Supplementary

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Table S1: Yields of camelina in different soil zones in Saskatchewan and their comparison with canola

Location	**Soil zone**	**Year**	**Camelina**		**Canola**	
			DM	Yield	DM	Yield
				kg ha^{-1} y^{-1}		kg ha^{-1} y^{-1}
Saskatoon	Dark Brown	2006	73	1755	86	1934
		2007	77	1973	88	2025
Scott	Dark Brown	2007	84	1890	87	1822
		2008	90	1840	95	2720
		2009	-	2360	-	2260
Watrous	Dark Brown	2007	83	1986	90	1790
Swift Current	Brown	2008	85	1910	95	1780
		2009	89	740	92	520
Indian Head	Black	2008	100	1530	97	3230

Source: Mupondwa et al.[1]

Table S2: Cost of delivering camelina straw bales to each pellet plant

Item	Symbol	Unit	Value	Source
Straw harvesting cost	c_{harvest}	\$/t	34.65	Shahrukh et al.[2]
Straw loading and unloading	c_{loading}	\$/t	4.72	Shahrukh et al.[2]
Straw transport cost	$c_{\text{transport}}$	\$/t/km	0.142	Shahrukh et al.[2]
Nutrient replacement cost	c_{nutrient}	\$/t	22.62	Sultana et al.[3]
Collection radius	r	km	100	
Avg. transport distance	L	km	66.67	
Straw yield	Y	t/ha/y	1.967	
Collection area	A	km^2	31,415.93	
		ha	3,141,592.65	
Available farmland factor	F_1		0.75	
Participant rate	F_2		0.1	
Straw capacity	D	t/y	463,463.46	
Harvesting cost	C_{harvest}	\$/y	16,059,008.76	
Loading and unloading cost	C_{loading}	\$/y	2,187,547.51	
Transport cost	$C_{\text{transport}}$	\$/y	4,387,454.05	
Total feedstock cost	C_{total}	\$/y	22,634,010.32	
Specific feedstock cost	c	\$/t	**48.84**	

Table S3: Specific transport cost in previous studies

Year	Feedstock	Location	Specific transport cost [\$/t/km]	Ref.
2016	Wheat straw	Canada	0.142	Shahrukh et al.[2], Sultana et al.[3]
2020	Wood residues	Italy	0.16	Pantaleo et al.[4]

Table S4: Feedstock cost in previous studies

Year	Feedstock	Location	Feedstock cost [\$/t]	Ref.
2021	Rice straw	Spain	30.53—55.40	Torregrosa et al.[5]
2011	Rice straw	Thailand	18.75—19.89	Delivand et al.[6]
2017	Straw	China	37.23—54.27	Sun et al.[7]
2022	Wheat straw	China	17.34—31.95	Fang et al.[8]
2011	Corn stover	USA	59 (d.b)	Humbird et al.[9]
2021	Straw	China	23.63—45.96	Wu et al.[10]
2012	Pine	USA	57 (d.b.)	Sen et al.[11]
2024	Wheat straw	Canada	59.5—62.7	Blue[12]

Table S5: Cost of delivering camelina straw pellets to the ethanol plant

Parameters	Unit	Value
Kindersley		
At-producer-plant pellet cost	$/t	252.00
Pellet transport cost	$/t/km	0.05
Distance to ethanol plant	km	184.00
Pellet supply capacity	t/y	250,320.00
Purchasing price	$/y	63,080,640.00
Transport price	$/y	2,180,120.32
Pellet price at ethanol plant	$/t	260.71
Swift Current		
At-producer-plant pellet cost	$/t	252.00
Pellet transport cost	$/t/km	0.05
Distance to ethanol plant	km	103.00
Pellet supply capacity	t/y	250,320.00
Purchasing price	$/y	63,080,640.00
Transport price	$/y	1,220,393.44
Pellet price at ethanol plant	$/t	256.88
Moose Jaw		
At-producer-plant pellet cost	$/t	252.00
Pellet transport cost	$/t/km	0.05
Distance to ethanol plant	km	99.00
Pellet supply capacity	t/y	250,320.00
Purchasing price	$/y	63,080,640.00
Transport price	$/y	1,172,999.52

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Table S5 continued from previous page

Parameters	Unit	Value
Pellet price at ethanol plant	$/t	256.69
Weyburn		
At-producer-plant pellet cost	$/t	252.00
Pellet transport cost	$/t/km	0.05
Distance to ethanol plant	km	244.00
Pellet supply capacity	t/y	250,320.00
Purchasing price	$/y	63,080,640.00
Transport price	$/y	2,891,029.12
Pellet price at ethanol plant	$/t	263.55
Location No. 5		
At-producer-plant pellet cost	$/t	252.00
Pellet transport cost	$/t/km	0.05
Distance to ethanol plant	km	97.00
Pellet supply capacity	t/y	250,320.00
Purchasing price	$/y	63,080,640.00
Transport price	$/y	1,149,302.56
Pellet price at ethanol plant	$/t	256.59
Average pellet feedstock cost	$/t	**258.88**

Table S6: Cost Factors and Assumptions in Techno-Economic Analysis for Pellet and Ethanol Production Facilities.

Item.	**Symbol**	**Unit**	**Pelleting Plant**	**Bioethanol Plant**	**Note**
Cost year			2023	2023	
Year construction starts			2023	2023	
Annual operation time		[d]	350	350	
		[h]	8400	8400	
Plant life		[y]	30	30	Humbird et al.[9]
Construction period		[y]	2	3	8% first year, 60% second year, 32% third year for ethanol plants
Startup period		[month]	6	6	
Equity financed		[%]	40	40	× DFC
Loan terms		[y]	10	10	
Interest rate		[%]	10	10	
Income tax rate		[%]	35	35	
Inflation rate		[%]	4	4	
Depreciation period		[y]	10	10	
Calculation method for depreciation			Straight line		
Salvage value		[%]	5	5	x DFC
Equipment Purchase Cost	PC		PC = LEPC + UEPC		

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Table S6 – continued from previous page

Item.	**Symbol**	**Unit**	**Pelleting Plant**	**Bioethanol Plant**	**Note**
Unlisted Equipment Purchase Cost	UEPC		0.1	0.1	x PC
Total Plant Direct Cost	TPDC		TPDC = PC + A + B + C + D + E + F + G + H		Towler and Sinnott [15]
Piping	A		0.05[a]–0.60[b]	0.60	x PC
Instrumentation	B		0.05[a]–0.30[b]	0.30	x PC
Insulation	C		0.03	0.03	x PC
Electrical Facilities	D		0.05[a]–0.20[b]	0.20	x PC
Buildings	E		0.05[a]–0.20[b]	0.20	x PC
Yard Improvement	F		0.05	0.05	x PC
Auxiliary Facilities	G		0.05[a]–0.40[b]	0.40	x PC
Installation	H		0.05[a]–0.50[b]	0.50	x PC
Total Plant Indirect Cost	TPIC		TPIC = I + J + K + L		Towler and Sinnott [15]
Engineering	I		0.05[a]–0.25[b]	0.25	x TPDC
Construction	J		0.05[a]–0.10[b]	0.10	x TPDC
Contractor's Fee & Contingency	CFC		CFC = K + L		
Contractor's Fee	K		0.05	0.05	x (TPDC + TPIC)
Contingency	L		0.05[a]–0.10[b]	0.10	x (TPDC + TPIC)
Total Plant Cost	TPC		TPC = TPDC + TPIC		
Direct Fixed Capital Cost	DFC		DFC = TPC + CFC		

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Table S6 – continued from previous page

Item.	**Symbol**	**Unit**	**Pelleting Plant**	**Bioethanol Plant**	**Note**
Labor cost		[\$ h^{-1}]	69	69	including benefits, supplies, supervision, and administration factors
Consumed electricity cost		[\$ kWh^{-1}]	0.11	0.11	
Natural gas		[\$ t^{-1}]	290	290	SaskEnergy Inc.
R.O. water cost		[\$ t^{-1}]	5	5	
Distilled water cost		[\$ t^{-1}]	5	5	
Water		[\$ t^{-1}]	0.5	0.5	
Fungal inoculum		[\$ t^{-1}]	2300	2300	
Glucose		[\$ t^{-1}]	400	400	
Medium		[\$ t^{-1}]	8.47	8.47	97.08% distilled H_2O, 2.43% KCl, 0.1% Urea, 0.39% yeast extract
L.P. steam		[\$ t^{-1}]	0	0	the steam was generated from the in-house co-gen plant
H.P. steam		[\$ t^{-1}]	0	0	the steam was generated from the in-house co-gen plant
Sulfuric acid		[\$ t^{-1}]	NA	270	Humbird et al.[9]

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Table S6 – continued from previous page

Item.	**Symbol**	**Unit**	**Pelleting Plant**	**Bioethanol Plant**	**Note**
Ammonia		[$ t^{-1}]	NA	750	Humbird et al.[9]
Sulfur dioxide		[$ t^{-1}]	NA	280	Humbird et al.[9]

[a]: Scenario 1-Cost factors A-L were set to minimum[13,14],

[b]: Scenario 2-Cost factors A-L were set to maximum[15]

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Table S7: Cost of camelina straw bales delivered to the ethanol plant gate

