Thematic Presentation – *ISOP Project*

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Innovation in Supercritical CO_2 Power Systems

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UNIVERSIDAD Ð SEVILLA 1505

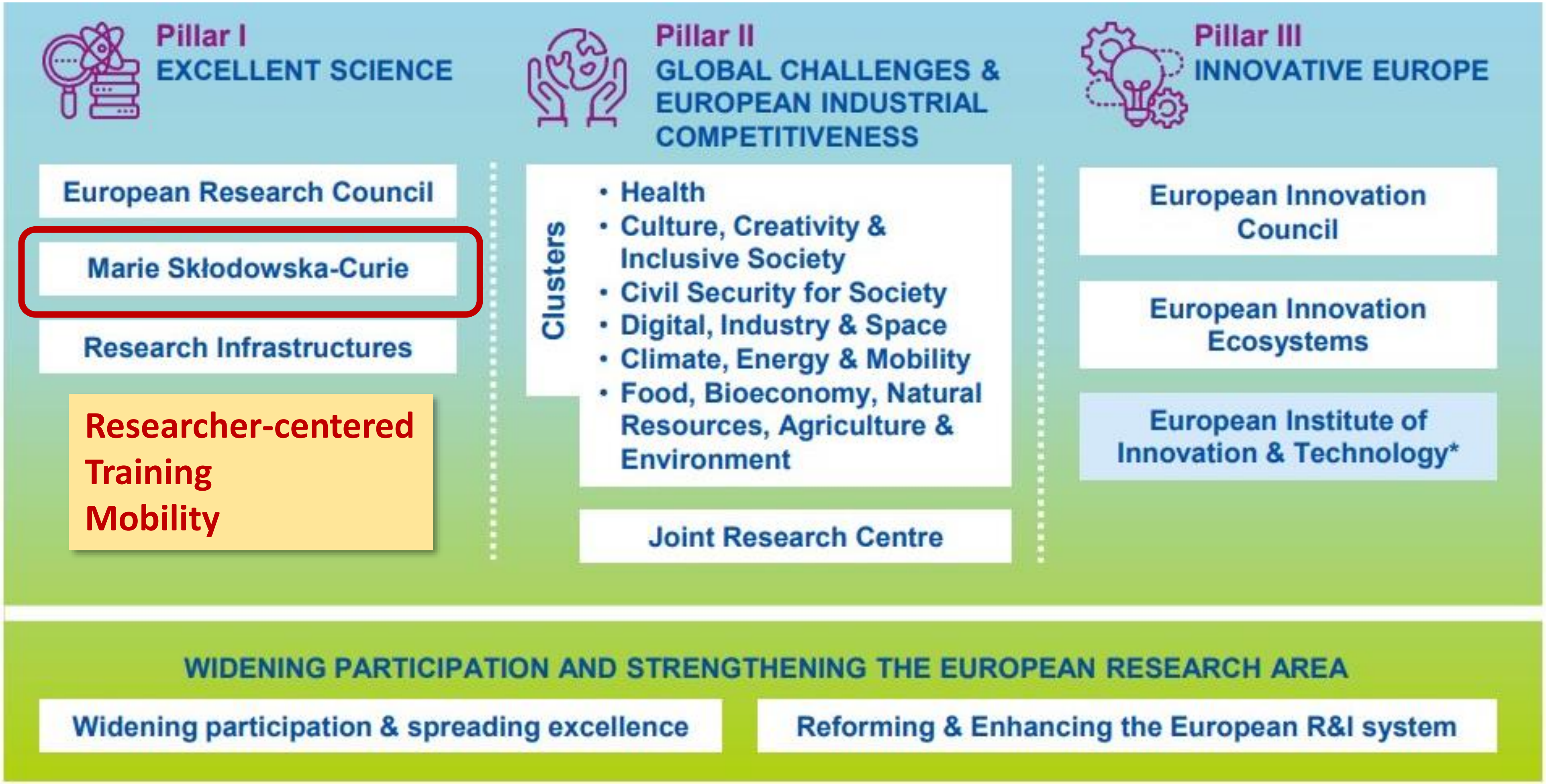
ETN Global October Workshop
Stuttgart, October 8-10 2024

The ISOP project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement no. 101073266

Marie Skłodowska-Curie Actions

R&D funding in EU – Horizon Europe (2021-2027, €95.5 billion)

