Comparative Mining Performance Report

Truck–Shovel vs Dragline — Technical, Cost & ESG Integration

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Includes: KPIs, Cycle Analytics, Production, TCO, Carbon Pricing, Recommendation, Methodology.

This report consolidates the full analytical chain from physical configuration through to cost and carbon-adjusted decision support. All quantities normalized to LCM; currency in Euro unless otherwise stated.

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Executive Summary

Leader: Dragline. TS total cost: 0.6 €/m³ (carbon 0.054 €/m³) vs DL 0.38 €/m³ (carbon 0.016 €/m³). Annual production TS 4,120,658 m³ vs DL 4,120,658 m³. Carbon intensity TS 0.899 kg/m³ vs DL 0.262 kg/m³. Annual CO, TS 3,704.83 t vs DL 1,080.58 t.

Key drivers impacting competitiveness: (i) fleet balancing (MF), (ii) energy intensity, (iii) ownership structure, (iv) carbon tax sensitivity. The recommendation algorithm equally weights cost and carbon intensity but can be re-weighted to align with decarbonization goals.

KPI Dashboard Snapshots

Mining KPI Board

Truck–Shovel vs Dragline (Live)

UNIT COST INCL. CARBON (€/M^3 LCM)

Truck–Shovel **0.6**

Dragline **0.38**

ANNUAL PRODUCTION (M^3 LCM)

TS

DL

SYSTEM CONSTRAINT & MATCHING

Truck-bound

MF: 1.08

CARBON INTENSITY (KG CO_2 / M^3)

TS: 0.899

DL: 0.262

CARBON TAX (€/M^3)

TS: 0.054

DL: 0.016

OPEX SPLIT

Truck–Shovel

Energy 1,209,600€ (68.0%) · Lube 362,880€ (20.4%) · Maint 49,214.51€ (2.8%) · Break 50,000€ (2.8%) · Labour 108,000€ (6.1%)

Dragline

Energy 403,200€ (55.1%) · Lube 120,960€ (16.5%) · Maint 71,787.51€ (9.8%) · Break 100,000€ (13.7%) · Labour 36,000€ (4.9%)

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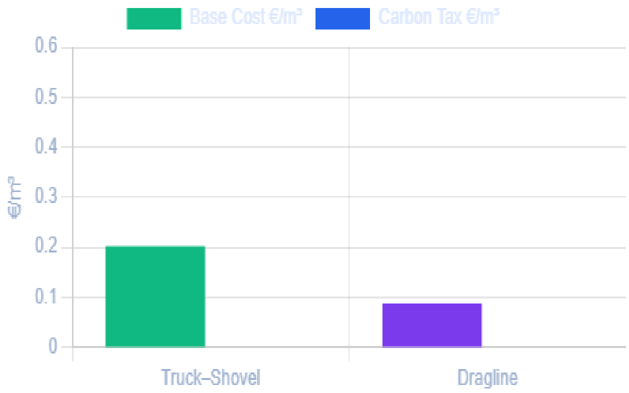
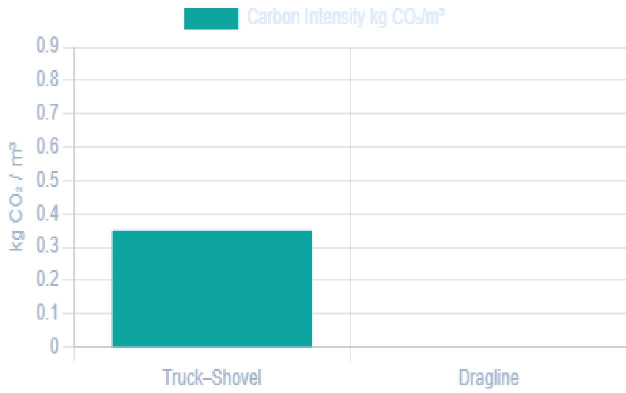
v3 Technical ESG Edition





Step 0 — Equipment Inputs

Parameter	Value
Shovels (units)	1
Shovel bucket (m^3 BCM)	5.4
Shovel cycle (s)	27
Trucks (units)	2
Truck body (m^3 BCM)	60
Truck payload (t)	—
Draglines (units)	1
Dragline bucket (m^3 BCM)	10.4
Dragline cycle (s)	52

Step 1 — Material, OEE & Calendar

Parameter	Value
D e n s i t y Á (t / m ^{3})	1.6
Swell Factor	1.2
Fill Factor	1.15
M factor TS	1.0
M factor DL	1.0
Availability A	0.9
Utilization U	0.8
Hours/shift	8
Shifts/day	3
Days/year	240
Stripping ratio (waste:ore)	7
Annual Hours	5,760

Step 2 — Cycle Analysis (Truck–Shovel)

Metric	Value
Passes	12
Load Time (s)	324.0

Metric	Value
Haul Time (s)	72.0
Dump Time (s)	52.0
Return Time (s)	48.0
Wait (s)	104.0
Total Cycle (s)	600.0
Matching Factor (MF)	1.08
Bottleneck	Truck-bound

Interpretation: High waiting or low MF indicates suboptimal truck allocation. Reducing haul distance or improving queuing can raise effective utilization.

