VSB TUO | CEET | ENERGY RESEARCH CENTRE

LCA of Solid Recovered Fuels Production: Environmental Trade-Offs of Pelletisation and Biomass Addition

David Kupka

International energy and environment conference

7-9 September 2026, Hotel Sepetna, Ostravice, Czech Republic

Energy utilization of SRF

Solid recovered fuel

- **Alternative fuel** processed from non-hazardous **non-recyclable** municipal, commercial, and industrial **waste**
- **Highly refined** – high calorific value, low moisture content, low chlorine levels
- Meets strict **quality standards**

- Utilization
  - Direct combustion systems
    - Cement kilns
    - Industrial boilers
    - CHP facilities
  - Advanced thermochemical systems
    - **Gasification facilities**
    - Pyrolysis plants

Goal and scope definition

Goal

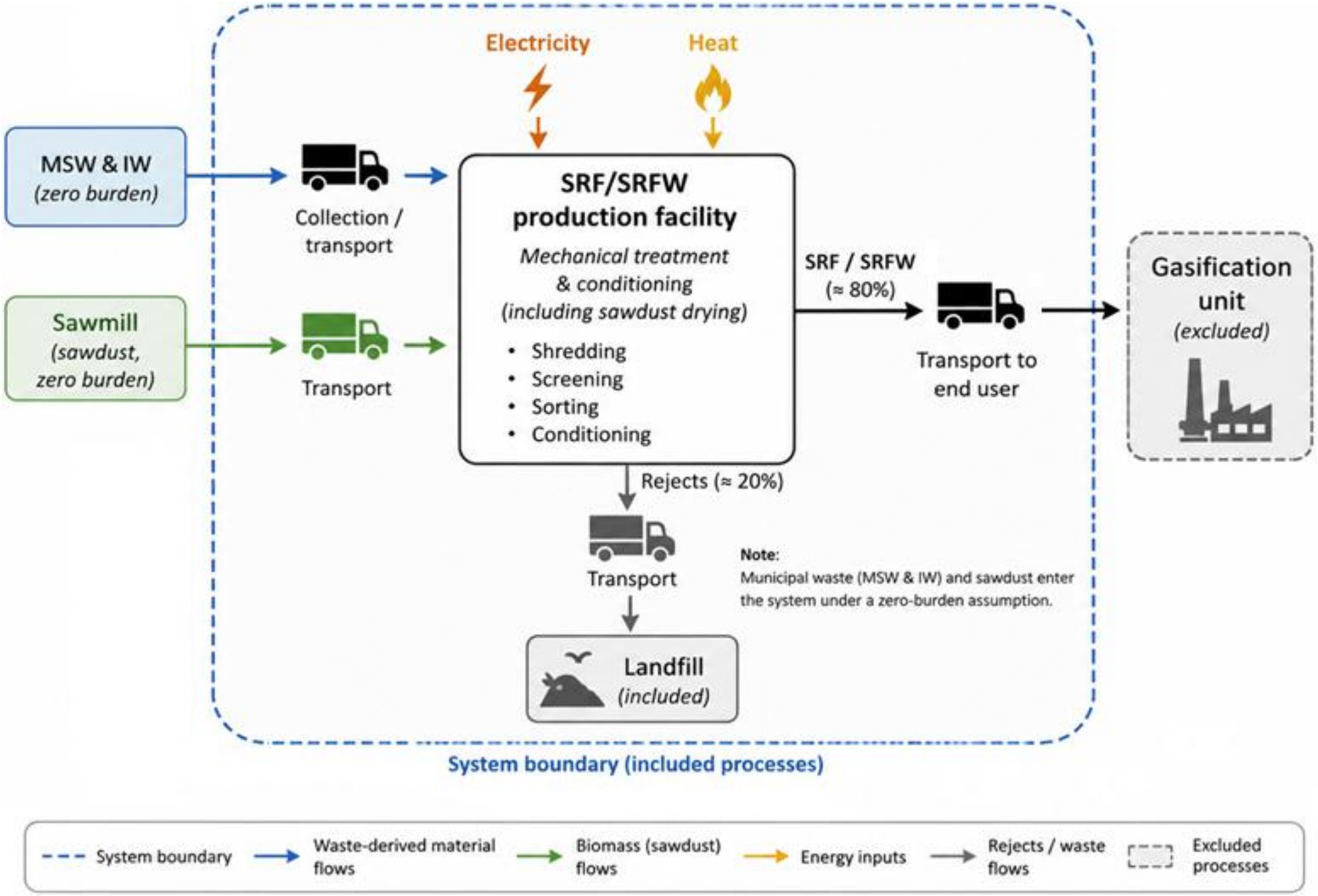
- Compare envrionmental profiles of SRF and biomass-enriched SRF through LCA methodology.

Functional unit

- 1 GWh of energy content based on the net calorific value (NCV).

System boundary

- Gate-to-gate approach (single process stage).



Scenarios

A: SRF fluff

BASE CASE:

Mechanical treatment only

B: SRF pellets

+ Densification

C: SRFW fluff

+ Sawdust drying

+ Mixing with SRF

(50% biomass content)

D: SRFW pellets

+ Sawdust drying

+ mixing with SRF

(50% biomass content)

+ Densification

LCI (materials, energy)

Scenario Product	A SRF fluff	B SRF pellets	C SRFW fluff	D SRFW pellets
Waste mech. treatment [kWh/t]	75	75	75	75
Sawdust conditioning [kWh/t]	-	-	15	15
Sawdust conditioning [GJ/t]	-	-	2.7	2.7
Mixing and homogen. [kWh/t]	-	-	15	15
Pelletization [kWh/t]	-	90	-	123

