

HydroFoamer PACE v 0.8.36

Pipeline Assessment for Cost & Execution

HydroFoamer PACE is a project assessment system for comparing pipeline installation methods across cost, execution time, material logistics, carbon impact, and engineering assumptions.

Scenario name: Typical Norwegian SHP

Model version: 0.8.36

Version 0.8.36 | Branch: main | Derived from: main v0.8.35

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Pipeline length	Pipe outside diameter	Country / environment	Excavation basis
1,600 m	900 mm	France	Ordinary Soil

Executive Summary

HydroFoamer saves €435,796, equivalent to €272.37/m, and shortens the project by 44.0 days.

Total construction saving	Saving per metre	Traditional total cost	HydroFoamer total cost
€435,796	€272.37/m	€938,071	€502,275
Project duration traditional	Project duration HydroFoamer	Days saved	Percentage faster
53.6 days	9.6 days	44.0 days	82.1%
Excavation volume reduction	Imported aggregate eliminated	CO2 reduction percentage	Total commercial advantage
2,738 m3	5,138 m3	91.9%	€660,341

Project Impact Summary

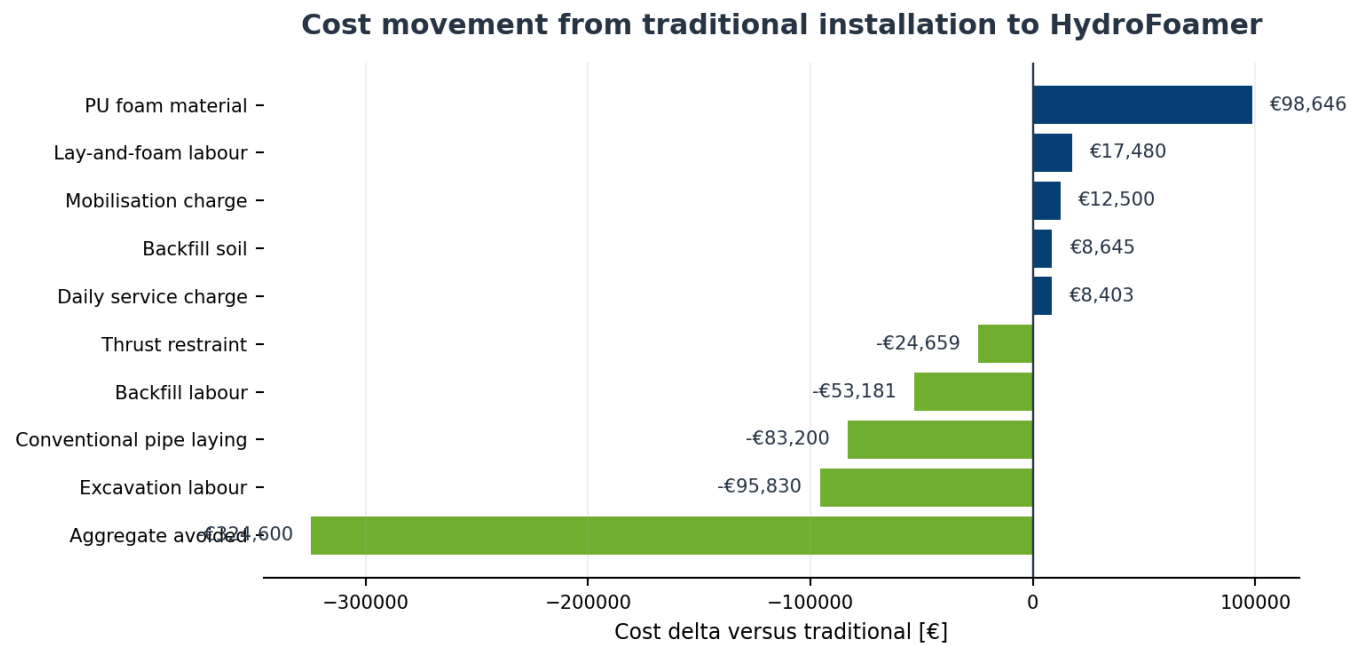
Metric	Traditional Installation	HydroFoamer Installation	Delta
Total cost	€938,071	€502,275	-€435,796
Production duration	49.6 days	5.6 days	44.0 days
Project duration incl. mob/demob	53.6 days	9.6 days	44.0 days
Excavation volume	9,916 m3	7,178 m3	2,738 m3 reduction
Imported aggregate / PU foam	5,138 m3 aggregate	671 m3 PU foam	4,467 m3 less engineered fill
CO2 emissions	97.2 tCO2e	7.9 tCO2e	89.4 tCO2e reduction

