Life Cycle Assessment of Acrylic Fibre and Garment in Thailand

Thai Acrylic Fibre Co. Ltd., Aditya Birla Group, India

Session TU-303: Improving the life cycle performance of chemical products and materials through data exchange along the value chain

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Aditya Birla Group

- 41 billion USD Indian Multinational, operating in 36 countries, 120000 employee with 42 nationals
- India largest and most reputed and league of fortune 500
- Metal, Mining, Carbon black, textile, chemicals, acrylic, Insulators, financial services, VSF, Cement, telecom, fashion and Retail sector
- World largest aluminum rolling company and Novelis being world largest aluminum recycling facility
- World largest in Carbon black and Viscose Staple Fibre
- Among the top 5 cement players globally
- Globally 4th largest in acrylic fibre and insulators

Goal and Scope

Quantification of environmental impacts for:

- One tonne of Acrylic Fiber (3 denier regular birlacril bright and semidull Staple Acrylic Fibre)
- Manufactured at Thai Acrylic Fibre Co. Ltd., Saraburi, Thailand (cradle to gate)
- One piece of Acrylic Garment entire life cycle i.e. cradle to grave (450 grams), 100 washes
- Life Cycle Assessment' as per ISO 14040/44 standard.
- Hot-spot analysis in the value chain (raw materials, manufacturing, transport, packaging, use nd end of life) across the various identified environmental impacts
- Development of LCA Report for Communication to stakeholders

System Boundary

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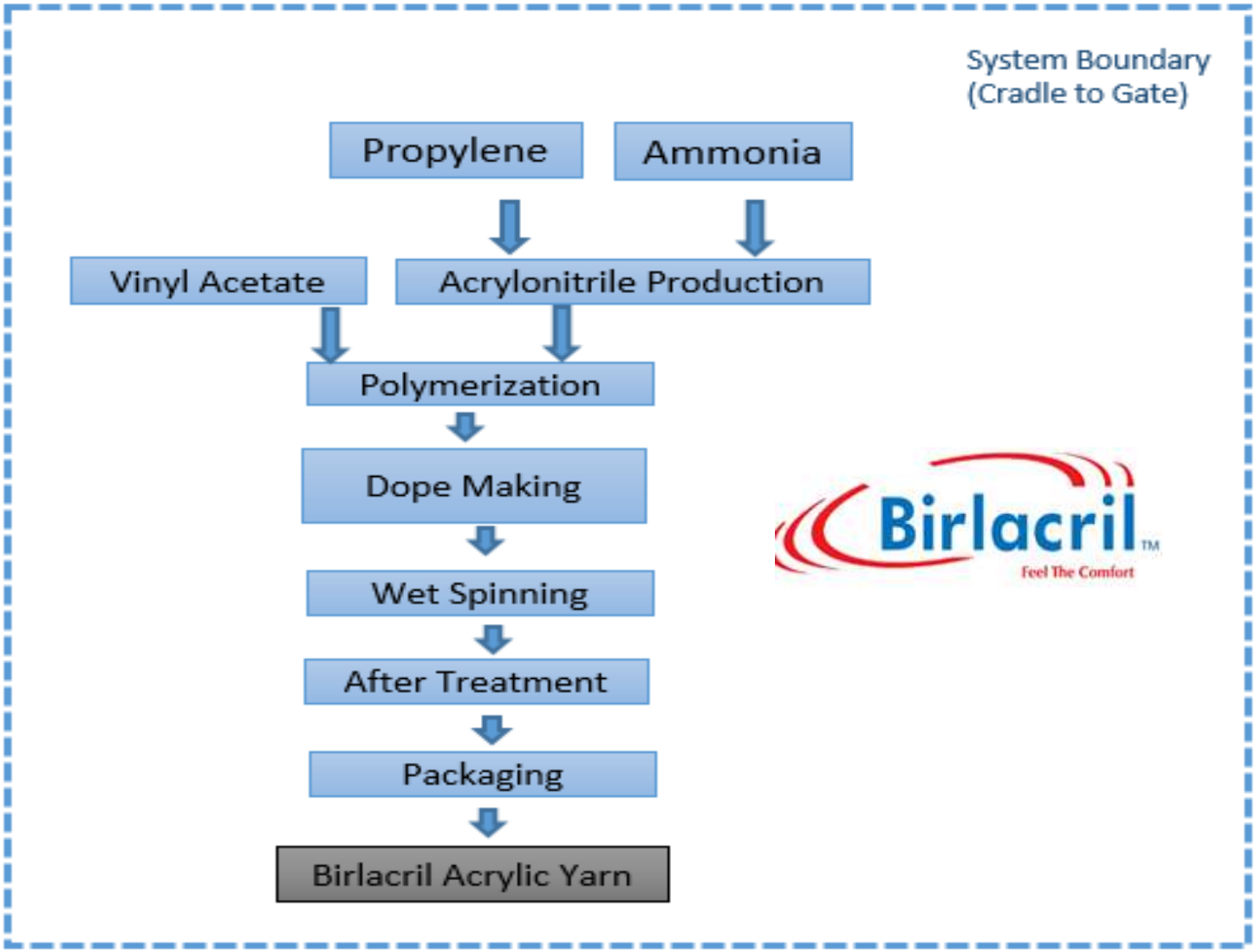
Acrylic Fibre (Cradle to Gate)



