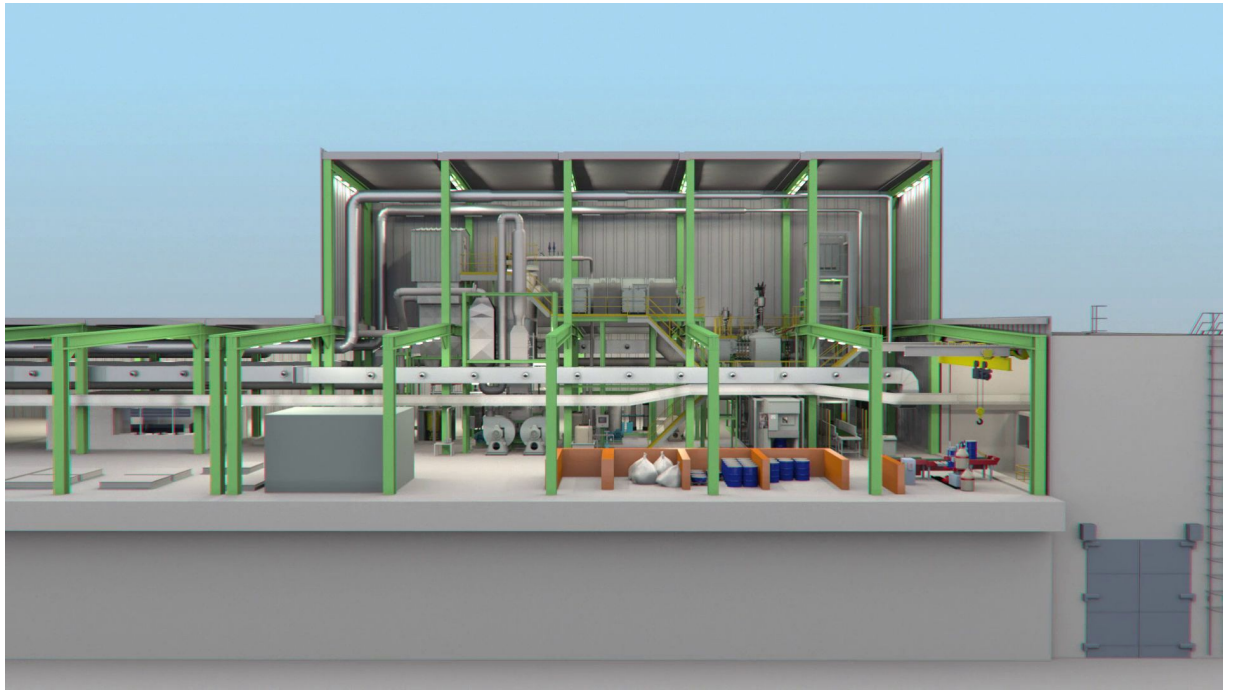
Visitor´s Guide

Treatment of low and intermediate level radioactive waste using Plasma Melting Process, and Performance Analysis

SERAW (Kozloduy NPP)

FOREWORD



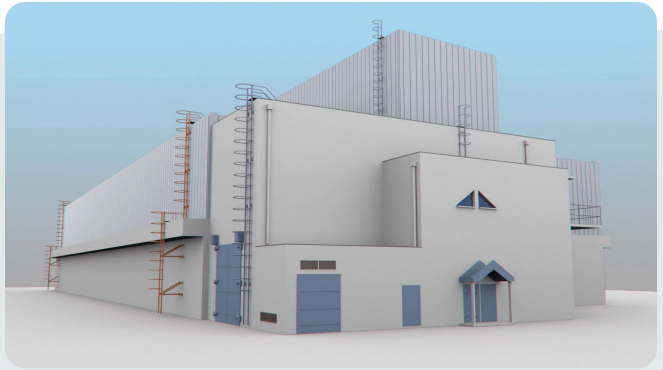
A visit aimed at sharing knowledge with EU Operators

The visit has been organised as part of a EU effort to spread the knowledge gained over the course of decommissioning and radioactive waste management activities across all EU Member States.

SERAW has collected relevant experience related to the design, construction and operation of a Plasma Melting Facility with the goal of making their knowledge available to other EU decommissioning Operators that may be interested in this technology.

