This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA No 101004730.

12.2 Design of advanced electron accelerator plant for biohazards treatment

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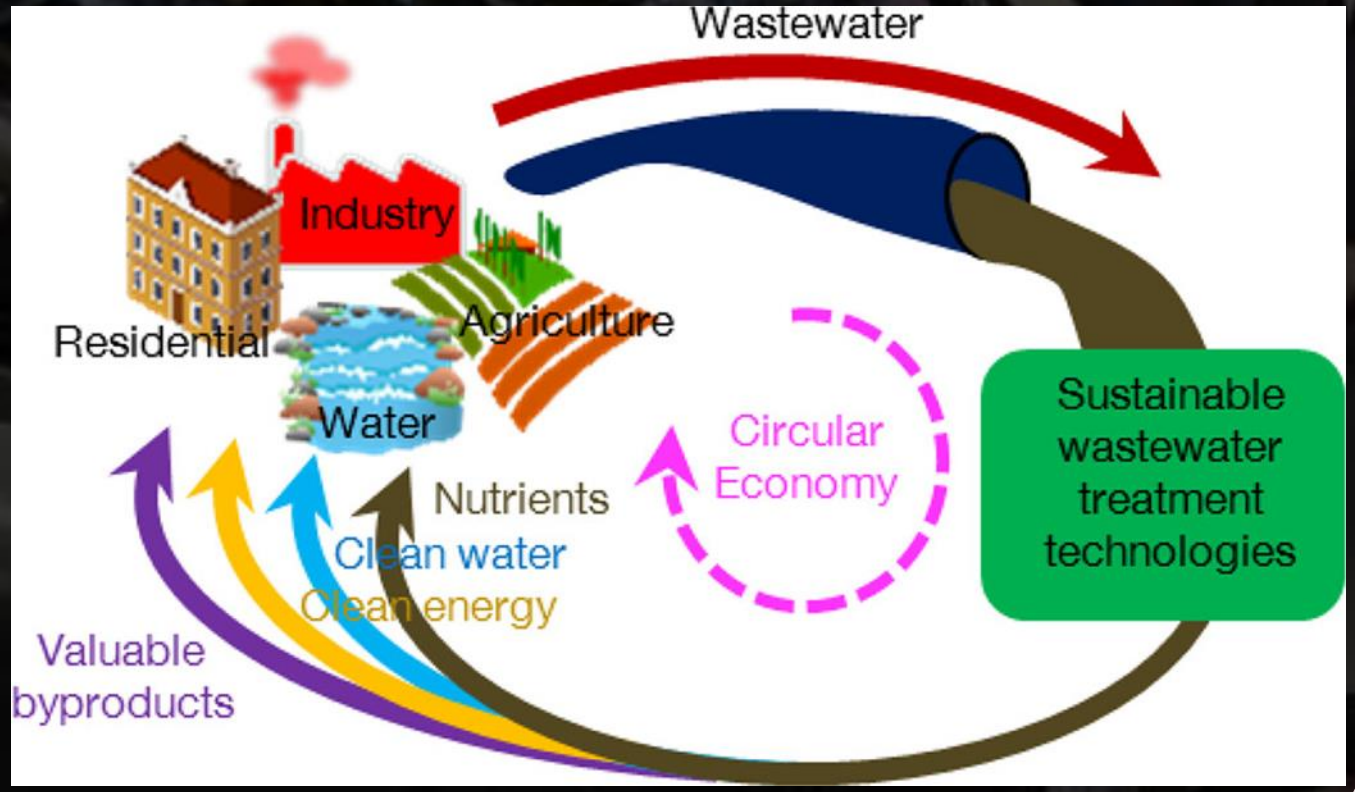
The I.FAST (Innovation Fostering in Accelerator Science and Technology) second Annual Meeting ,

17-21 April 2023, Trieste, Italy.

Transitioning Wastewater Treatment Plants toward Circular Economy and Energy Sustainability

iFAST



- Increasing trend to recognize sludge (and WW) as valuable resources. (Water, P, N, org. C,..)
- 80 to 90 % P- removal at most of the treatment plants in central Europe (having no P - ores)
- P - recycling is a matter of intensive research in EU.
- EU commission is preparing a P-policy

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Directives

- Council directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture
- Directive 91/271/EEC on urban waste water treatment

Sludge arising from waste water treatment shall be reused whenever appropriate. Disposal routes shall minimise the adverse effects on the environment.