System Boundary

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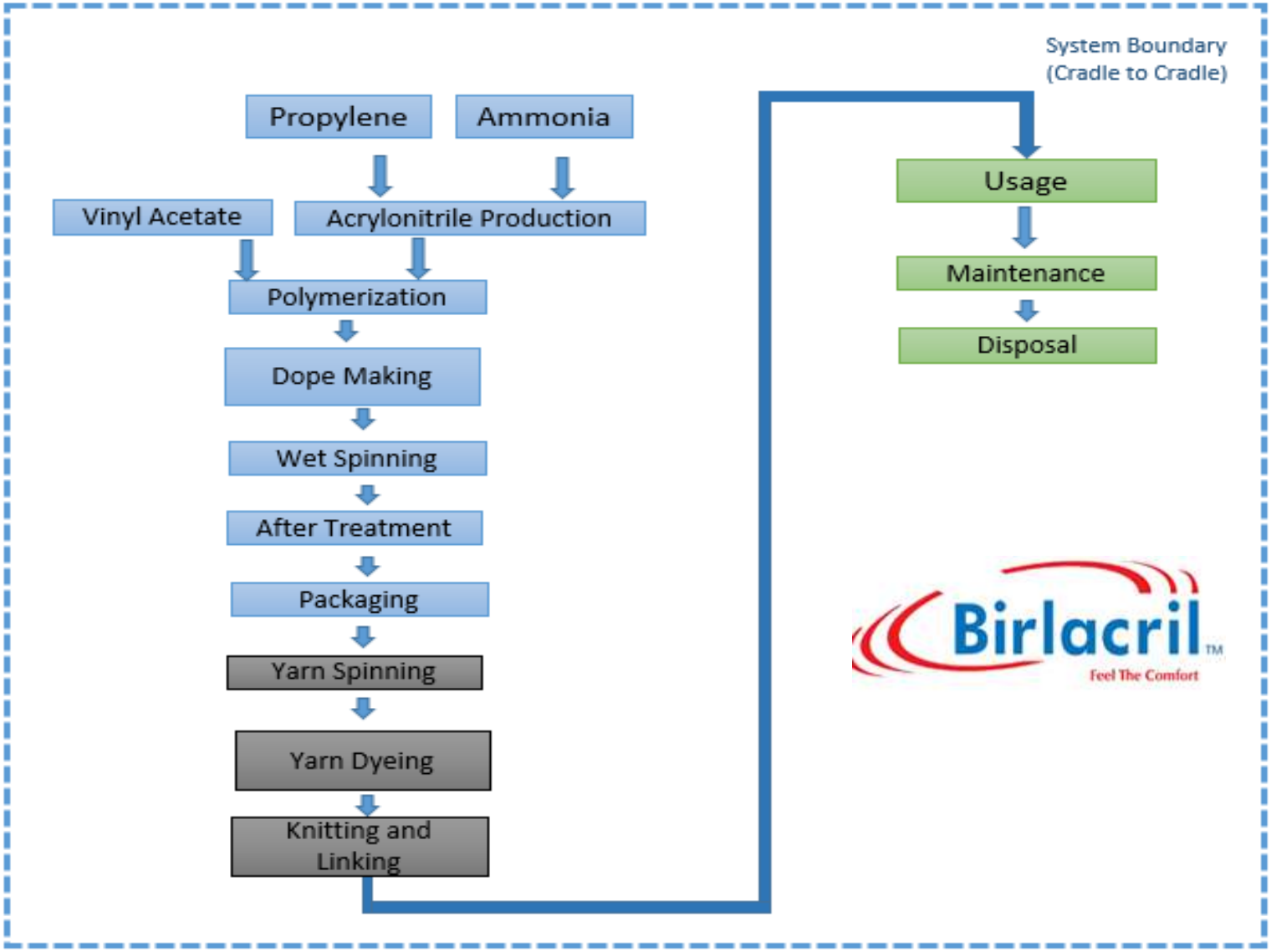
Acrylic Garment (Cradle to Grave)