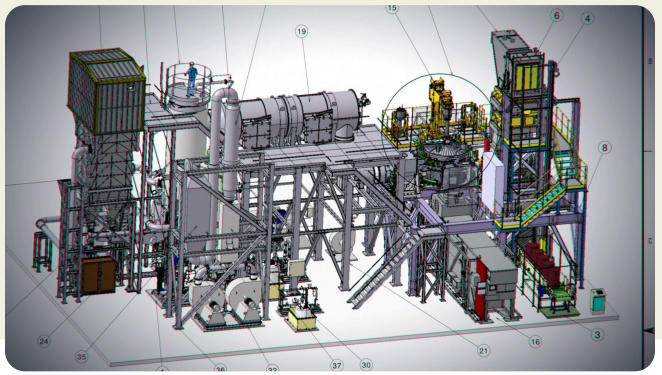
START

01



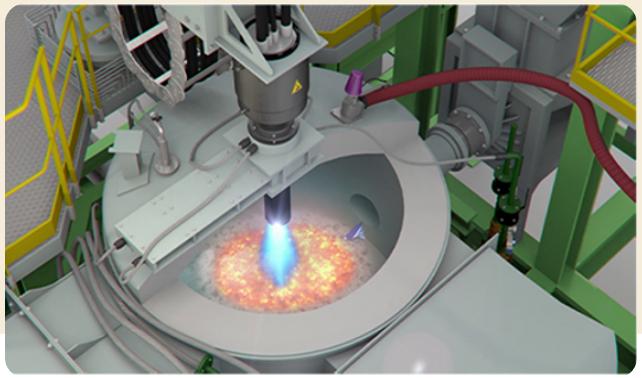
Facility Description

02



Construction

03



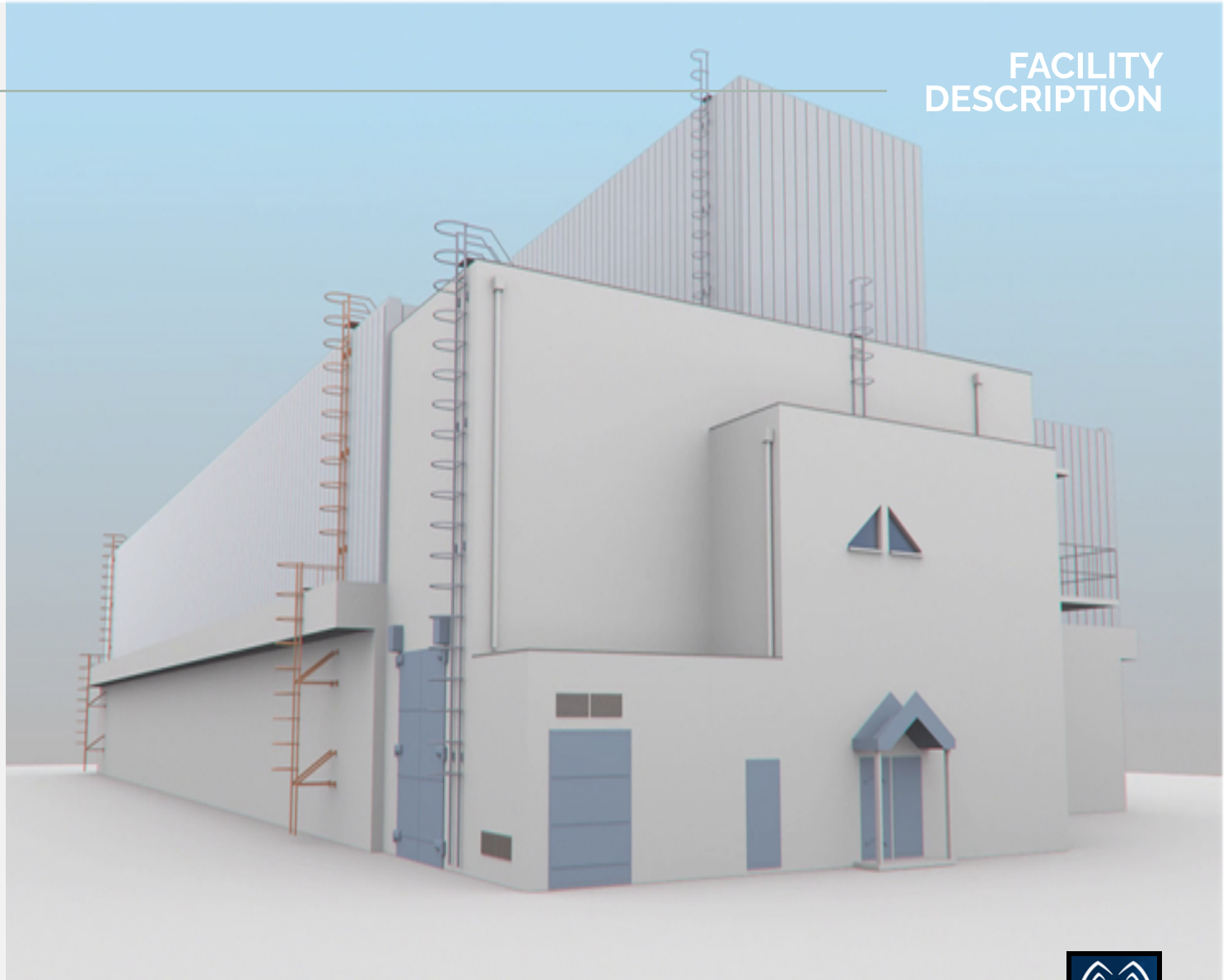
Operation

04

Project Feasibility

Facility Description

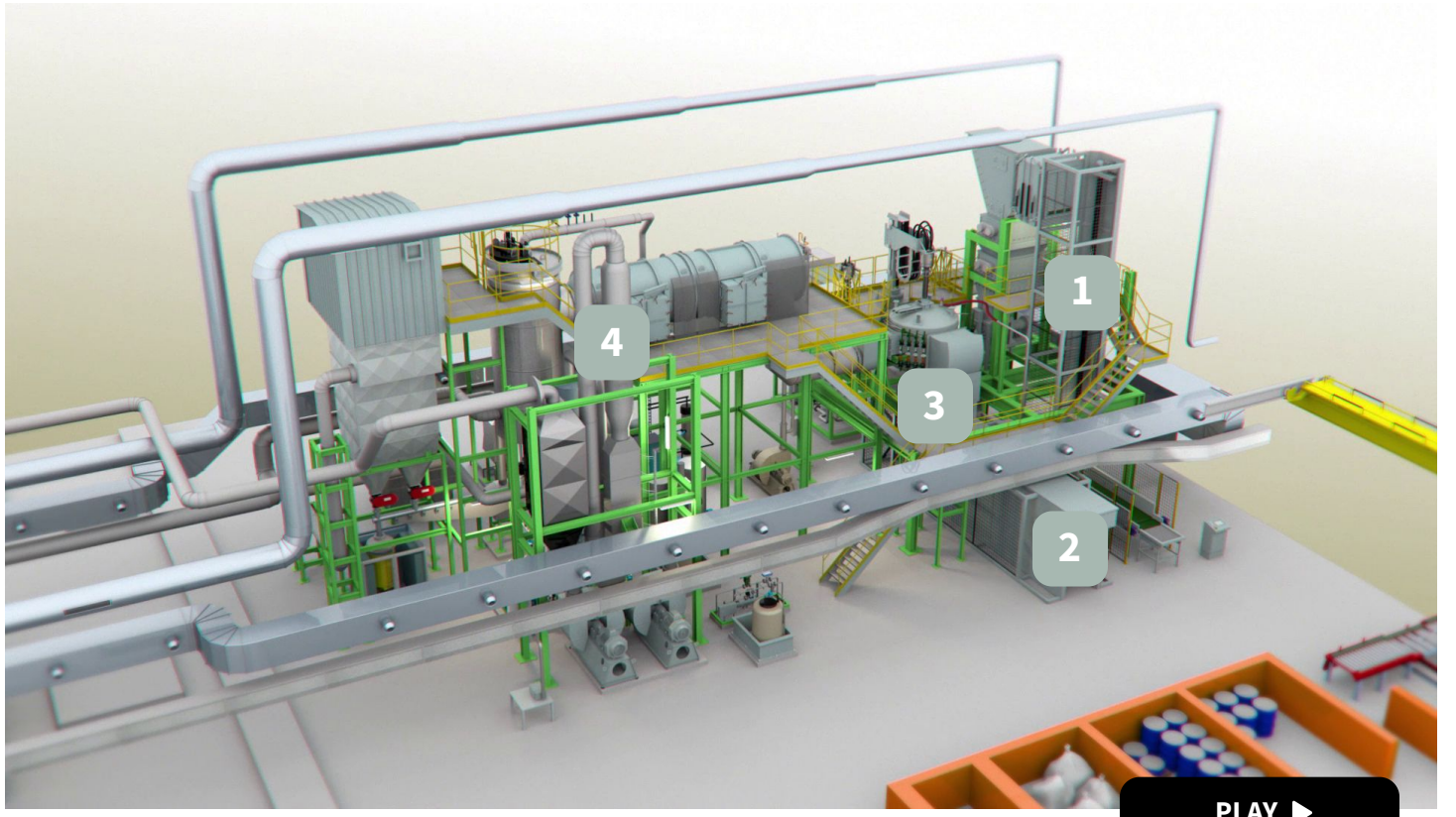
MORE



Technology

The facility is based on high-energy technology, creating a thermal plasma field by directing an electric current through a gas flow, which is able to process a wide range of waste – organic and inorganic. The temperature of the arc reaches 5,000÷15,000˚C, where the working temperature in the furnace reaches 1,500˚C. Processing throughput is 250 t/year. Treatment rate is up to 65 kg/h.

