Geothermal Water in RAS: Business Plan Perspectives (Shrimp)

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interreg-baltic.eu/project/tetras

Synopsis

Completed actions

Analyzed geothermal heat & mineralization impacts; validated in Pilot-2; modeled 100/300/1000mt facilities.

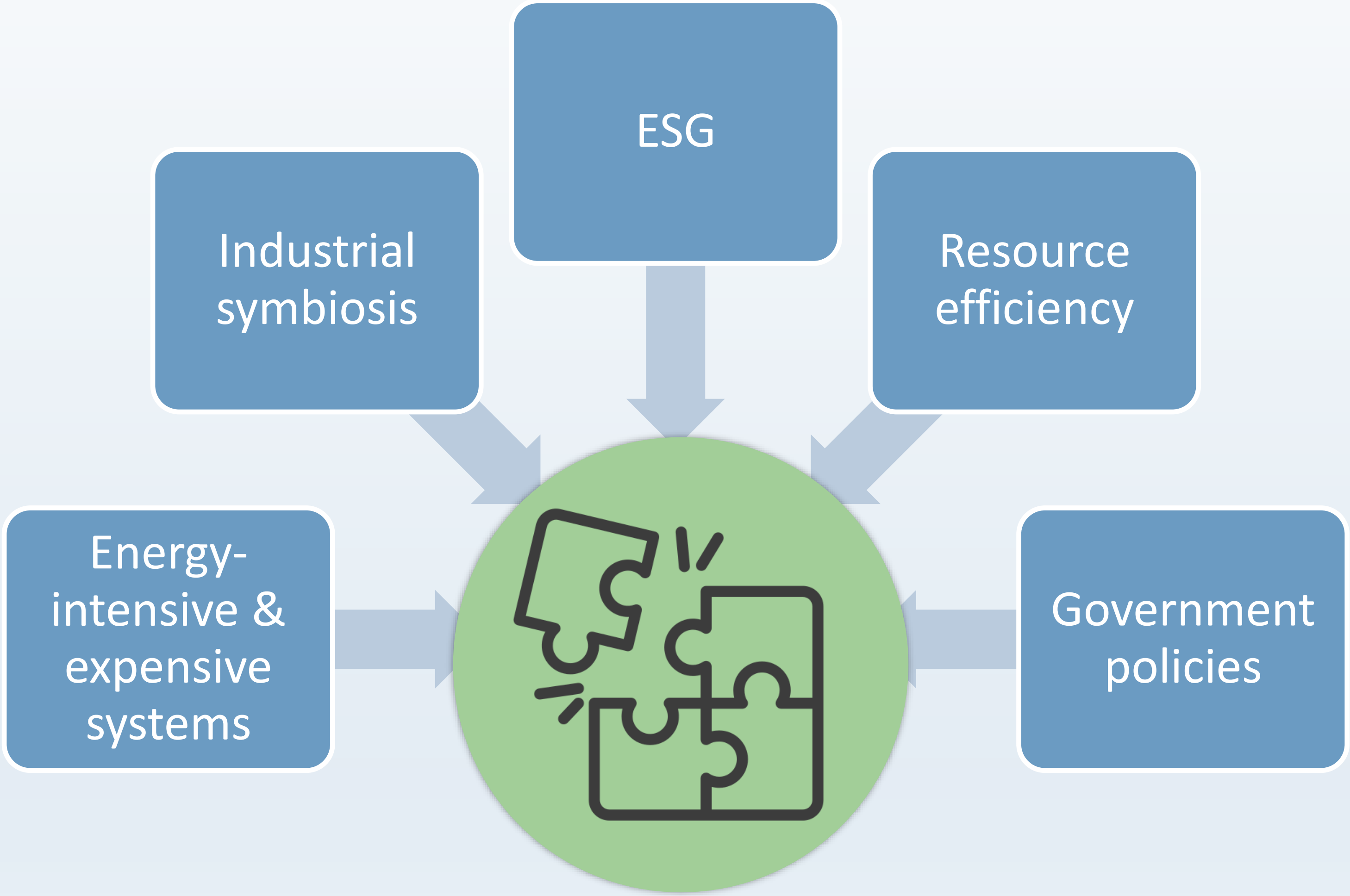
Results

Potential economic impact; system stability maintained; ambiguities

Future prospects

Geothermal availability; Integration potential; Estimates for go/ no-go gates.