Electricity – sourced from Czech mix 2022

Heat – produced in industrial gas boiler

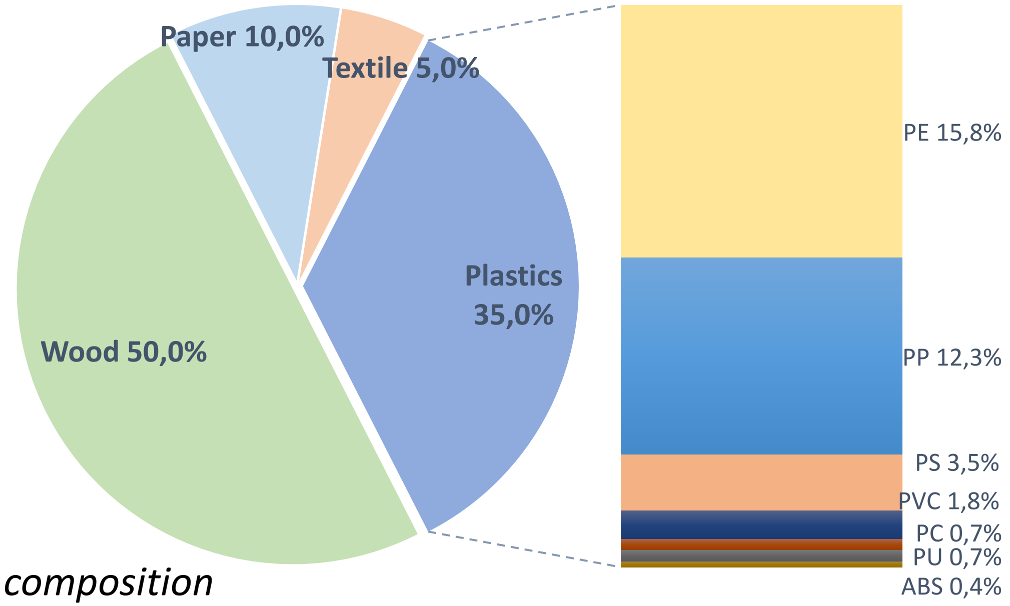
Direct emissions from SRF/SRFW production not assumed.

Capital goods included: SRF facility + pellet factory

Zero burden approach = feedstock with no upstream impacts

sawdust (wet, 50% moisture content)

non-recyclable MW & IW (80% SFR yield ratio)



SRFW composition

LCI (transport)

Transport	Mean	Distance [km]
Waste to SRF facility	Dump truck	30
Sawdust (wet) to SRF facility	Truck 16-32 t	30
Rejects to landfill	Truck 16-32 t	30
Product to end user	Truck >32 t	200

Fluff
Volume limited
(90 m^3 truck capacity)

Pellets
Weight limited
(24 t legal capacity)

Transport was modelled using **EURO 6**-compliant heavy-duty freight vehicles.

Internal vehicle operations were **not assumed**.

Scenario / **Product**	**A** SRF fluff	**B** SRF pellets	**C** SRFW fluff	**D** SRFW pellets
Bulk density [kg/m^3]	160	650	150	540
LHV [MJ/kg]	23.8	23.8	19.9	19.9
Energy density [kWh/m^3]	1060	4300	830	2990
Total mass per FU [t]	151.1	151.1	180.6	180.6
Total volume per FU [m^3]	945	233	1206	335
Total energy per FU [GWh]	**1**	**1**	**1**	**1**

Scenario / **Product**	**A** SRF fluff	**B** SRF pellets	**C** SRFW fluff	**D** SRFW pellets
Number of trips per FU	11	7	14	8
Effective payload [t]	13.74	21.59	12.90	22.58
Vehicle distance [km]	2200	1400	2800	1600
Transport service [tkm]*	**35 112**	**22 344**	**44 688**	**25 563**

**Avg. payload for selected ecoinvent dataset = 15.96 t*

Life cycle impact assessment

EF3.1 method
(all 16 impact categories included)