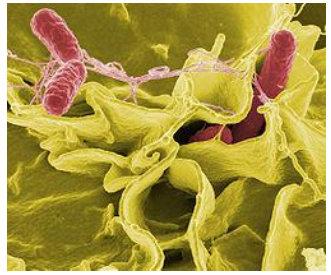
- Art. 96.4 Act from 14 December 2012 (law on waste)

Usage of municipal waste is possible only if they're stabilised and prepared directly to it's purpose and way of use, especially by biological, chemical, thermal or any other treatment that decreases tendency to rotting or eliminates threat for human health and environment.

Patogens to be removed.

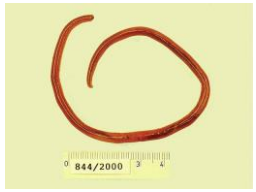
Pathogenic bacteria acceptable content

- In Poland one pathogenic bacteria species is considered: *Salmonella*
- None living cells of salmonella can be detected in 100g sample of municipal sludge



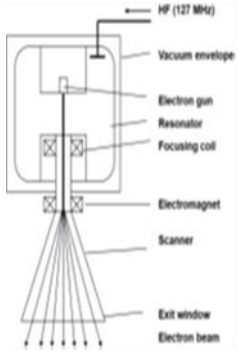
Species of parasites which have to be detected:

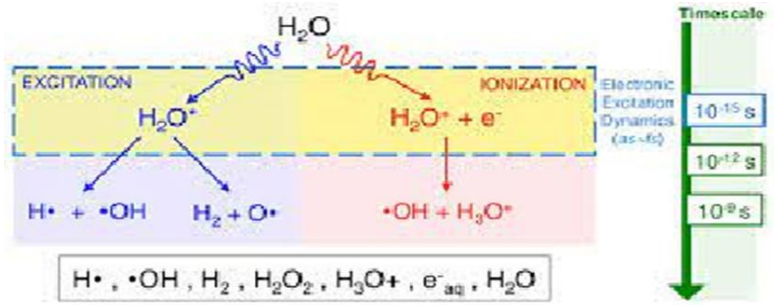
- *Ascaris sp.* – human parasitic roundworm
- *Trichuris sp.* – human whipworm
- *Toxocara sp.* – animal (mostly cats and dogs) parasitic worms
- Parasites and eggs acceptable content = 0

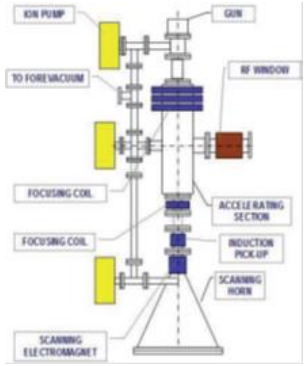


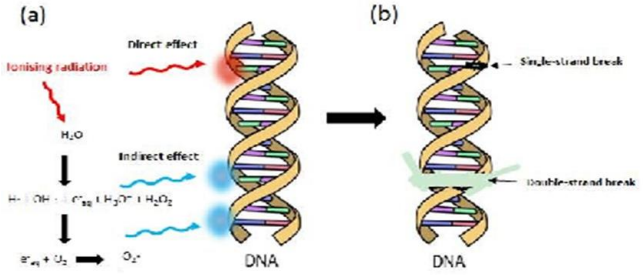
DELIVERABLE: D12.2

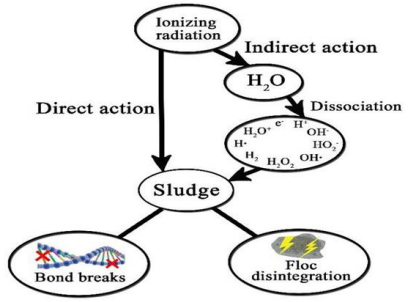
Basic engineering of e-beam sludge processing line