Context: Why This Matters



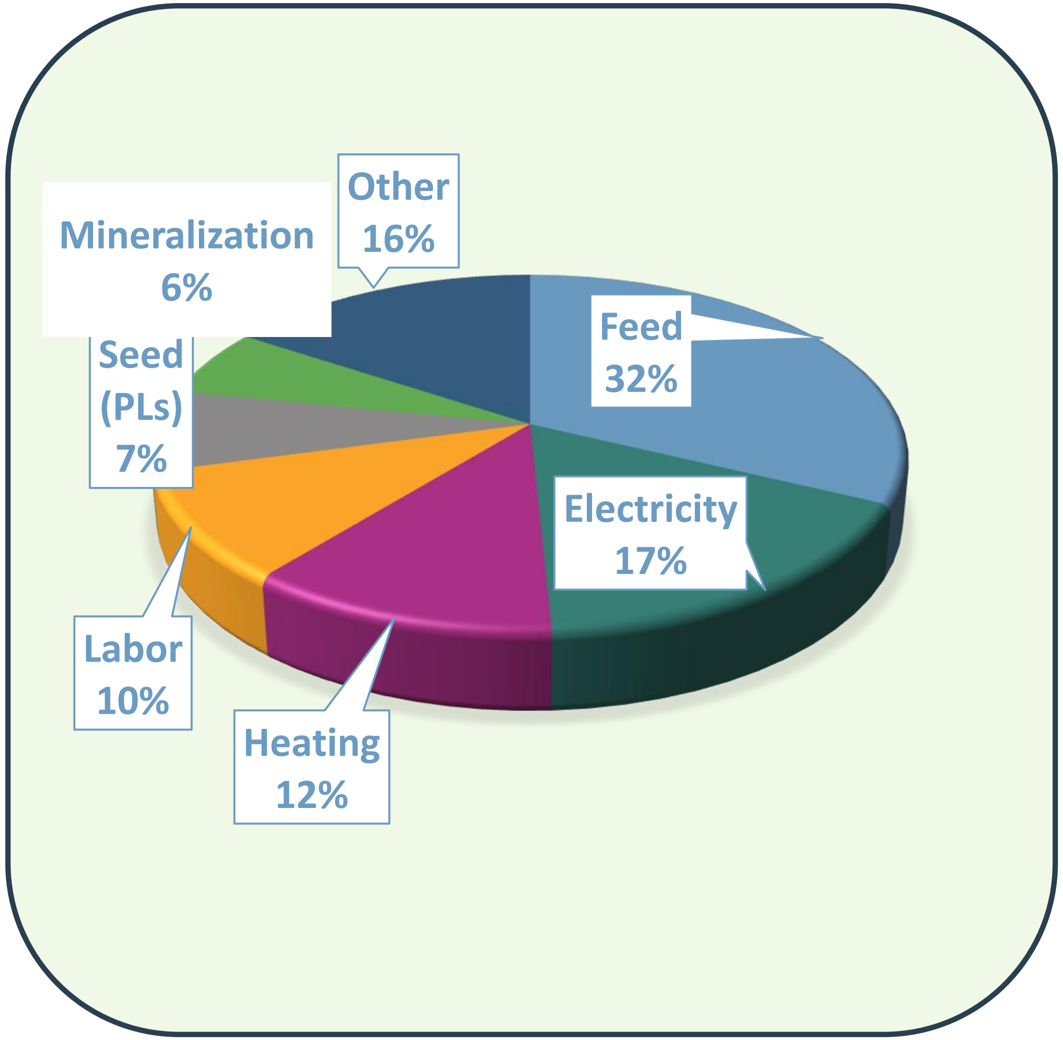
Shrimp RAS Basics - What Matters to Shrimp

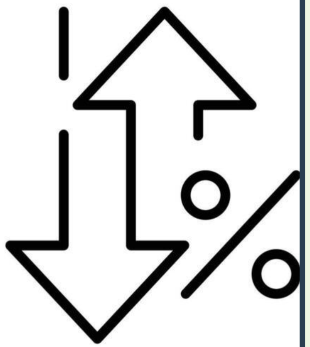
Stable physics = stable biology = stable economics.

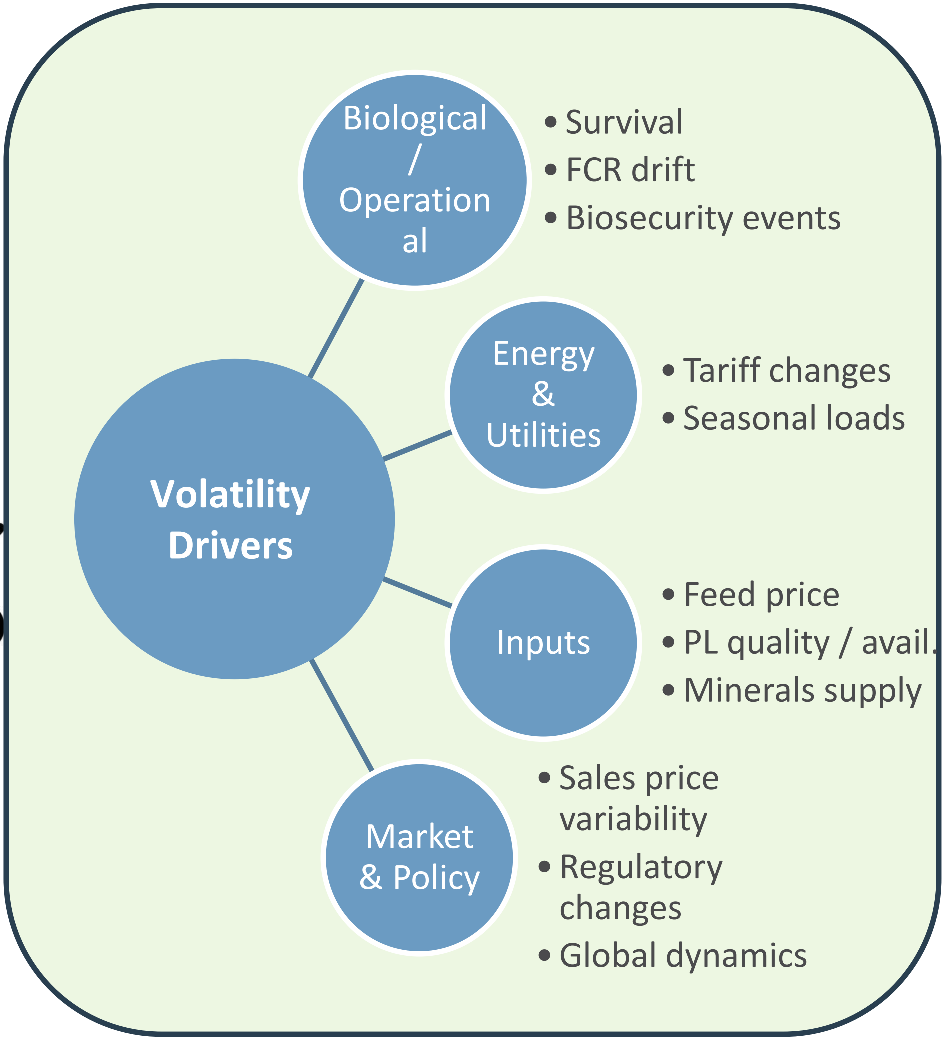
Water Temperature (°C)	27-29
Salinity (ppt)	15-20
Dissolved O2 (mg/L)	5-7
pH	7.5 – 8.5
Alkalinity (mg/L)	120-180
Ammonia (mg/L)	<5
CO2 levels (mg/L)	50-100