BENEFITS



Benefits

WASTE VOLUME

WASTE STABILITY

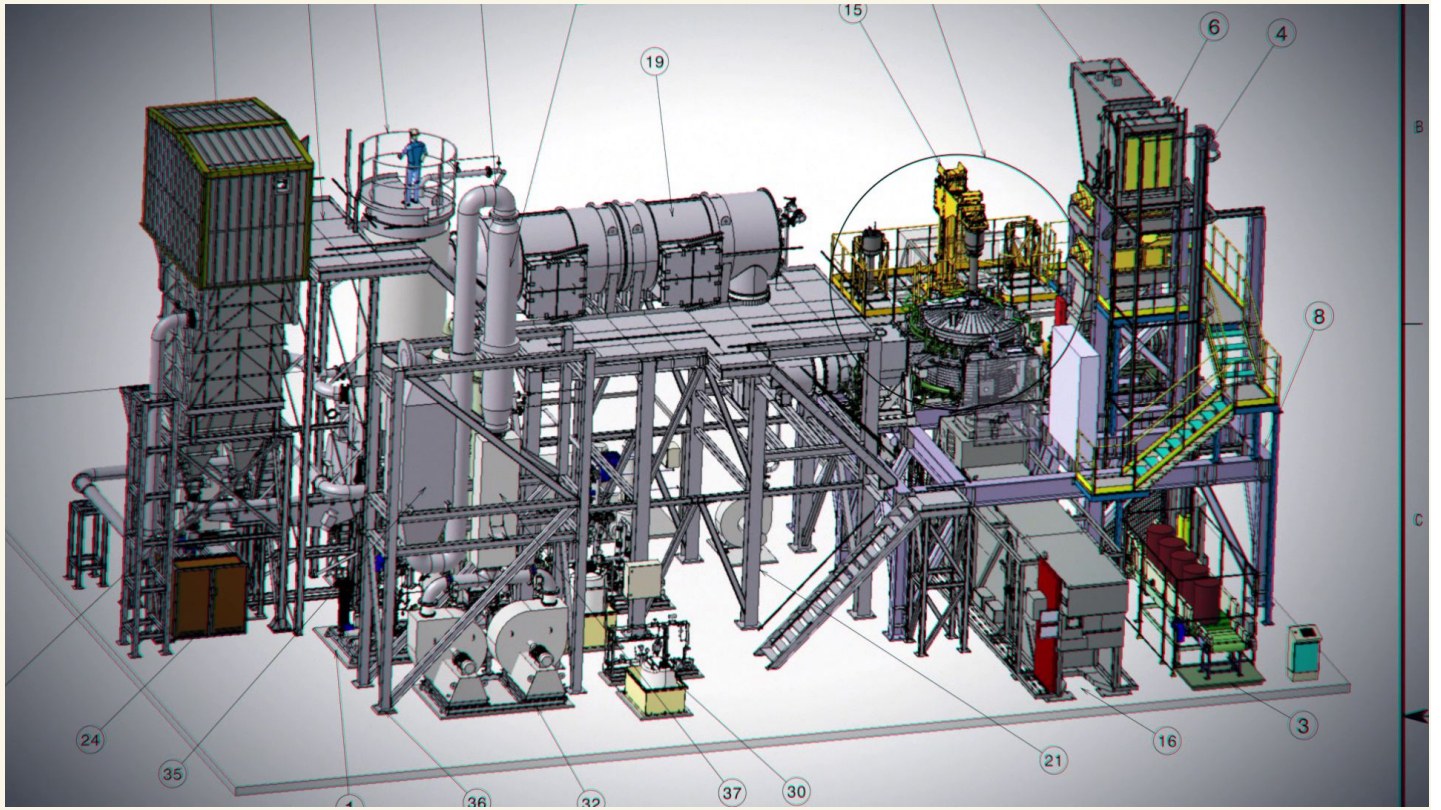
COST SAVING

DRAWBACKS >

Drawbacks

- LIQUID WASTE
- METALLIC WASTE
- POLYMERS PRESENCE

Construction



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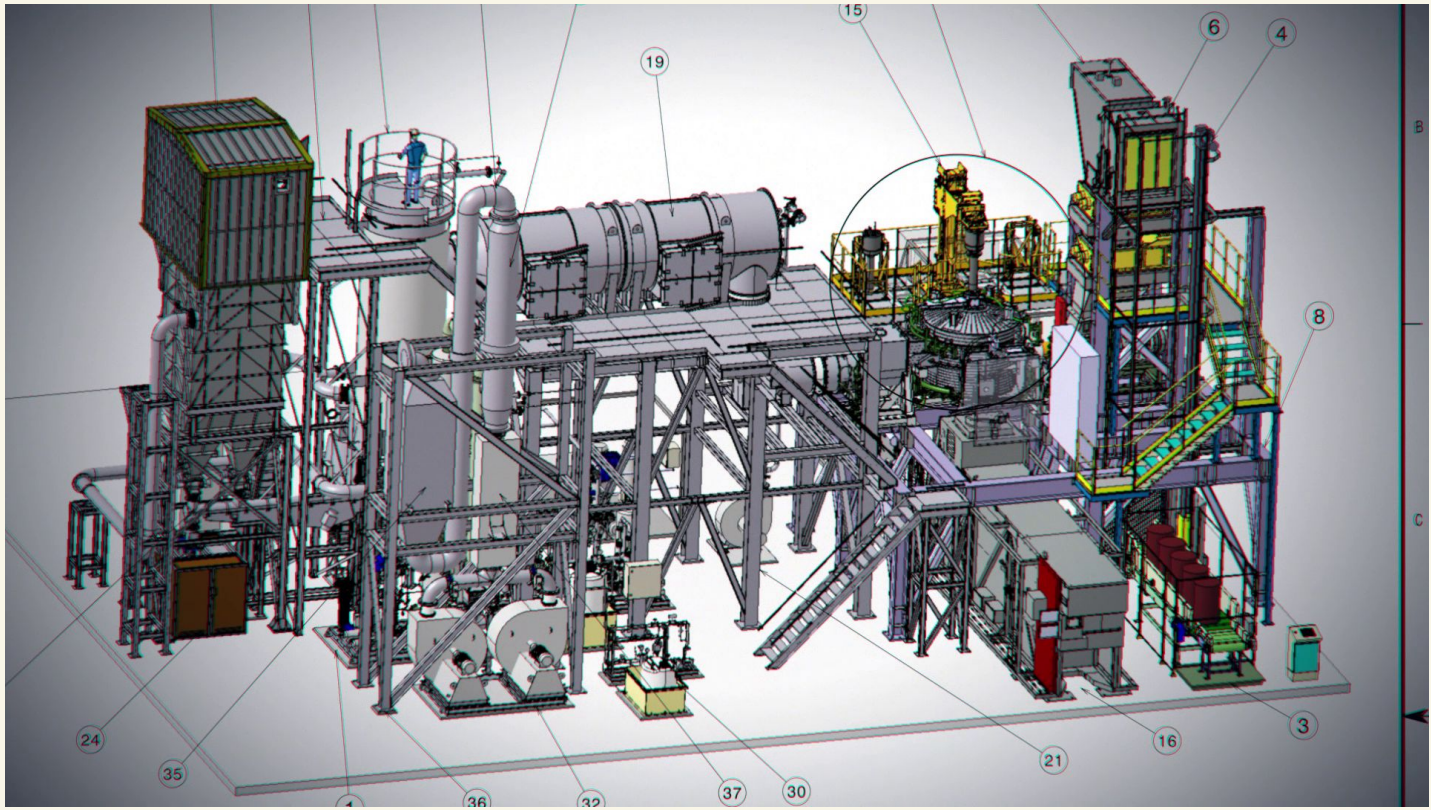
Construction



