



P-REX

Life Cycle Cost

Anders Nättorp, Kirsten Remmen, FHNW
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PHOSPHORUS RECYCLING
FROM PROTOTYPE TO MARKET



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University of Applied Sciences and Arts
Northwestern Switzerland

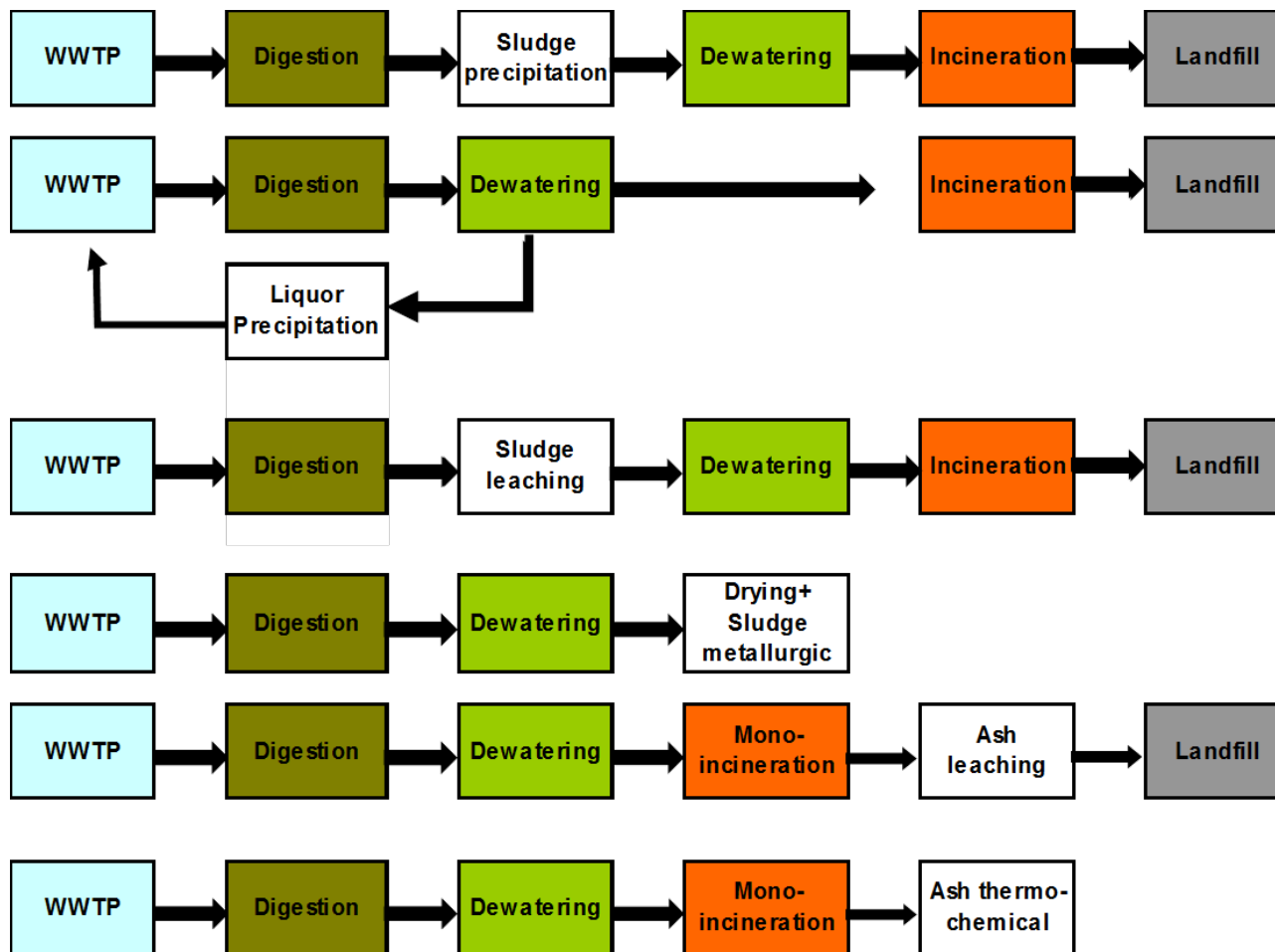
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- Financial aspects considered from the customer/operator viewpoint
- Data on processes from P-REX WA1 and WA2
 - Operational data and simulations
 - Equipment based on offers for Germany
 - Concentration of ash from municipal sludge, no mixed ash
- Only phosphorus material sales with guaranteed offtake included in the calculation (Pearl, Ecophos)
- Harmonized specific costs (personnel, chemicals,...)
- Comparison to status quo yields transition cost
- System
 - CAPEX+OPEX
 - Treatment trains from WWTP to landfill/agriculture