Ecoinvent database 3.10

Climate change

Air pollution

Ozone depletion

Water and ocean pollution

Biodiversity loss

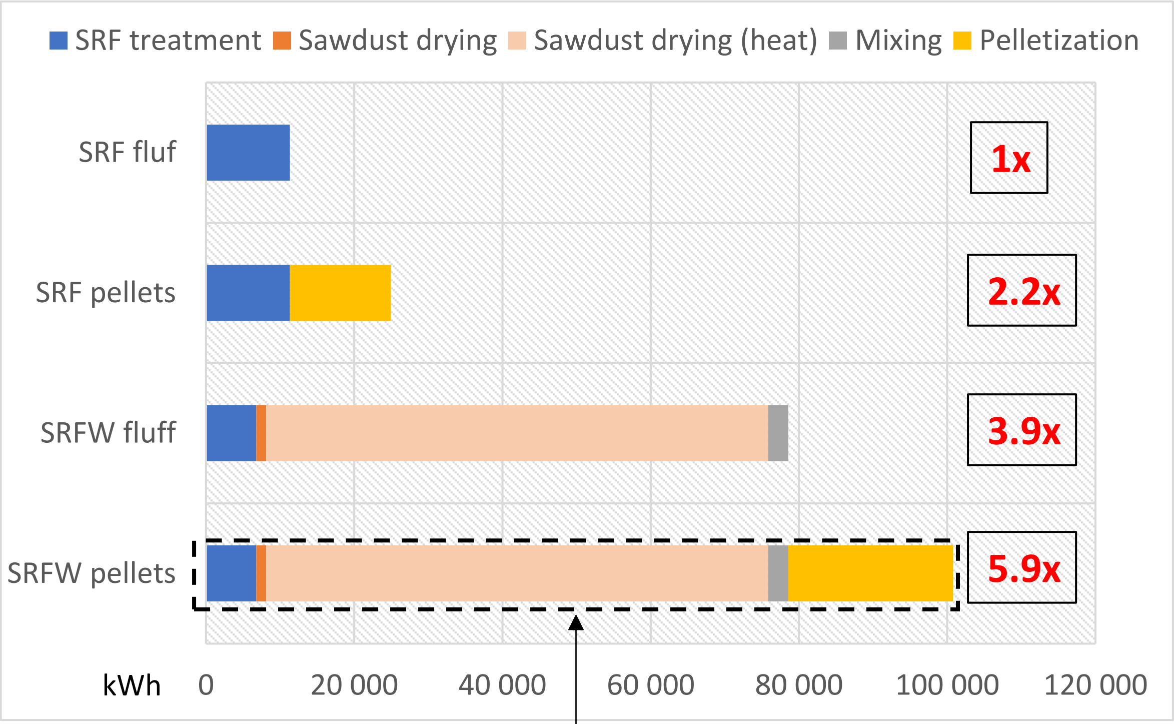
Land degradation

Overexploitation of natural resources

Chemical contamination and toxic substances

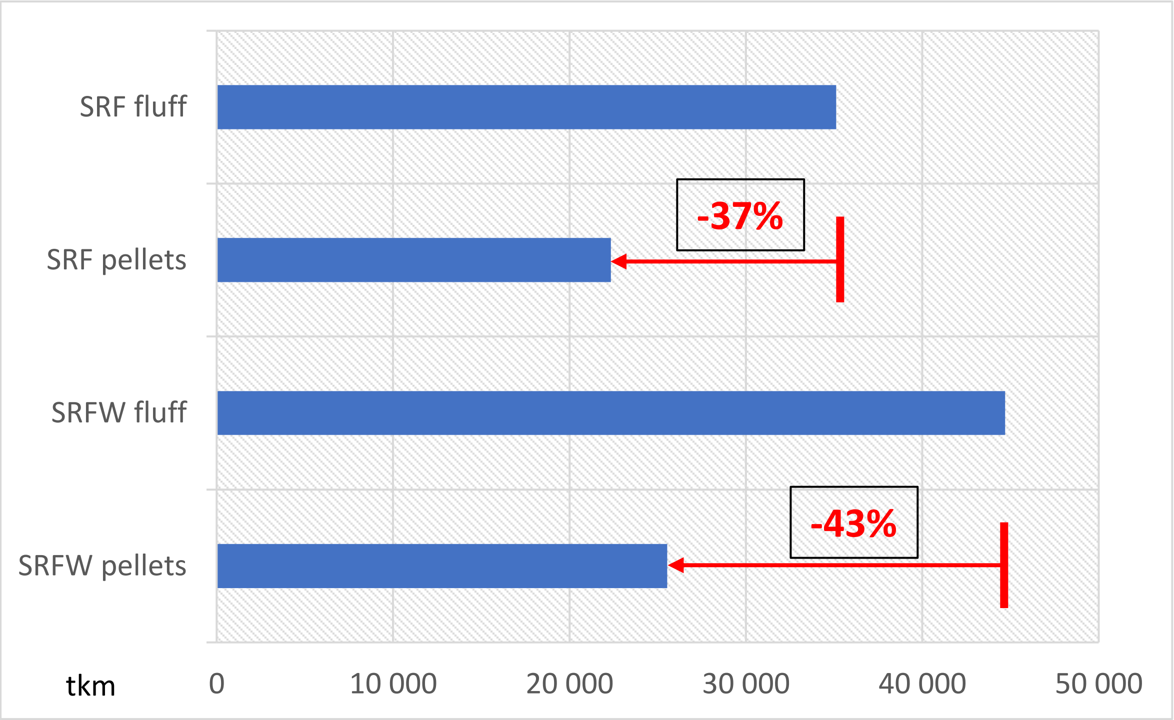
Results and interpretation

Energy requirements for SRF production (per FU)



