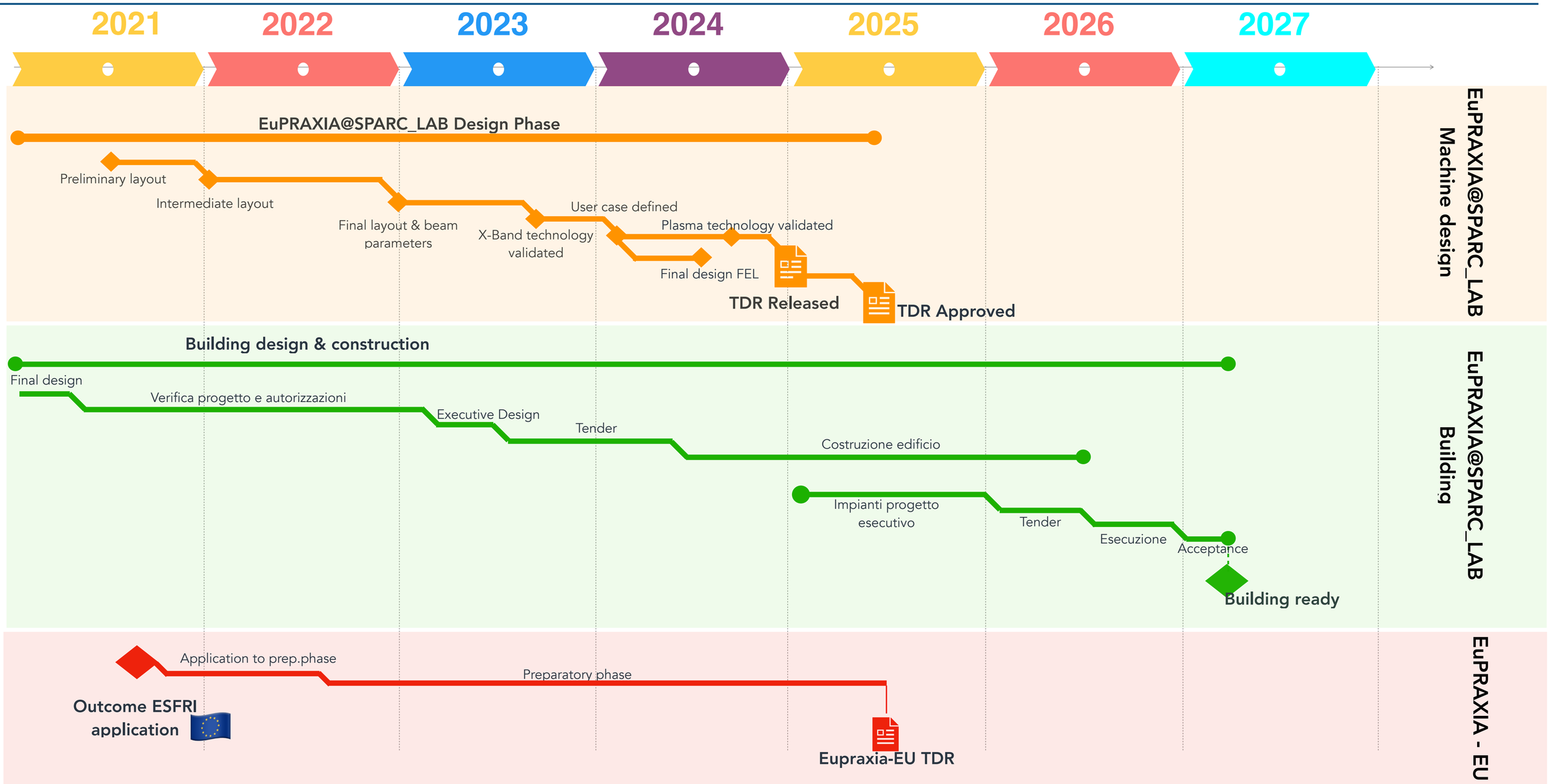
PROJECT OFFICE

WA	WP	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
Project Office			**1120 g**	**ven 01/01/21**	**gio 17/04/25**		**0,00 €**
PO.010		Project Management Plan Technical Design Report	2 mes	ven 01/01/21	gio 25/02/21		0,00 €
PO.011		Cost estimation for the implementation	4 mes	ven 01/01/21	gio 22/04/21		0,00 €
PO.012		Project Managemetn Plan Implementation phase	12 mes	ven 26/02/21	gio 27/01/22	175	0,00 €
PO.013		Cost estimation ImplementationRevision	2 mes	ven 01/10/21	gio 25/11/21		0,00 €
PO.013		TDR Redaction preparation	12 mes	ven 01/12/23	gio 31/10/24	40;87;118;1;21	0,00 €
PO.014		TDR revision	6 mes	ven 01/11/24	gio 17/04/25	179	0,00 €
PO.M1		Project Management Plan TDR	0 g	ven 26/02/21	ven 26/02/21	175	0,00 €
PO.M2		Project Management Plan Implementation Phase	0 g	ven 28/01/22	ven 28/01/22	177	0,00 €
PO.M3		Cost book implementation phase	0 g	ven 28/01/22	ven 28/01/22	177	0,00 €
PO.M4		TDR READY	0 g	ven 01/11/24	ven 01/11/24	179	0,00 €
PO.M5		TDR Approved	0 g	ven 18/04/25	ven 18/04/25	180	0,00 €