Technology	Pathways	Elimination	Plant	Scale
Airprex™	Sludge precipitation	EBPR	Mgladbach (GER)	Commercial product
Pearl®	Liquor precipitation 1	EBPR	Slough (GB)	Commercial product
Struvia™	Liquor precipitation 2	EBPR	Brussels (BE)	Pilot
Gifhorn	Sludge leaching 1	EBPR	Gifhorn (GER)	Long-term test production
Stuttgart	Sludge leaching 2	ChemP	Offenburg (GER)	Pilot
Mephrec ¹ integrated	Sludge metallurgic (integrated in MSWI)	ChemP	Freiberg (DE)	Pilot/Simulation
Leachphos	Ash leaching 1	ChemP	Berne (CH)	Test production
Ecophos	Ash leaching 2	ChemP	Louvain-la-Neuve (BE)	Commercial product from rock, Pilot with ash
Ashdec ² integrated	Ash thermo-chemical (integrated in mono-inc.)	ChemP	Leoben (AU)	Test production

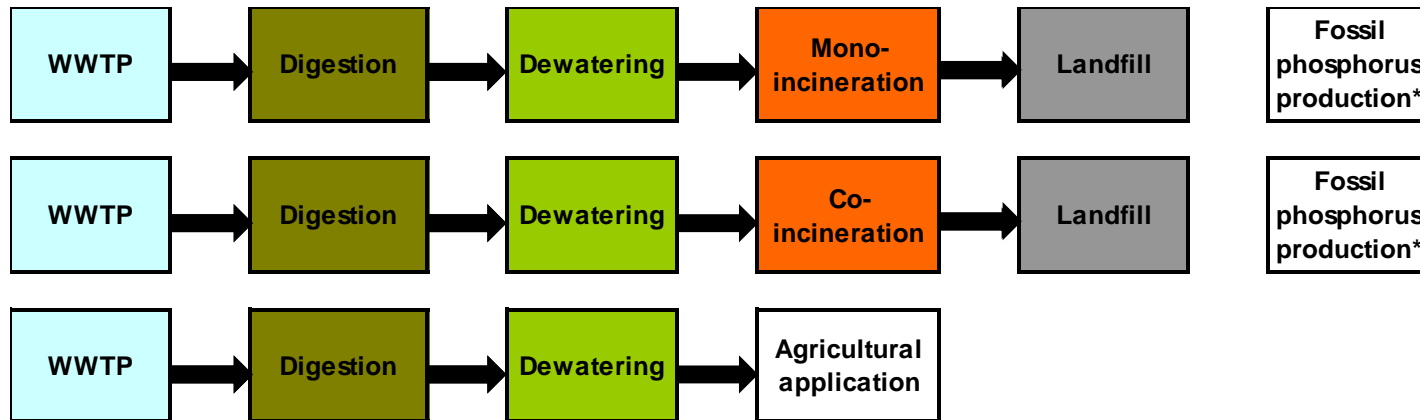
¹ incl. drying of dewatered sludge to 85% dry matter, cost for gas cleaning and electricity turbine included

- Treatment trains with 9 recovery processes in 6 groups



Similar to Zürich case study of Lüscher and Nättorp (2009)