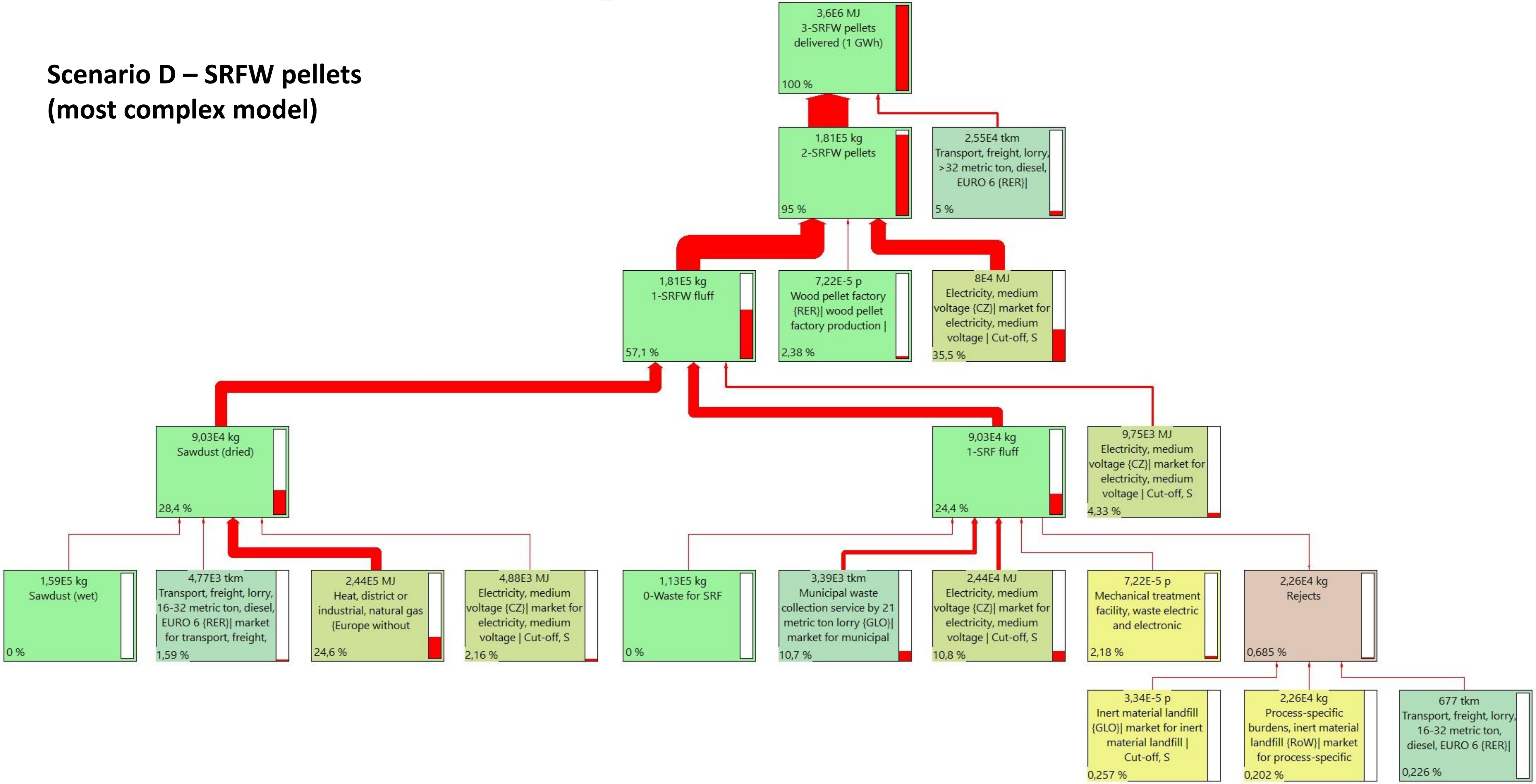
Equal to 10% of energy content

SRF transport requirements (per FU)



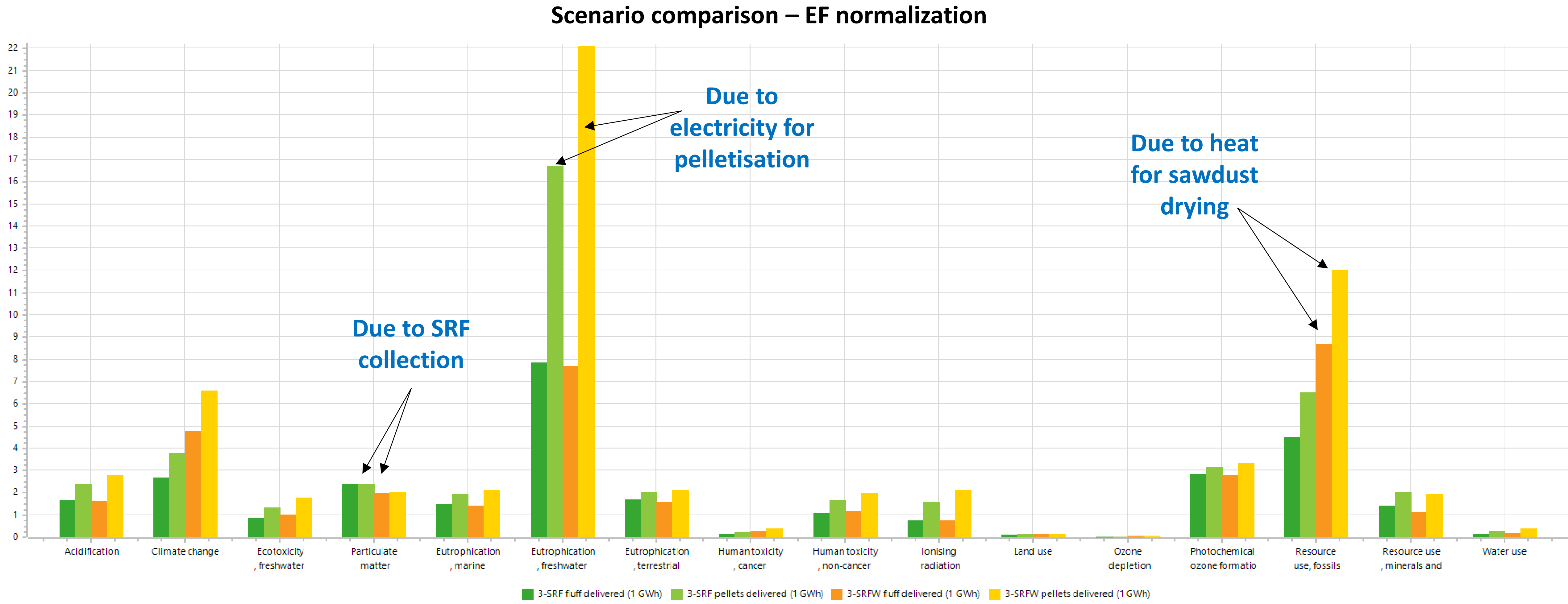
Results and interpretation

Scenario D – SRFW pellets (most complex model)