€25B €53.5B €13.6B

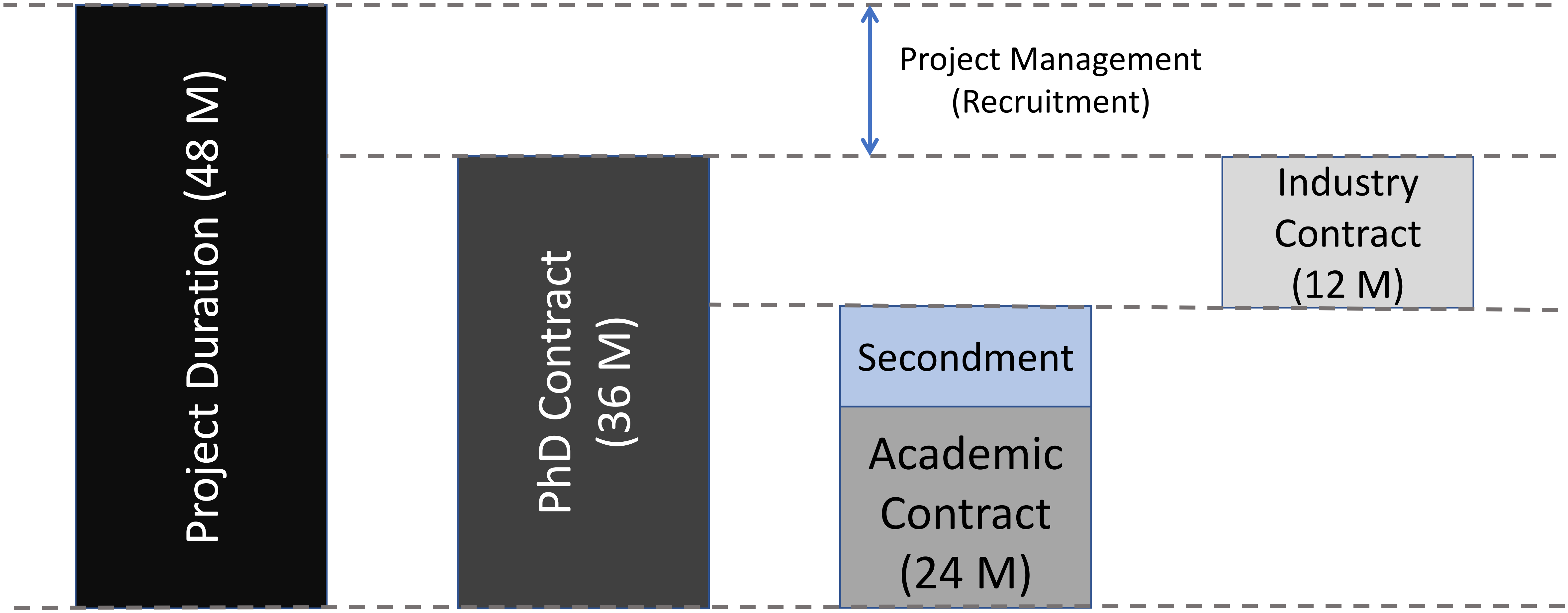


€3.4B

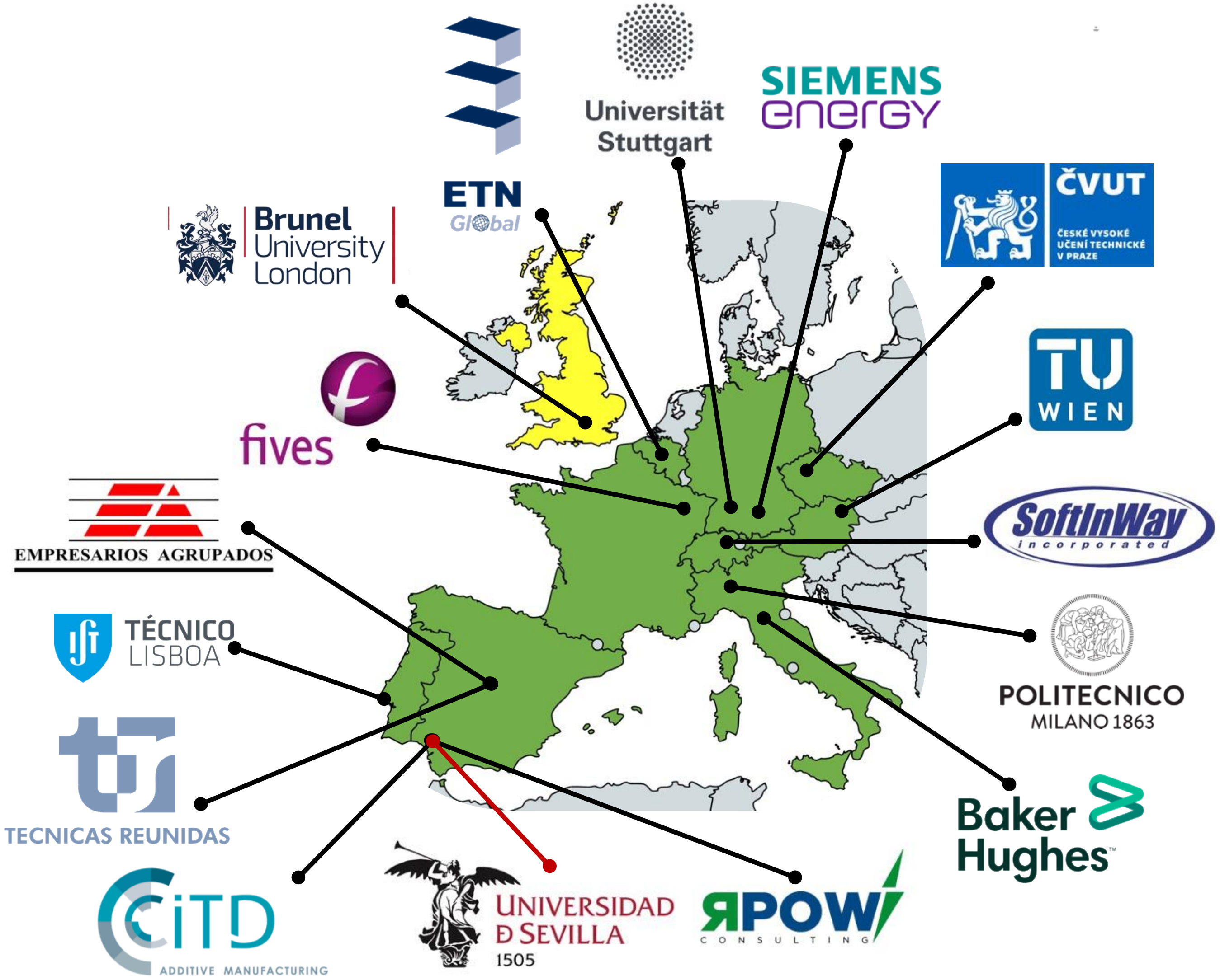
ISOP – Facts & Figures

- Only EU-project specific to sCO_2 technologies funded by EU in 2022
- Largest sCO_2-related project funded by EU in 2022
- Largest consortium of any sCO_2-related project funded by EU
  - 6+1 Academic institutions
  - 9 Industry partners
  - 6 Associated Partners for secondments (1 R&D Centre + 5 Industry)
- 10 countries involved
- 4.4 M€ (3.85 EU + 0.55 UKRI) total budget
- 4 years: January 1st 2023 – December 31st 2026