Parameter	Symbol	Unit	Value
Kindersley			
Straw capacity	D	t/y	463,463.46
Feedstock cost to center	C_{total}	\$/y	22,634,010.32
Additional transport distance	ΔL	km	184.00
Additional transport cost	$\Delta C_{\text{transport}}$	\$/y	12,109,373.18
Total feedstock cost	C_{total}	\$/y	34,743,383.51
Specific feedstock cost	c	\$/t	74.96
Swift Current			
Straw capacity	D	t/y	463,463.46
Feedstock cost to center	C_{total}	\$/y	22,634,010.32
Additional transport distance	ΔL	km	103.00
Additional transport cost	$\Delta C_{\text{transport}}$	\$/y	6,778,616.51
Total feedstock cost	C_{total}	\$/y	29,412,626.83
Specific feedstock cost	c	\$/t	63.46
Moose Jaw			
Straw capacity	D	t/y	463,463.46
Feedstock cost to center	C_{total}	\$/y	22,634,010.32
Additional transport distance	ΔL	km	99.00
Additional transport cost	$\Delta C_{\text{transport}}$	\$/y	6,515,369.27
Total feedstock cost	C_{total}	\$/y	29,149,379.59
Specific feedstock cost	c	\$/t	62.89
Weyburn			
Straw capacity	D	t/y	463,463.46

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Table S7 continued from previous page

Parameter	Symbol	Unit	Value
Feedstock cost to center	C_{total}	\$/y	22,634,010.32
Additional transport distance	ΔL	km	244.00
Additional transport cost	$\Delta C_{\text{transport}}$	\$/y	16,058,081.83
Total feedstock cost	C_{total}	\$/y	38,692,092.15
Specific feedstock cost	c	\$/t	83.48
Location No. 5			
Straw capacity	D	t/y	463,463.46
Feedstock cost to center	C_{total}	\$/y	22,634,010.32
Additional transport distance	ΔL	km	97.00
Additional transport cost	$\Delta C_{\text{transport}}$	\$/y	6,383,745.65
Total feedstock cost	C_{total}	\$/y	29,017,755.97
Specific feedstock cost	c	\$/t	62.61
Average Feedstock Cost	c_{average}	\$/t	**69.48**

Table S8: Kinetics of reactions used for simulating SSF microbial pretreatment bioreactors

Growth Kinetics	Parameter	Symbol	Unit	Value
Fungal growth	Maximum specific growth rate	μ_{max}	$[\mathrm{d}^{-1}]$	1.005
	Half saturation coefficient	K_{s}	$[\mathrm{d}^{-1}]$	0.682
	Self-inhibiting factor	X_{m}	[g X (g d.b. substrate)$^{-1}$]	0.052
Equation: $\frac{\mathrm{d}X}{\mathrm{d}t} = \mu_{\mathrm{m}} \left(\frac{S}{K_{\mathrm{S}}+S}\right) \left(1 - \frac{X}{X_{\mathrm{m}}}\right) X(1)$ where: X = fungal biomass concentration, [g X (g d.b. substrate)$^{-1}$]; t = incubation time, [d]; S = substrate concentration, [g holocellulose (g d.b. substrate)$^{-1}$].				
Holocellulose consumption	Yield coefficient from substrate to biomass	$Y_{\mathrm{x/s}}$	[g X (g d.b. substrate)$^{-1}$]	0.180
	Cell maintenance coefficient	m_{s}	[g S (g X)$^{-1}$]	0.086
	Lignin degradation coefficient	k_{LD}		0.528
Equation: $\frac{\mathrm{d}S}{\mathrm{d}t} = -\frac{1}{Y_{\mathrm{X/S}}}\frac{\mathrm{d}X}{\mathrm{d}t} - m_{\mathrm{C}}X - k_{\mathrm{LD}}\frac{\mathrm{d}L}{\mathrm{d}t}(2)$ where: S = holocellulosic substrate concentration, [g holocellulose (g d.b. substrate)$^{-1}$]; $Y_{\mathrm{X/S}}$ = yield coefficient from substrate to fungal biomass, [g X (g d.b. substrate)$^{-1}$]; L = lignin concentration, [g lignin (g d.b. substrate)$^{-1}$].				
Lignin degradation	Lignin degradation constant	k_1		0.008
	Lignin degradation constant	k_2		-0.043
Equation: $\frac{\mathrm{d}L}{\mathrm{d}t} = -e^{\frac{\left(-1+e^{-k_2 t}\right)k_1}{k_2} - k_2 t} k_1 L_0(3)$ where: L_0 = the initial lignin concentration of the substrate, [g lignin (g d.b. substrate)$^{-1}$].				
Oxygen uptake	Yield coefficient from oxygen to biomass	$Y_{\mathrm{x/o}}$	[g X (mmol O_2)$^{-1}$]	0.080
	Maintenance coefficient	m_{o}	[mmol O_2 (g X)$^{-1}$ d^{-1}]	9.525
Equation: $\mathrm{OUR} = \frac{\mathrm{dO_2}}{\mathrm{d}t} = \frac{1}{Y_{\mathrm{X/O}}}\frac{\mathrm{d}X}{\mathrm{d}t} + m_{\mathrm{O}}X(4)$ where: OUR = oxygen uptake rate, [mmol d^{-1}]				
Carbon dioxide production	Yield of CO_2 from biomass	$Y_{\mathrm{c/x}}$	[mmol CO_2 (g X)$^{-1}$]	20.394
	Maintenance coefficient	m_{c}	[mmol CO_2 (g X)$^{-1}$ d^{-1}]	6.886
Equation: $\mathrm{CPR} = \frac{\mathrm{dCO_2}}{\mathrm{d}t} = Y_{\mathrm{C/X}}\frac{\mathrm{d}X}{\mathrm{d}t} + m_{\mathrm{C}}X(5)$ where: CPR = carbon production rate, [mmol d^{-1}]				

Table S9: Chemical reactions and their corresponding conversion factors at the ethanol plant

	Pretreatment Reactors	
Temperature	[°C]	158

Pressure	[atm]	5.5
Retention Time	[h]	0.083
Fractional Conversion Factor	Referenced Component	Reaction
0.003	Cellulose	Cellulose → Glucose Oligomer
0.099	Cellulose	H_2O + Cellulose → Glucose
0.003	Cellulose	Cellulose → HMF + 2 H_2O
0.024	Xylan	Xylan → Xylose Oligomer
0.9	Xylan	H_2O + Xylan → Xylose
0.05	Xylan	Xylan → Furfural + 2 H_2O
0.024	Mannan	Mannan → Mannose Oligomer
0.9	Mannan	H_2O + Mannan → Mannose
0.05	Mannan	Mannan → HMF + 2 H_2O
0.024	Galactan	Galactan → Galactosee Oligomer
0.9	Galactan	H_2O + Galactan → Galactose
0.05	Galactan	Galactan → HMF + 2 H_2O
0.024	Arabinan	Arabinan → Arabinosee Oligomer
0.9	Arabinan	H_2O + Arabinan → Arabinose
0.05	Arabinan	Arabinan → 2 H_2O + Furfural
1	Acetate	Acetate → Acetic Acid
1	Furfural	3 H_2O + Furfural → Tar
1	HMF	3 H_2O + HMF → 1.2 Tar
0.05	Lignin	Lignin → Soluble Lignin
1	Sucrose	Sucrose → HMF + 2 H_2O + Glucose
Secondary Oligomer Conversion Reactors		
Temperature	[°C]	130
Pressure	[atm]	5.7
Retention Time	[h]	0.5
Fractional Conversion Factor	Referenced Component	Reaction
1	Xylose Oligomer	Xylose Oligomer + H_2O → Xylose

1	Mannose Oligomer	Mannose Oligomer + H_2O → Mannose
1	Galactose Oligomer	Galactose Oligomer + H_2O → Galactose
1	Arabinose Oligomer	Arabinose Oligomer + H_2O → Arabinose
	Enzymatic Hydrolysis Reactors	
Temperature	[°C]	48
Pressure	[atm]	1
Retention Time	[h]	84
Fractional Conversion Factor	Referenced Component	Reaction
0.04	Cellulose	Cellulose → Glucose Oligomer
0.012	Cellulose	2 Cellulose + H_2O → Cellobiose
0.9	Cellulose	Cellulose + H_2O → Glucose
1	Cellobiose	Cellobiose + H_2O → 2 Glucose
	Fermentation Reactors	
Temperature	[°C]	32
Pressure	[atm]	1
Retention Time	[h]	36
Fractional Conversion Factor	Referenced Component	Reaction
0.95	Glucose	Glucose → 2 Ethanol + 2 CO_2
0.02	Glucose	Glucose + 0.018 DAP + 0.3704 Proteins → 6 *Z. mobilis* + 2.4 H_2O
0.004	Glucose	Glucose + 2 H_2O → 2 Glycerol + O_2
0.006	Glucose	Glucose + 2 CO_2 → 2 Succinic Acid + O_2
0.85	Xylose	3 Xylose → 5 Ethanol + 5 CO_2
0.019	Xylose	Xylose + 0.015 DAP + 0.3087 Proteins → 5 *Z. mobilis* + 2 H_2O
0.003	Xylose	3 Xylose + 5 H_2O → 5 Glycerol + 2.5 O_2
0.046	Xylose	Xylose + H_2O → Xylitol + 0.5 O_2
0.009	Xylose	3 Xylose + 5 CO_2 → 5 Succinic Acid + 2.5 O_2

0.85	Arabinose	3 Arabinose $\rightarrow$ 5 Ethanol + 5 CO_2
0.019	Arabinose	Arabinose + 0.015 DAP + 0.3087 Proteins $\rightarrow$ 5 *Z. mobilis* + 2 H_2O
0.003	Arabinose	3 Arabinose + 5 H_2O $\rightarrow$ 5 Glycerol + 2.5 O_2
0.015	Arabinose	3 Arabinose + 5 CO_2 $\rightarrow$ 5 Succinic Acid + 2.5 O_2
	Seed Train Reactors	
Temperature	[°C]	32
Pressure	[atm]	1
Retention Time	[h]	180
Fractional Conversion Factor	Referenced Component	Reaction
0.9	Glucose	Glucose $\rightarrow$ 2 Ethanol + 2 CO_2
0.04	Glucose	Glucose + 0.018 DAP + 0.3704 Proteins $\rightarrow$ 6 *Z. mobilis* + 2.4 H_2O
0.004	Glucose	Glucose + 2 H_2O $\rightarrow$ 2 Glycerol + O_2
0.006	Glucose	Glucose + 2 CO_2 $\rightarrow$ 2 Succinic Acid + O_2
0.8	Xylose	3 Xylose $\rightarrow$ 5 Ethanol + 5 CO_2
0.04	Xylose	Xylose + 0.015 DAP + 0.3087 Proteins $\rightarrow$ 5 *Z. mobilis* + 2 H_2O
0.003	Xylose	3 Xylose + 5 H_2O $\rightarrow$ 5 Glycerol + 2.5 O_2
0.046	Xylose	Xylose + H_2O $\rightarrow$ Xylitol + 0.5 O_2
0.009	Xylose	3 Xylose + 5 CO_2 $\rightarrow$ 5 Succinic Acid + 2.5 O_2
0.001	Arabinose	3 Arabinose $\rightarrow$ 5 Ethanol + 5 CO_2

