

Strategic asymmetry in a contractor-mediated forest biomass supply chain: Evidence from Central Slovakia

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Electronic Supplementary Material (ESM)

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The tables report the organisation-level expert scores used in the weighted SWOT-TOWS analysis; weighted score = impact × importance; the permitted importance range was 1–3.

Table S1. Factor-level matrix for LESY SR

Category	Factor	Impact	Importance	Weighted score
Strength	biomass availability	5	3	15
Strength	stable and reliable supplies	5	2	10
Strength	transparent business relationships and direct contracts	2	2	4
Strength	diverse biomass portfolio	2	2	4
Strength	modern technology	3	3	9
Strength	SURE certificate validation	3	2	6
Strength	skilled workforce	2	2	4
Strength	strong infrastructure	5	2	10
Weakness	lack of own wood chippers	4	3	12
Weakness	limited expansion options	3	2	6
Weakness	absence of digitalisation and AI	1	1	1
Weakness	mismatch between production and demand	5	3	15
Weakness	dependence on customers	4	3	12
Opportunity	growing demand for renewable energy sources	5	3	15
Opportunity	cooperation with research institutions	1	1	1
Opportunity	subsidy programmes	3	3	9
Opportunity	new technological solutions in logistics and transport	2	2	4
Opportunity	long-term contracts	3	2	6
Threat	price fluctuations in the market	5	2	10
Threat	delivery delays due to weather conditions	4	3	12
Threat	decrease in demand outside the heating season	5	3	15
Threat	competition with private suppliers	4	2	8
Threat	legislative restrictions	2	1	2
Threat	degradation of forest-biomass quality during storage	2	2	4
Threat	high storage and transport costs	5	3	15
Threat	seasonality of demand and need for storage	5	3	15
Threat	market stagnation during mild winters	5	3	15

Totals: $S = 62$; $W = 46$; $O = 35$; $T = 96$

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Table S2. Factor-level matrix for WorldWood

Category	Factor	Impact	Importance	Weighted score
Strength	complete technological chain	4	3	12
Strength	own extensive machinery and vehicle fleet	4	3	12
Strength	long-term presence on the market	3	3	9
Strength	stable and repeatedly concluded contracts with LESY SR	5	3	15
Strength	professional and qualified staff	4	3	12
Strength	ability to supply quality wood chips	4	3	12
Strength	high logistics flexibility through own transport	4	3	12
Strength	automated internal processes and digital technologies	5	2	10
Strength	certification	4	2	8
Weakness	high dependence on energy consumers	4	2	8
Weakness	low share of deliveries to MHTH Zvolen	2	2	4
Weakness	limited biomass storage capacity	3	3	9
Weakness	labour shortage	4	3	12
Weakness	problems processing some biomass types	3	2	6
Weakness	sensitivity to customers' payment discipline	3	2	6
Opportunity	growth of the renewable-energy market	5	3	15
Opportunity	entering new markets and diversifying customers	5	3	15
Opportunity	digitalisation and AI in logistics and harvesting planning	4	3	12
Opportunity	investment in more energy-efficient technology	3	3	9
Opportunity	cooperation with research institutions	4	3	12
Opportunity	changes in depreciation and investment legislation	4	2	8
Threat	instability of forest-biomass prices	4	2	8
Threat	low purchase prices and public tenders for heating plants	4	3	12
Threat	growth in input costs	5	3	15
Threat	legislative instability and administrative burden	4	3	12
Threat	seasonality and adverse climatic conditions	3	2	6
Threat	competition from other contractors	3	3	9
Threat	long-term risks associated with a changing energy mix	3	2	6

Totals: $S = 102$; $W = 45$; $O = 71$; $T = 68$

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Table S3. Factor-level matrix for MHTH Zvolen

Category	Factor	Impact	Importance	Weighted score
Strength	diversified supplies	5	3	15
Strength	supply stability and long-term experience	5	3	15
Strength	use of local forest biomass	3	2	6
Strength	technological readiness	4	3	12
Strength	emission-control technologies	5	3	15
Strength	forest biomass from SURE-certified suppliers	5	3	15
Strength	collaboration with multiple suppliers	5	3	15
Strength	compliant legislation and supported environmental goals	4	2	8
Weakness	technological limitations of boilers	4	2	8
Weakness	risk of limited raw-material availability	5	3	15
Weakness	fluctuations in biomass quality and availability	5	3	15
Weakness	potentially higher transport and processing costs	5	3	15
Weakness	regulatory and legislative challenges	4	3	12
Opportunity	growing market demand for renewable energy	4	2	8
Opportunity	support for renewable energy sources	4	2	8
Opportunity	switching to pellets	1	1	1
Opportunity	new biomass-processing and storage technologies	3	1	3
Threat	instability of biomass prices and availability	5	3	15
Threat	increasing competition in the renewable-energy market	4	2	8
Threat	regulatory pressure and legislative change	5	3	15
Threat	problems with raw-material quality	4	2	8

Totals: $S = 101$; $W = 65$; $O = 20$; $T = 46$

Table S4. Sensitivity of the WorldWood external coordinate to the corrected importance weight

Importance assigned to technology-investment item	Opportunity total	Threat total	$y = O - T$	Interpretation
1	65	68	-3	ST
2	68	68	0	boundary
3 (primary analysis)	71	68	3	SO
4 (recorded but invalid)	74	68	6	outside declared scale; not used

O – opportunity; T – threat; SO – strength-opportunity; ST – strength-threat; the internal coordinate remained $x = 57$ in all scenarios