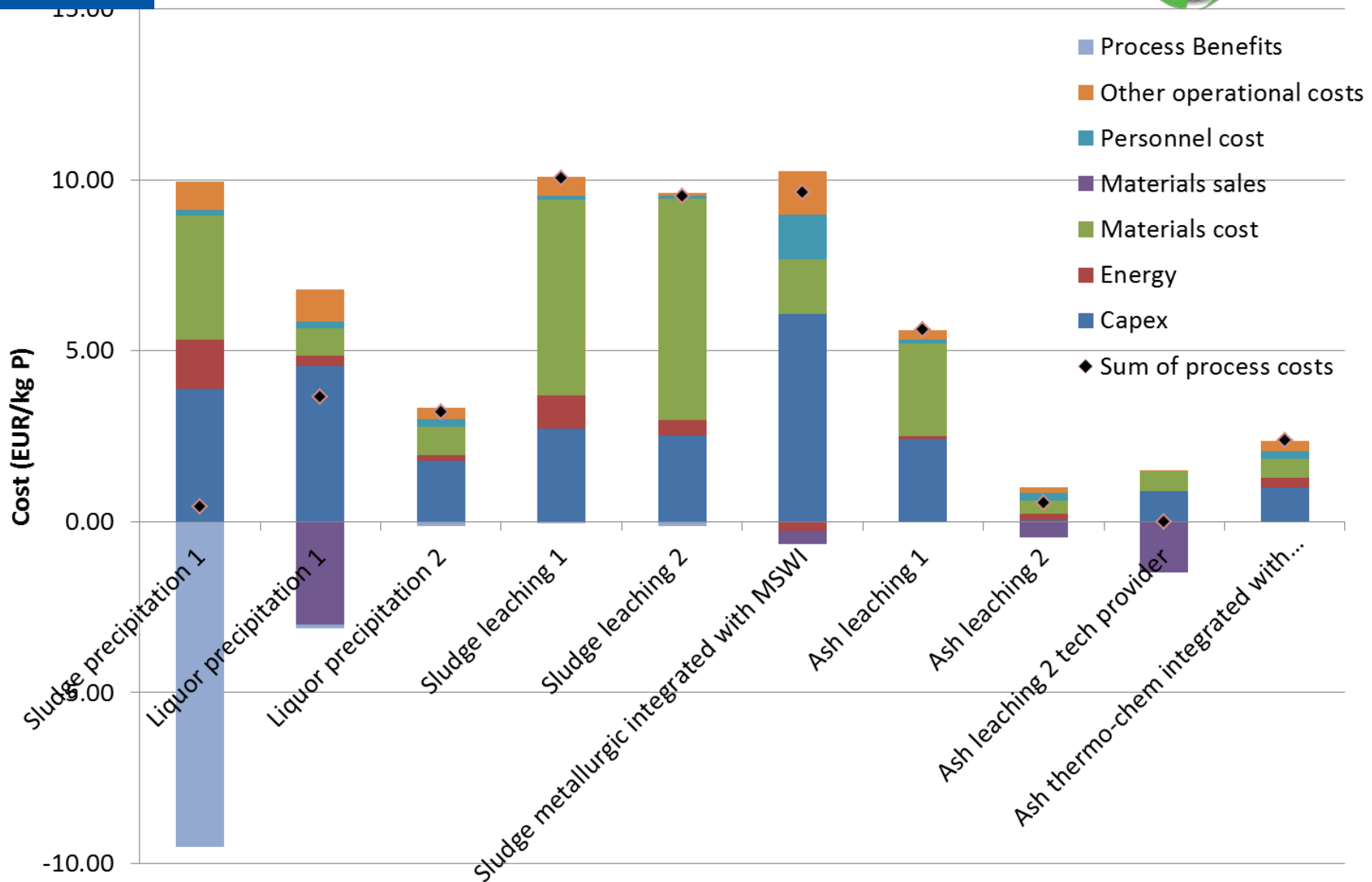
- 3 reference treatment trains



Similar to Zürich case study of Lüscher and Nättorp (2009)
 *included in the LCA

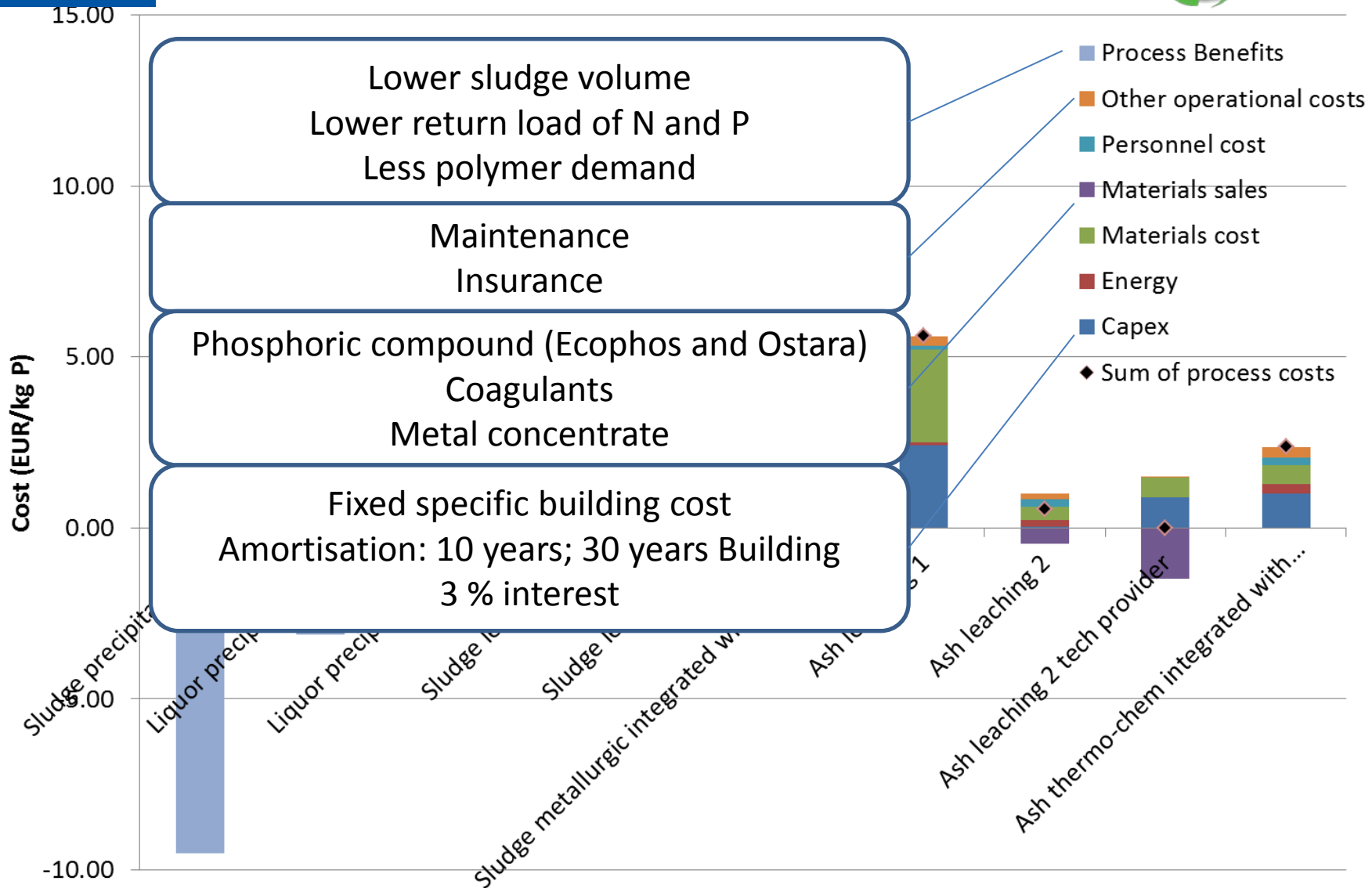


Process cost composition



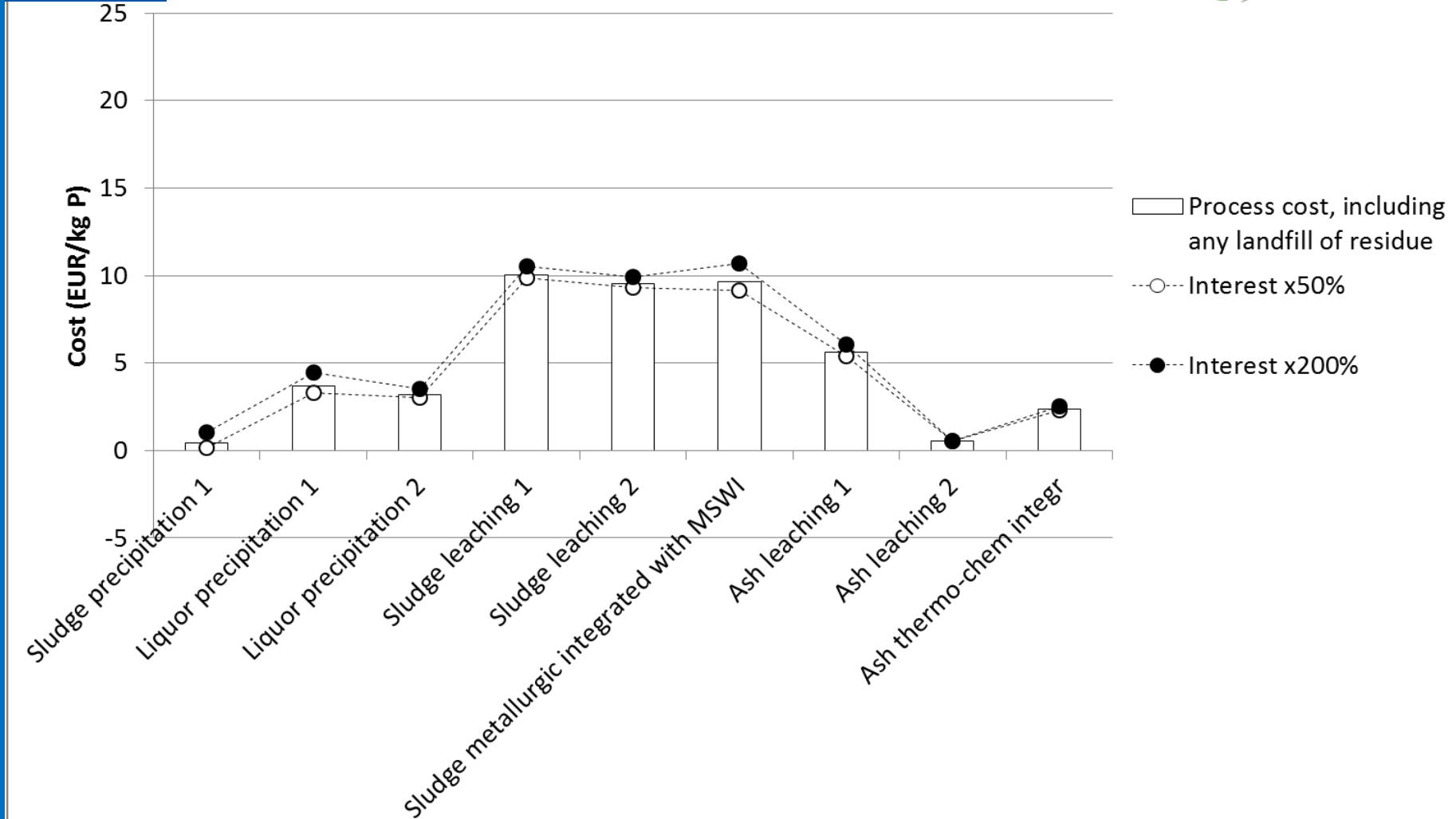


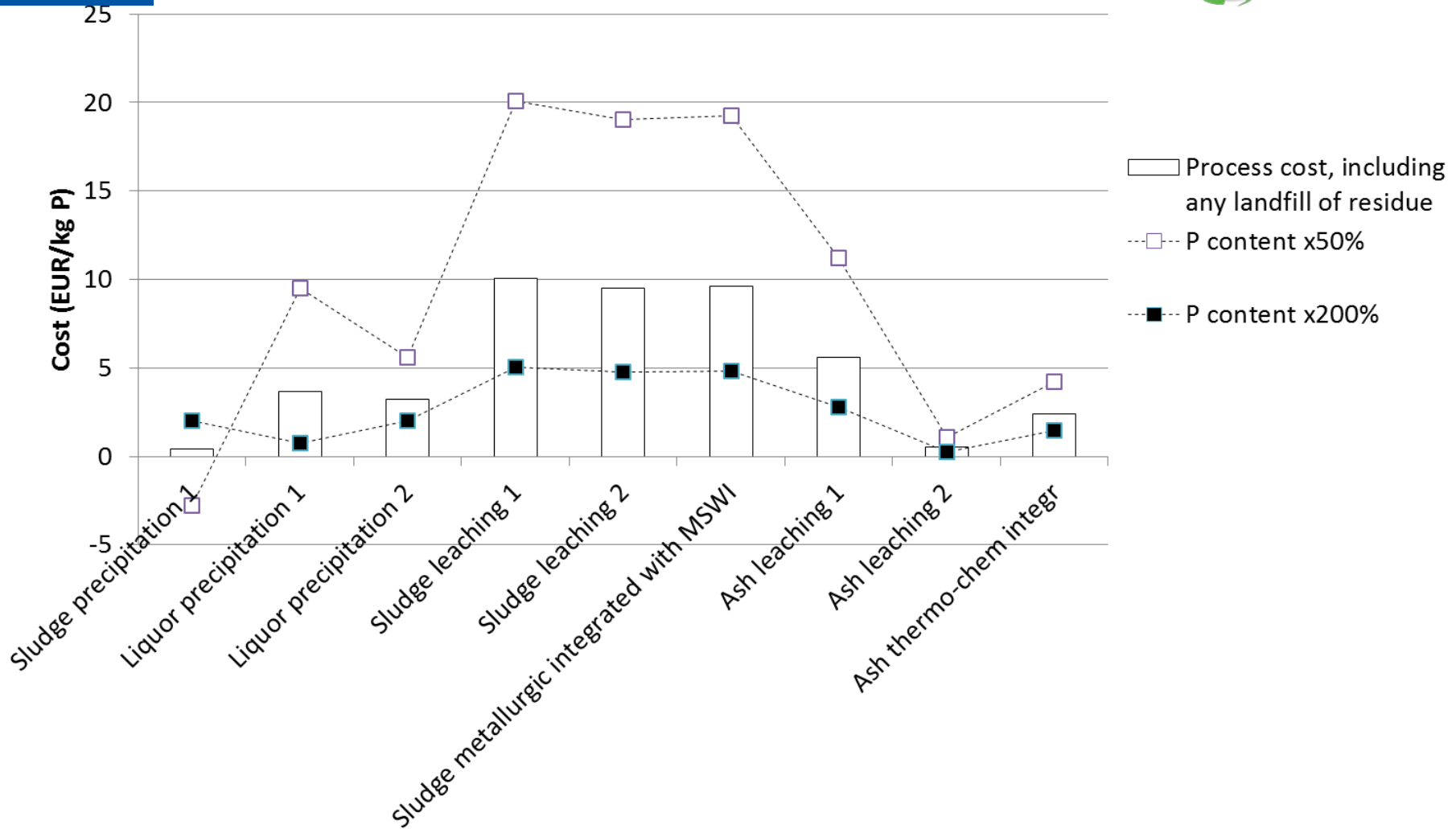
Process cost composition





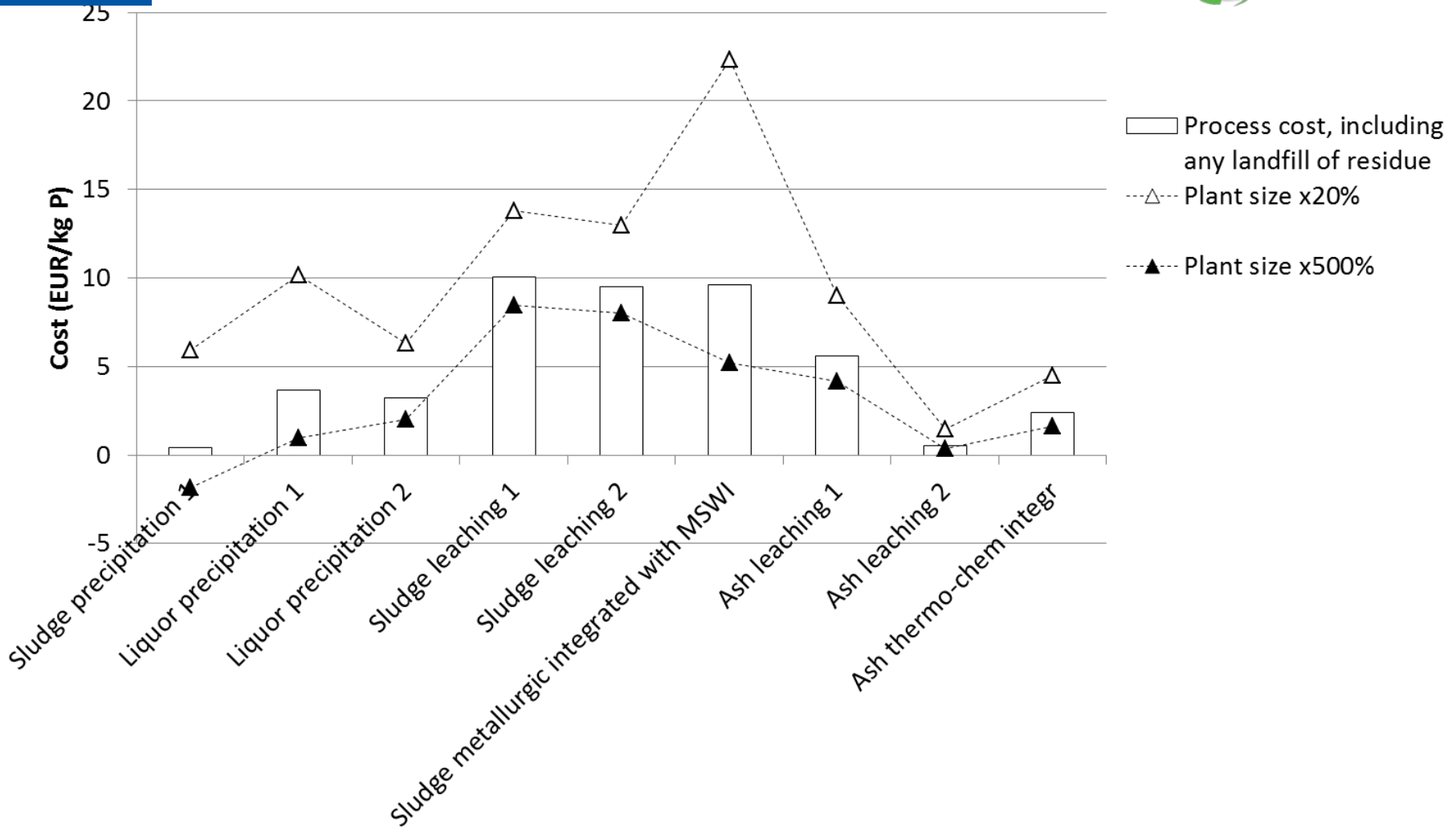
Sensitivity interest rate