Table S10: Determination of average selling price of Turkey tail extract

Product name	Description	Price [CAD]	Mass [g]	Unit Price [CAD/g]	Source
Turkey Tail Concentrated Mushroom Powder	Our Turkey Tail Powder is extracted in water at a ratio of 8:1. This means that you get 5000mg of fruiting body Turkey Tail within 1/4 TSP of Concentrated Powder. Concentrated Mushroom Powders make it easy to incorporate fruiting body mushroom extracts into your daily routi ne. The mushrooms we source are cultivated on sustainable farms using traditional mediums to ensure the highest quality and potency. Medicinal Ingredients (per dose unit): *Turkey Tail (*Trametes versicolor*, Fruiting Body)... 625 mg (8:1, 5000 mg dry). Polysaccharides >30%. Each serving (1/4 TSP) contains the equivalent of 5000mg of fruiting body Turkey Tail. Organic.	37.95	45	0.843	[16]

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Table S10 continued from previous page

Product name	Description	Price [CAD]	Mass [g]	Unit Price [CAD/g]	Source
Real Mushrooms, Turkey Tail, Organic Mushroom Extract Powder, 1.59 oz (45 gm)	Turkey tail mushroom extract comes from a polypore mushroom known as *Trametes versicolor*. It also goes by the names *Coriolus versicolor* and Polyporus versicolor. The general meaning of *Trametes versicolor* is ‘of several colors.’ Its distinct coloration is reminiscent of a wild turkey, which makes identifying turkey tail mushrooms in the wilderness rather easy. Turkey tail mushrooms form in thin, leathery concentric circles and often resemble leaves in shape. As an extract, turkey tail mushroom powder may provide several benefits but taking a bite out of one won’t do much good by itself. Turkey tail mushroom extract is much more potent than consuming the mushroom, and it’s a much more convenient and reliable method of experiencing results. Every dose of turkey tail mushroom powder contains a concentrated amount of the mushroom, which removes the guesswork of taking this supplement.	46.975	45	1.044	[17]
Turkey Tail Mushroom Capsules	Step into the realm of natural wellness with our meticulously crafted Turkey Tail Mushroom capsules. These capsules are not just any supplement; they’re your daily ally in the pursuit of holistic health. Packed with a treasure trove of nature’s most remarkable compounds, each capsule offers a carefully balanced blend designed to promote antioxidant activity and foster overall well-being. Turkey tail mushroom extract 4:1 (1000 mg) - *Coriolus versicolor*	51	1000	0.051	[18]

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Table S10 continued from previous page

Product name	Description	Price [CAD]	Mass [g]	Unit Price [CAD/g]	Source
Optimi Immunity Turkey Tail Supplement - 120 Capsules	Immunity Turkey Tail The immune system is complex and demands balance to fulfill its role in safeguarding against disease and illness. Let's admit it – everyone endeavors to make mindful lifestyle choices, yet occasional assistance may be necessary. The turkey tail formulation undertakes the heavy lifting of supporting your immune system.	45	60	0.75	[19]
Activation Extracted Turkey Tail Mushroom	Certified Organic Turkey Tail (*Coriolus versicolor*). Whole Full-Spectrum Activation extracted Fruiting Body & Mycelium. Includes Important Fermented Mycelial Extracellular compounds	39.99	112	0.357	[20]
Real Mushrooms Turkey Tail Powder 100gm, 3.53 oz, 100 Servings	Fulfilled by our friends at Real Mushrooms. Hot water extracted from 100% turkey tail mushrooms. USDA Certified Organic. Gluten-Free, Non-GMO, Vegan. Guaranteed $>$30% Beta-glucans. No added starch, mycelium, or grain of any kind. Verified for quality at accredited 3rd party labs. Made in an NSF-certified facility in the USA.	95	100	0.95	[21]
Turkey Tail Mushroom Full Spectrum Capsules (Organic)	Each vegan capsule contains a 500mg serving of organic full spectrum turkey tail mushroom powder. Our capsules are 100% free from additives, fillers, and preservatives. Common Name Turkey Tail, Yun Zhi. Latin Name *Trametes versicolor*. Origin United States	55	30	1.833	[22]

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Table S10 continued from previous page

Product name	Description	Price [CAD]	Mass [g]	Unit Price [CAD/g]	Source
Eversio Wellness DEFEND Now Organic Turkey Tail 12:1 Extract	Eversio's DEFEND Now Turkey Tail mushroom capsules are high in beta-d-glucans and specialized antioxidants (PSP) that strengthen the immune system and fight viral infections by activating cells that clear pathogens from the body. Research verifies that prolonged use of therapeutic dose whole fruiting body turkey tail mushroom supplements can improve natural defenses by increasing chemokines and cytokines that prompt the immune system. Turkey tail mushroom benefits also include the support of beneficial bacteria to improve gut health and promoting the maintenance of glutathione levels to protect the liver. Directions: Take 1-2 capsules daily or as recommended by your health care practitoner. Cautions: Consult a health care practitioner prior to use if you are pregnant breastfeeding or if symptoms persist or worsen.	65	30	2.167	[23]
Life Essentials - Turkey Tail Capsules - 20:1 Mushroom Extract - 8000mg Equivalent Dose		27.26	480	0.057	[24]
AVERGAGE	[CAD/g]			0.895	
AVERGAGE	[CAD/kg]			894.7	

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Table S10 continued from previous page

Product name	Description	Price [CAD]	Mass [g]	Unit Price [CAD/g]	Source
AVERGAGE	[USD/kg]			653.1	

Table S11: Energy balance of the bioethanol production process

Enzyme Production				
In		**Out**		%Δ
Flow	**MJ h^{-1}**	**Flow**	**MJ h^{-1}**	
SO2	52.0	Cellulase Seed Fermentor Vents (S-150)	100.9	
NH3	187.5	Cellulase Production Fermentor Vents (S-102)	866.6	
Air	669.5	Cellulase Out (S-195)	353.6	
Glucose 1	89.4			
Water 1	179.7			
Nutrient	1.0			
Heat Sterilization (P-33/ST-101)	107.1			
Heat Sterilization (P-36/ST-104)	0.4			
Cellulase Seed Fermentor (P-38/SFR-102)	5.1			
Cellulase Production Fermentor (P-39/FR-101)	29.5			
TOTAL	1321.0		1321.2	0.01
Feedstock Handling and Pretreatment				
In		**Out**		%Δ
Flow	**MJ h^{-1}**	**Flow**	**MJ h^{-1}**	
Pretreated CS Pellets	7,849.0	Fine Particles	392.5	
Water 2	21,011.1	S-138 (to Waste Treatment)	3,317.3	
L.P. Steam 1	42,940.2	S-141 (Hydrolysate to Fermentation)	18,178.3	
H2SO4 (1)	322.1	S-126 (to Waste Treatment)	808,356.3	
Ammonia	3,482.3			
H2SO4 (2)	-			
Cellulase In (S-195)	353.7			

Water 3	1,805.5			
Pump (P-6/GP-101)	122.1			
Pump (P-18/PP-102)	18.6			
Pretreatment Reactor	778,297.4			
Pump (P-15/PP-101)	5.3			
Oligomer Conversion	10,144.9			
Pump (P-58/PM-101)	5.1			
Pump (P-59/PM-102)	0.6			
Pump (P-63/PM-103)	5.6			
Ammonia Conditioning	-179.4			
Pump (P-64/PM-104)	5.7			
Reacidification	236.9			
Pump (P-65/PM-105)	5.8			
Pump (P-67/PM-106)	3.3			
Pump (P-68/PM-107)	5.5			
TOTAL	866,441.2		830,244.3	-4.36

Enzymatic Hydrolysis and Fermentation

In		**Out**		%Δ
Flow	**MJ h^{-1}**	**Flow**	**MJ h^{-1}**	
S-141 (Hydrolysate in)	18,178.3	S-201 (to Product Recovery)	9,413.2	
CSL	3.5	S-127 (Co-fermentation vent)	13,057.7	
DAP	0.1	S-180 (Seed fermentor vents)	5,473.5	
Proteins	108.6	Seed fermentor cooling water	1,728.0	
Glucose	308.4	Enzymatic Hydrolysis Cooling Water	4,104.0	
Air for Seed Fermentors (S-181)	5,480.2	Co. Fermentation Cooling Water	7,272.0	
Air for Fermentation (S-200)	7,569.3			
Seed fermentors	340.5			
Enzymatic hydrolysis reactors	2,107.2			
Co-fermentation reactors	897.7			
Pump (P-70/PM-109)	0.8			