Growth Rate (g/week)	1.5 - 2.5
FCR	1.5 – 1.7
Survival Rate (%)	65 - 75

Shrimp RAS - Costs and Volatility Drivers

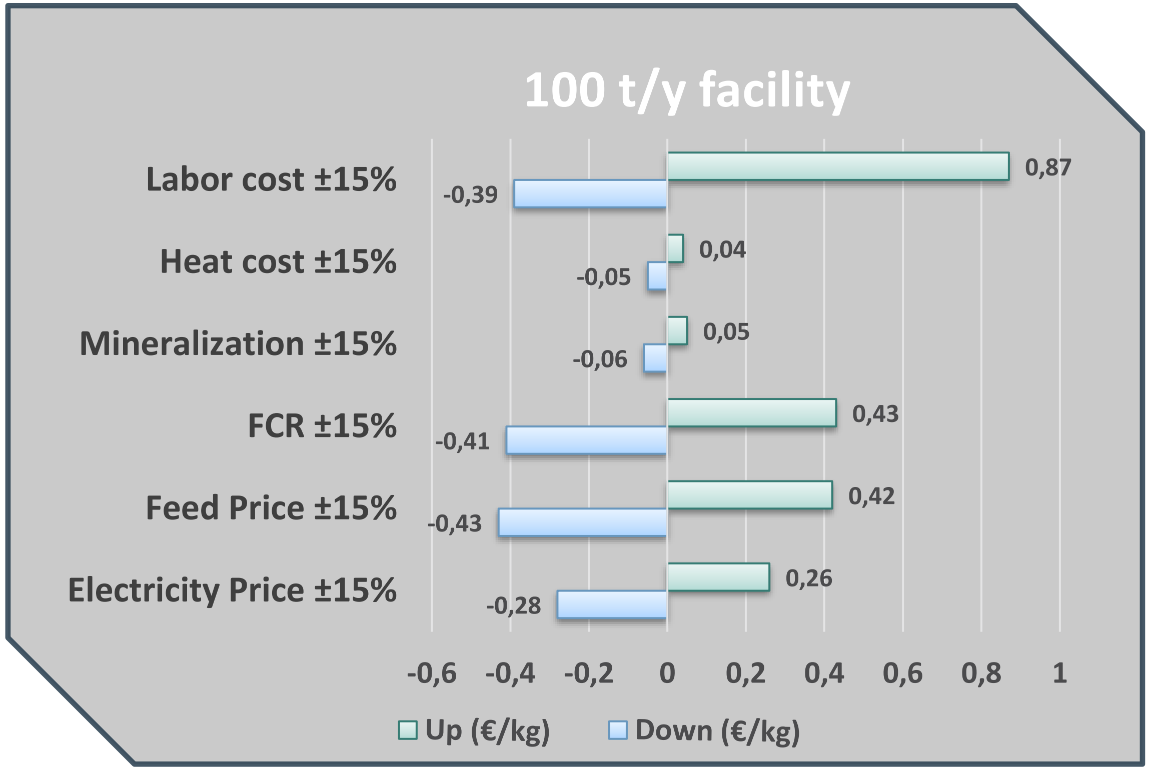


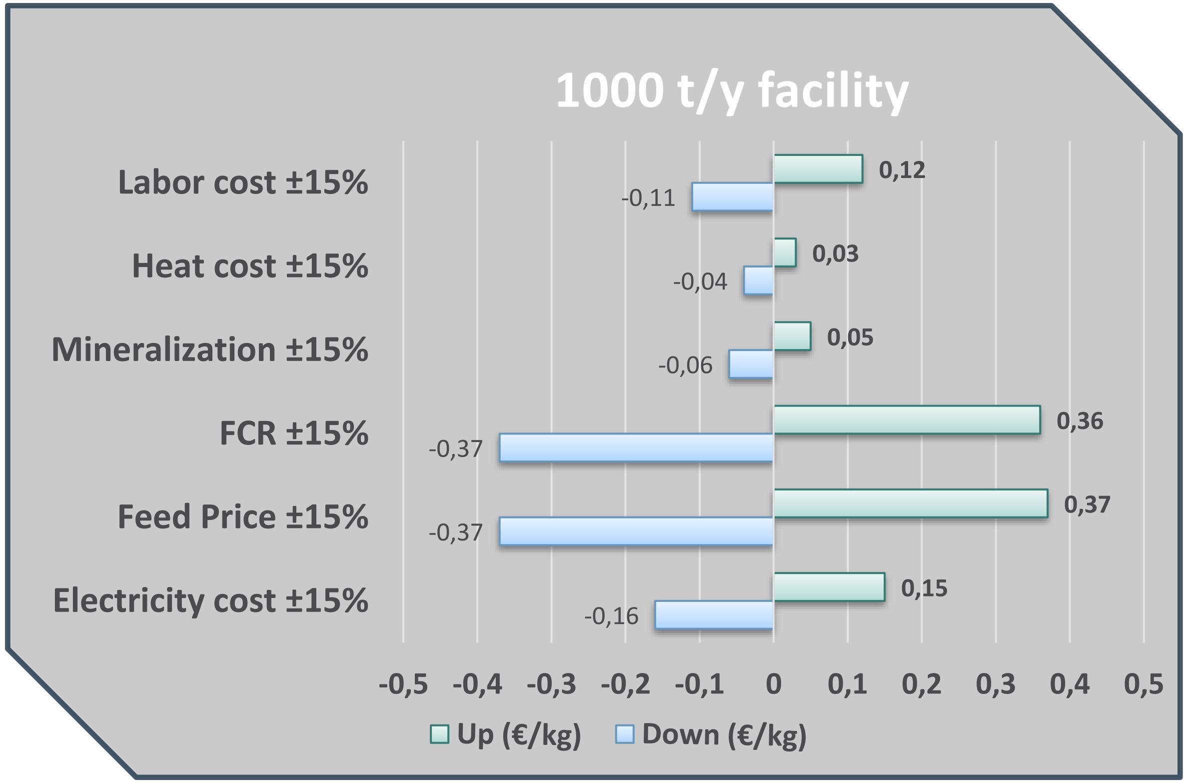


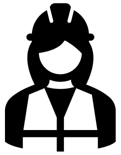