Environmental Impacts
1 tonne of Acrylic Fibre

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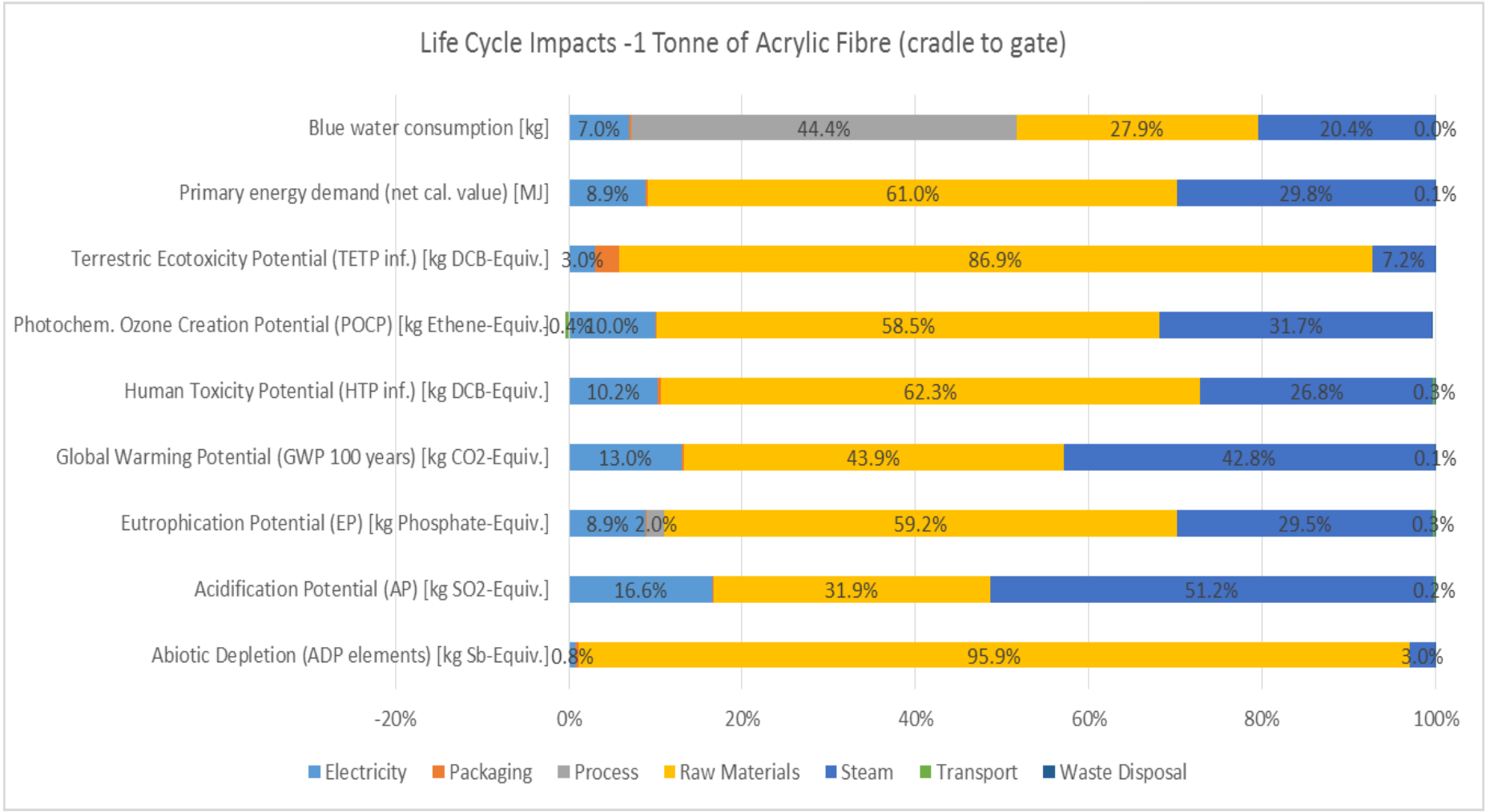
(Cradle to Gate)