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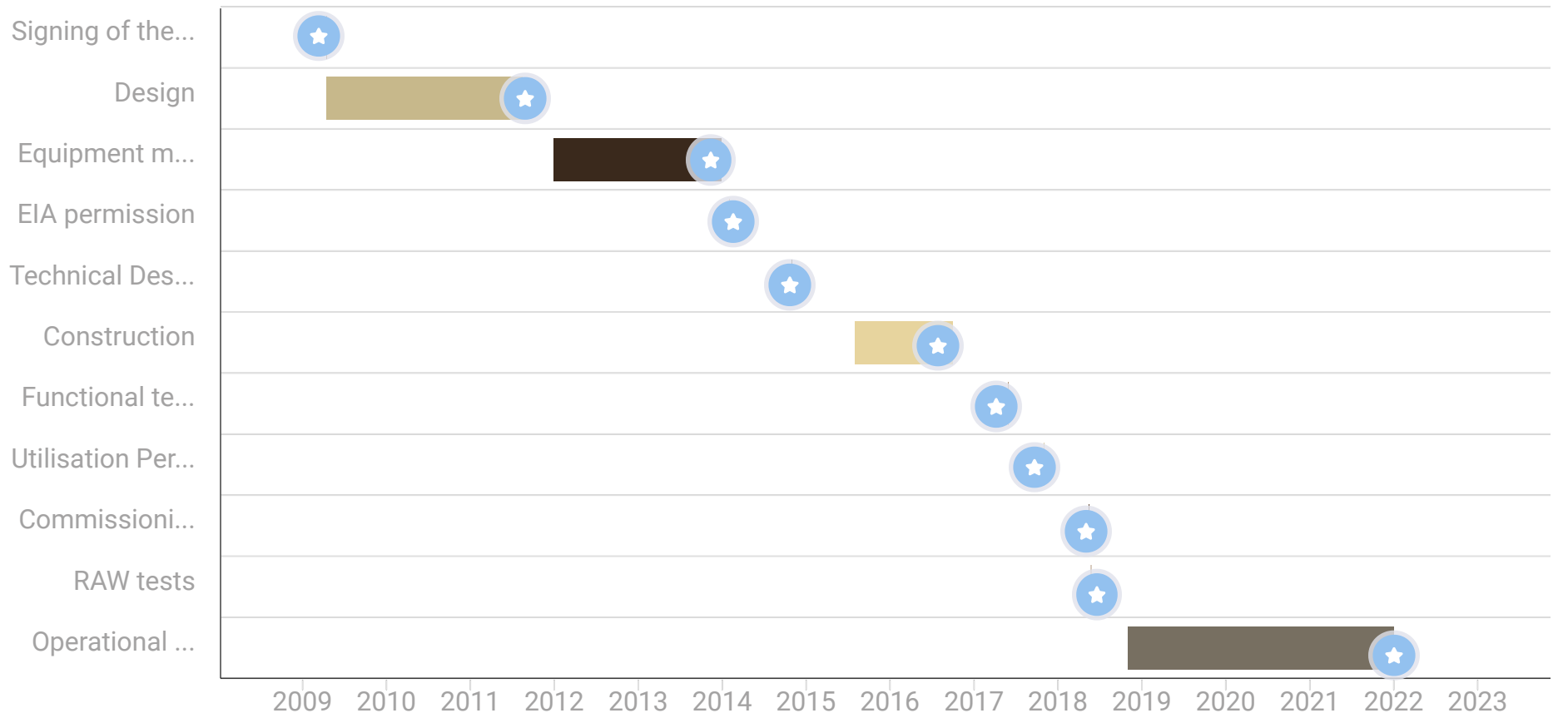
Timeline



+ INFO

Adaptation of the infrastructure to the new facility

The design of the PMF was consistent with the use of the existing infrastructure at the Kozloduy NPP site..

The decision to install the PMF in the existing building of AB-2 required some design modifications.

Building structure

The dimensions of the PMF required some modifications of the structure of the building

+ INFO

Ventilation Systems

Exsiting ventilation systems required reconfiguration given the new PMF design requirememts

+ INFO

Power Supply & Cabling

Exsiting cabling was insufficent for the new PMF installation

+ INFO

Diesel supply

The new PMF facility required the instalation of diesel supply to the existing building