Business Case / Cost Breakdown

Category	Cost item	Traditional	HydroFoamer	Basis / notes
Materials	Selected bedding/embedment aggregate	€324,600	€0.00	5,138.1 m³ x 63.17 €/m³; tonne_based_delivered
	Backfill soil	€18,800	€27,445	Conventional and HydroFoamer backfill soil, included according to selected scope.
	PU foam material	€0.00	€98,646	Pipe support foam material.
	Materials subtotal	€343,400	€126,091	
Labour	Excavation / rehabilitation labour	€347,060	€251,230	Same volume-based cost base for both methods, applied to each method trench volume. HydroFoamer can be lower because the trench is smaller.
	Pipe laying conventional	€83,200	€0.00	Conventional pipe laying crew days x working hours x labour rate.
	Pipe laying & foaming HydroFoamer	€0.00	€17,480	HydroFoamer lay-and-foam crew labour; includes pipe handling/laying and foam placement.
	Backfill placement / compaction labour	€138,810	€85,629	Conventional selected aggregate plus backfill soil volume 8,898.1 m³ / 200.0 m³/day x working hours x crew size x labour rate. HydroFoamer backfill labour is costed separately from the lay-and-foam crew using 219.6 backfill hours where backfill is in scope.
	Labour subtotal	€569,070	€354,339	
Other	Thrust restraint	€25,600	€940.80	Conventional concrete thrust blocks versus HydroFoamer replacement case.
	HydroFoamer daily service charge	€0.00	€8,403	5.6 production days x €1,500/day; Civil works, pipe laying, foaming and backfill
	HydroFoamer mobilisation charge	€0.00	€12,500	Civil works, pipe laying, foaming and backfill
	Surplus spoil disposal / haulage	€0.00	€0.00	Excluded from totals; surplus spoil volumes are still calculated.
	Construction access / temporary works	€0.00	€0.00	Excluded from totals; construction footprint remains a Sustainability metric.
	Access infrastructure impact	€0.00	€0.00	Excluded from totals; access infrastructure impact remains informational.
	Other subtotal	€25,600	€21,844	
Total	Total priced installation cost	€938,071	€502,275	

Where the saving comes from

Negative values reduce the traditional cost; positive values are added HydroFoamer-specific costs.