EXTERNAL CONSTRAINTS

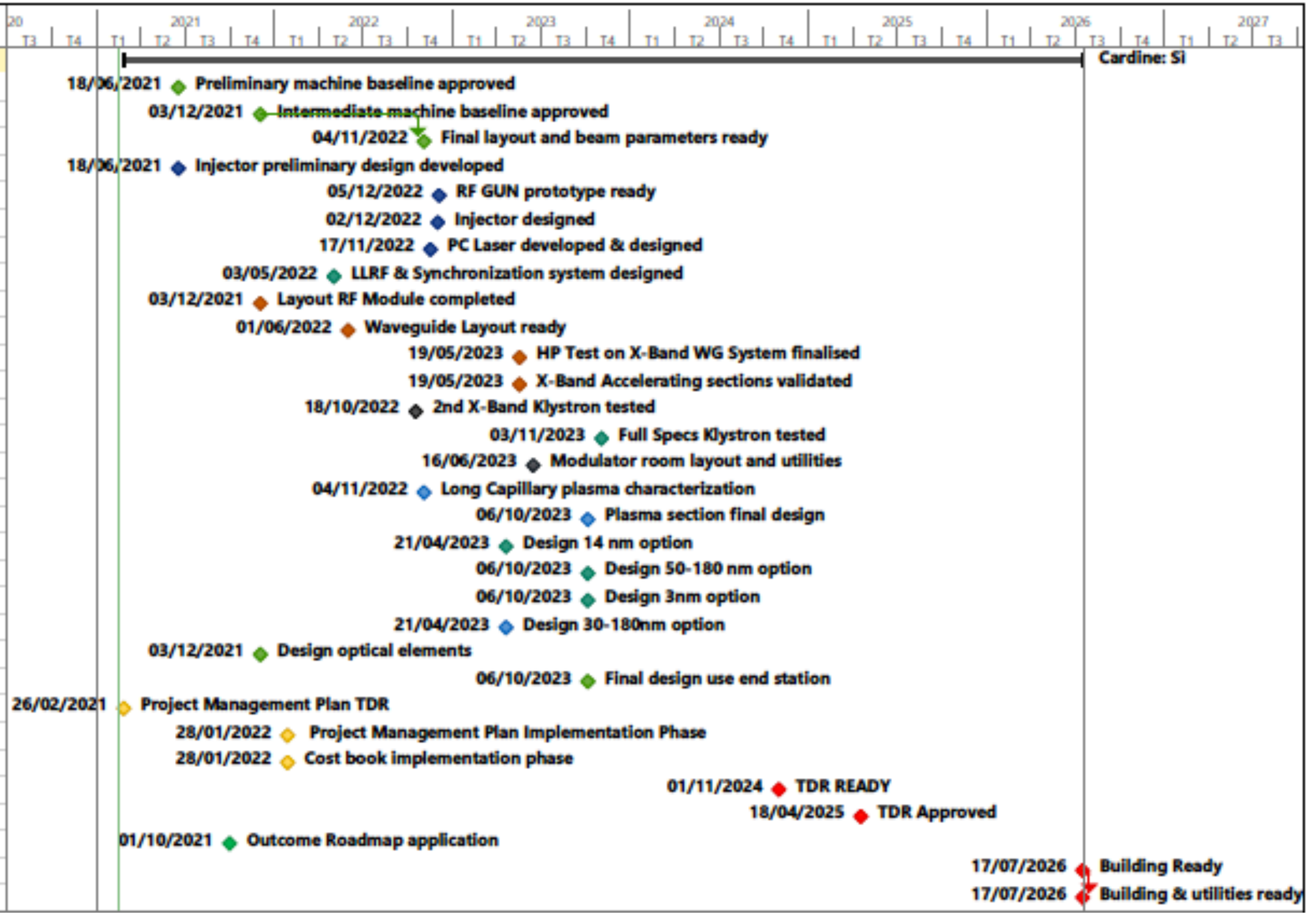
External constraints			1381 g	gio 01/04/21	ven 17/07/26		0,00 €
ESFRI.M1		Hearings & Critical questions	2 mes	gio 01/04/21	mer 26/05/21		0,00 €
ESFRI.M2		Outcome Roadmap application	0 g	ven 01/10/21	ven 01/10/21		0,00 €
BLDG.010		Tender for construction	12 mes	lun 21/08/23	ven 19/07/24		0,00 €
BLDG.020		Building construction	24 mes	ven 19/07/24	gio 21/05/26	190	0,00 €
BLDG.030		Building handover	2 mes	ven 22/05/26	gio 16/07/26	191	0,00 €
BLDG.M1		Building Ready	0 g	ven 17/07/26	ven 17/07/26	192	0,00 €
BLDG.040		Utilities executive design	12 mes	sab 09/12/23	gio 07/11/24		0,00 €
BLDG.050		Tender utilities	8 mes	ven 08/11/24	gio 19/06/25	194	0,00 €
BLDG.060		Utilities works	6 mes	ven 20/06/25	gio 04/12/25	195	0,00 €
BLDG.070		Utilities acceptance	2 mes	ven 05/12/25	gio 29/01/26	196	0,00 €
BLDG.M2		Building & utilities ready	0 g	ven 17/07/26	ven 17/07/26	197;193	0,00 €

Road map

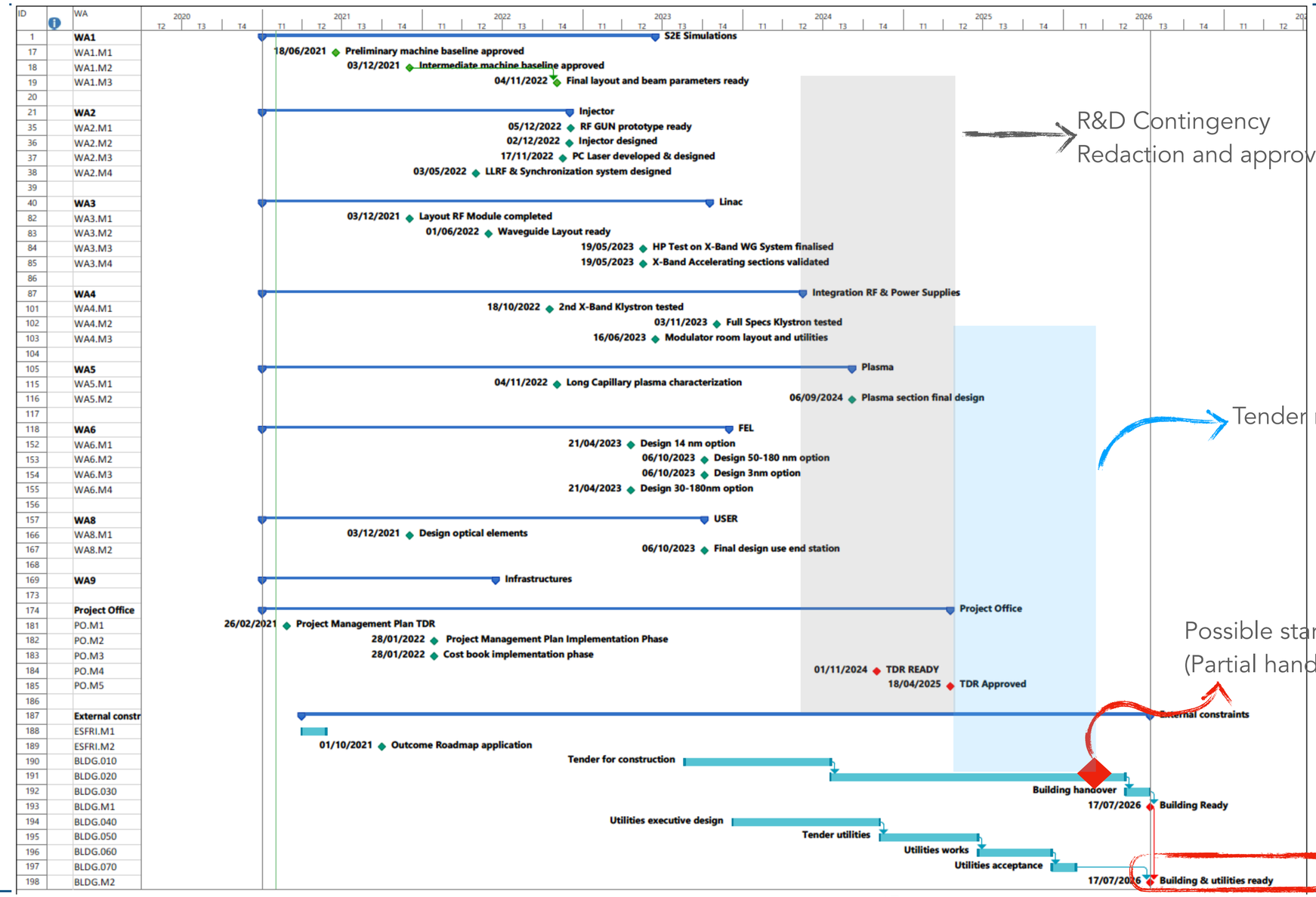

2021
2022
2023
2024
2025
2026
2027
EuPRAXIA@SPARC_LAB Design Phase
Preliminary layout
Intermediate layout
Final layout & beam parameters
X-Band technology validated
User case defined
Plasma technology validated
Final design FEL
TDR Released
TDR Approved
EuPRAXIA@SPARC_LAB Machine design
Building design & construction
Final design
Verifica progetto e autorizzazioni
Executive Design
Tender
Costruzione edificio
Impianti progetto esecutivo
Tender
Esecuzione
Acceptance
Building ready
EuPRAXIA@SPARC_LAB Building
Application to prep.phase
Preparatory phase
Outcome ESFRI application
Eupraxia-EU TDR
EuPRAXIA - EU