ISOP – Facts & Figured



ISOP – Facts & Figures



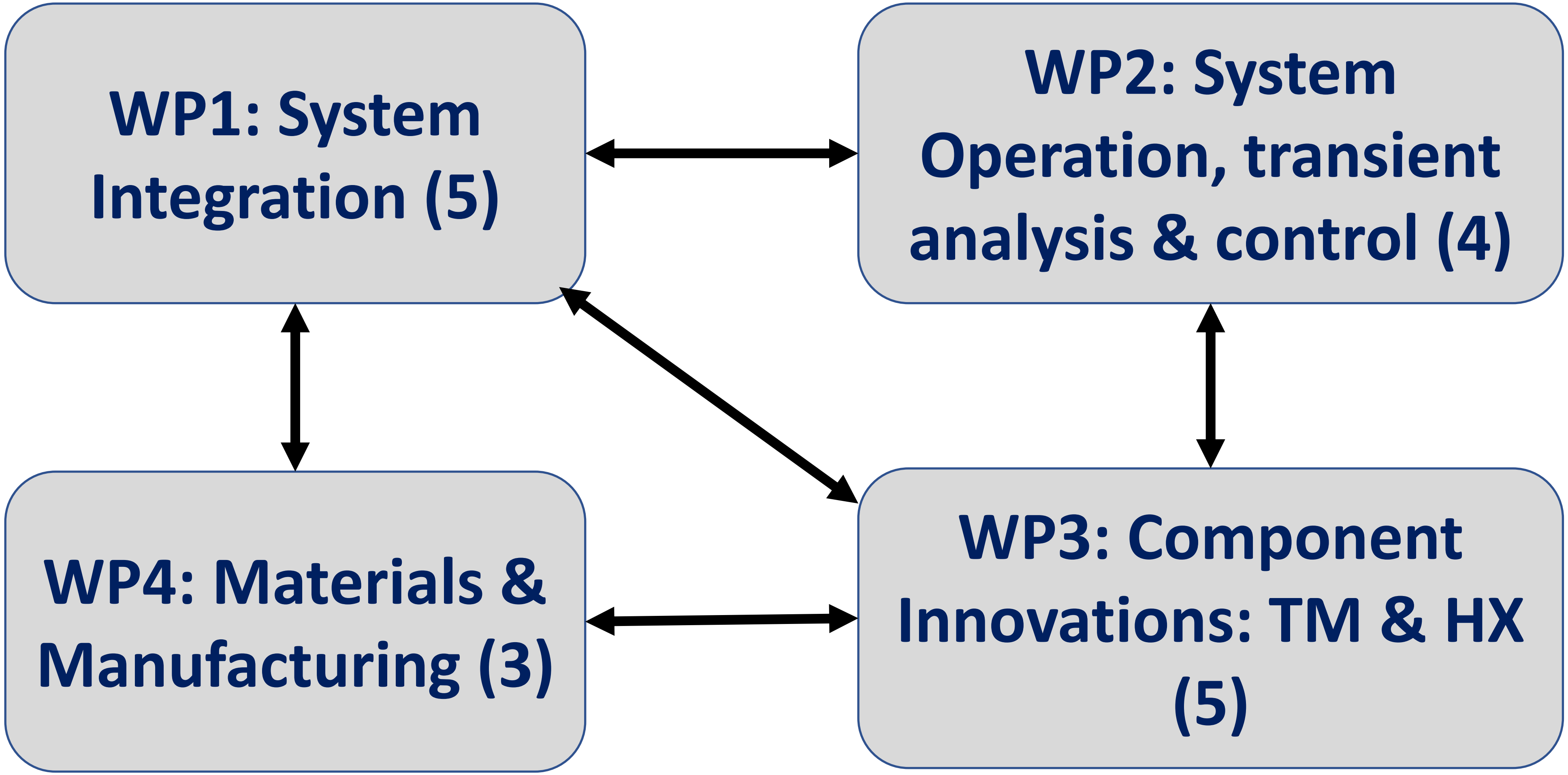
ISOP – Facts & Figures

Academia (7)