COGS split is based on industry averages and can vary.

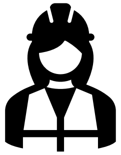
Shrimp RAS - Cost Volatility Impact on COGS







6 personnel total
17 (t / person)

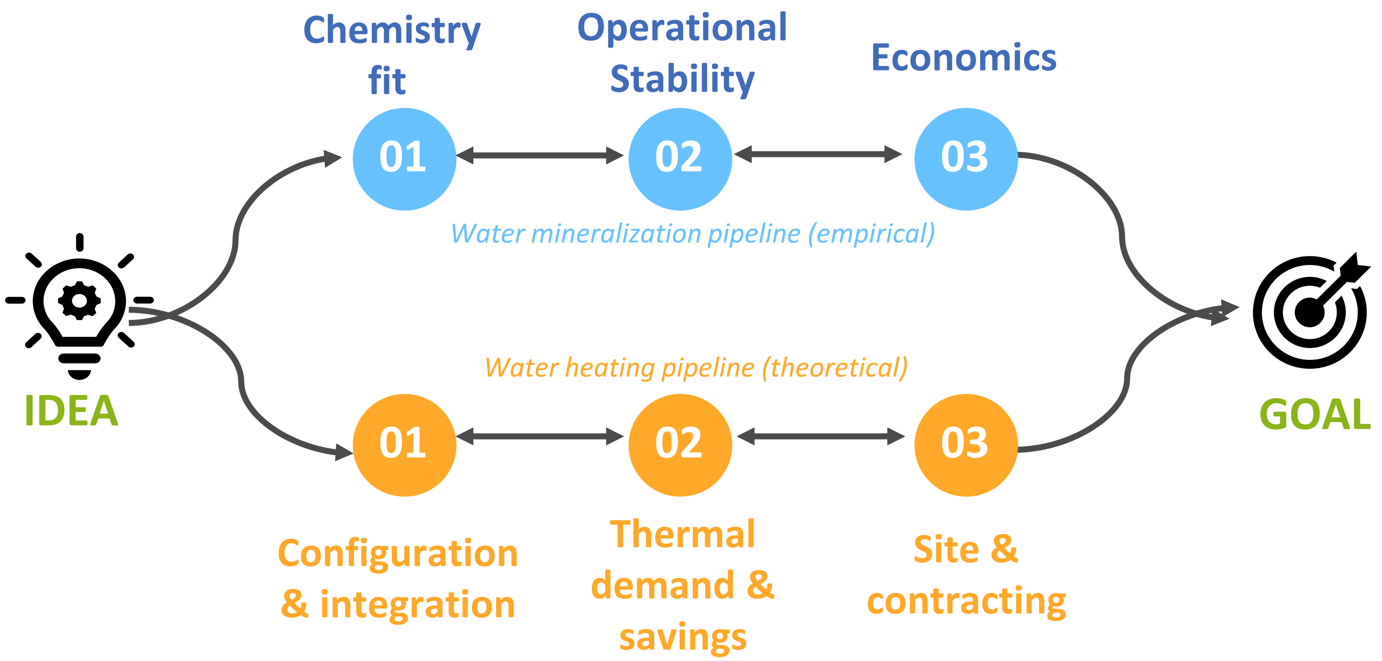


18 personnel total
55 (t / person)