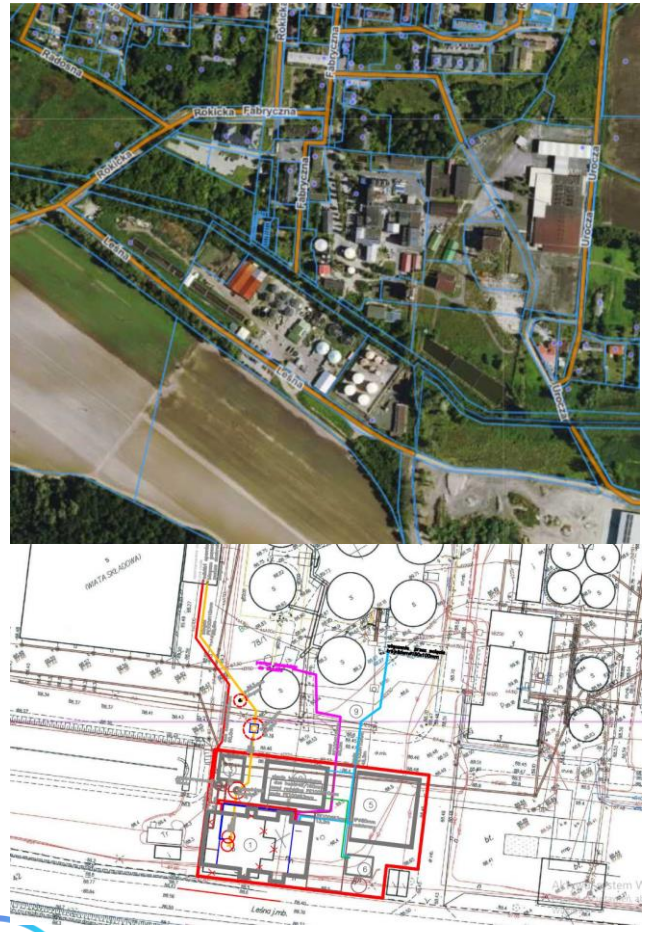






- Accelerator
  1 MeV to 10 MeV,
  preferably 1–3 MeV
- Radiation dose
  5 kGy to 20 kGy
- Yield 2.8 t/h (d.m.7.4%
  6 kGy - 8000 h/year
- TRL 4. Technology is validated in lab.

MILESTONE: MS59
Approval of basic engineering
VALIDATED BY DESIGN OFFICE



Egz. nr

Biopolinex sp. z o. o.
ul. Władysława Kunickiego 45
20-417 Lublin

RAPORT BASIC ENGEENERING

Opracowanie podstaw projektowania dotyczących zastosowania instalacji wykorzystującej moduł biogazowy oraz zaawansowany moduł z akceleratorem elektronów do usuwania zagrożeń biologicznych w oczyszczalni ścieków

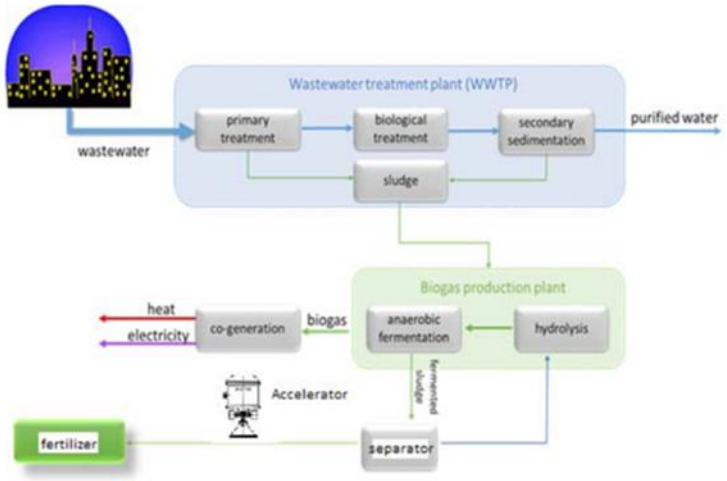
Tom I: Moduł biogazowy
Tom II: Moduł akceleratora elektronów