Pump (P-70/PM-113)	5.1			
Seed fermentor power input	378.6			
Enzymatic Hydrolysis power input	5,386.3			
Co. Fermentation power input	283.9			
TOTAL	41,048.3		41,048.3	0.00
		Product Recovery		
In		**Out**		%Δ
Flow	**MJ h^{-1}**	**Flow**	**MJ h^{-1}**	
S-201 (from Fermentation)	9,413.2	S-156	23.8	
Pump (P-78/PM-114)	5.3	S-229 to Waste Treatment	23,270.1	
Pump (P-87/PM-115)	5.5	Bioethanol	2,098.3	
Pump (P-88/PM-116)	3.6	Distillation P-21a/C-101 condenser	37,800.0	
Pump (P-89/PM-117)	0.2	Distillation P-21b/C-102 condenser	38,520.0	
Distillation P-21a/C-101 reboiler	56,160.0			
Distillation P-21b/C-102 reboiler	38,520.0			
TOTAL	104,107.7		101,712.1	-2.36
		Waste Recovery		
In		**Out**		%Δ
Flow	**MJ h^{-1}**	**Flow**	**MJ h^{-1}**	
S-214	26,587.3	S-199	30,831.5	
S-126	808,356.3	S-231	24.5	
S-219	10,505.6	S-222	823,952.6	
Pump (P-84/PM-111)	3.2	S-151	6,923.3	
Pump (P-83/PM-113)	0.6			
Evaporation - heating	16,365.6			
TOTAL	861,818.5		861,731.8	-0.01

Co-Generation Plant

In		Out		%Δ
Flow	**MJ h^{-1}**	**Flow**	**MJ h^{-1}**	
Solid fuels	1.8	Fluegas	318,616.3	
Natural gas	154,000.0	H.P. Steam	729,610.7	
S-151	1,231,240.9	L.P. Steam	368,240.0	
Make-up Water	302,819.7	Condensation	106,570.4	
Boiler Air	18,651.6	Bottom ashes	1,444.7	
		Total Shaft Power	182,232.0	
TOTAL	1,706,713.95		1,706,713.95	0
UTILITIES				
Item.	**Unit**	**Value**		
Electricity generated	[MW]	36.24		
L.P. Steam generated	[MT/h]	139.86		
H.P. Steam generated	[MT/h]	241.58		
Electricity consumed	[MW]	29.3		
L.P. Steam consumed	[MT/h]	134.25		
H.P. Steam consumed	[MT/h]	239.18		

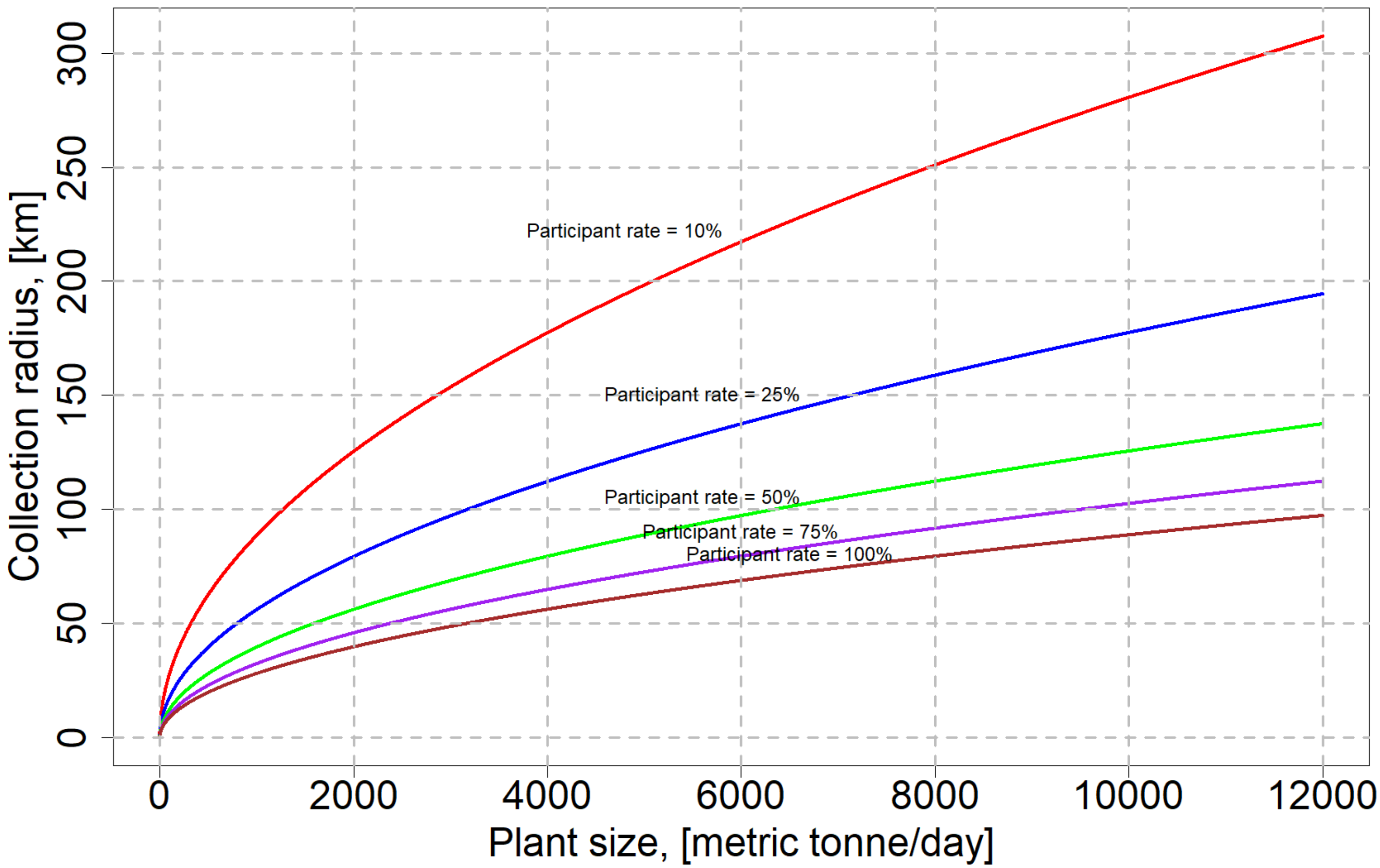

Figure S1: The effect of plant capacity on the collection radius (Assumption: 75% of the total farmland is available for the feedstock, $F_1 = 0.75$)

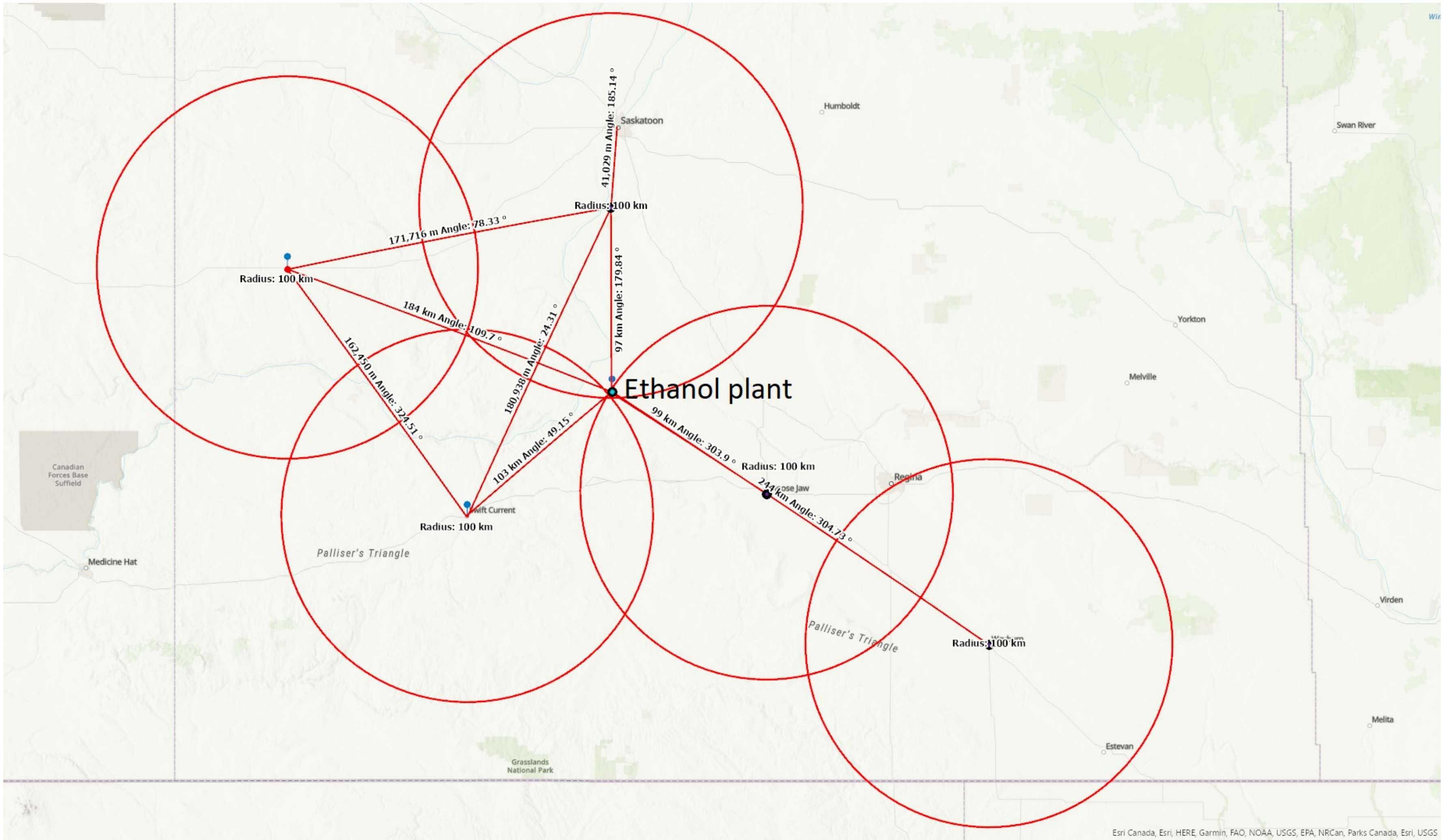

Figure S2: Determination of the optimal location to place the cellulosic bioethanol plant.