Geothermal Resources: Two Tracks

- Blue track - Pilot 2 empirical data
- Orange track – theoretical desk study

Utilize local geothermal resources to facilitate RAS shrimp economics



Scalable integration model that turns local geothermal resources into competitive advantage

Geothermal: How It Fits In

Operational Targets
- Salinity 15-20 ppt
- Alkalinity 120-180

Potential Impact
- Net eur/m3 for new-water mineralization vs synthetic mix

KPIs to Watch
- Stability (ph/alk/N)
- Survivability
- eFCR

Constraints
- Site-specific chemistry
- Pretreatment SOP (if needed)

Operational Targets
- Maintain 27-29 C
- Culture water + Building

Potential Impact
- Effective eur/kWh
- Heat pumps, HEX losses, O&M, amortized tie-in CAPEX

KPIs to watch
- Thermal kWh/kg
- Resource Stability

Constraints
- Source availability
- Source parameters
- Priority alignment (cascading)

Pilot-2 Snapshot & Learnings

Goals

Evaluate biological, economical, technical aspects of geothermal brine use in RAS

Hypothesis

Positive economic impact by shared resource utilization; water parameter stability

Results

Stable growth metrics; suitable water quality; positive economic impact

Limitations

Control variables; small scale pilot; uncertain replication at scale

Experimental Data

Metrics / KPIs	Control (w. LCSM*)	Geothermal Brine 1	Geothermal Brine 2
FCR	1.71	1.52	1.5
Survivability (%)	33	63	42
Growth Rate (g/day)	0.22	0.2	0.29
Dissolved O2 (%)	70	70	93
Salinity Average (PPT)	22	20.5	23

*LCSM – Low Cost Salt Mixture (Na, K, Ca, Mg)

Modular RAS Farm Model (Baseline)

Capacity / output (MT/y)

100 (3 modules)

Total System Volume (m3)

2100

Daily Water Intake (%)

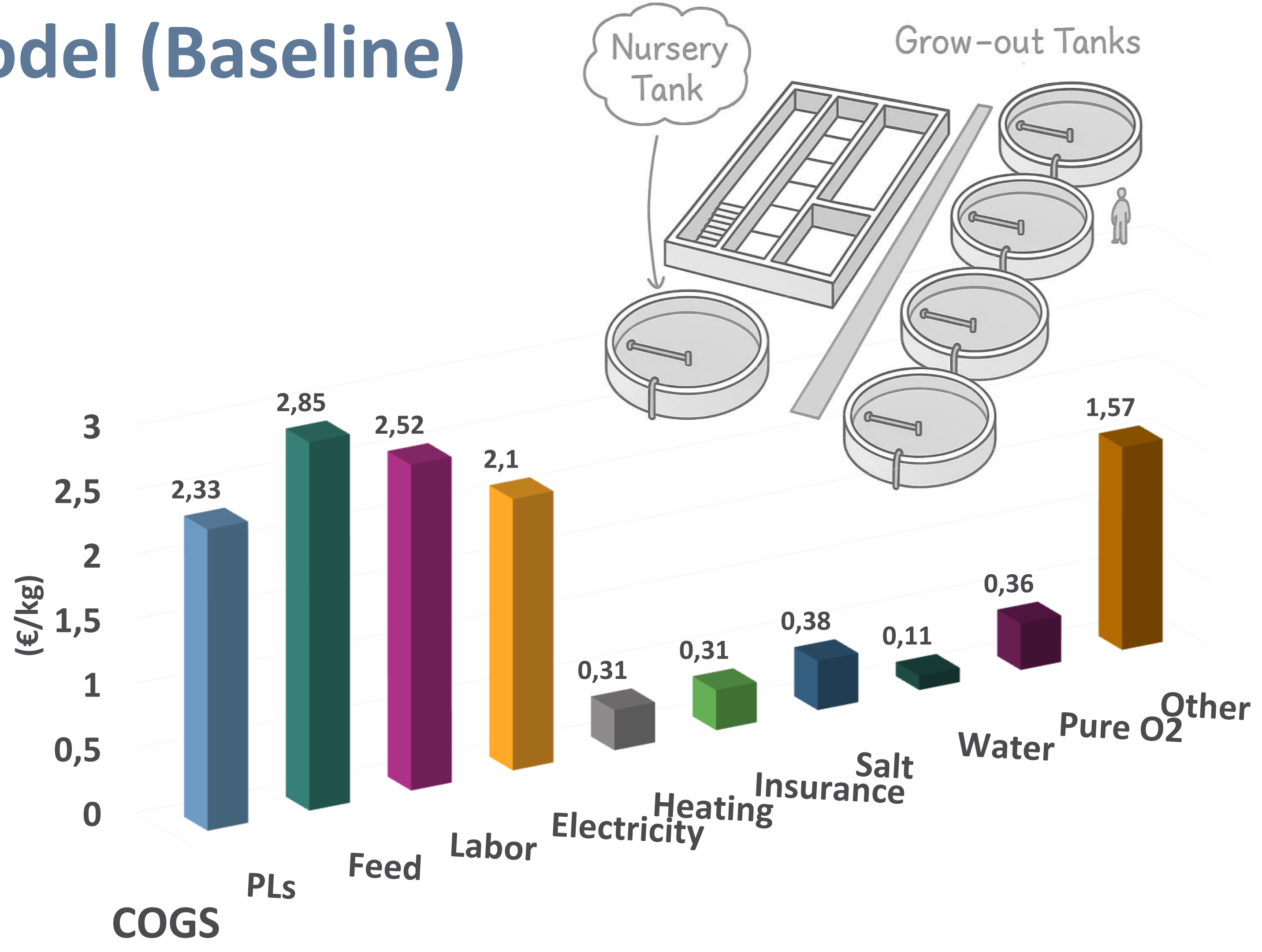
1.5 - 3

Stocking Density (kg/m3)