+ INFO

Water Supply

There was a new need for water supply and wastewater evacuation from the PMF

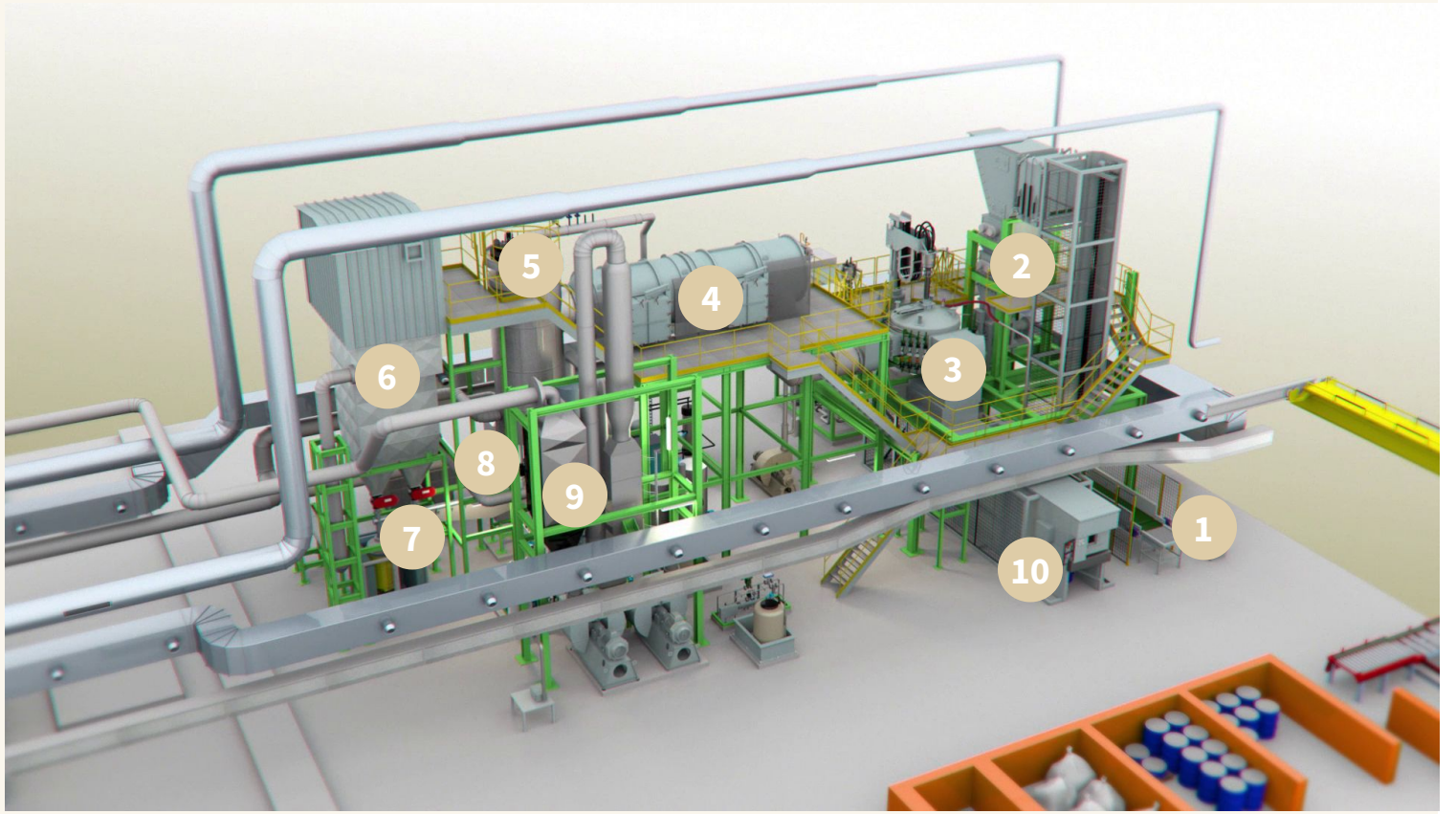
+ INFO

Air Supply

New need for air and nitrogen supply to the PMF to ensure function and safety

+ INFO

Operation



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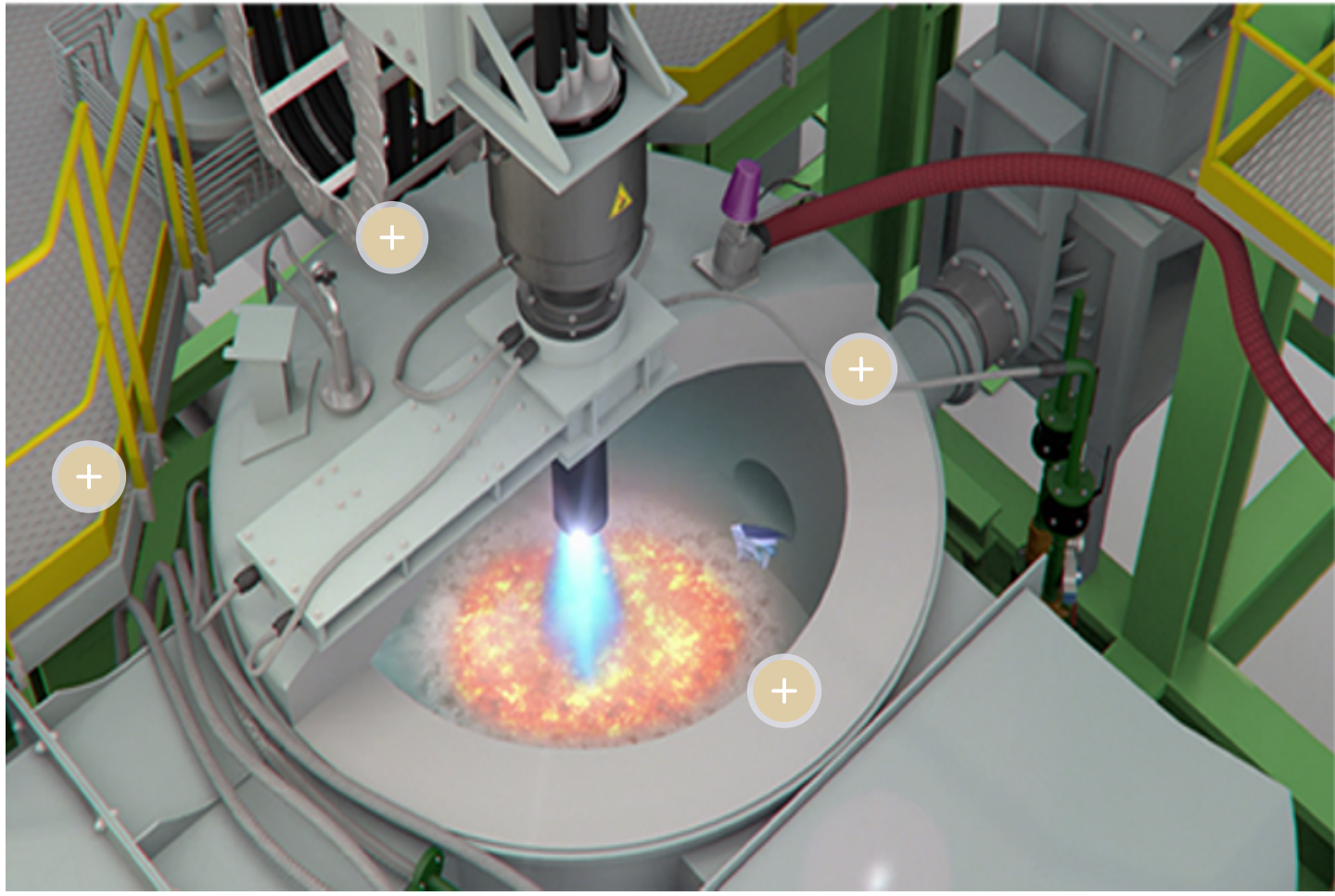
Packages

The type of packaging to process over the four campiagns for the received radioactive waste (RAW) included:

- RAW in super-pressed drums (super-compacted)
- RAW in pressed drums (compacted)
- RAW in polyethylene bags (non-compacted)

Processing sorted RAW without pretreatment in polyethylene bags achieves the highest Volume Reduction Factor (VFR) and extends the life of the feed auger. Resources are also saved by eliminating the need for pre-treatment (pressing, super-pressing) of the RAW.