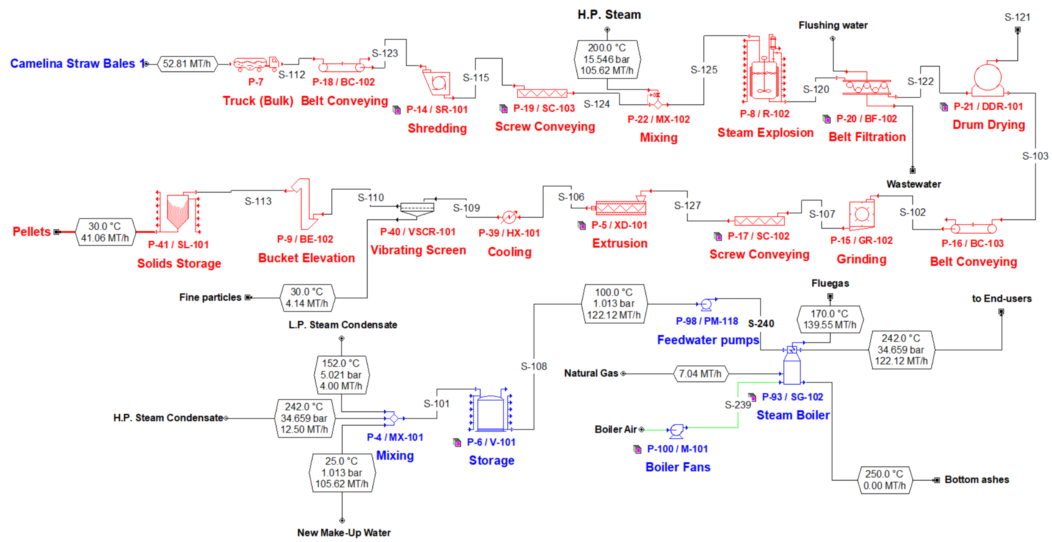

Figure S3: Process model of camelina straw pellets production using steam-explosion pretreatment method (**Pellet Plant B**: All feedstock was used to produce pellets, the heat was supplied by a natural gas steam boiler, electricity was purchased from the grid.)

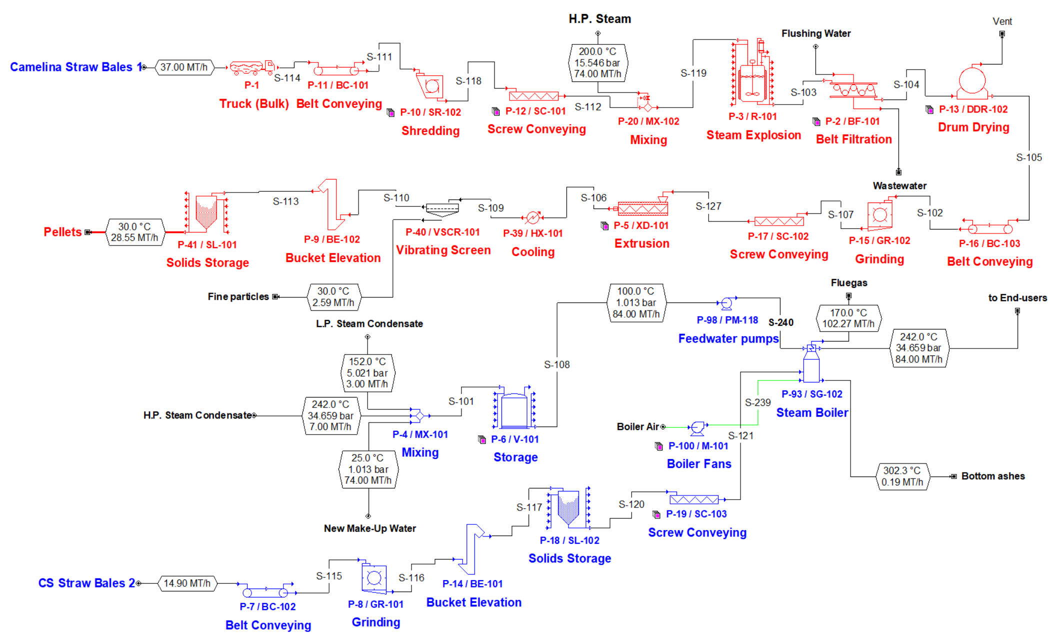

Figure S4: Process model of camelina straw pellets production using steam-explosion pretreatment method (**Pellet Plant C**: Part of feedstock was used to operate the biomass steam boiler, electricity was purchased from the grid.)

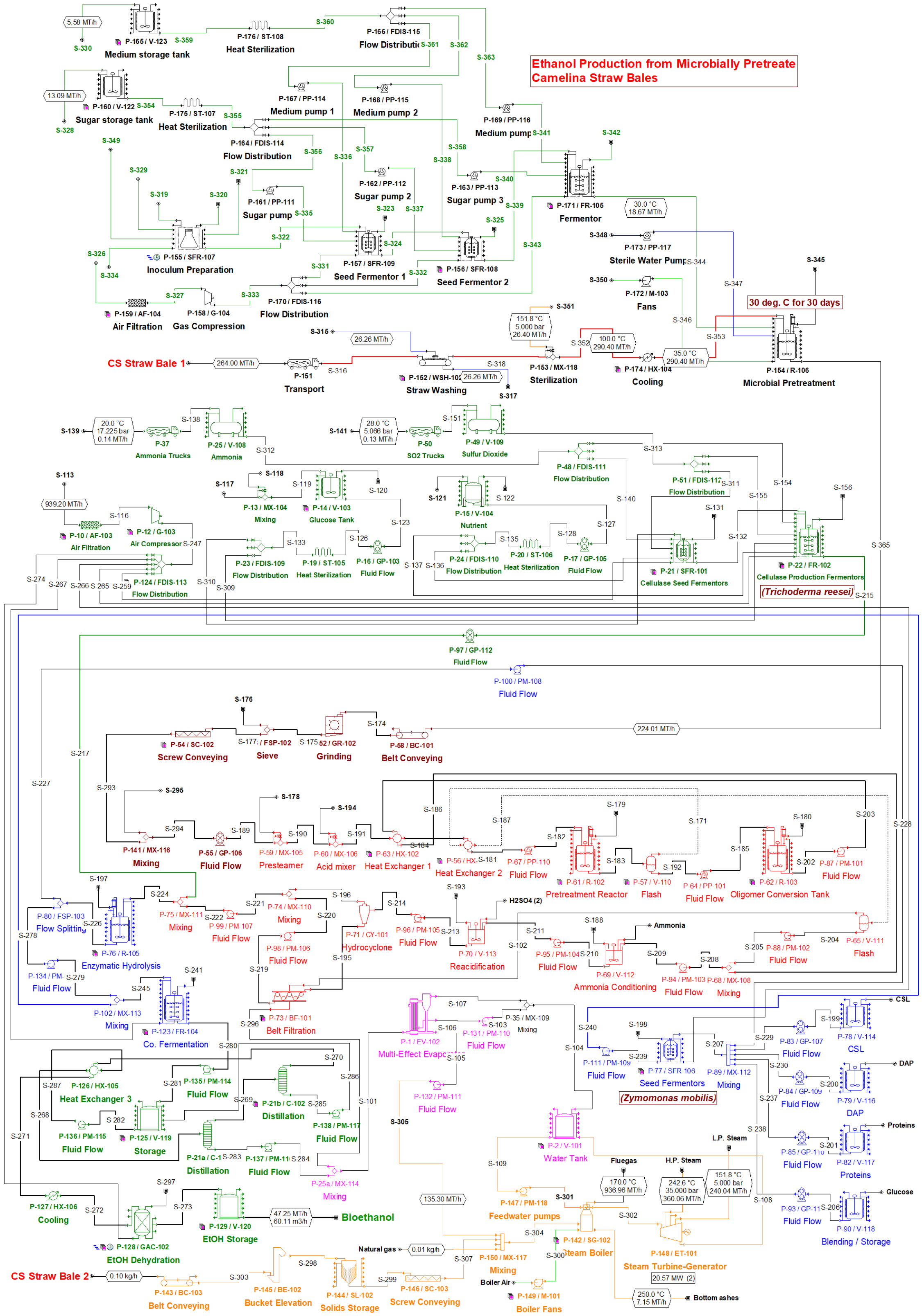

Figure S5: Process model of ethanol production using microbial pretreatment (**Ethanol Plant B**: Camelina straw is microbially pretreated on-site).

