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Life Cycle Assessment

November, 2017

LCA – Definition and scope

Life Cycle Assessment is the systematic analysis of the environmental impact of products during their entire life cycle

ISO 14040:2006 – Principles and framework for life cycle assessment

Type of assessment – Cradle to Grave

ThinkStep

Operations covered – Anjar and Vapi

Products covered – Bedsheet, Towels, TOB, rugs

Impact categories

Impact Category	Units (equivalents)	Source of Impact
Abiotic Depletion of Fossil elements	kg Sb eq.	Depletion of fossil elements (metals, non-metals etc.)
Acidification Potential (AP)	kg SO_2 eq.	Emission of SO_2, NO_x, NH_4
Eutrophication Potential (EP)	kg PO_4 eq.	Emission of P, PO_4
Global Warming Potential (GWP)	kg CO_2 eq.	Emission of CO_2 , N_2O, CH_4 etc.
Global Warming Potential (GWP) -excl. Biogenic	kg CO2-eq.	Biogenic Carbon Stored through Photo Synthesis
Ozone Layer Depletion Potential (ODP)	kg R11 eq.	Emission of Ozone depleting substances i.e. CFC
Photochemical Ozone Creation Potential (POCP)	Kg ethane eq.	Emission of Non-methane volatile organic compounds
Primary Energy Demand	MJ	Energy demand from non-renewable and renewable sources
Blue Water Consumption	m^3	Ground and surface water consumption

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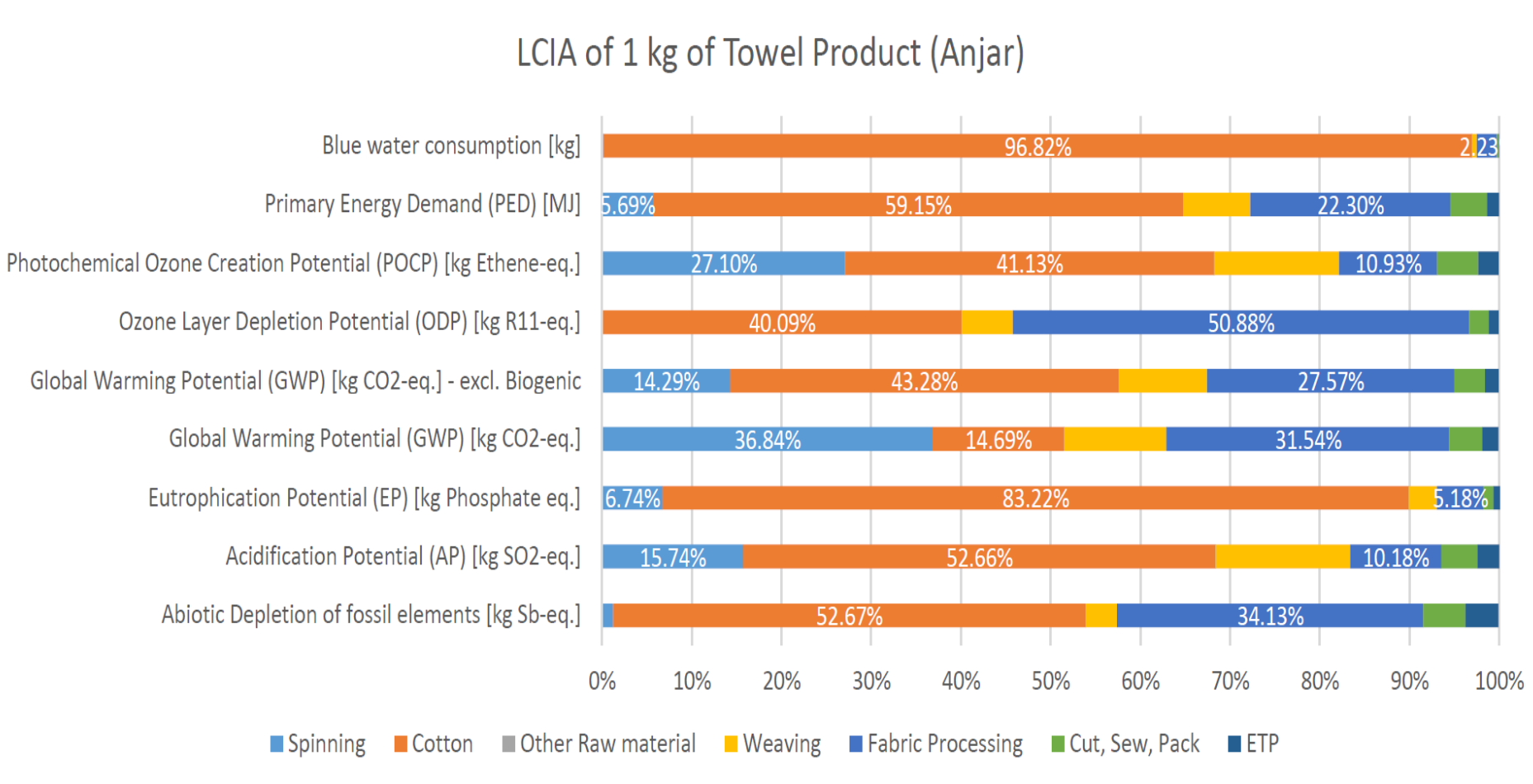
LCA – Towel, Anjar (Cradle to gate)