CAMPAIGNS

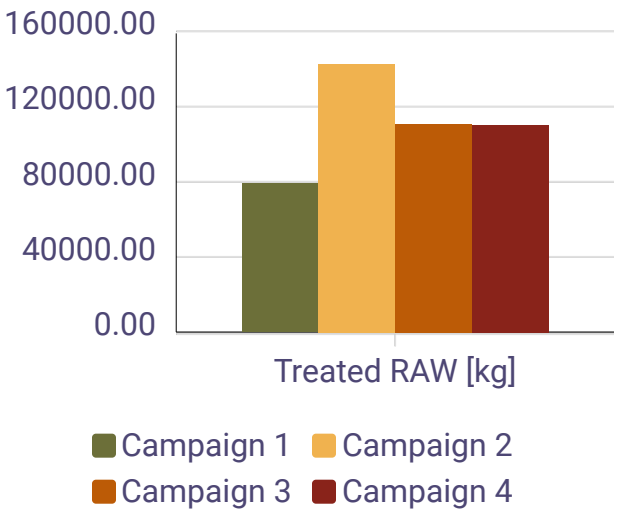


Campaigns

Total RAW Treated (kg)

442,835.58

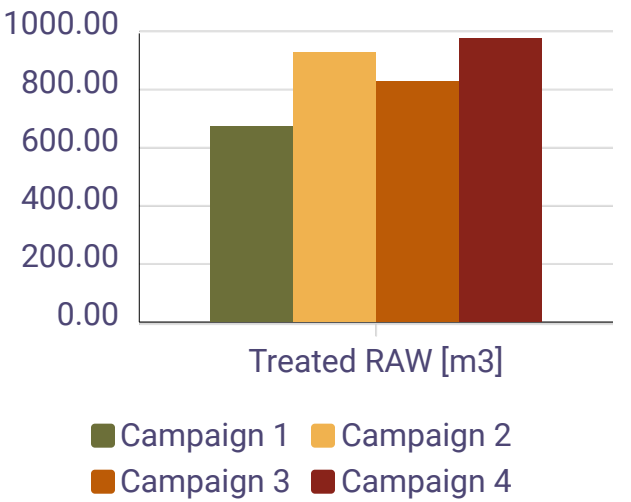
Across all four campaigns



Total RAW Treated (m^3)

3,400.41

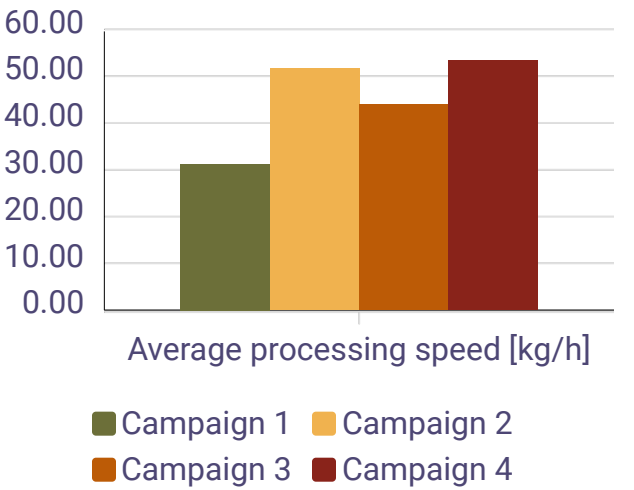
Across all four campaigns



Average processing speed (kg/h)

45.06

Across all four campaigns



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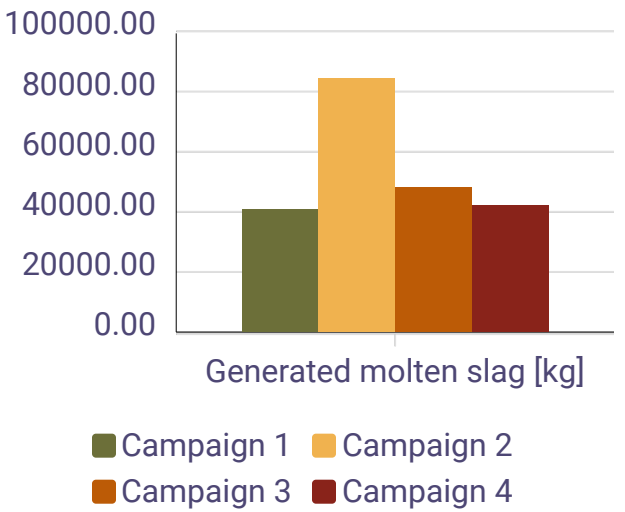
Campaigns

Generated molten slag (kg)