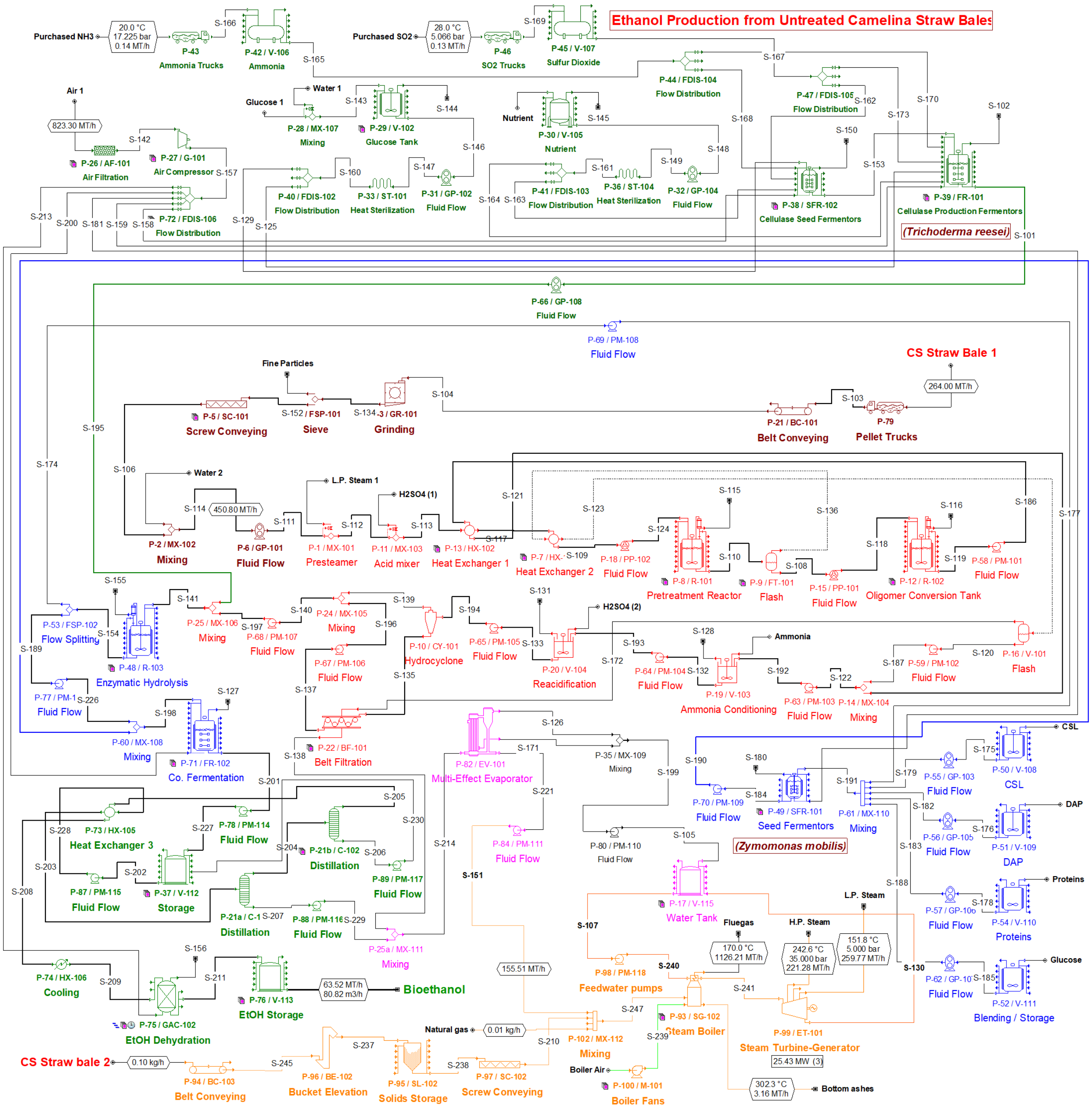

Figure S6: Process model of conventional cellulosic ethanol production (**Ethanol Plant C**: There is no microbial pretreatment and densification of camelina straw feedstock).

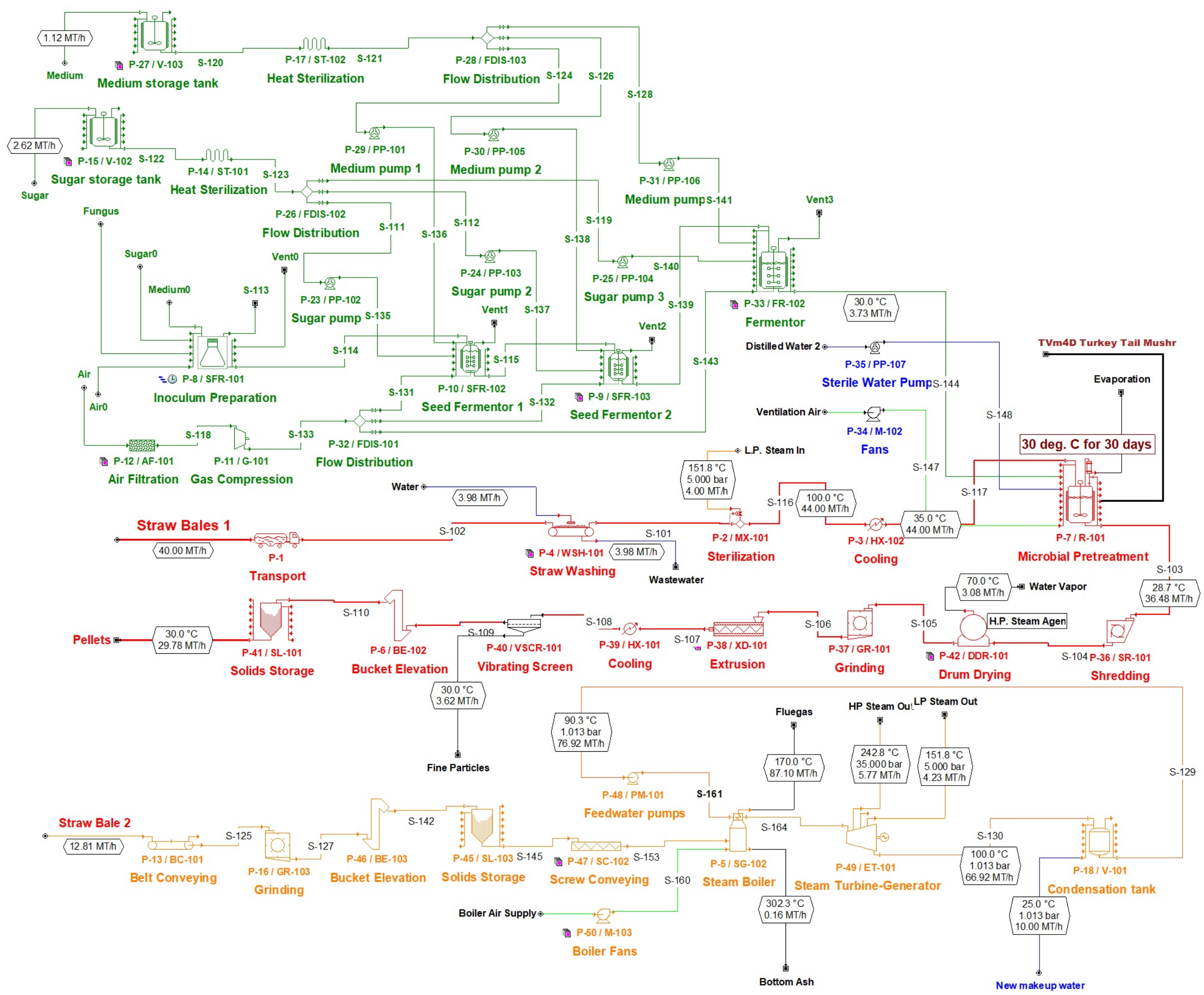

Figure S7: Process model of camelina straw pellets production using microbial pretreatment (**Pellet Plant A**): participant rate = 10%, feedstock capacity = 1,270 t d^{-1} = 52.81 t h^{-1} (Note: Green color: Fungal Inoculum Preparation (FIP) block, Red color: Pellet Production (PP) block, Orange color: Boiler-Turbine-Generator (BTG) block.)