Milestone schedule

ID	WA	Nome attività
		Cardine: Si
17	WA1.M1	Preliminary machine baseline approved
18	WA1.M2	Intermediate machine baseline approved
19	WA1.M3	Final layout and beam parameters ready
35	WA2.M1	Injector preliminary design developed
36	WA2.M2	RF GUN prototype ready
37	WA2.M3	Injector designed
38	WA2.M4	PC Laser developed & designed
39	WA2.M5	LLRF & Synchronization system designed
83	WA3.M1	Layout RF Module completed
84	WA3.M2	Waveguide Layout ready
85	WA3.M3	HP Test on X-Band WG System finalised
86	WA3.M4	X-Band Accelerating sections validated
102	WA4.M1	2nd X-Band Klystron tested
103	WA4.M2	Full Specs Klystron tested
104	WA4.M3	Modulator room layout and utilities
115	WA5.M1	Long Capillary plasma characterization
116	WA5.M2	Plasma section final design
152	WA6.M1	Design 14 nm option
153	WA6.M2	Design 50-180 nm option
154	WA6.M3	Design 3nm option
155	WA6.M4	Design 30-180nm option
166	WA8.M1	Design optical elements
167	WA8.M2	Final design use end station
181	PO.M1	Project Management Plan TDR
182	PO.M2	Project Management Plan Implementation Phase
183	PO.M3	Cost book implementation phase
184	PO.M4	TDR READY
185	PO.M5	TDR Approved
189	ESFRI.M2	Outcome Roadmap application
193	BLDG.M1	Building Ready
198	BLDG.M2	Building & utilities ready



Detailed schedule



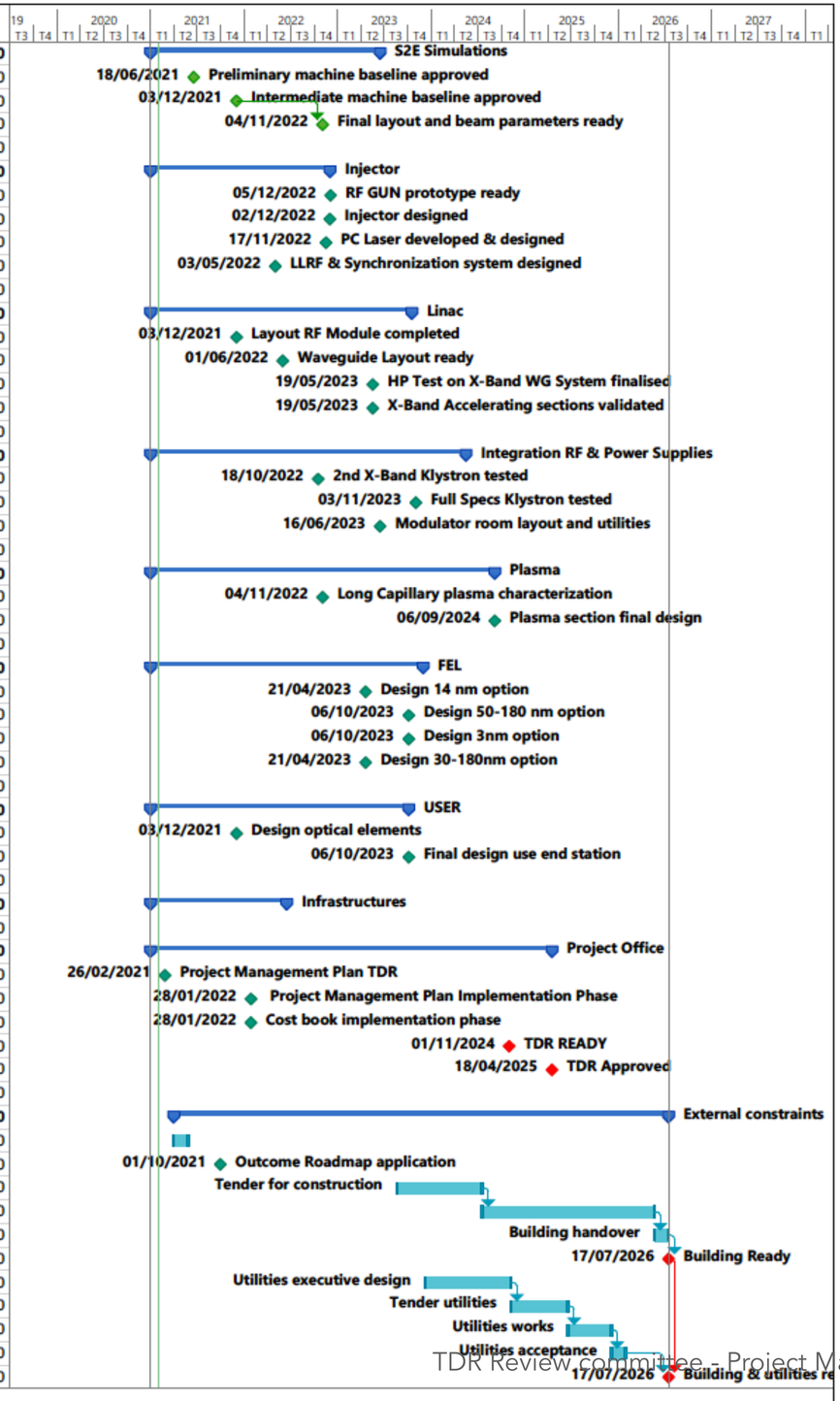
R&D Contingency
Redaction and approval of the TDR

Tender modulators et al.