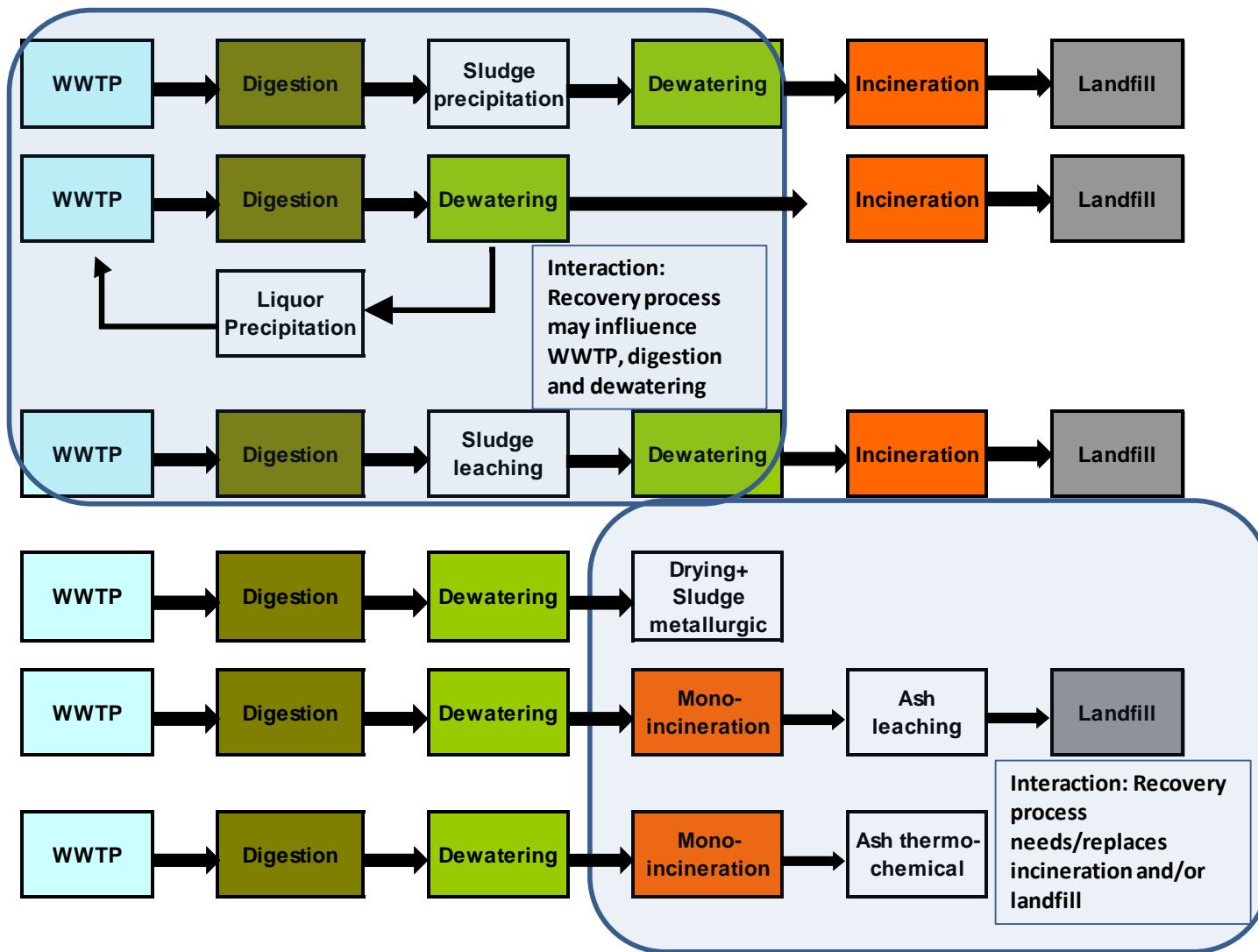


Sensitivity plant size



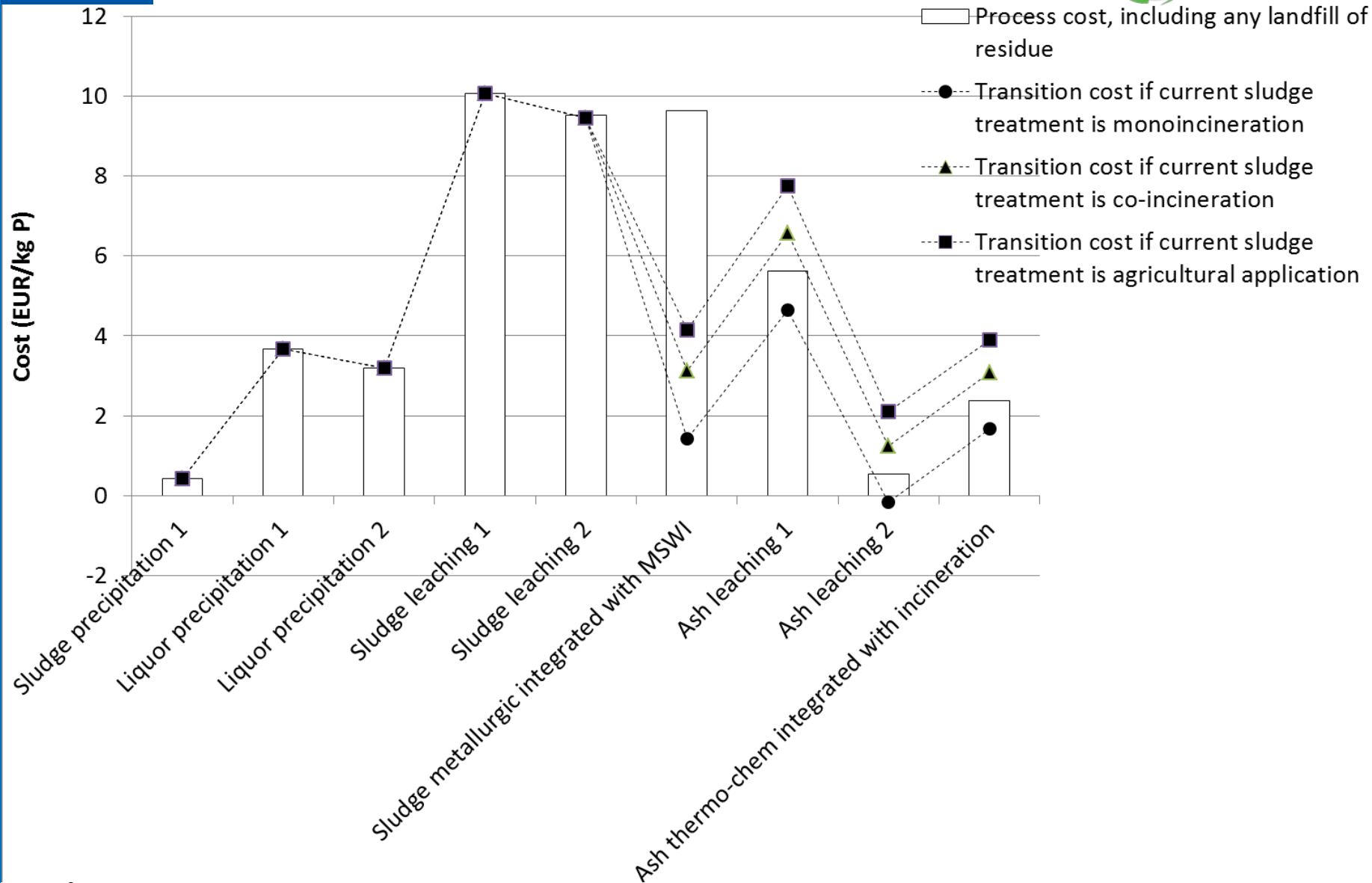


Calculating transition costs



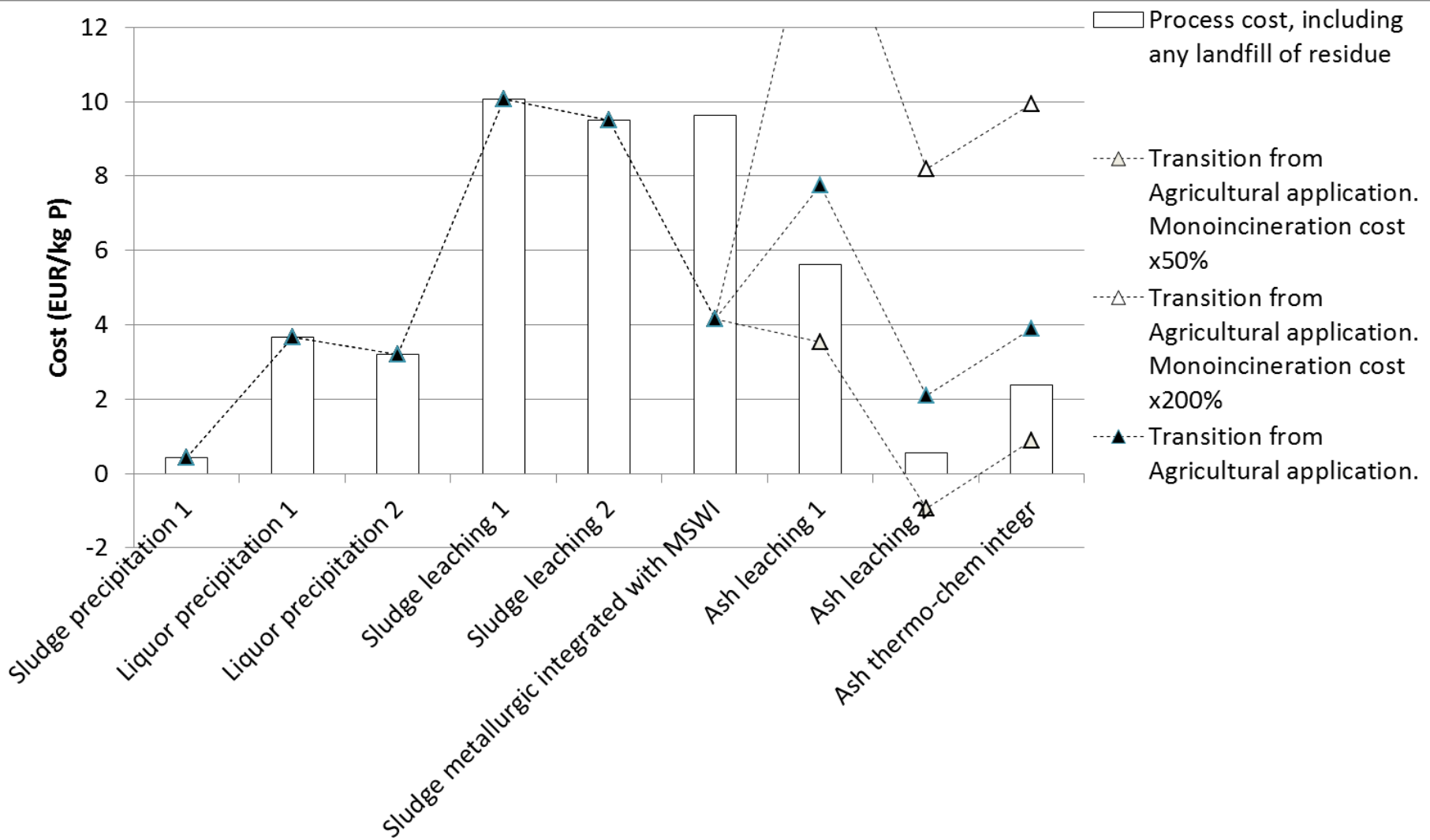


Process cost vs transition cost





Transition cost sensitivity to monoincineration cost





- Input parameters with large range of variations give
 - up to 180% cost increase
 - up to 80% cost decrease