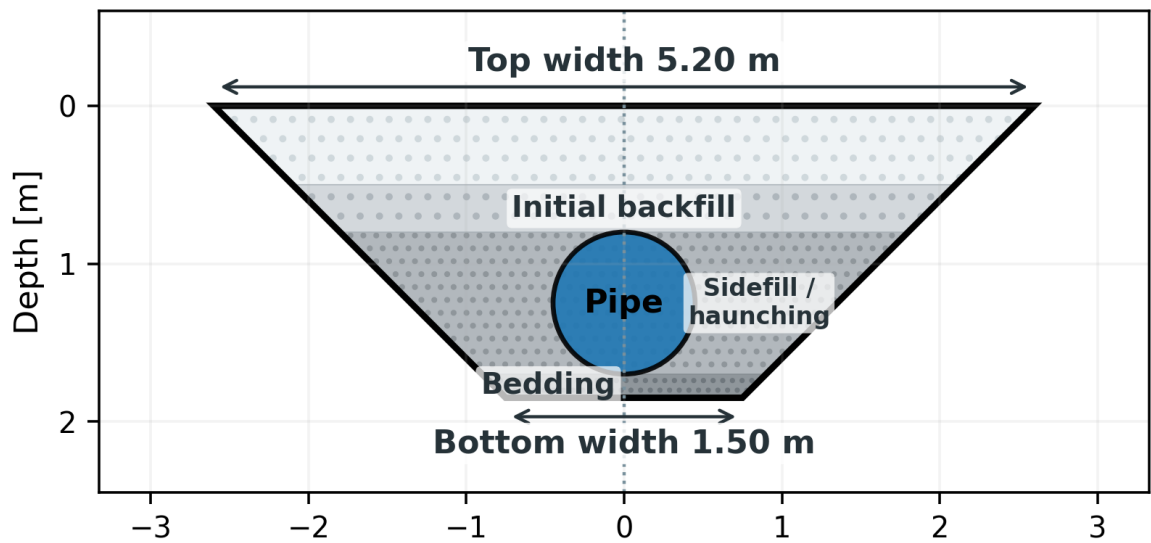


Traditional: €938,071 | HydroFoamer: €502,275

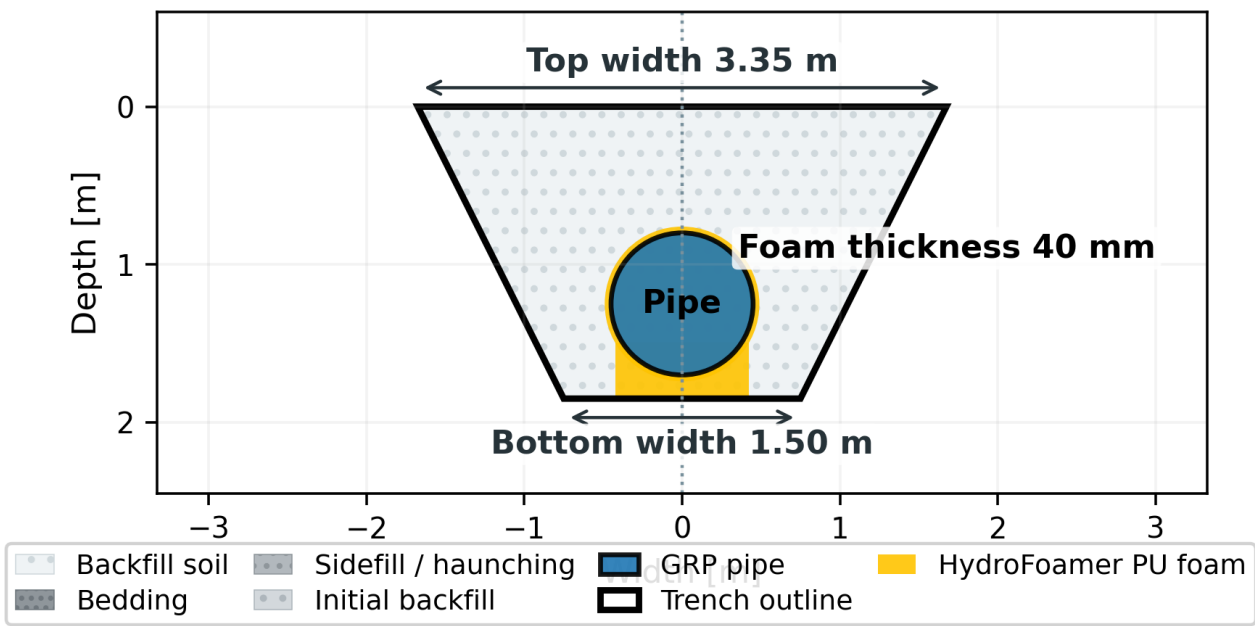
Engineering Case / Trench Profiles

Trench profiles are shown at equal horizontal and vertical scale. The HydroFoamer profile illustrates the reduced excavation envelope and foam support geometry.