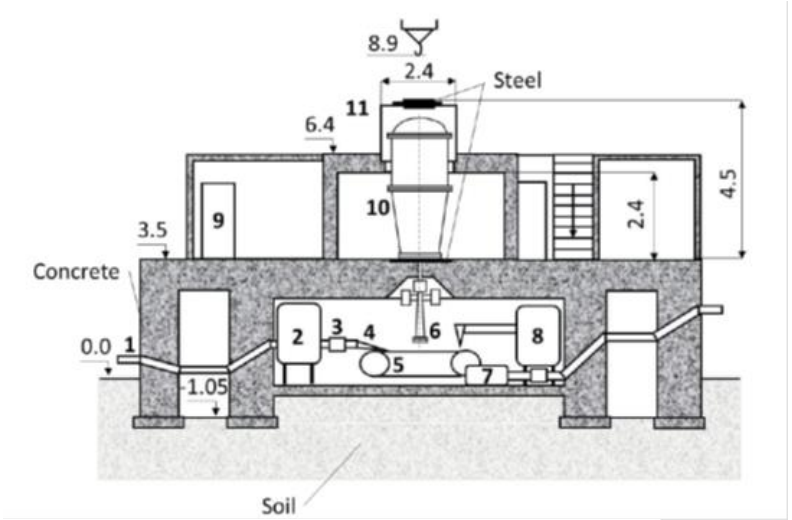
BRANŻA: **Architektura, konstrukcja, instalacje**

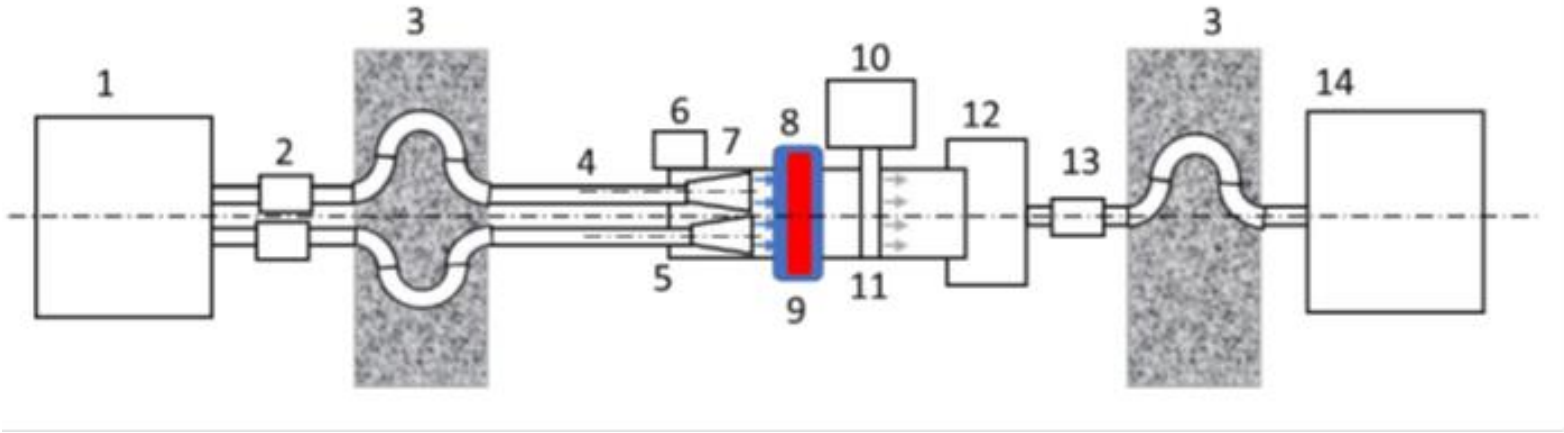
Projektant mgr inż. arch. Henryk Dołęgowski	Uprawnienia budowlane w specjalności architektonicznej Nr 259/BP/85, 812/85	Podpis
Sprawdzający mgr inż. arch. Marek Tesławski	Uprawnienia budowlane w specjalności architektonicznej Nr 434/63 i 18/64	Podpis mgr inż. arch. Marek Tesławski upr. proj. Nr 18/64 bez ograniczeń w specj. architektonicznej
Zatwierdzający inż. Waldemar Jakubaszek	Uprawnienia budowlane w specjalności konstrukcyjno-budowlanej Nr 831/BP/97	Podpis
Data opracowania	Marzec 2023 r.	