Source wise environmental impacts breakup



Environmental Impacts
1 tonne of Acrylic Fibre

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Unit process wise environmental impacts breakup

(Cradle to Gate)

Life Cycle Impacts (CML)	Total	Dope Making	Polymerization	Solvent Recovery	Textile- Wet Spinning
Abiotic Depletion (ADP elements) [kg Sb-Equiv.]	0.001	-	0.001	-	-
Acidification Potential (AP) [kg SO2-Equiv.]	32.7	1.6	17.7	4.1	9.0
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	3.2	0.09	2.3	0.2	0.6
Global Warming Potential (GWP 100 years) [kg CO2-Equiv.]	9428.8	389.3	5889.5	990.3	2159.6
Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	156.4	4.2	112.2	11.3	28.5
Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	2.6	0.08	1.9	0.2	0.4
Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	5.2	0.04	1.4	0.1	3.6
Primary energy demand (net cal. value) [MJ]	164421.5	4731.8	121048.2	12015.9	26625.5
Blue water consumption [kg]	38924.1	1005.1	26727.7	3921.3	7269.9

Environmental Impacts
1 tonne of Acrylic Fibre

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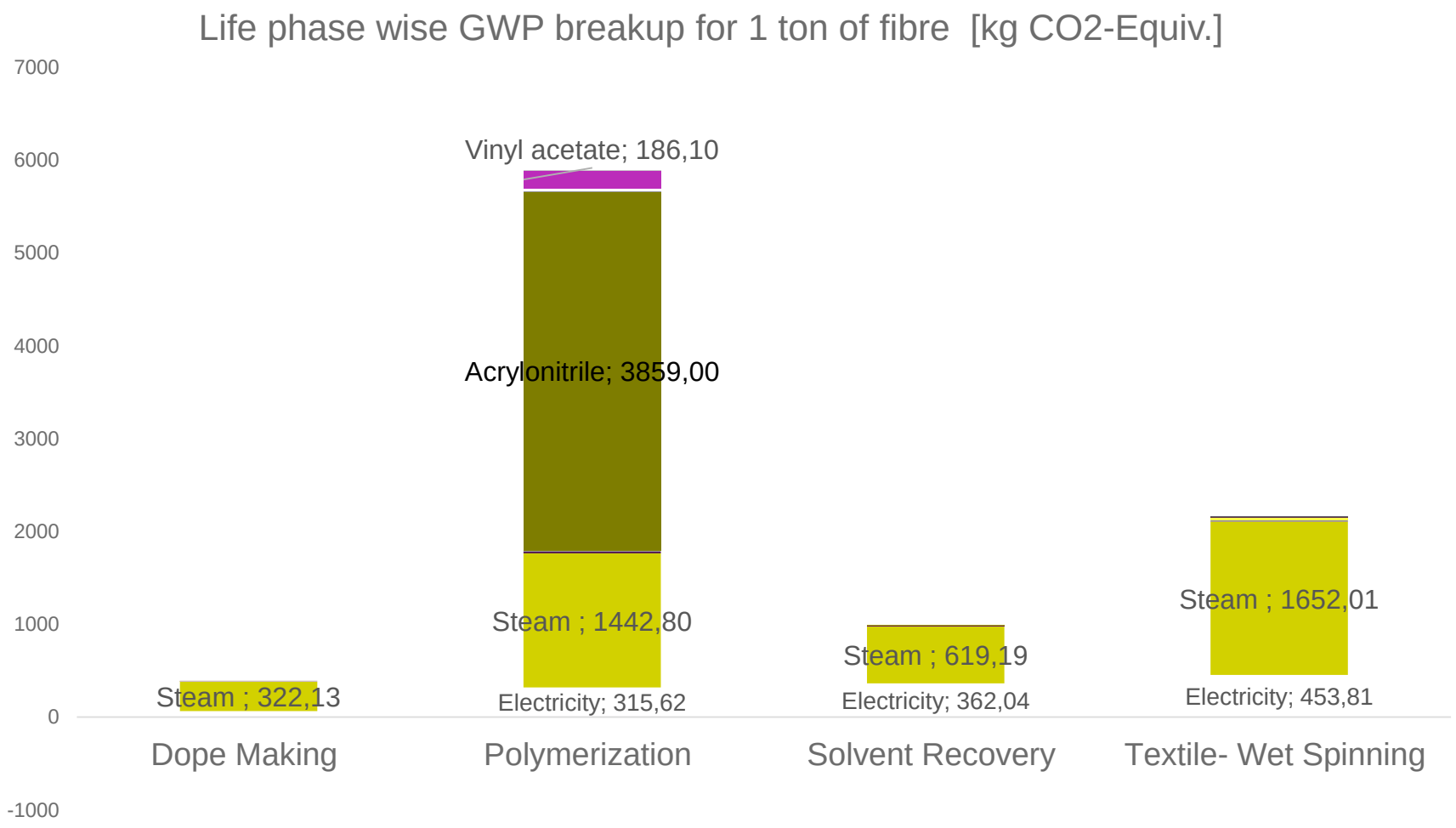
(Cradle to Gate)



Environmental Impacts
1 pc of Acrylic Garment

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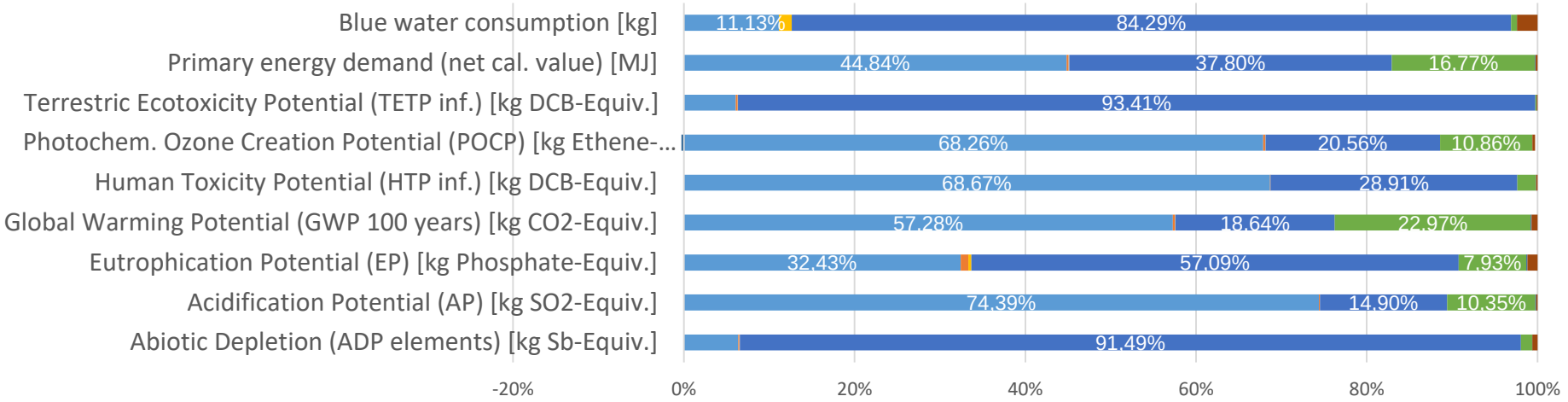
Source wise environmental impacts breakup