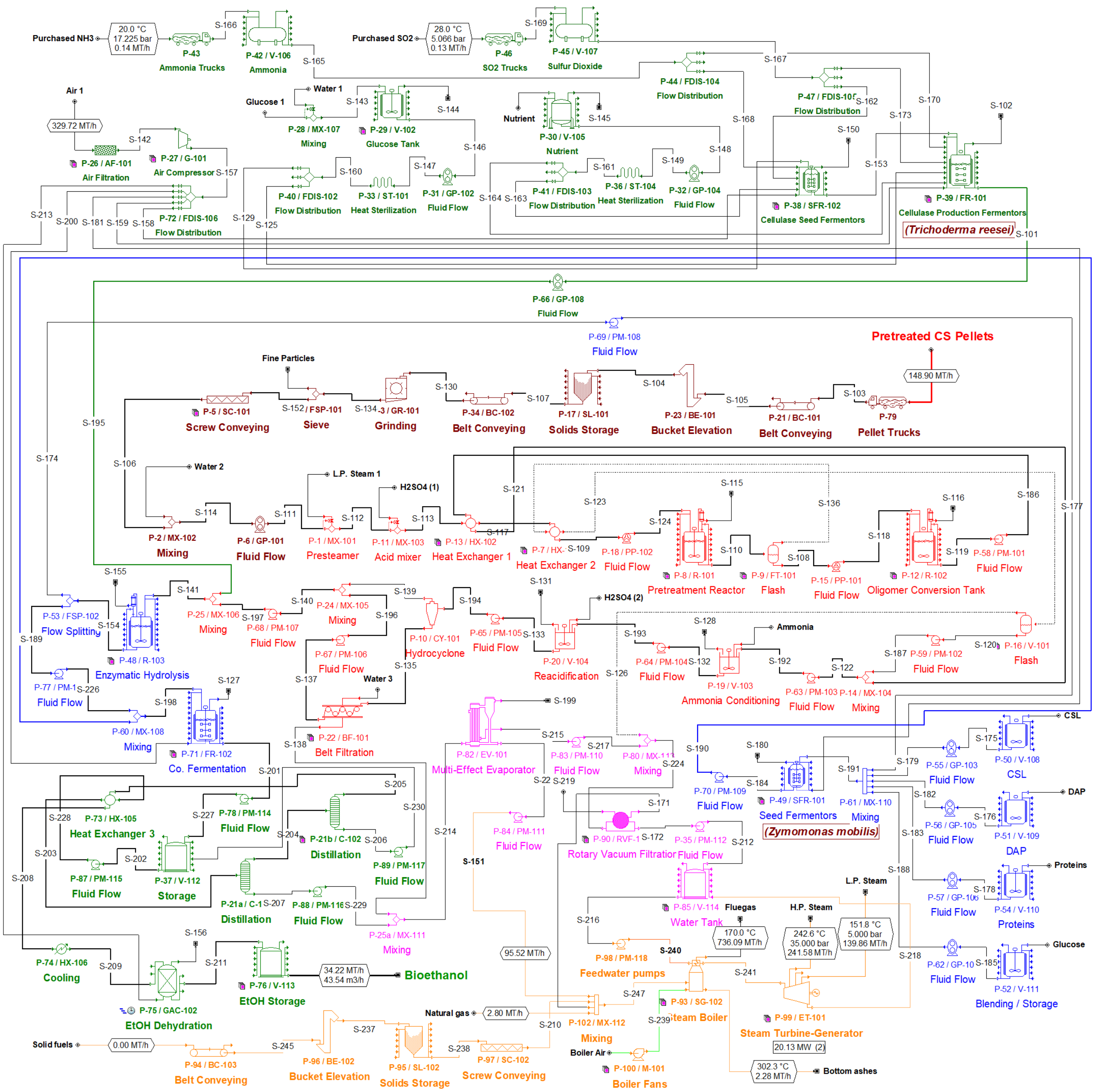

Figure S8: Process model of cellulosic ethanol production using microbially pretreated CS pellets as feedstock (**Ethanol Plant A**): farmer participant rate = 10%, pellet feedstock capacity = 148.90 t h^{-1} (Note: Dark green color: Enzyme Production, Brown color: Feedstock Handling and Storage, Red color: Pretreatment, Blue color: Enzymatic Hydrolysis and Fermentation, Green color: Product Recovery, Violet color: Waste Recovery, and Orange color: Co-generation Plant.)

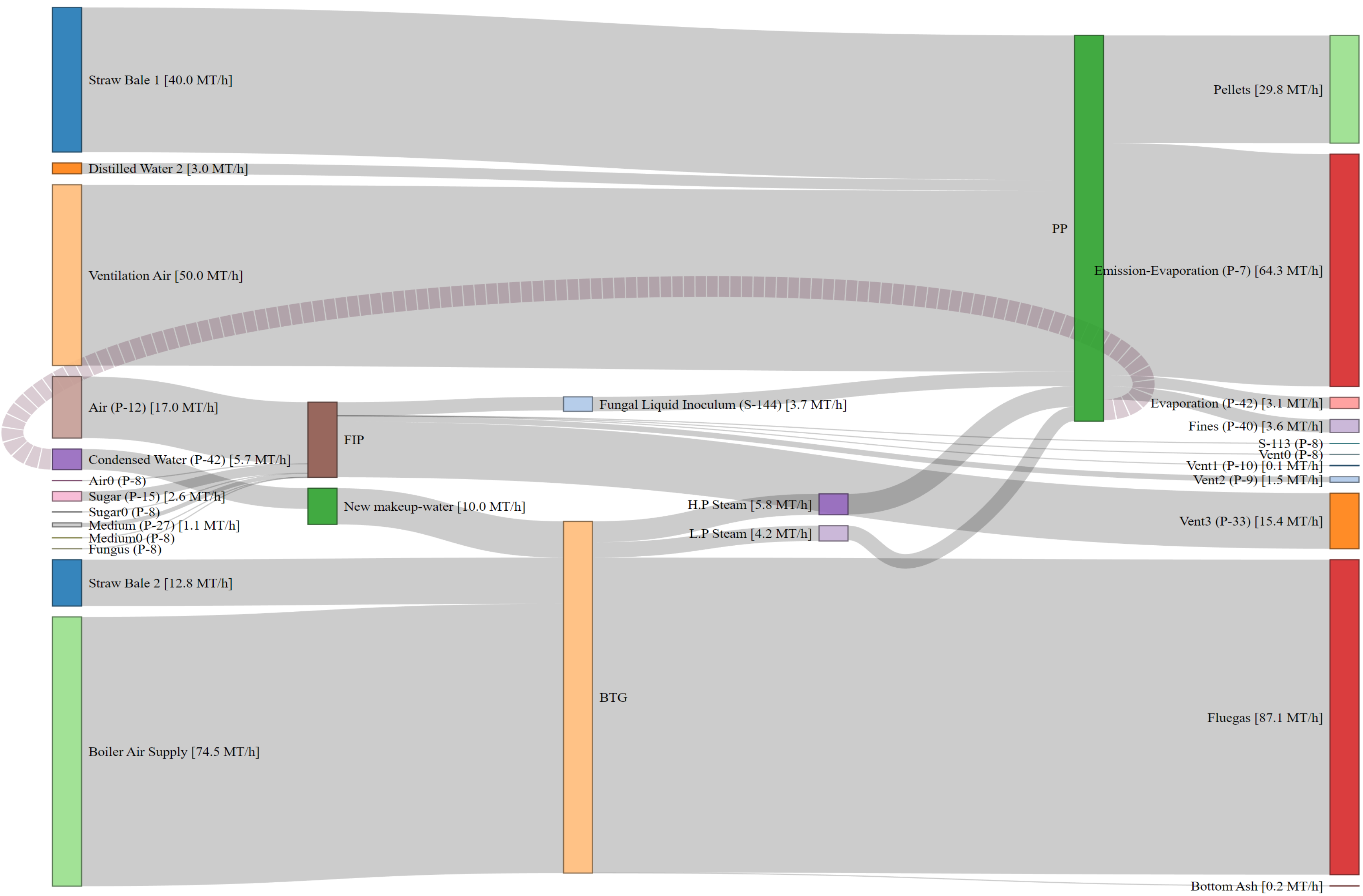

Figure S9: Mass balance of Pellet Plant A: **FIP** = fungal inoculum preparation block, **PP** = pellet production block, **BTG** = boiler-turbine-generator block.

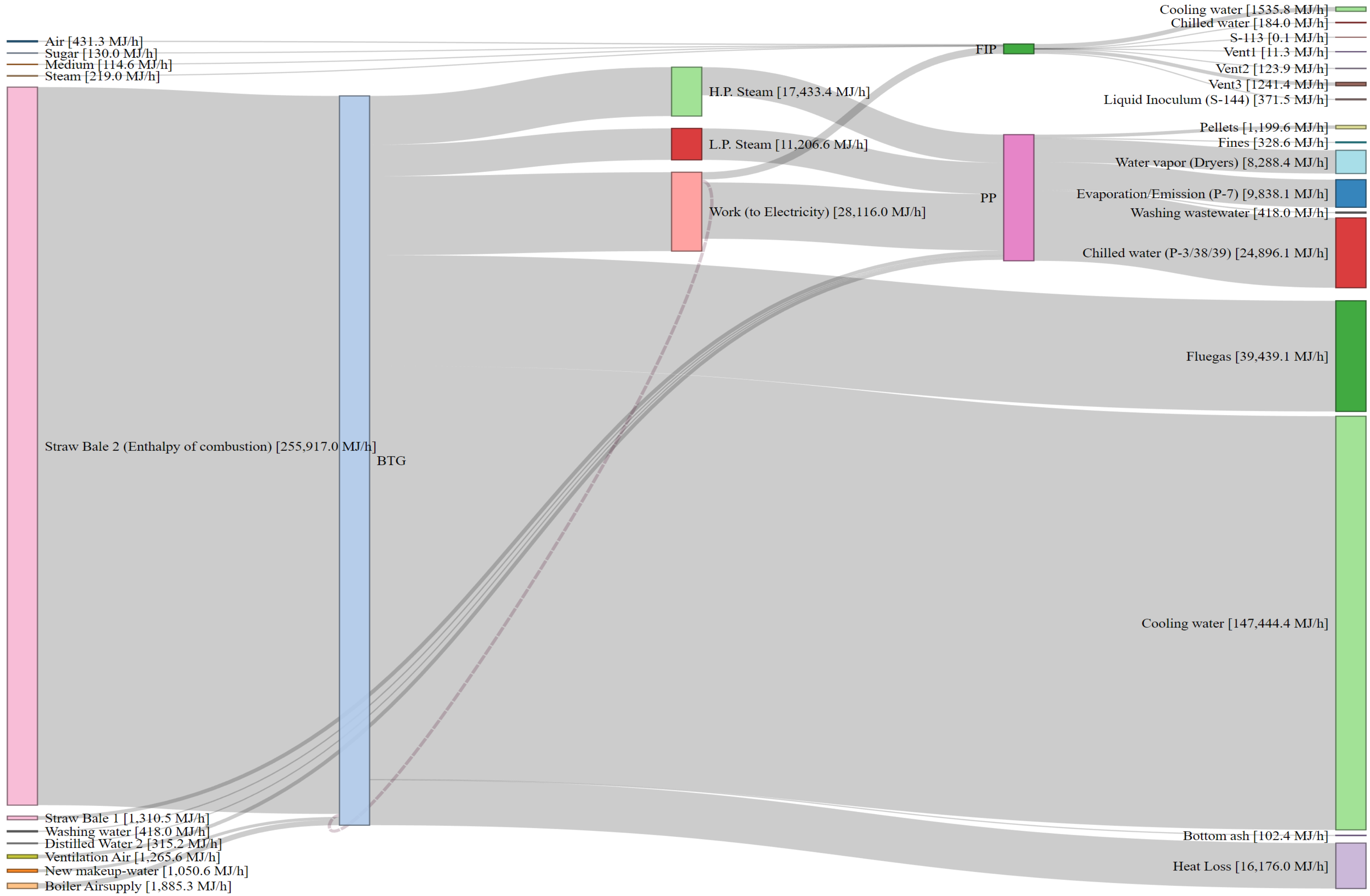

Figure S10: Energy balance of Pellet Plant A: **FIP** = fungal inoculum preparation block, **PP** = pellet production block, **BTG** = boiler-turbine-generator block.