- **Basic engineering has been based on documents elaborated by licensed designers according to the requirements of construction permit following Polish Law, adopting Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU), has been elaborated and is attached to this Report.**

EB installation for sludge treatment

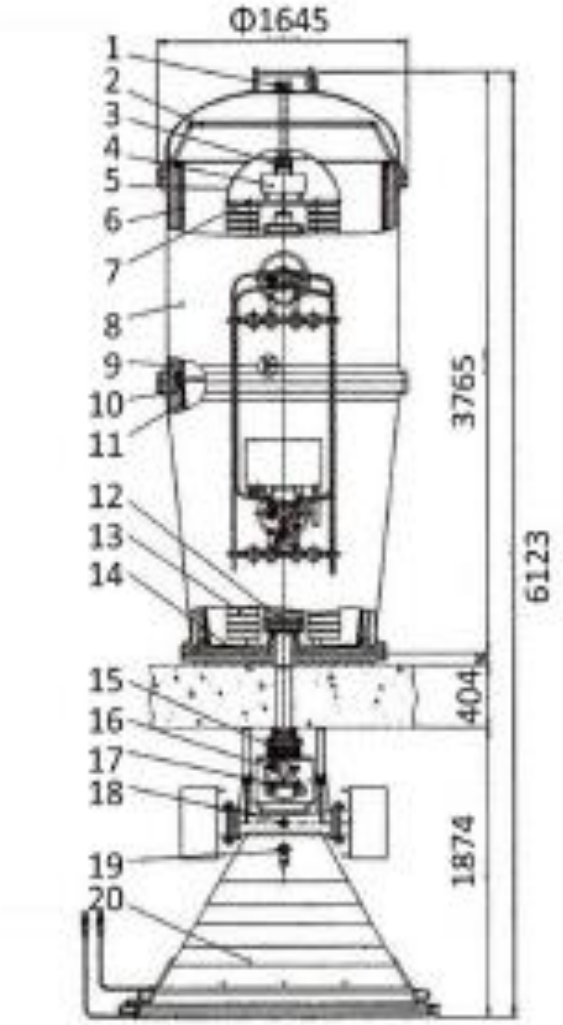






Accelerators

Producer Parameter	EB-Tech Korea	BINP Russia	Wasik USA	Vivirad France	Waxi El Pont, China	IBA Belgium
	1	2	3	4	5	6
Type of accelerator	ELV-8	ELV-8	-		AB3.0	
Type of HV power supply	Transfor. without core	Transfor. without core	HV transform.	Transfor. isolated core	Voltage multipli-cation	Voltage multipli-cation
HV isolation	SF6	SF6	-	SF6	SF6	SF6
Energy	2,5 MeV	2,5 MeV	do 1 MeV	3 MeV	3 MeV	3 MeV
Current	40 mA	40 mA	-	35 mA	34 mA	34 mA
Beam power	100 kW	100 kW		100 kW	100 kW	100 kW
Scan width	1,6 m	1,6 m	-			
Hight	6300 mm		-			
Efficiency	70 %	70 %	70 %	70 %	30-60 %	30-60 %
Basi spare parts	Cathode Ti foil Vacuum pump	Cathode Ti foil Vacuum pump	Cathode Ti foil Vacuum pump	Cathode Ti foil Vacuum pump	Cathode Ti foil Vacuum pump Tetrode	Cathode Ti foil Vacuum pump Tetrode
Cost	0,85 M$	0,793 M$	-	≈2 MEuro		