15

Recirculation rate (%)

95-98



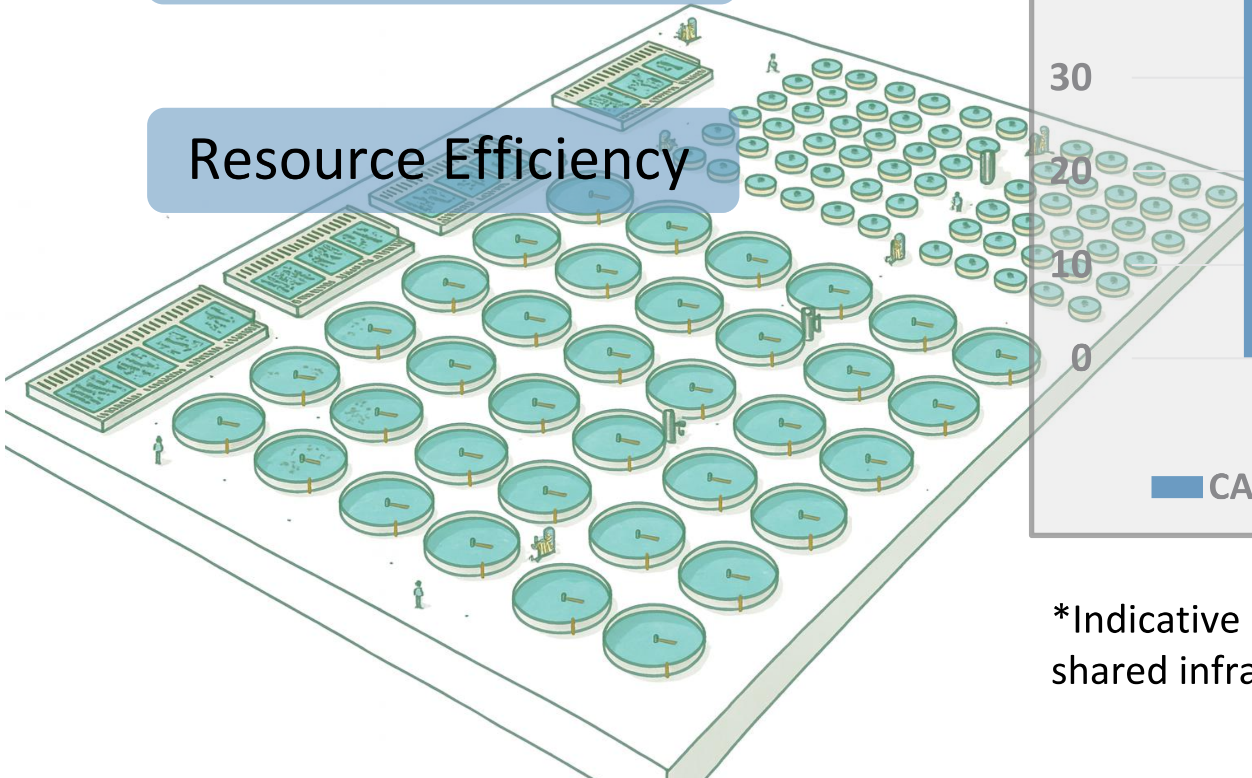
Design and performance targets are based on commercially proven pilot RAS practices and Akola's engineering synthesis.