(Cradle to Grave)



	Abiotic Depletion (ADP elements) [kg Sb-Equiv.]	Acidification Potential (AP) [kg SO2-Equiv.]	Eutrophication Potential (EP) [kg Phosphate-Equiv.]	Global Warming Potential (GWP 100 years) [kg CO2-Equiv.]	Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	Primary energy demand (net cal. value) [MJ]	Blue water consumption [kg]
Electricity	6,38%	74,39%	32,43%	57,28%	68,67%	68,26%	6,07%	44,84%	11,13%
EoL	0,13%	0,10%	0,89%	0,26%	0,06%	0,23%	0,26%	0,22%	0,00%
Packaging	0,05%	0,02%	0,02%	0,07%	0,02%	0,05%	0,03%	0,10%	0,01%
Process	0,00%	0,00%	0,33%	0,00%	0,00%	0,00%	0,00%	0,00%	1,49%
Raw Materials	91,49%	14,90%	57,09%	18,64%	28,91%	20,56%	93,41%	37,80%	84,29%
Steam	1,35%	10,35%	7,93%	22,97%	2,16%	10,86%	0,14%	16,77%	0,71%
Transport	0,00%	0,09%	0,14%	0,08%	0,04%	-0,29%	0,00%	0,06%	0,00%
Waste Disposal	0,60%	0,14%	1,18%	0,69%	0,15%	0,33%	0,10%	0,23%	2,37%

Electricity EoL Packaging Process Raw Materials Steam Transport Waste Disposal

Environmental Impacts
1 pc of Acrylic Garment

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(Cradle to Grave)

Unit process wise environmental impacts breakup

Life Cycle Impacts (CML)	TOTAL	Acrylic Garment Production	Transport (To Use)	Garment Use	Transport (To Disposal)	Garment Disposal
Abiotic Depletion (ADP elements) [kg Sb-Equiv.]	4.84E-06	1.48E-06	4.99E-11	3.35E-06	4.99E-11	6.28E-09
Acidification Potential (AP) [kg SO2-Equiv.]	9.33E-02	3.58E-02	2.73E-05	5.73E-02	2.73E-05	9.52E-05
Eutrophication Potential (EP) [kg Phosphate-Equiv.]	9.94E-03	3.14E-03	8.86E-05	6.70E-03	4.32E-06	4.32E-06
Global Warming Potential (GWP 100 years) [kg CO2-Equiv.]	12.67	7.76	3.29E-03	4.86	3.29E-03	0.03
Human Toxicity Potential (HTP inf.) [kg DCB-Equiv.]	1.80	0.46	2.11E-04	1.34	2.11E-04	0.00
Photochem. Ozone Creation Potential (POCP) [kg Ethene-Equiv.]	0.005185	0.002461	-4.8E-06	0.002722	-4.8E-06	1.18E-05
Terrestric Ecotoxicity Potential (TETP inf.) [kg DCB-Equiv.]	0.25	0.02	2.20E-06	0.23	2.20E-06	6.46E-04
Primary energy demand (net cal. value) [MJ]	238.2	133.3	0.05	104.2	0.05	0.52
Blue water consumption [kg]	547.1	39.4	7.77E-03	507.6	7.77E-03	1.35E-03