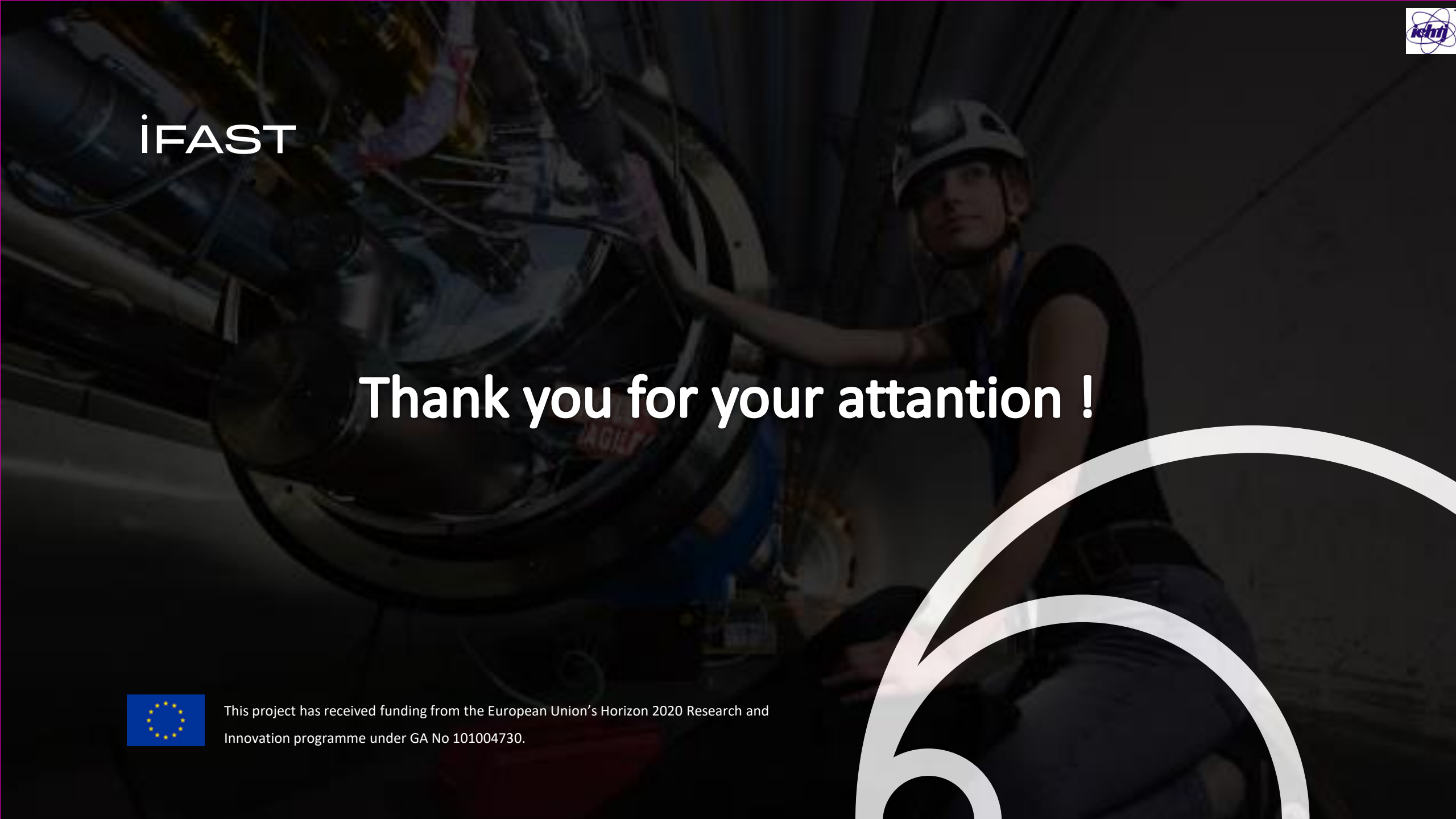


Conclusions

- DELIVERABLE: D12.2 „Basic engineering of e-beam sludge processing line” has been elaborated. Component pieces were tested with one another , therefore we may consider that TRL 4 has been achieved.

- MILESTONE: MS59 „Approval of basic engineering” BE has been validated by a design office. Basic engineering is based on documents elaborated by licensed designers according to the requirements of construction permit following Polish Law, adopting Environmental Impact Assessment (EIA) Directive (2011/92/EU as amended by 2014/52/EU).

- Basic Engineering provides all data needed for technical design of pilot plant what is requirement to movr technology to TRL 5 at which technology is validated in relevant industrial environment. At TRL 6 technology has a fully functional prototype or representational model. After its operation technology will move to TRL7System prototype demonstration in operational environment. Next TRL7 comes – System is complete and qualified and it is a proof that it passed all assumed requirements and possess declared advantages over other completive solutions. Technology moves to TRL9 – actual system proven in operational environment. Next step is commercialization.



Thank you for your attantion !

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