Possible start of installation process
(Partial handover) fine 2025

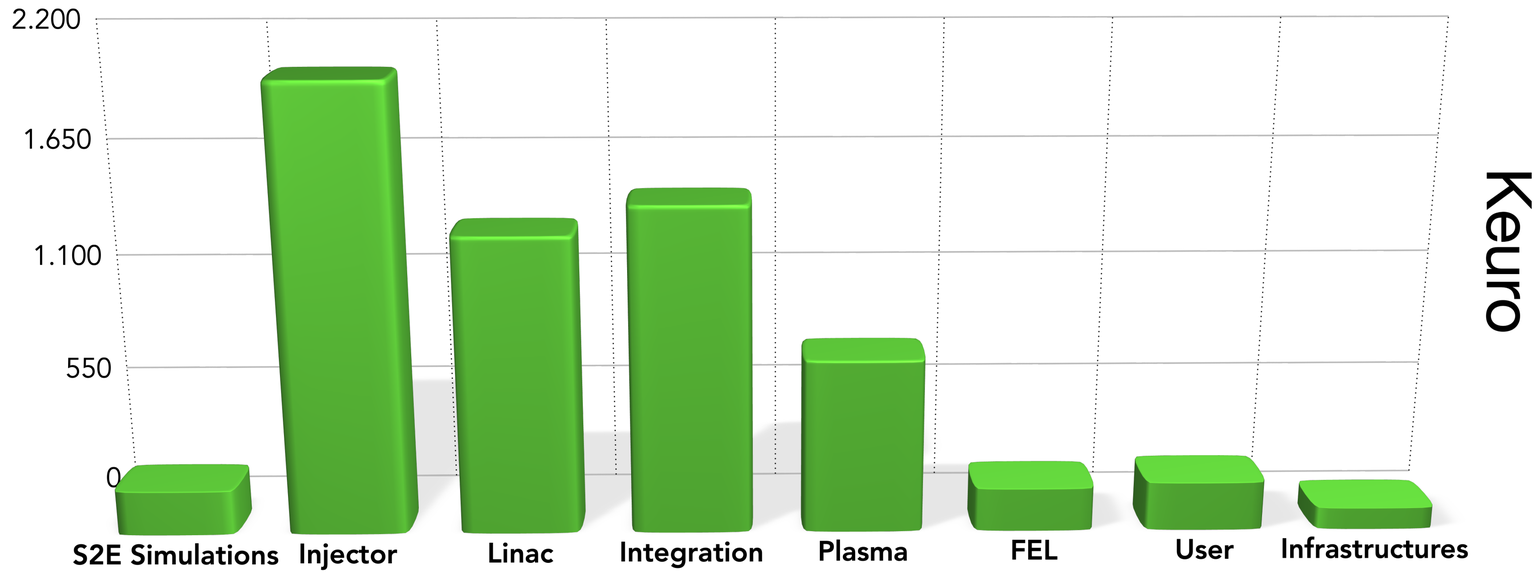
NO CONTINGENCY IN THE BUILDING CONSTRUCTION!

ID	WA	Nome attività	Durata	Inizio	Fine	Predecessori	Costo
1	**WA1**	**S2E Simulations**	**640 g**	**ven 01/01/21**	**gio 15/06/23**		**€205.000,00**
17	WA1.M1	Preliminary machine baseline approved	0 g	ven 18/06/21	ven 18/06/21	4;7	€0,00
18	WA1.M2	Intermediate machine baseline approved	0 g	ven 03/12/21	ven 03/12/21	9	€0,00
19	WA1.M3	Final layout and beam parameters ready	0 g	ven 04/11/22	ven 04/11/22	18FI+12 mes	€0,00
20							€0,00
21	**WA2**	**Injector**	**501 g**	**ven 01/01/21**	**ven 02/12/22**		**€2.045.000,00**
35	WA2.M1	RF GUN prototype ready	0 g	lun 05/12/22	lun 05/12/22	26	€0,00
36	WA2.M2	Injector designed	0 g	ven 02/12/22	ven 02/12/22	27	€0,00
37	WA2.M3	PC Laser developed & designed	0 g	gio 17/11/22	gio 17/11/22	30	€0,00
38	WA2.M4	LLRF & Synchronization system designed	0 g	mar 03/05/22	mar 03/05/22	32;33;34	€0,00
39							€0,00
40	**WA3**	**Linac**	**728 g**	**ven 01/01/21**	**mar 17/10/23**		**€1.365.000,00**
82	WA3.M1	Layout RF Module completed	0 g	ven 03/12/21	ven 03/12/21	61	€0,00
83	WA3.M2	Waveguide Layout ready	0 g	mer 01/06/22	mer 01/06/22		€0,00
84	WA3.M3	HP Test on X-Band WG System finalised	0 g	ven 19/05/23	ven 19/05/23	72	€0,00
85	WA3.M4	X-Band Accelerating sections validated	0 g	ven 19/05/23	ven 19/05/23	80	€0,00
86							€0,00
87	**WA4**	**Integration RF & Power Supplies**	**880 g**	**ven 01/01/21**	**gio 16/05/24**		**€1.500.000,00**
101	WA4.M1	2nd X-Band Klystron tested	0 g	mar 18/10/22	mar 18/10/22	91	€0,00
102	WA4.M2	Full Specs Klystron tested	0 g	ven 03/11/23	ven 03/11/23	93	€0,00
103	WA4.M3	Modulator room layout and utilities	0 g	ven 16/06/23	ven 16/06/23	94	€0,00
104							€0,00
105	**WA5**	**Plasma**	**960 g**	**ven 01/01/21**	**gio 05/09/24**		**€800.000,00**
115	WA5.M1	Long Capillary plasma characterization	0 g	ven 04/11/22	ven 04/11/22	110	€0,00
116	WA5.M2	Plasma section final design	0 g	ven 06/09/24	ven 06/09/24	114	€0,00
117							€0,00
118	**WA6**	**FEL**	**760 g**	**ven 01/01/21**	**gio 30/11/23**		**€200.000,00**
152	WA6.M1	Design 14 nm option	0 g	ven 21/04/23	ven 21/04/23	126	€0,00
153	WA6.M2	Design 50-180 nm option	0 g	ven 06/10/23	ven 06/10/23	137	€0,00
154	WA6.M3	Design 3nm option	0 g	ven 06/10/23	ven 06/10/23	148	€0,00
155	WA6.M4	Design 30-180nm option	0 g	ven 21/04/23	ven 21/04/23	151	€0,00
156							€0,00
157	**WA8**	**USER**	**720 g**	**ven 01/01/21**	**gio 05/10/23**		**€225.000,00**
166	WA8.M1	Design optical elements	0 g	ven 03/12/21	ven 03/12/21	161	€0,00
167	WA8.M2	Final design use end station	0 g	ven 06/10/23	ven 06/10/23	165	€0,00
168							€0,00
169	**WA9**	**Infrastructures**	**380 g**	**ven 01/01/21**	**gio 16/06/22**		**€100.000,00**
173							€0,00
174	**Project Office**	**Project Office**	**1120 g**	**ven 01/01/21**	**gio 17/04/25**		**€0,00**
181	PO.M1	Project Management Plan TDR	0 g	ven 26/02/21	ven 26/02/21	175	€0,00
182	PO.M2	Project Management Plan Implementation Phase	0 g	ven 28/01/22	ven 28/01/22	177	€0,00
183	PO.M3	Cost book implementation phase	0 g	ven 28/01/22	ven 28/01/22	177	€0,00
184	PO.M4	TDR READY	0 g	ven 01/11/24	ven 01/11/24	179	€0,00
185	PO.M5	TDR Approved	0 g	ven 18/04/25	ven 18/04/25	180	€0,00
186							€0,00
187	**External constr**	**External constraints**	**1381 g**	**gio 01/04/21**	**ven 17/07/26**		**€0,00**
188	ESFRI.M1	Hearings & Critical questions	2 mes	gio 01/04/21	mer 26/05/21		€0,00
189	ESFRI.M2	Outcome Roadmap application	0 g	ven 01/10/21	ven 01/10/21		€0,00
190	BLDG.010	Tender for construction	12 mes	lun 21/08/23	ven 19/07/24		€0,00
191	BLDG.020	Building construction	24 mes	ven 19/07/24	gio 21/05/26	190	€0,00
192	BLDG.030	Building handover	2 mes	ven 22/05/26	gio 16/07/26	191	€0,00
193	BLDG.M1	Building Ready	0 g	ven 17/07/26	ven 17/07/26	192	€0,00
194	BLDG.040	Utilities executive design	12 mes	sab 09/12/23	gio 07/11/24		€0,00
195	BLDG.050	Tender utilities	8 mes	ven 08/11/24	gio 19/06/25	194	€0,00
196	BLDG.060	Utilities works	6 mes	ven 20/06/25	gio 04/12/25	195	€0,00
197	BLDG.070	Utilities acceptance	2 mes	ven 05/12/25	gio 29/01/26	196	€0,00
198	BLDG.M2	Building & utilities ready	0 g	ven 17/07/26	ven 17/07/26	197;193	€0,00