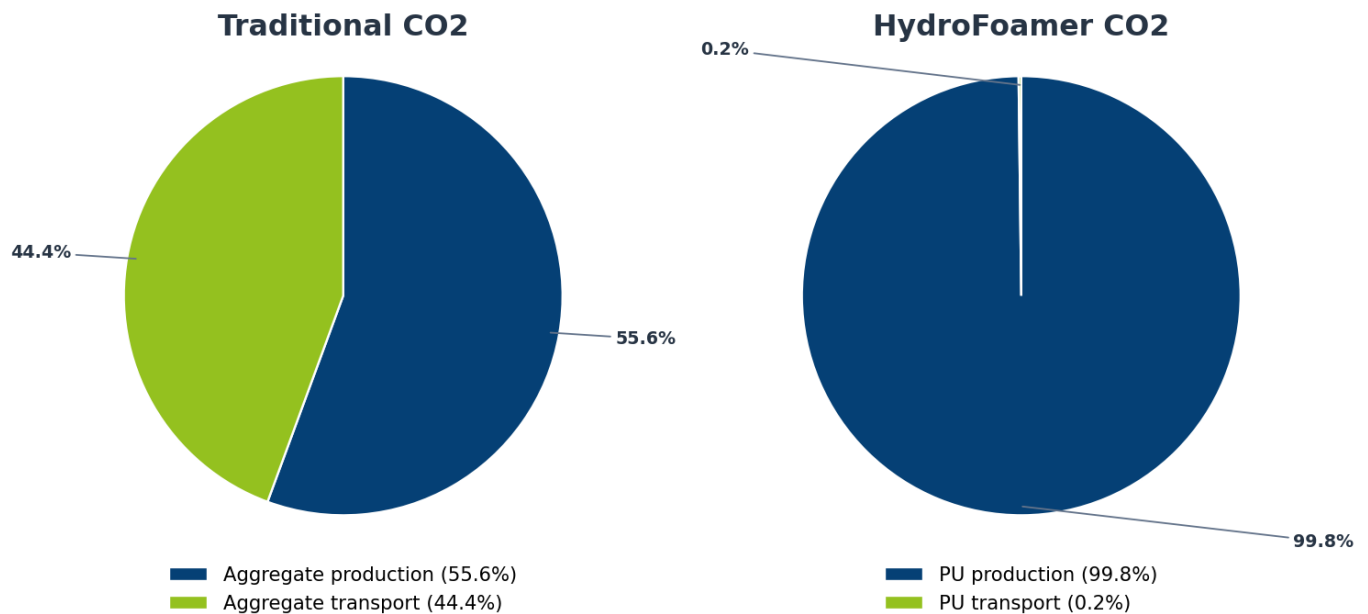
Traditional Installation



HydroFoamer Installation



Carbon Case / CO2 Summary



Metric	Value
CO2 model source	20250407 - HydroFoamer CO2 Calculation Model.xlsx
CO2 model source date	2025-04-07
CO2 model boundary	Cradle-to-site support/embedment system only
Conventional CO2 total	97.2 tCO2e
HydroFoamer CO2 total	7.9 tCO2e
CO2 saving	89.4 tCO2e
CO2 saving percent	91.9%
Aggregate mass	9,762.4 t
PU production mass	28.18 t
PU transport mass	28.18 t
Quarry transport distance	50.0 km
Quarry truck capacity	30.0 t

CO2 model source: 20250407 - HydroFoamer CO2 Calculation Model.xlsx (2025-04-07). Boundary: Cradle-to-site support/embedment system only. Included components are aggregate production, aggregate transport, PU production and foam transport.

Installation Certainty

- Known pipe position and geometry
- Reduced embedment variability
- Reduced dependency on imported granular material placement quality
- Shorter open-trench exposure
- Repeatable support geometry
- Future compatibility with PGMS, Leica survey control and digital QA
- Better basis for as-built verification and installation traceability

Screening	Result
Excavation HSE screening	Conditional model result: Headline outputs are conditional on excavation assumptions that need project-specific HSE, geotechnical or temporary works validation.
Profile	Generic international

Key Assumptions and Sensitivities

Assumption	Value
Aggregate pricing mode	tonne_based_delivered
Delivered aggregate cost	€63.17/m3
Foam price	€3.50/kg
Foam density	42 kg/m3
Labour rate	€65.00/hour
Backfill productivity	50 m3/hour
Excavation capacity	200 m3/day
Backfill capacity	200 m3/day
Derived excavation rate	Conventional 32.3 m/day; HydroFoamer 44.6 m/day
Haul distance	50 km
Site logistics modifier	1.10
Surplus spoil disposal	Excluded
Surplus spoil avoided	4,461 m3; €0.00 avoided
Construction access costs	Excluded
Construction access saving	€0.00; All-weather access road
HydroFoamer production mode	Civil works, pipe laying, foaming and backfill
Open excavation factor enabled	Yes
HydroFoamer open excavation factor	0.50

Results are most sensitive to aggregate logistics, excavation productivity, labour productivity, foam price and trench geometry assumptions.

Appendix - Disclaimer

HydroFoamer PACE - Disclaimer

HydroFoamer PACE - Pipeline Assessment for Cost & Execution is a conceptual engineering and economic assessment system intended to support the preliminary evaluation of pipeline installation methods.

The outputs generated by PACE are estimates based upon user-provided inputs, configurable assumptions and internally defined engineering models. Results are intended for feasibility studies, option evaluations, budget estimates and comparative assessments only.

PACE does not constitute:

- A detailed engineering design.
- A geotechnical assessment.
- A temporary works design.
- A construction method statement.
- A regulatory approval.
- A health and safety assessment.
- Professional engineering advice.

HydroFoamer Open Excavation Factor

Where enabled, the HydroFoamer Open Excavation Factor applies only to the HydroFoamer trench geometry by reducing the Excavation Stability Class baseline side slope for a short-duration open excavation scenario.

The factor is intended solely to illustrate the potential project impact of reduced excavation exposure, including possible effects on:

- Excavation volumes
- Material movements
- Transport requirements
- Carbon emissions
- Programme duration
- Project costs

The factor does not represent a legal entitlement to use steeper trench walls, reduced shoring, reduced benching, or alternative excavation methods.

Actual trench geometry must always be determined by suitably qualified personnel taking account of:

- Applicable laws and regulations
- Ground conditions
- Soil stability
- Groundwater conditions
- Weather conditions
- Excavation depth
- Duration of open excavation
- Construction methodology
- Temporary works requirements
- Site-specific risk assessments

Where enabled, the HydroFoamer Open Excavation Factor is a scenario-based engineering assumption. The conventional gravel trench retains the Excavation Stability Class baseline geometry. Actual trench geometry must be determined by the contractor and approved in accordance with applicable regulations, geotechnical conditions, groundwater conditions and temporary works design requirements.

User Responsibility

The user remains solely responsible for verifying all assumptions, inputs, outputs and conclusions before using any information generated by the assessment system for commercial, engineering, procurement, construction or operational purposes.

HydroFoamer B.V. accepts no liability for any loss, damage, cost, delay, injury or claim arising from the use of PACE or reliance upon its outputs.