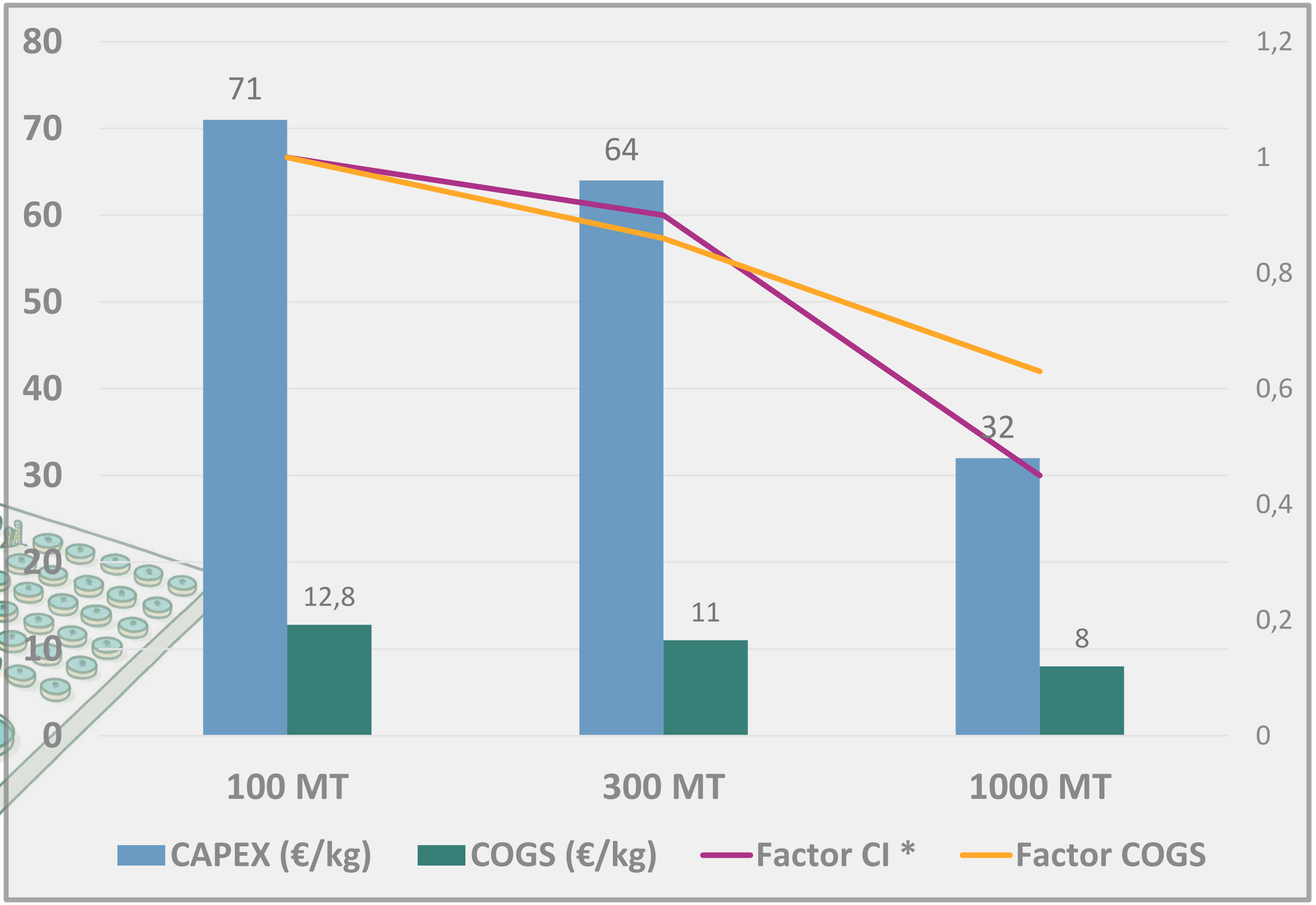
Favorable Scale Economies

Modular Design

Shared Capacities

Resource Efficiency

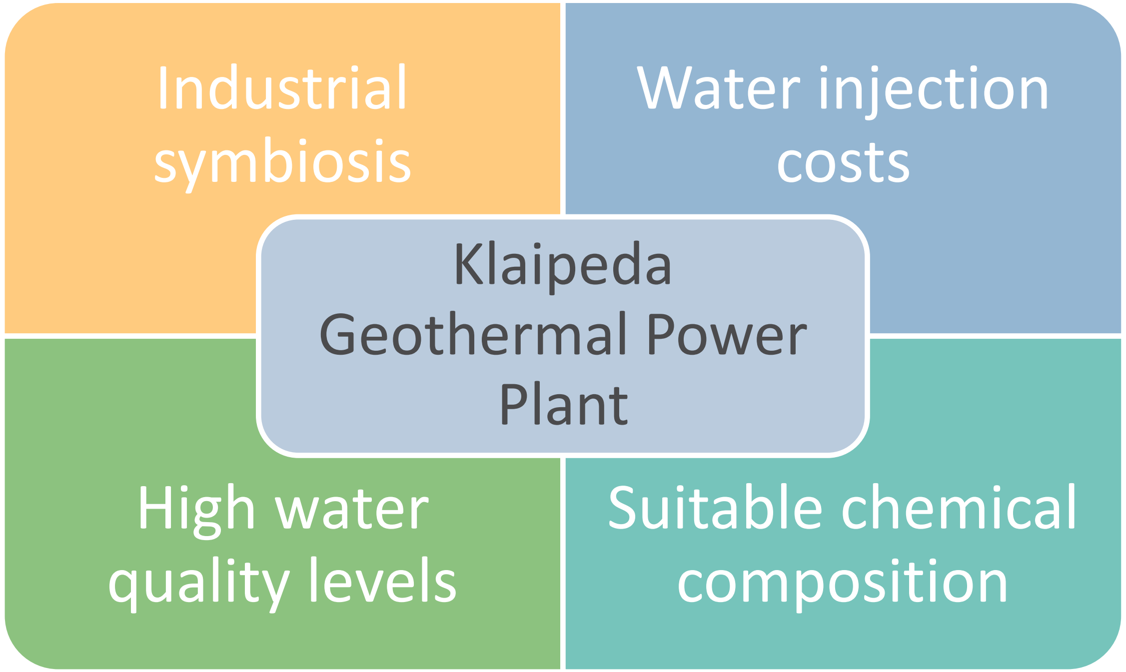


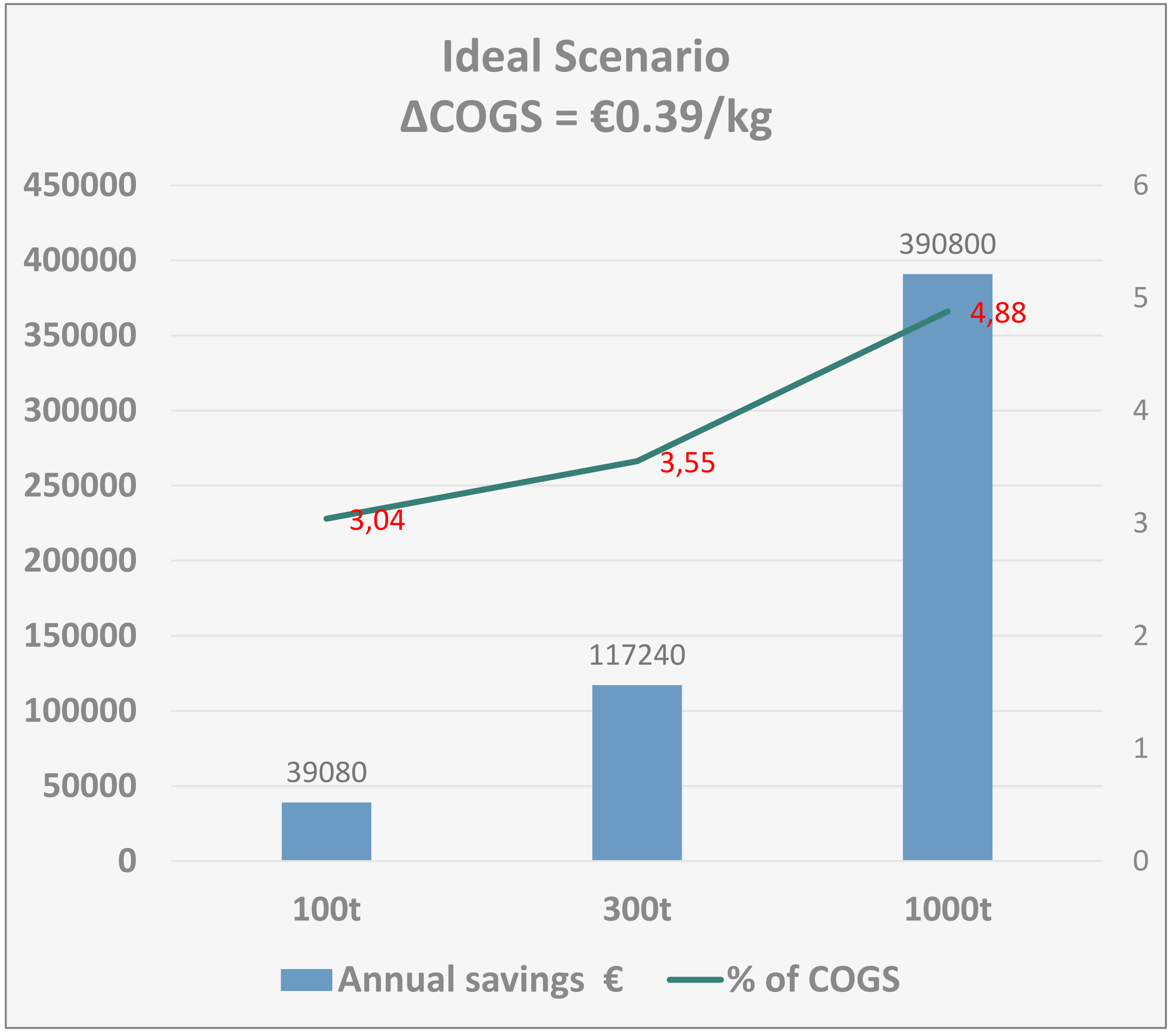


*Indicative (assumed) “less-than-linear” CAPEX due to shared infrastructure, more efficient system design etc.

Economic Lever A - Mineralization Impact

Source justification





Economic Lever B—Heat Impact (theoretical)

Prerequisites

- ✓ Source availability
- ✓ Accessibility potential
- ✓ Parameter compatibility
- ✓ Regulatory influence

Scenario	Tin>Tout (°C)	ΔT	Flow (L/s)	Availability	Usable heat (MWh/y)	Pumping (MWh/y)
S1 Warm Well	55>35	20	0.5	0.95	282.4	1.89
S2 Plant effluent	45>30	15	0.8	0.95	338.9	3.02
S4 Low temp, high flow	35>28	7	2.0	0.95	395.4	7.55
S5 High temp, low flow	65>40	25	0.3	0.95	211.8	1.13
S6 Seasonal	45>30	15	1.0	0.70	313.2	2.78
S7 Ideah high-capacity	75>35	40	2.5	0.98	2.913	9.74

*Scenarios based on geothermal resource locations

Risks & Guardrails

Mineralization

- Chemistry drift
- Trace contaminants
- QA SOPs

Heating

- Availability & stability
- Seasonal load matching
- Redundancy systems
- CAPEX

Regulatory

- Brine handling
- Resource coupling

Economics

- Cost mitigation
- Payback rate

Recommendations

Stabilize the platform

- Robust, economically viable RAS technology at scale

Quantify resource integration value

- Calculate economic potential and risks

Validate ESG and permits

- Evaluate sustainability / environmental impact

Anchor demand and finance

Contract the exposures

- Pursue term sheets from resource supply