R&D Cost Estimation

ID	AREA	Amount (k€)	%
WA1	S2E Simulations	205	3,18
WA2	Injector	2045	31,75
WA3	Linac	1365	21,20
WA4	Integration	1500	23,29
WA5	Plasma	800	12,42
WA6	FEL	200	3,11
WA8	User	225	3,49
WA9	Infrastructures	100	1,55
	Budget At Completion	**6440**	**100,00**



NOT INCLUDE

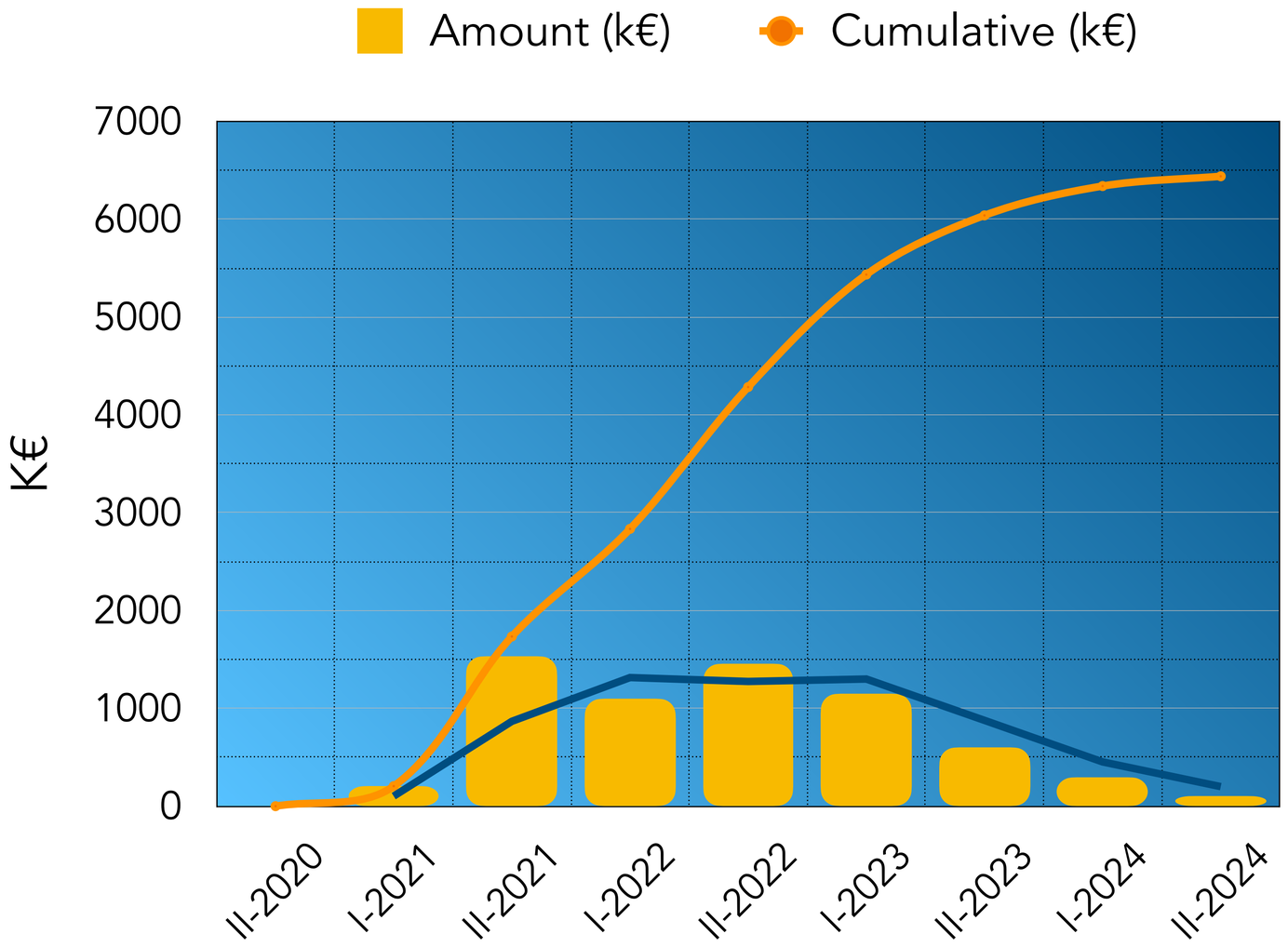
- Manpower
- High Power Laser activities
- Costi di esercizio (TEX & SPARC_LAB)
- Missioni
- Conference fee
- PCs
- Manutenzione (TEX & SPARC_LAB)

Investment per working area

~6’500’000 € for the TDR

R&D Cost Estimation

Semester	Tot [k€]	Cumulative [k€]
II-2020	0	0
I-2021	205	205
II-2021	1530	1735
I-2022	1100	2835
II-2022	1450	4285
I-2023	1150	5435
II-2023	605	6040
I-2024	300	6340
II-2024	100	6440