215,372.22

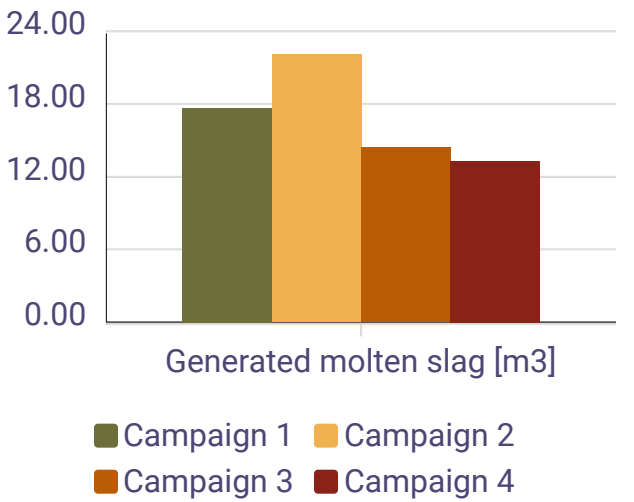
Across all four campaigns



Generated molten slag (m^3)

67.49

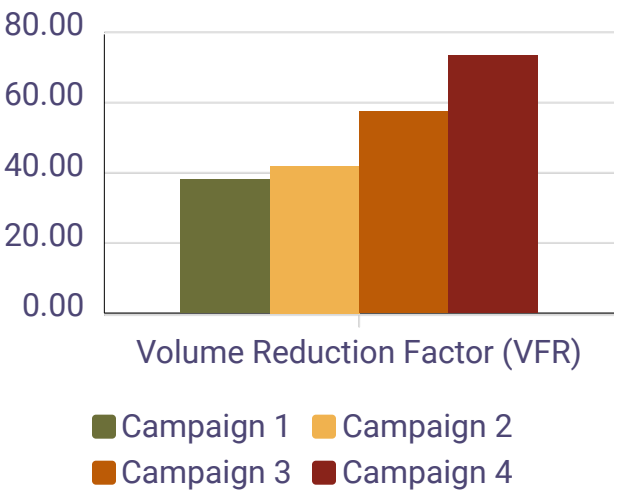
Across all four campaigns



Volume Reduction Factor (VFR)

50.38

Across all four campaigns



CONTINUE

LESSONS LEARNED

Project Feasibility

MORE

Key factors

When preparing a feasibility study for a RAW treatment facility, the key factors for decision-making are summarised below.

1. The expected amount of the RAW to be treated in the facility during the exploitation period.
2. Assessment of the price for treatment of this inventory through alternative technologies: PMF against other suitable choices.
3. Assessment of the price for disposal of the final amount of the conditioned waste in the chosen alternatives.
4. Overall assessment of the treatment and disposal price per unit of the selected inventory in each of the selected alternatives.

START

Assumptions

Lifetime
The expected lifetime used in the analysis is **25 years**

Technologies
The analysis compares **plasma melting** and **super-compaction** technologies

Estimated RAW
In this period, the estimated amount of RAW to be treated is **44 000 m3**

Cost estimation
The calculation of costs has been made from the data obtained during the 4 campaigns.

Expenses

EVALUATION >

Investment cost

The investment cost made for the PMF is estimated to be **€39,397,663.61.**

Operational costs

The PMF operational costs for the four periods are estimated at **€4,404,988.13** (including costs for Personnel, Depreciation, Consultant services (JV Support) and used spare parts, energy and consumables)

The super-compaction operational costs during this period for the same amount of RAW treatment are estimated to be **€4,264,414.64.**

Disposal costs

Based on the design information for NDF, the estimated price for disposal of 1 package of waste (RCC) is **€ 16,230.78.**

Evaluation of the costs of trearment of RAW through PMF and AB

Input data for calculation of 1 RCC package produced in PNF		
Investment cost	€	39 397 663.61
Operational cost for the analysis period	€	4 404 988.13
Generated RCC	units	20.82
Cost for production of 1 empty RCC	€/unit	2 818.61
Operational cost for treatment for 1 tonne of RAW during the analysis period	€/t	9 947.24
	€/m3	1 295.43
RAW in 1 RCC	t/RCC	21.27
	m3/RCC	163.30

Calculation of costs for the production of 1 package of RCC with processed RAW

		PMF costs	SC costs
Operational cost for treatment RAW [t]	€/RCC	211 538.98	4 463.12
Operational cost for treatment RAW [m3]	€/RCC	211 538.98	27 512.35
Disposal of 1 RCC in NDF	€	16 230.78	16 230.78
Total operational and disposal cost for 1 RCC	€	230 588.37	51 024.87
Investment costs per 1 RCC package	€	145 917.27	N/A
Total Cost per RCC (Including Investment Costs)	€	376 505.65	N/A

Cost calculation for the treatment and disposal of total RAW

As a consequence of the treatment of 3,400 m3 of RAW using the **PMF**, 67.49 m3 of final RAW volume was generated. This resulted in the generation of 20.82 RCCs for disposal.

Taking into consideration the technical parameters of the **super-compaction technology** as a result of the treatment of 3,400 m3 of RAW would lead to the creation of 154.21 RCCs for disposal.

Costs for treatment and disposal of 3 400 m3 of RAW trough SC and PMF	Costs (RCC x Operational and disposal costs for 1 RCC)
Through SC	€ 7 890 365.02
Through PMF	€ 4 801 663.80

Cost calculation for the treatment and disposal of total RAW

Taking into account that a total of 270 RCCs will be generated through the PMF technology for the lifetime of the facility and the coefficient calculated in the previous slide, 2,000.7 RCCs from SC would be generated during the lifetime of the facility.

According to that, the following calculations can be made:

Calculation PMF Ops Lifetime Costs (Assume assessment period as average)	€ 62 258 861.18
Calculation for processing of the same waste using super-compaction (SC)	€ 102 307 275.20
Savings over the operational lifetime comparing the PMF vs. SC	€ 40 048 414.02
Recovery period for Capital Investment in years	24.59

Thank you for your visit