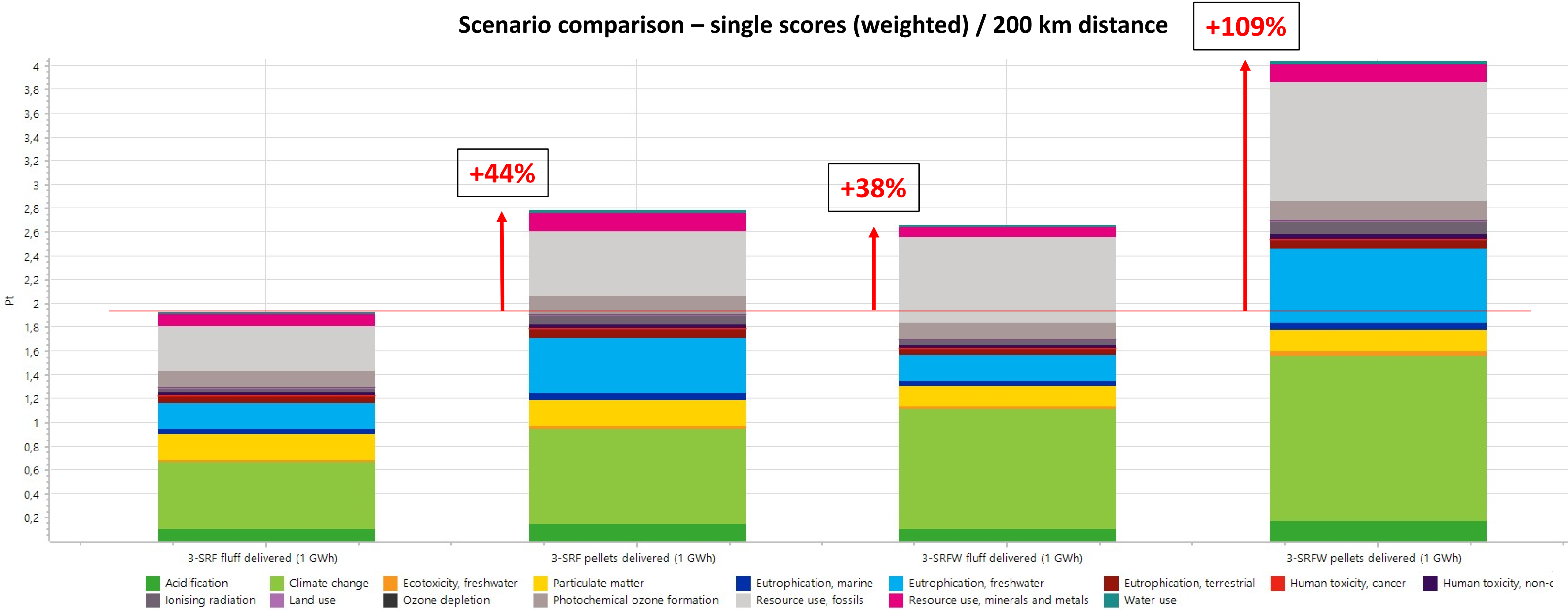


VSB TUO | CEET | ENERGY RESEARCH CENTRE

Results and interpretation

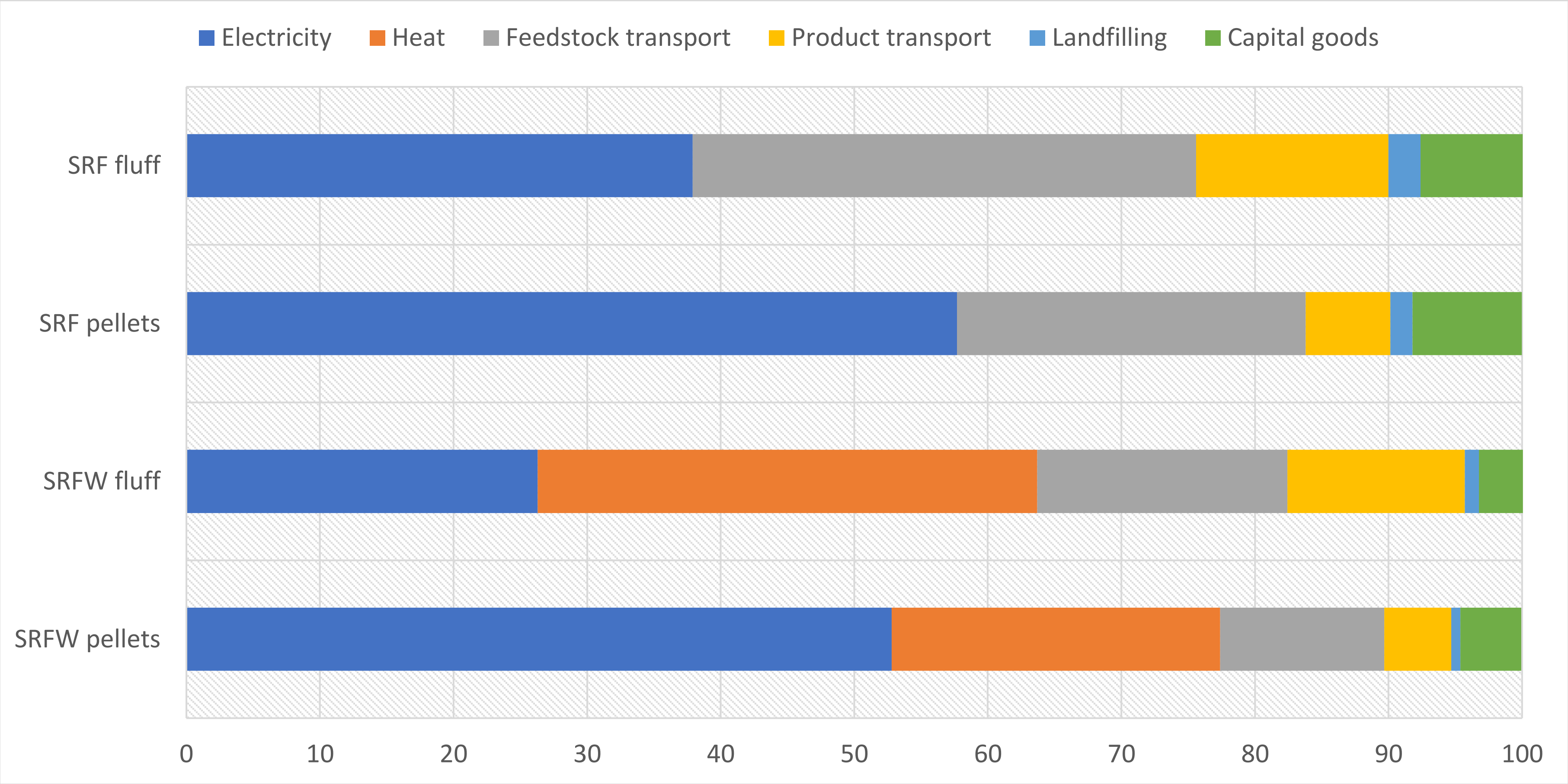


Results and interpretation



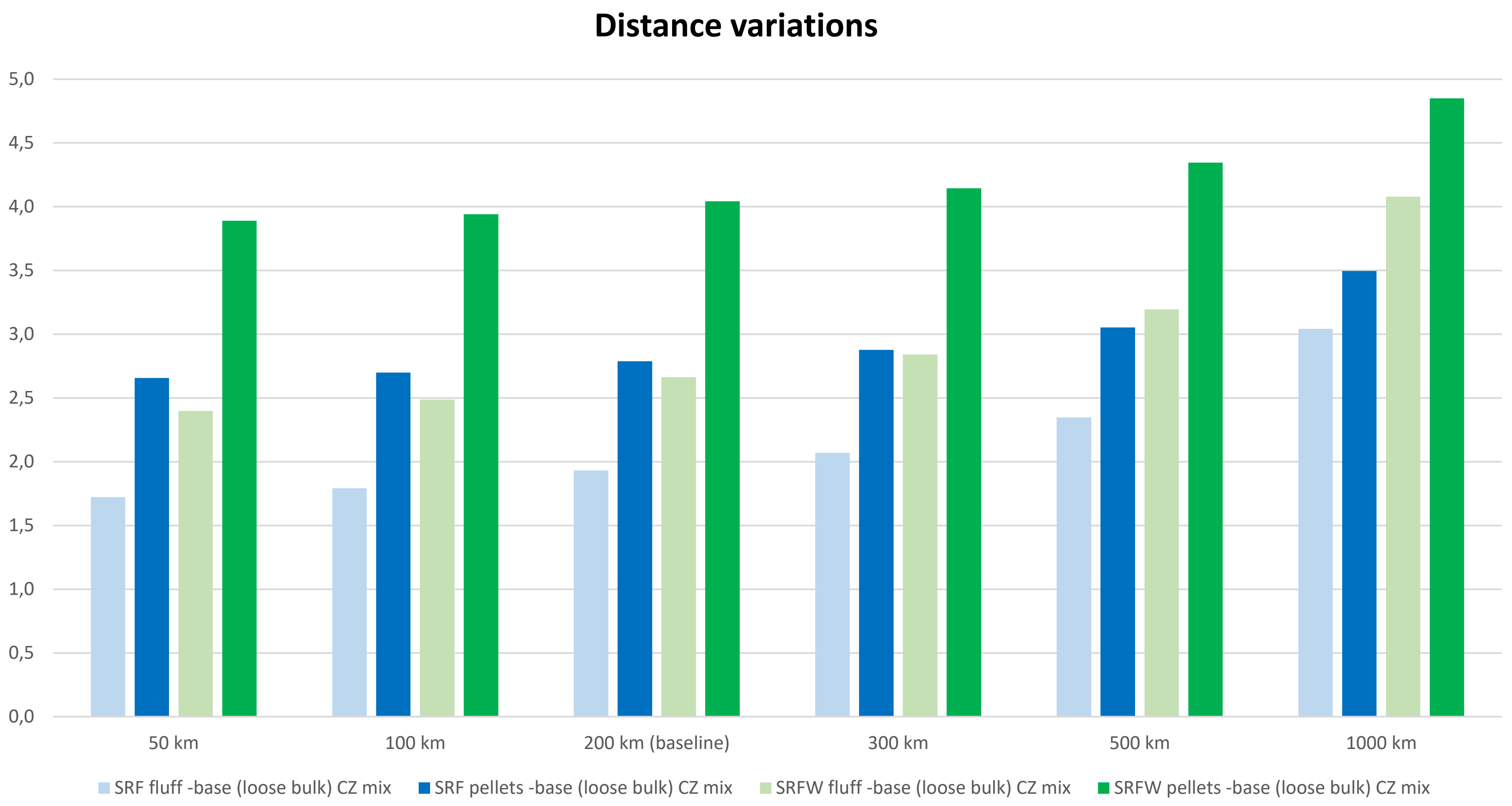