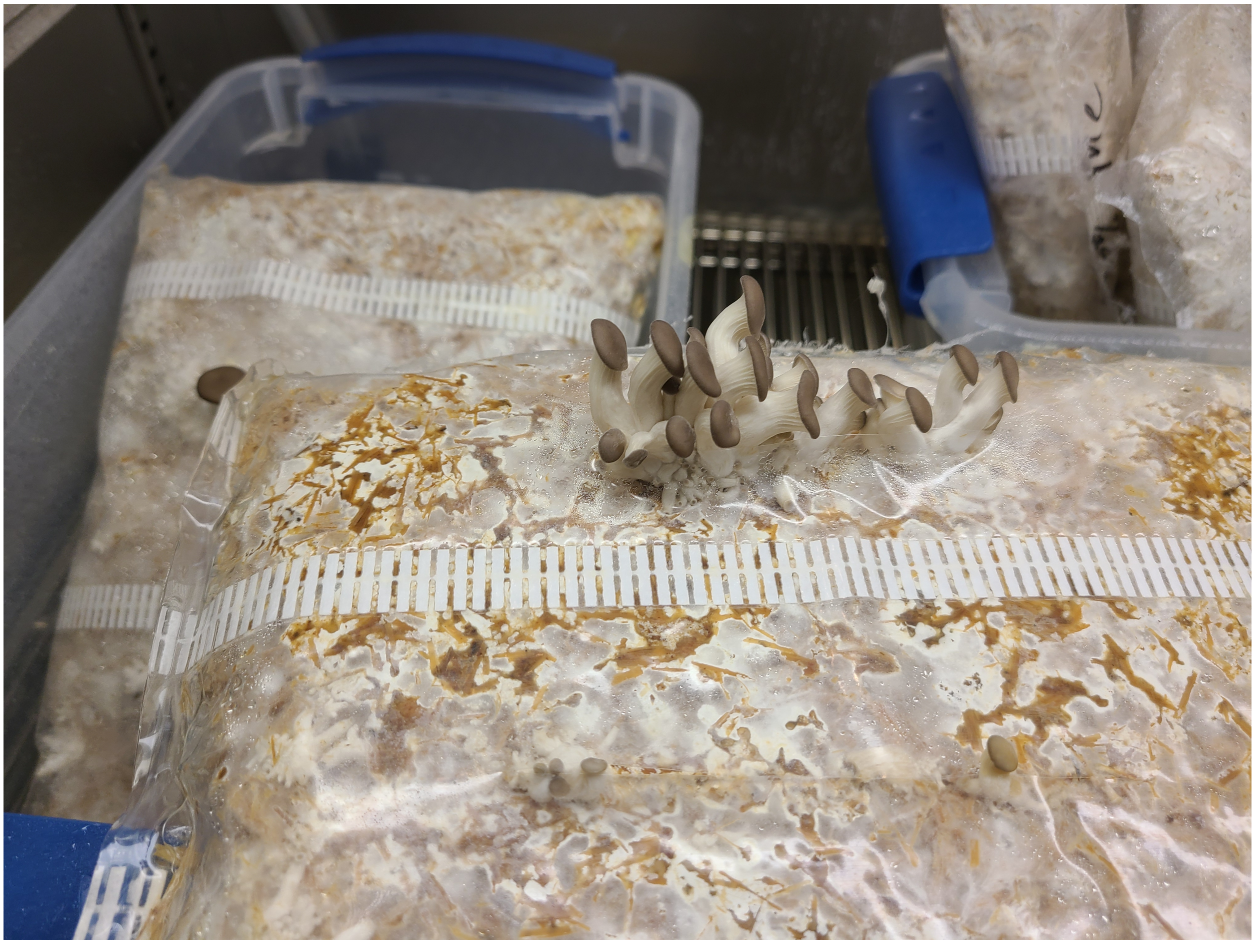

Figure S11: The combination of microbial pretreatment of camelina straw by *P. ostreatus* with oyster mushrooms cultivation results in the production of mushrooms for supplementary food and solid biofuel pellets for bioenergy. (Source: AAFC-Saskatoon by Dr. Tim Dumonceaux.)

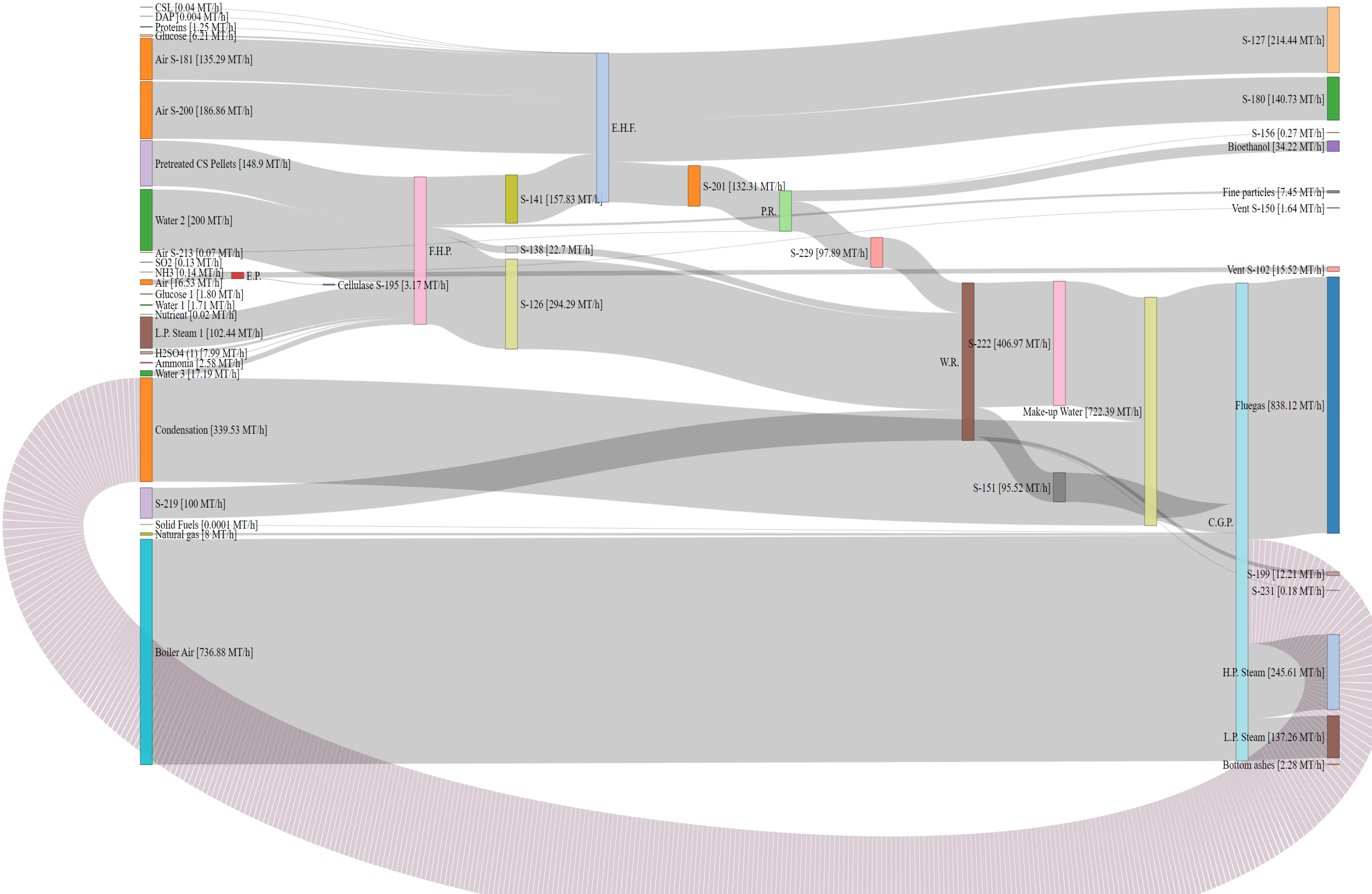

Figure S12: Mass balance of Ethanol Plant A (Base-case scenario with 148.9 MT h^{-1} of pellets supplied): **E.P.** = enzyme production, **F.H.P** = feedstock handling & pretreatment, **E.H.F.** = enzymatic hydrolysis & fermentation, **P.R.** = product recovery, **W.R.** = waste recovery, **C.G.P.** = co-generation plant.

```
# This code is written to find the logistically optimal point to locate the bioethanol
# plant.
# Provide coordinates data for the 5 locations:
x1 <- 51.5
y1 <- -109.2
x2 <- 50.3
y2 <- -107.8
x3 <- 50.4
y3 <- -105.5
x4 <- 49.7
y4 <- -103.9
x5 <- 51.8
y5 <- -106.7

# Define the five points:
points <- data.frame(
  x = c(x1, x2, x3, x4, x5),
  y = c(y1, y2, y3, y4, y5))

# Define the objective function to minimize:
objective <- function(coords) {
  sum(dist(rbind(coords, points)))
}

# Define the initial point:
start <- c(0, 0)
```

```
# Use the optim() function to minimize the objective function:
result <- optim(start, objective, method = "BFGS")

# Print the optimal coordinates and the minimum distance:
cat("Optimal coordinates: (", result$par[1], ", ", result$par[2], ")\n")
cat("Minimum distance: ", result$value, "\n")

# This is the optimal point:
x_optim <- 50.8878
y_optim <- -106.7043

# Create dataframe:
df <- data.frame(
  x = c(x1, x2, x3, x4, x5, x_optim),
  y = c(y1, y2, y3, y4, y5, y_optim)
)

# Create a scatterplot with the first 5 points
plot(df$y[1:5], df$x[1:5], pch = 19, col = "blue", xlab = "x", ylab = "y")

# Add the sixth point to the graph
points(df$y[6], df$x[6], pch = 19, col = "red")

# Add lines connecting the sixth point to the other points
for (i in 1:5) {
  lines(c(df$y[i], df$y[6]), c(df$x[i], df$x[6]), col = "gray", lwd = 2)
}
```

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