Environmental Impacts
1 pc of Acrylic Garment

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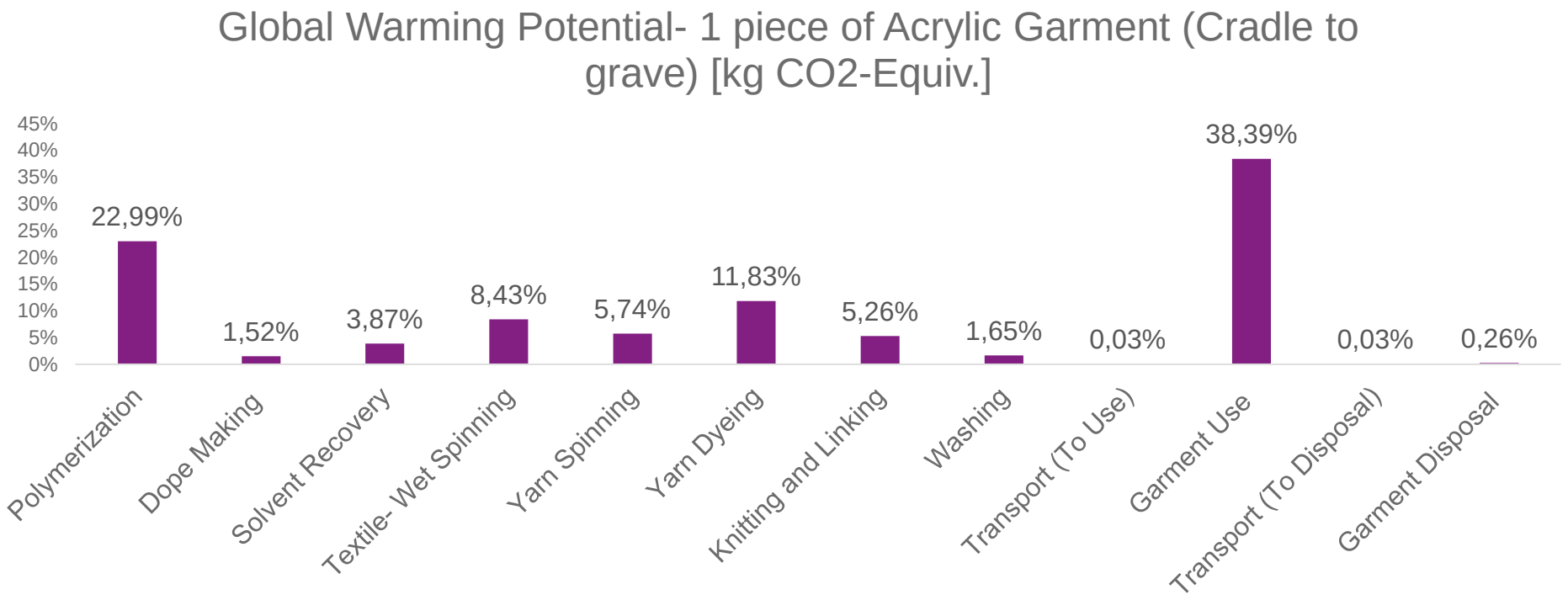
(Cradle to Grave)