Implementation cost estimation

First estimation of the implementation costs

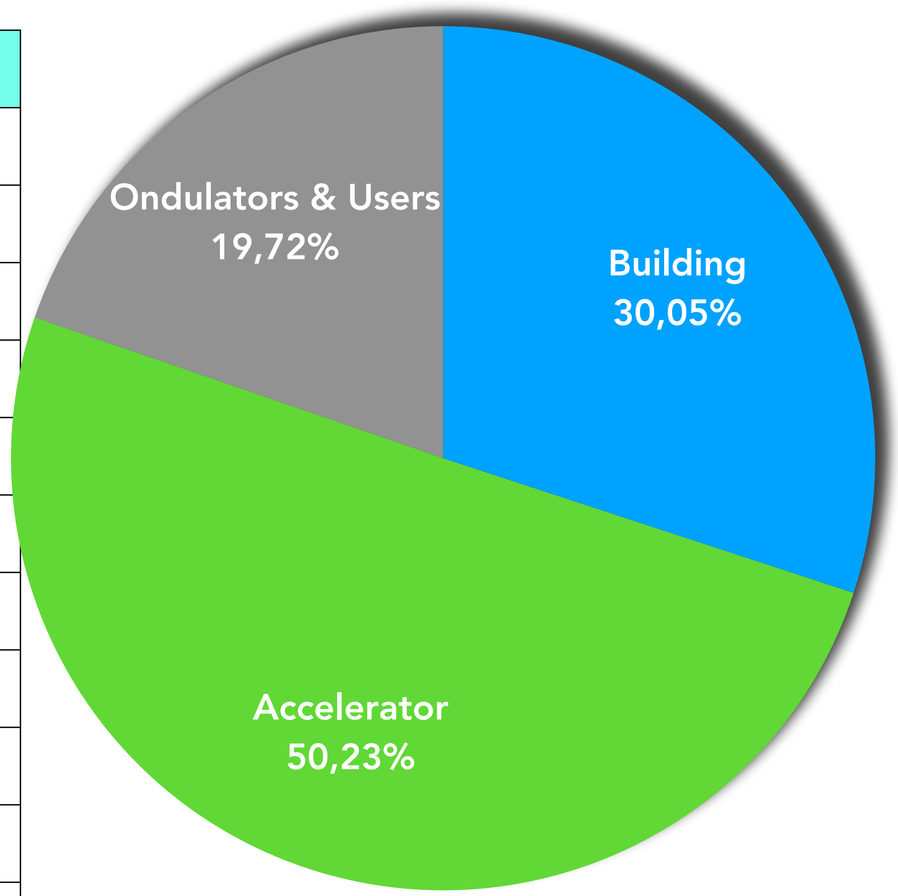
INCLUDE	NOT INCLUDE
• X-Band Linac @ 1 GeV + Plasma acceleration stage	• Manpower
• 1 FEL Line	• Additional cost for designing and/or verification
• 1 USER Station	• Authorization
• Cabling and secondary utilities	• Taxes (not VAT)
• Building and primary utilities	• Running costs

Implementation cost estimation

Item*	Costo stimato **[k€]	Note
Building	32.000	Preliminary estimation MYTHOS
Impianti alta tecnologia	6.000	Secondary plants
Cablaggi	3.000	Power & Signal cable
Iniettore	3.500	
Linac	21.500	
Plasma	4.000	
Laser	3.000	
General	12.000	Diag, Controls, mechanical support etc..
Ondulatori	17.000	1 Ondulators line
User end station	4.000	
Beam dump & Raradioprotection	500	
Total	*106.500*	TOT FUNDING 108’