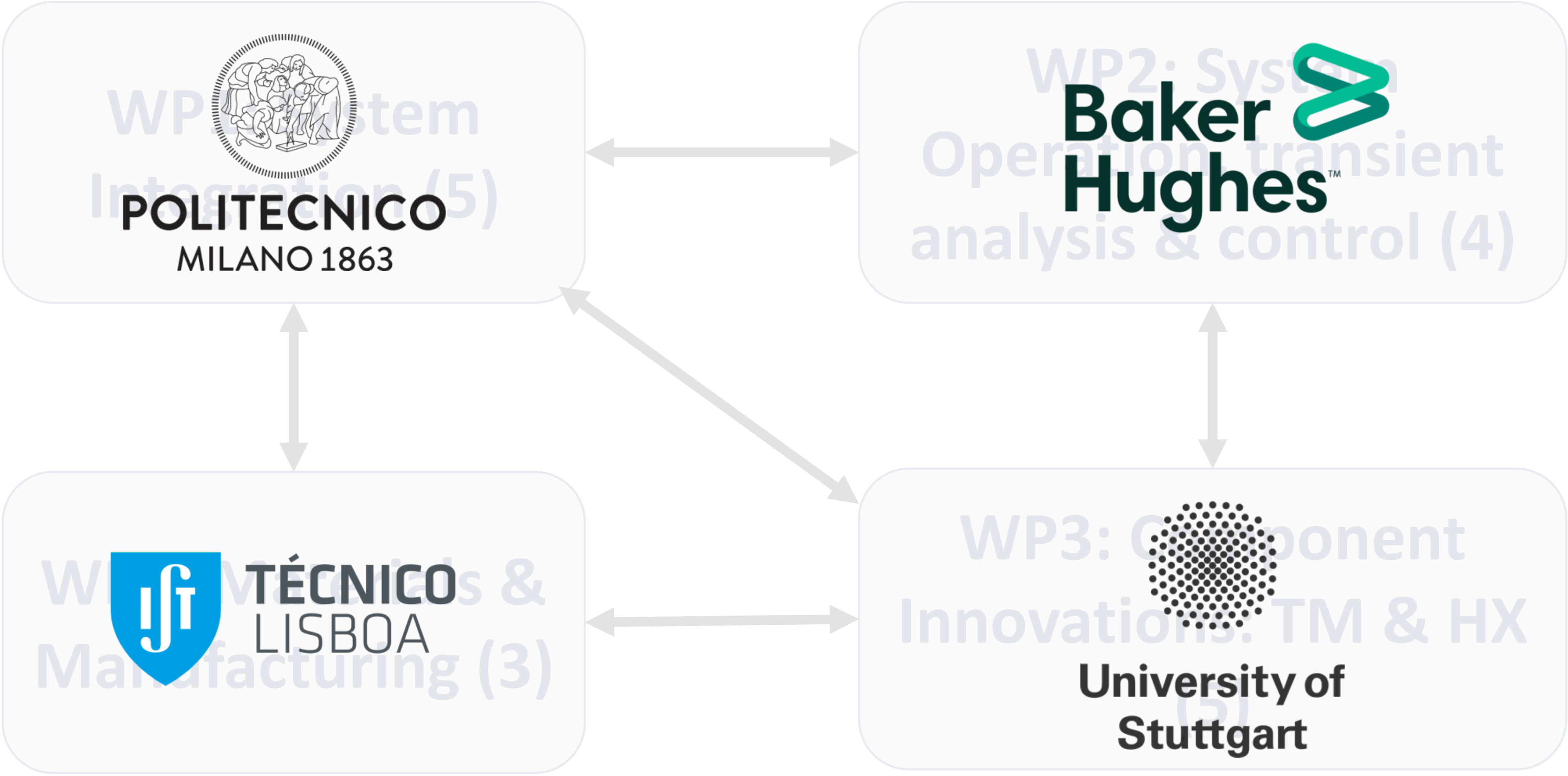
Industry (9)

Associates (6)

ISOP – Implementation



ISOP – Implementation



ISOP – Implementation (objectives WP1)

WP1:

- To develop advanced AI algorithms that enable the optimal integration of sCO_2 power systems components…
- …for various thermal energy sources and end use applications,…
- …with direct and indirect heating…
- …and including carbon capture in the former,…
- …based on KPIs of thermal, economic environmental and societal nature

ISOP – Implementation (objectives WP1)

- DC1: Integration of directly-fired oxycombustion sCO_2 power cycles
- DC2: Market uptake of sCO_2 power systems for carbon-neutrality by 2050
- DC3: Integration of indirect sCO_2 power cycles
- DC4: Large Scale Energy Storage based on sCO_2 systems
- DC16: sCO_2 mixtures to expand the design space of sCO_2 power systems

ISOP – Implementation (objectives WP2)

WP2:

- To develop accurate prediction tools for the simulation of transient operation of sCO_2 power cycles,…
- …and to investigate innovative concepts for control and optimisation of operational strategies…
- …using advanced digital and artificial intelligence techniques.

ISOP – Implementation (objectives WP2)

- DC5: Operation of indirect sCO_2 power cycles
- DC6: Operation of directly-fired sCO_2 power cycles with carbon capture
- DC7: Dynamic operation of sCO_2 power systems under variable load
- DC8: Control strategies and optimisation of control of sCO_2 power systems for direct and indirect heating configurations

ISOP – Implementation (objectives WP3)

WP3:

- To develop innovative methods to enhance aerodynamic and mechanical performance, reliability, and operability of key system components, namely:
  - Turbomachinery and
  - Heat exchangers.