Step 3 — Production Results (LCM)

Metric	Truck–Shovel	Dragline
m³/h	715.39	715.39
Monthly m³	343,388.16	343,388.16
Annual m³	4,120,657.92	4,120,657.92

Step 4 — Total Cost of Ownership

System	Ownership €/y	OPEX €/y	Total €/y
Truck–Shovel	452,027.98	1,779,694.51	2,231,722.49
Dragline	760,857.86	731,947.51	1,492,805.37

Ownership Detail

Component	Depreciation €/y	IIT €/y	Ownership €/y
Shovel	96,818.81	59,761.41	156,580.22
Trucks	74,626.87	73,097.01	295,447.76
Dragline	358,937.54	401,920.32	760,857.86

OPEX Component Shares (TS Aggregated)

Category	Value €/y (TS Total)
Energy	1,209,600
Lube	362,880
Maintenance	49,214.51
Breakdown	50,000
Labour	108,000

Step 5 — ESG & Carbon Integration

Metric	Truck–Shovel	Dragline
Fuel L/h	240	70
CO_2 kg/h	643.2	187.6
Annual CO_2 t	3,704.83	1,080.58
Carbon Intensity kg/m³	0.899	0.262

Metric	Truck–Shovel	Dragline
Carbon Tax €/m³	0.054	0.016
Total Cost €/m³ (incl carbon)	0.6	0.38

Carbon pricing magnifies efficiency differentials. Lower intensity systems gain proportionally larger benefit as carbon cost escalates.

Comparative Analysis & Recommendation

Indicator	Value
Cost Difference (TS - DL) €/m³	0.218
Carbon Intensity Difference (TS - DL) kg/m³	0.637
TS Composite Score	2.502
DL Composite Score	1
Preferred System	Dragline

Composite scoring normalizes cost and carbon against current minima. A score "H1 me

Sensitivity analysis: increasing carbon price raises relative weight of intensity implicitly even if explicit weighting unchanged.

Methodology & Formulae

The model synthesizes equipment productivity theory, deterministic cost allocation, and direct emissions pricing. It excludes stochastic delays, secondary support equipment, and multi-phase haul profiles. All OPEX intensity inputs are user-specified simplifying assumptions.

Key Equations:

1. Rate_shovel = (3600 / cycle_s)*Bucket_BCM*Fill*Swell*M*Units*A*U
2. Rate_truck = (3600 / T_cycle_truck_s)*Body_BCM*Fill*Swell*Units*A*U
3. System Rate = min(Rate_shovel, Rate_truck)
4. Depreciation = (Cost - Salvage)/Life
5. AYI = ((n+1)C + (n-1)S)/(2n); IIT = AYI * IIT%
6. OPEX = Energy + (Lube%·Energy) + (Maint%·Dep) + (Break%·Cost) + Labour
7. Unit Cost = Total Annual Cost / Annual LCM
8. CO, kg/h = Fuel_L/h * EF_kg/L ; Intensity kg/m³ = (CO, kg/h * Hours_y)/Annual LC
9. Carbon Tax €/m³ = (CO,_t_y * Price €/t) / Annual LCM
10. Score = 0.5*(Cost/MinCost)+0.5*(CI/MinCI)

Glossary

Term	Definition
LCM	Loose Cubic Meter (post-swell volume)
BCM	Bank Cubic Meter (in-situ volume)
Swell Factor	LCM / BCM expansion ratio
Fill Factor	Actual bucket fill vs nominal capacity
Availability (A)	Time fraction equipment is mechanically ready
Utilization (U)	Operational time / Available time
MF (Matching Factor)	(NT * t_load)/(Nsh * T_cycle) indicating loading balance
AYI	Average Yearly Investment (financial averaging for IIT calc)
IIT	Interest, Insurance & Taxes on average investment
OPEX	Operating Expenditure (variable + semi-variable)
Depreciation	Systematic cost allocation over asset life
Carbon Intensity	kg CO, per m³ LCM moved
Composite Score	Normalized cost + carbon performance metric

Appendix A — Raw Input Parameters

Element ID	Value
ts_nShov	1
ts_bucket	5.4
ts_cycle	27
ts_nTrucks	2
ts_truckVol	60
ts_truckPayload	
dl_units	1
dl_bucket	10.4
dl_cycle	52
mat_density	1.6
mat_swell	1.2
mat_fill	1.15
mat_M_ts	1.0
oee_A	0.9
oee_U	0.8
mat_M_dl	1.0
cal_hps	8
cal_spd	3
cal_dpy	240
econ_sr	7
ts_dist	0.2
ts_vh	10
ts_vr	15
ts_dump	52
ts_wait	104
ts_loadpos	0
ts_s_cost	700000
ts_s_life	7.23
ts_s_salv	0
ts_s_iit	15
ts_s_disc	10
ts_s_ops	3
ts_s_opw	600
ts_s_hlp	3
ts_s_hlw	400
ts_s_power	70
ts_s_ep	1
ts_s_lube	30
ts_s_maint	20
ts_s_break	2
ts_t_cost	900000

Element ID	Value
ts_t_life	12.06
ts_t_salv	0
ts_t_iit	15
ts_t_disc	10
ts_t_ops	3
ts_t_opw	600
ts_t_hlp	3
ts_t_hlw	400
ts_t_power	70
ts_t_ep	1
ts_t_lube	30
ts_t_maint	20
ts_t_break	2
dl_cost	5000000
dl_life	13.93
dl_salv	0
dl_iit	15
dl_disc	10
dl_ops	3
dl_opw	600
dl_hlp	3
dl_hlw	400
dl_power	70
dl_ep	1
dl_lube	30
dl_maint	20
dl_break	2
esg_ef_litre	2.68
esg_fuel_ts	240
esg_fuel_dl	70
esg_carbon_cost	60
fx_eur_inr	100
fx_show_inr	no

Appendix B — Assumptions & Limitations

1. Single haul profile; constant speeds. 2. No queuing theory simulation. 3. Energy inputs assume linear consumption with time. 4. Carbon emission factor constant (no biodiesel blends). 5. Labour treated as fully utilized; no shift efficiency degradation. 6. No tire, GET, or rebuild cycles explicitly modeled. 7. Currency inflation & escalation ignored beyond discount via CRF. 8. Carbon tax uniformly applied; no thresholds or free allocations.