Results and interpretation

Process contributions to overall impacts (weighted) / 200 km distance

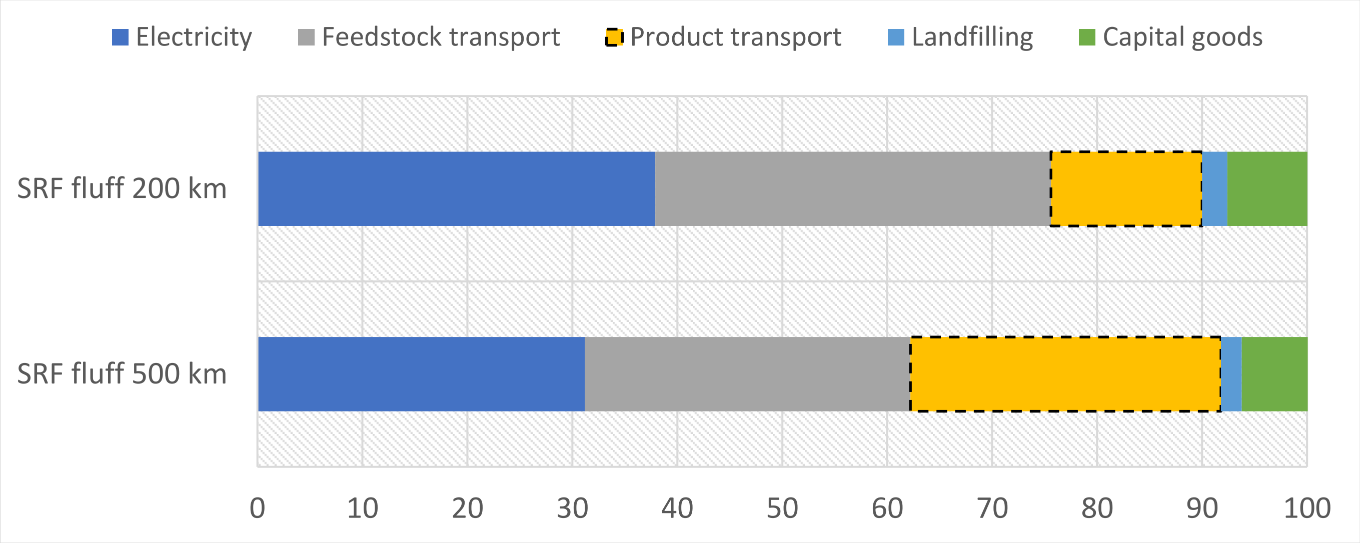


Overall impacts associated with the SRF/SRFW production process: 46–82%