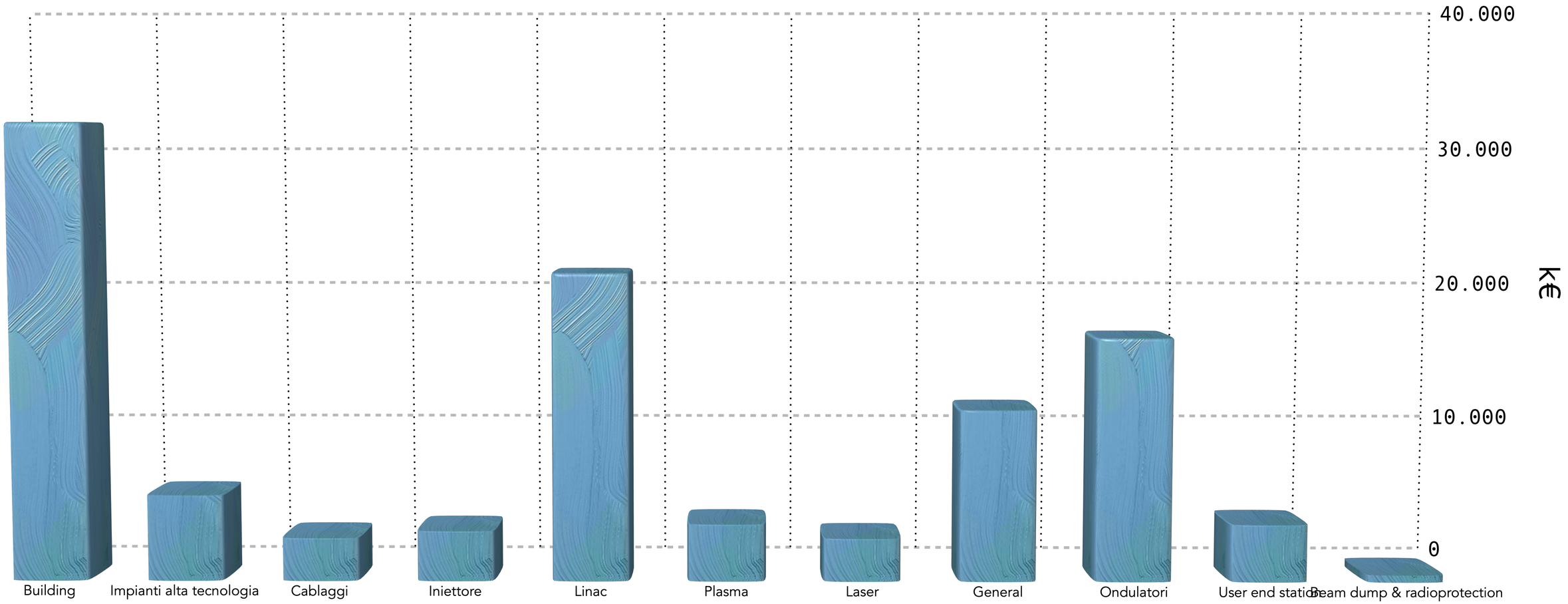
*** 5% contingency per item (approx)**

** VAT Included

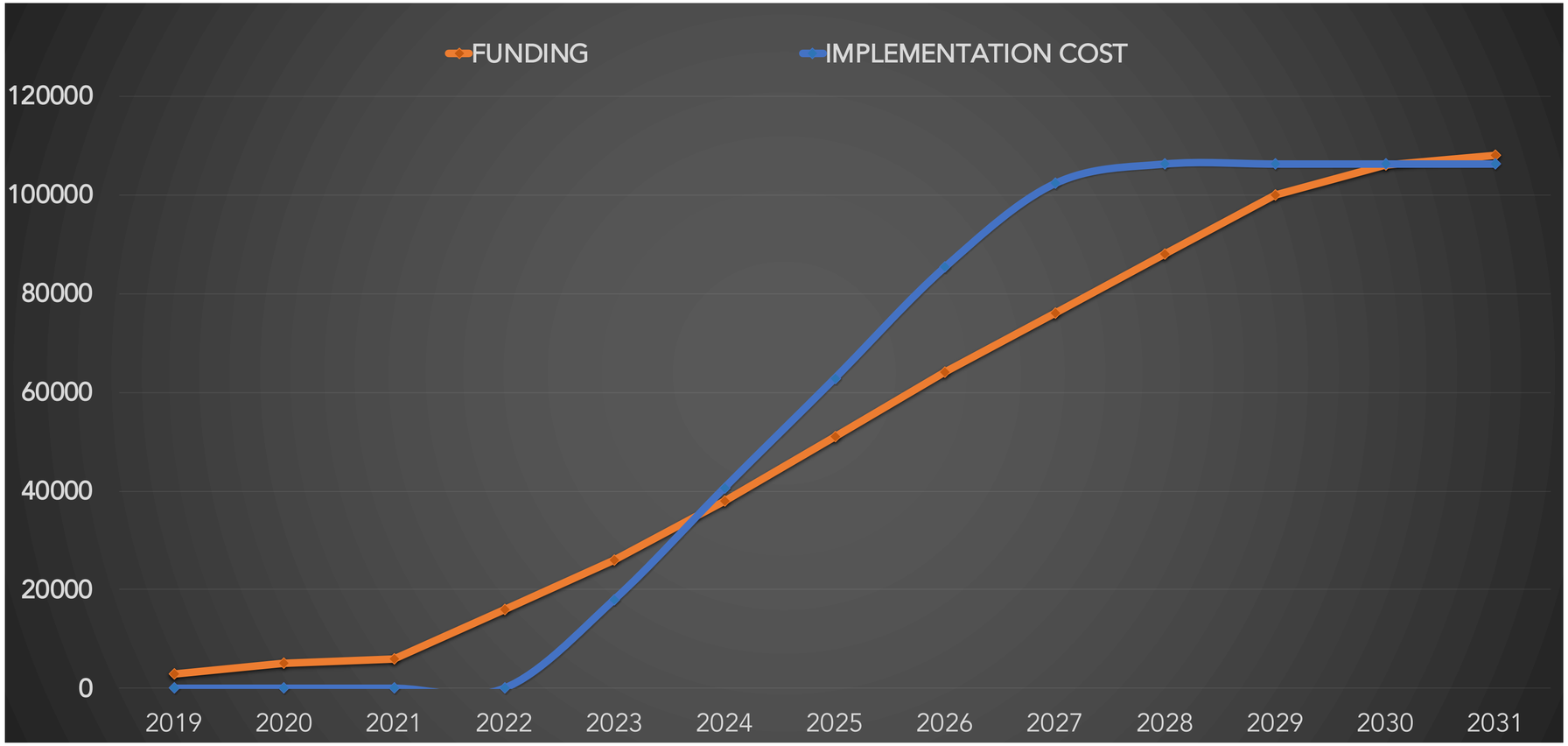


R&D ~10% Implementation costs

Implementation cost estimation



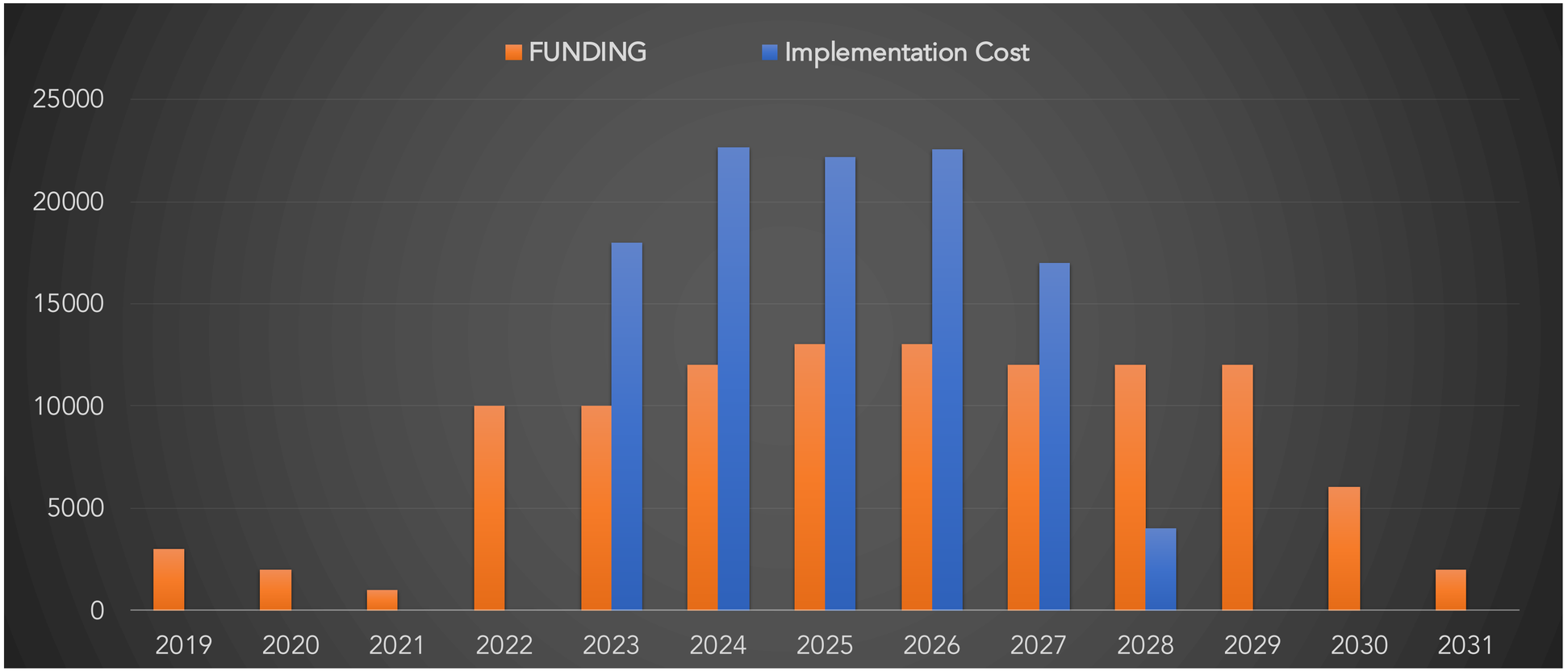
Implementation cost estimation



Very small contingency —> TDR oriented and guided by financial sustainability

Cost & Schedule review by the end of 2021 to better assess potential risks for delays and/or extra costs and validation of mitigation actions