 - when disregarding larger relative uncertainties for processes which have already very low costs (Ecophos, Airprex)

	Sludge precipitation 1	Liquor precipitation 1	Liquor precipitation 2	Sludge leaching 1	Sludge leaching 2	Sludge metallurgic integrated with MSWI	Ash leaching 1	Ash leaching 2	Ash thermo-chem integr
Interest rate x50%	-67	-10	-5	-2	-2	-5	-4	-1	-3
Interest rate x200%	142	21	11	4	4	11	8	1	7
Phosphorus content x50%	-734	160	75	100	100	100	100	100	77
Phosphorus content x200%	367	-80	-37	-50	-50	-50	-50	-50	-39
Plant size x20%	1254	177	96	37	36	132	61	167	90
Plant size x500%	-523	-73	-36	-16	-15	-46	-25	-36	-31
Agri use. Monoincineration x50%	0	0	0	0	0	0	-54	-145	-77
Agri use. Monoincineration x200%	0	0	0	0	0	0	109	291	154

- Process cost calculated without recovered material sales*. Represents worst case for operator since sales will be positive (up to ~1.40 EUR/kg P)
- Transition cost per capita (0.7 kg P recovered) and year based on German reference WWTP
 - Precipitation from sludge liquor/sludge 0-3 €
 - Leaching of sludge 5-10 €
 - Recovery from dry sludge or ash 0-3 €
 - +2€ if additional mono-incineration needed
- Cost sensitivity to varying conditions within the range (-80%) to +180%
- Low cost in comparison to
 - wastewater treatment in Europe 40-120 EUR/ cap y
- Demonstration plants next step, which will prove technical feasibility and improve cost predictions

*two exceptions: Pearl, Ecophos



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Thank you for your attention!

Contact:

anders.naetorp@fhnw.ch

Download at www.p-rex.eu :

D10.1 Report on LCC of European P recovery processes (Autumn 2015)



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