Results and interpretation

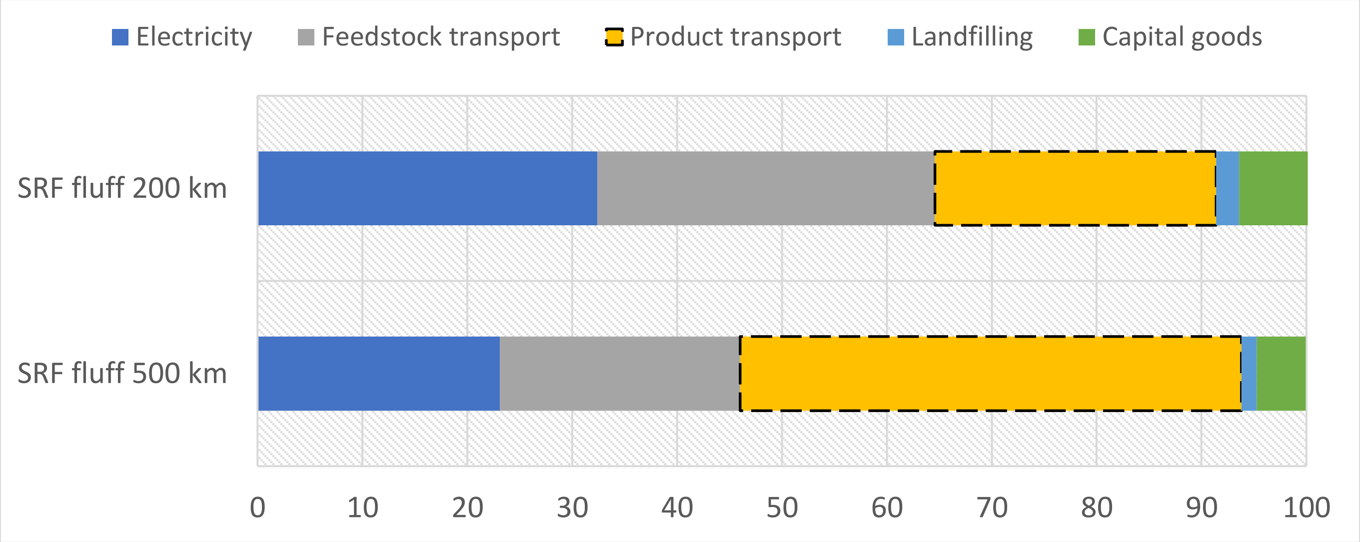


Results and interpretation



Contribution increased from 14 to 30%.

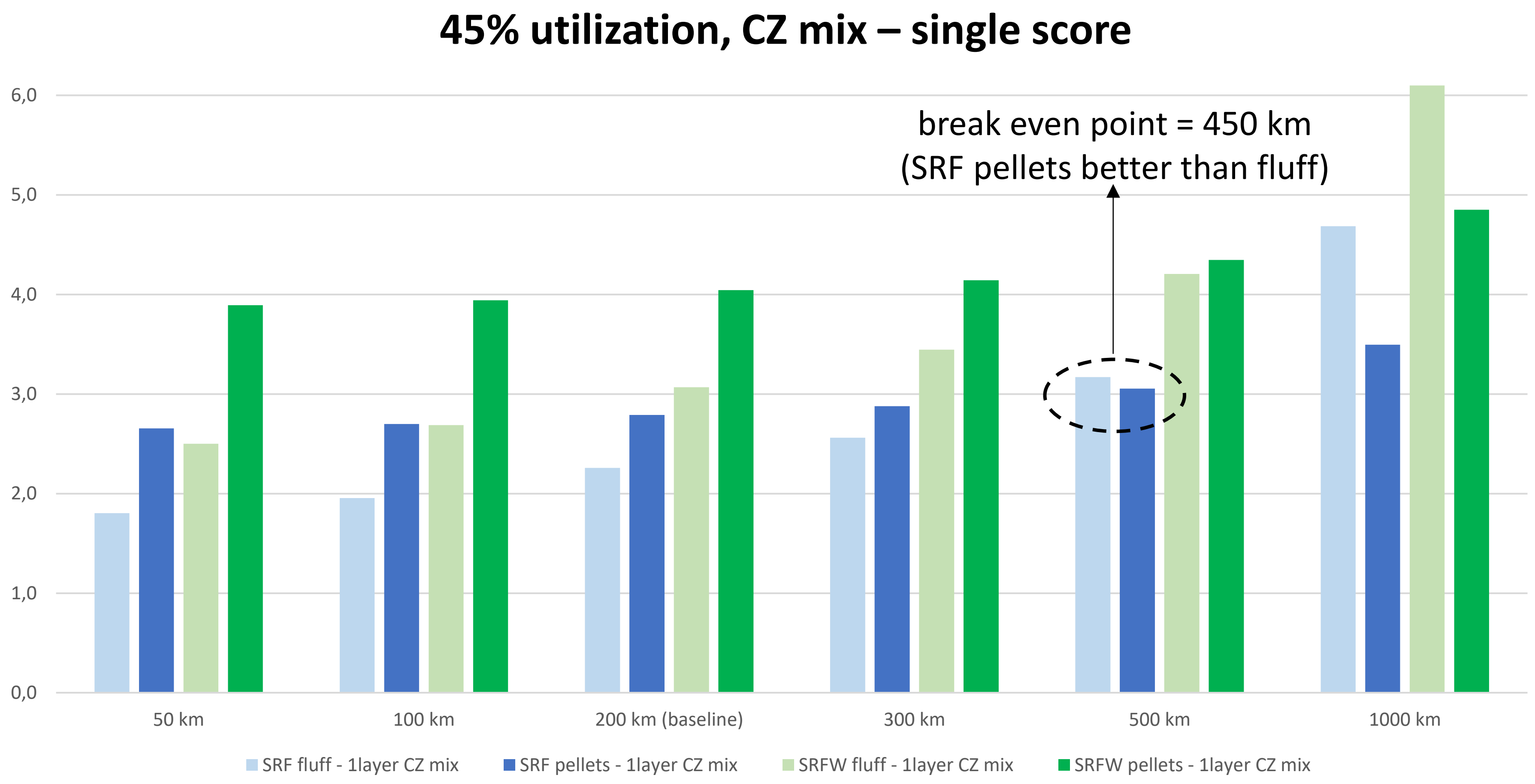
100% volume utilization (loose bulk)