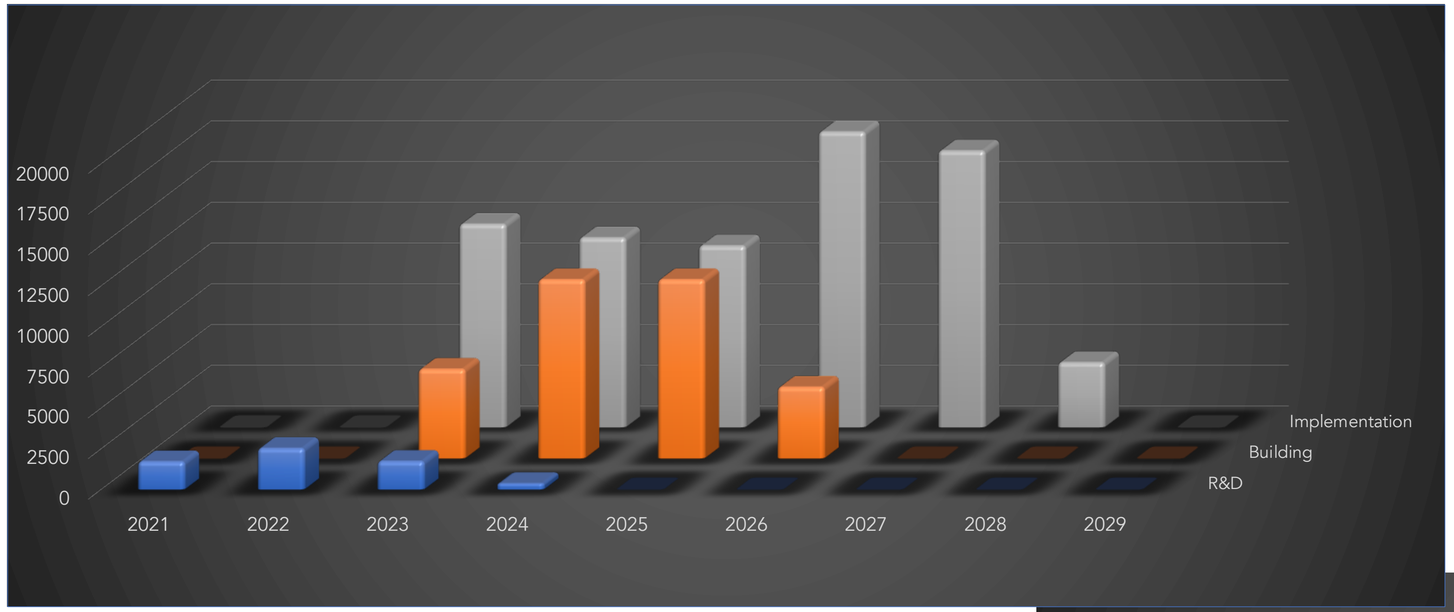
Implementation cost estimation

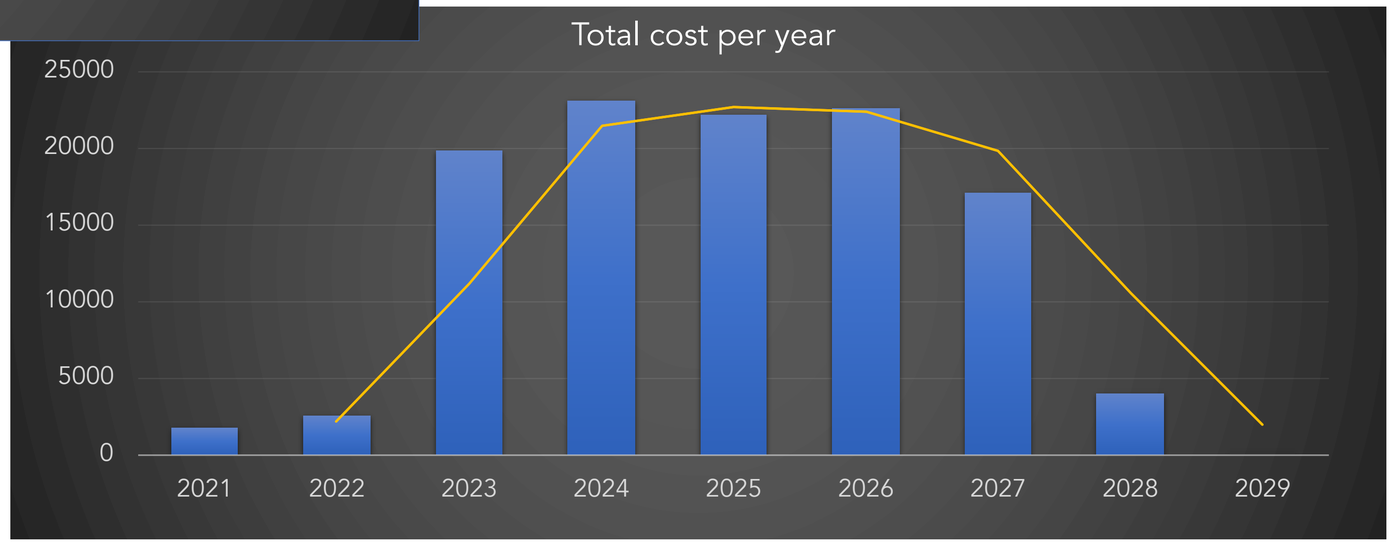


Very small contingency —> TDR oriented and guided by financial sustainability

Cost & Schedule review by the end of 2021 to better assess potential risks for delays and/or extra costs and validation of mitigation actions

Global Picture





Risk Assessment

A Risk Assessment analysis is an ongoing activity:

- Technical Risks assessment and proper mitigation actions are part of the TDR
- Management Risks are evaluated and mitigation actions to be implemented are under consideration.

Risk Assessment

Area	Event	Description	Probability	Impact	RISK	Risk Level	Comments
Building	Authorization	Authorization delay	Low	Medium	Time	MODERATE	Contingencies reasonable at the moment
Building	Tender	Tender Delay	Medium	High	Time	HIGH	European tender and lots of compettitors
Building	Construction	Extra cost Construction	Medium	Medium	Cost	MODERATE	Contingencies reasonable at the moment
Building	Construction	Delay building construction	High	High	Time	CRITICAL	NO CONTINGENCY AT THE MOMENT
TDR	Financial Resources availability	Lack of financial resources	Low	High	Time	LOW	
TDR	Manpower	Resources allocated not enough	Medium	High	Time	HIGH	Man power under dimensioned at the moment
TDR	X-Band Development	X_band Klystron development agreement	Low	Medium	Time & Cost	MODERATE	Scope and cost not clear at the moment
Implementation	Ritardi amministrativi	Number of tenders in parallel	High	High	Time & Cost	CRITICAL	Pre qualificiation necessary. Needs to have a procurement office dedicated to Eupraxia
Implementation	Extra Cost	Possible extra cost	Medium	High	Cost	HIGH	TDR Oriented to financial sustainability and pragmatic approach.

Other management activities

High priority has been given to set up a functioning organization, but many other things have been done from Project Management Perspective in the last months:

- ESFRI Application (as already discussed)
- Consortium Agreement
- Setting up a DMS - Document Management System (currently under upgrading process)
- Setting up periodic meeting at different level of the organigram
- Setting up a Project Office (Myself+1 full time + 2 part-time)
- Naming convention for machine equipments
- Database for the PBS (Project Breakdown Structure).
- Meeting with INFN - Management to secure R&D funding
- Coordination activities between building design & machine design

- … and many more in the next months

Other management activities

TO BE DONE

- Follow up & monitoring of the design
- Introduction of metrics and KPIs to assess the performances of the advancement
- Project Management Plan document
- Release of progress report (twice per year)

Conclusions

Project Management framework has been put in place.

Set-up a project office

Reasonable and sound breakdown for the TDR

Achievable schedule for the TDR

Financial resources for the TDR identified (and possibly approved).

Cost estimation for the implementation phase and mitigation actions

Risks assessment