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Brunel University London

Baker Hughes

fives

SoftInWay incorporated

POLITECNICO MILANO 1863

Universität Stuttgart

TECNICAS REUNIDAS

SIEMENS energy

EASY ENERGY CONSULTING & TECHNOLOGY

ISOP – Implementation (objectives WP3)

- DC9: Fundamental studies to enhance off-design performance of MW-scale sCO2 compressors
- DC10: MW-scale axial sCO_2 turbine flow path enhancements to improve off-design performance
- DC11: Fundamental study of pseudo-condensation of sCO_2
- DC12: Numerical investigation of mixing process in headers of sCO_2 heat exchangers
- DC17: Innovative MW-scale, axial turbine designs for enhanced flexibility

ISOP – Implementation (objectives WP4)

WP4:

- To develop advanced modelling and experimental methods that enable selection and development of
  - materials
  - coatings
  - and manufacturing techniques
- for the reliable and safer operation of key components in sCO_2 power cycles

ISOP – Implementation (objectives WP4)

- DC13: Advancing the durability of polymeric parts and coated components in sCO_2 power systems
- DC14: Advancing the durability of corrosion resistant alloys for sCO_2 power systems
- DC15: Additive manufacturing technologies of heat exchangers

ISOP – project interaction

		WP1: System Integration					WP2: Operation, Performance, Control				WP3: Component Innovations					WP4: Materials, Manufacturing		
	Doctoral Candidates	**DC1**	**DC2**	**DC3**	**DC4**	**DC16**	**DC5**	**DC6**	**DC7**	**DC8**	**DC9**	**DC10**	**DC17**	**DC11**	**DC12**	**DC13**	**DC14**	**DC15**
	Hosts	POLIMI EAI	USE ETN	CVUT EAI	TUW EAI	POLIMI RPOW	CVUT BH	TUW BH	USE SIW	BUL	BUL	POLIMI BH	USE SIEMENS	USTUTT TR	USTUTT FIVES	IST CITD	IST CITD	USTUTT CITD
	Secondments	System Integration	LCA/Env, Market	System Integration	Energy Storage	sCO2 Mixtures	Operation - direct	Operation - indirect	Transient Perfo.	System Control	Compress.	Expansion - Off-design	Expansion - Flexibility	Heat Exch. - Condenser	Hext Exch. - Recuperat.	Materials - Polymeric	Materials - Corrosion	Additive Manuf.
WP1	DC1 (TR)																	
	DC2 (ACO2)																	
	DC3 (INERCO)																	
	DC4 (ETN)																	
	DC16 (AAL)																	
WP2	DC5 (DSPW)																	
	DC6 (SIW)																	
	DC7 (DSPW)																	
	DC8																	
WP3	DC9																	
	DC10 (EASY)																	
	DC17 (SIW)																	
	DC11 (FIVE)																	
	DC12 (TR)																	
WP4	DC13 (BH)																	
	DC14 (ROSS)																	
	DC15 (ROSS)																	

Type of Interaction			
Share cycle parameters	Share models and validation data	Share material properties
Secondments	Share component characteristics	Share manufacturing limitations
Share design parameters	Market and cost limitations	Share transient behaviour

Current and next steps

	Theme(s) and main programme	Organiser	Where	Time
WSH1	**Introduction to sCO_2 power systems**	POLIMI/BH	Milan	**Sep23**
WSC1	**Introduction to material coatings, manufacturing techniques and fundamental modelling of heat transfer**	USTUTT/FIVES	Stuttgart	**Jan24**
WSH2	**Commercialisation: IPR management, economics, policy and regulations**	USE/EAI/RPOW	Seville	**May24**
WSC2	**Advancements on materials for energy**	IST/CITD	Lisbon	**Nov24**
WSH3	**Modelling Power Systems**	TUW/SIW	Vienna	**Apr25**
WSH4	**sCO_2 system component design and analysis**	CVUT/SIEMENS	Prague	**Sep25**
WSC3	**Energy Cultures**	BUL/BH	London	**Feb26**
ISC	**sCO_2 in the future power systems mix**	ETN/BH/USE	Brussels	**Jul26**

Proof of life...

ISOP

Innovation in Supercritical CO_2 Power Generation Systems

Thank you for your attention!

Website

LinkedIn

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