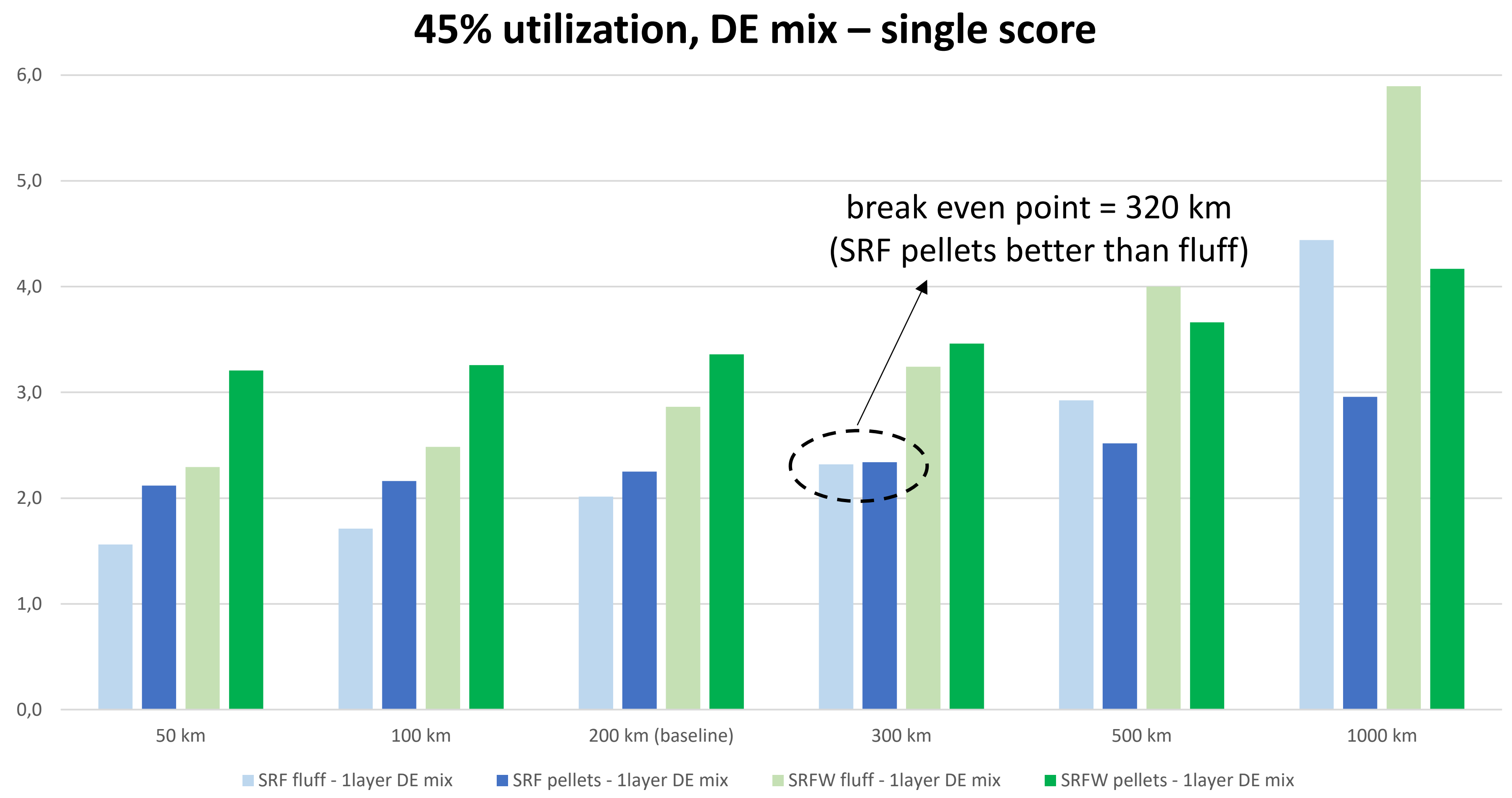
Contribution increased from 27 to 48%.

45% volume utilization (big bags in one layer)

Results and interpretation



Results and interpretation



Coclusions

- **Electricity** consumption is the **dominant environmental hotspot** across all scenarios, whereas transport of the final SRF/SRFW product contributes less than 15% of the total impacts. Notably, **waste collection** has a greater environmental impact than transport of the final product.
- Although pelletization improves transport efficiency by increasing bulk density, its additional **electricity demand outweighs the transport savings** under the baseline assumptions (100% trailer volume utilization and Czech electricity mix) until transport distances exceed approximately 1000 km.
- The break-even transport distance decreases when a **lower-impact electricity mix** is assumed and when **lower trailer volume utilization** is considered for loose SRF/SRFW.
- The environmental viability of pelletization is highly site-specific and depends on the electricity mix, pelletization energy demand, and transport logistics.

Thank you for your attention

David Kupka
david.kupka@vsb.cz

www.vsb.cz
ceet.vsb.cz/vec/en