Value Chain Assessment



Environmental Impacts
1 pc of Acrylic Garment

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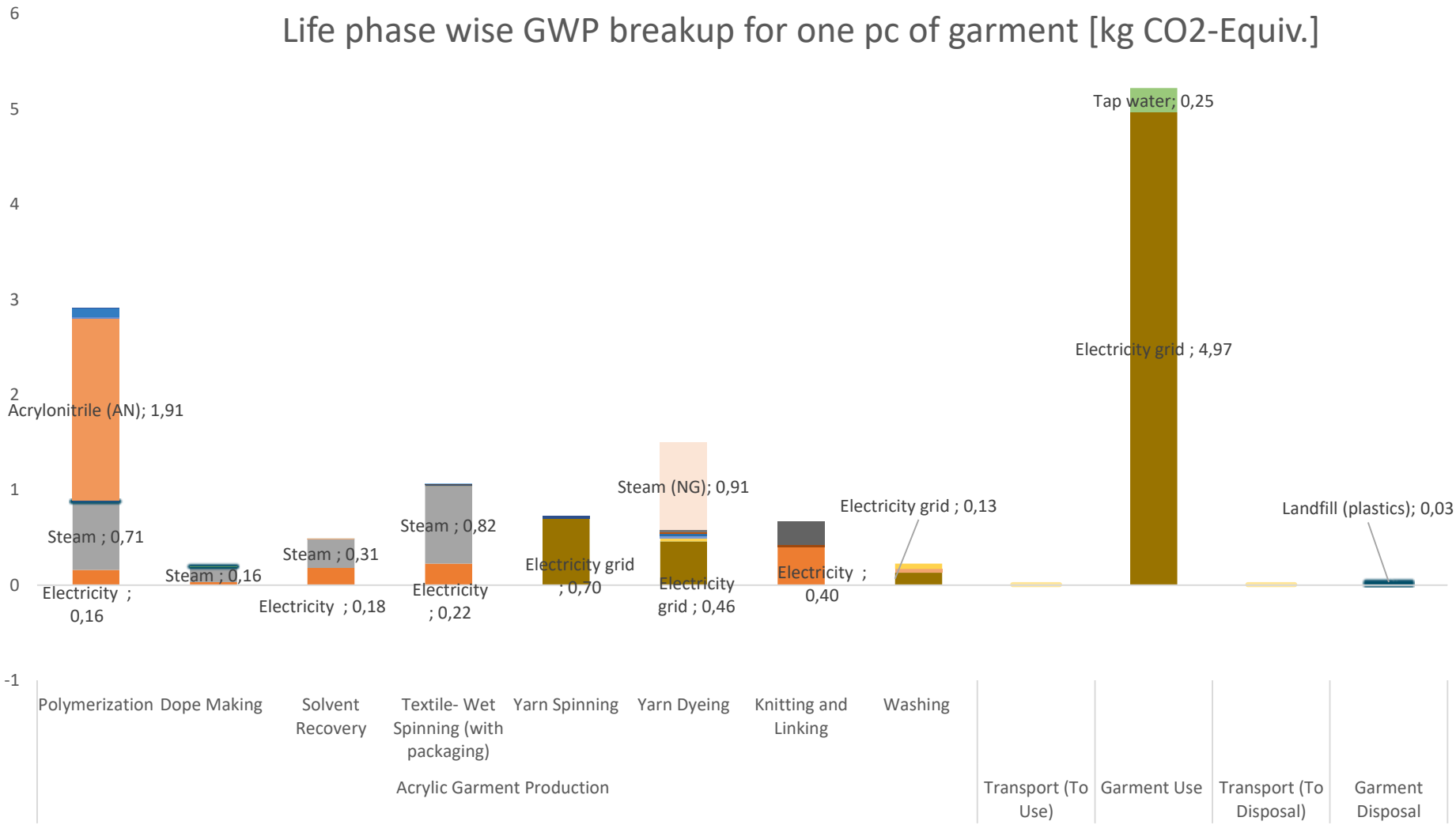
(Cradle to Grave)



Conclusion

- LCI profile of acrylic fibre for the specific process has been developed using actual plant data
- Acrylonitrile, electricity and steam consumption are major hot-spots
- Improvement in captive power plant efficiency
- Improvement in steam and electricity consumption in polymerisation, solvent recovery and wet-spinning processes.
- Use stage electricity and water consumption are also hot-spots in cradle to grave

Future Scope

Scenarios for usage of AN produced through propane route will be analysed in future to understand the following aspects :

- SOHIO process propylene ammoxidation route versus Propane route.
- Yield of Propane based production route in comparison to SOHIO process.
- Advantage over propylene (difference between propylene and propane)
- Fractional distillation of petroleum versus propylene goes through cracking or catalytic dehydrogenation.
- Ammonia and electricity consumption in both process

Thank you For Your Kind Attention

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