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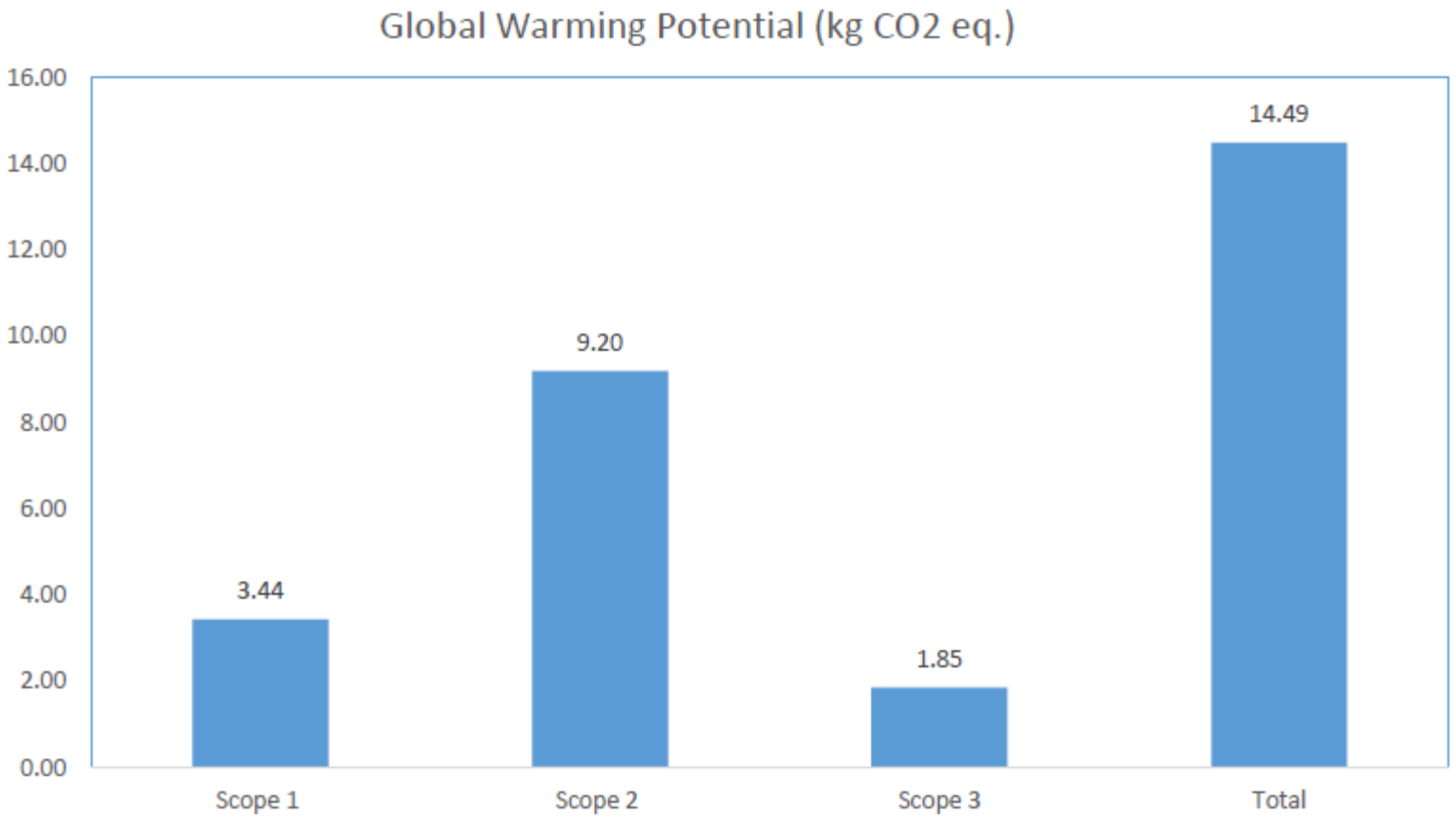
Impact wise breakup – Towel, Anjar

Environmental Indicator	Source of Impact	Raw Materials	Disposal	Energy	Fuel	Packaging	Process Impact	Transport	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	1.77E-06	0.00	4.12E-07	1.23E-08	9.06E-08	0.00	9.77E-09	2.30E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	1.82E-02	0.00	1.08E-01	1.93E-03	1.64E-03	3.70E-03	1.82E-03	0.14
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	2.38E-02	9.50E-05	4.90E-03	2.38E-04	1.58E-04	4.45E-04	2.22E-04	2.99E-02
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	1.18	0.00	9.20	0.36	0.21	3.43	0.11	14.49
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	3.66	0.00	9.18	0.36	0.26	3.43	0.11	17.01
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	4.20E-10	0.00	1.93E-10	2.11E-12	7.16E-12	0.00	5.48E-13	6.23E-10
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	1.05E-03	0.00	5.15E-03	1.83E-04	1.31E-04	1.76E-04	8.99E-06	6.70E-03
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	107.53	0.00	106.10	45.83	7.07	0.00	1.45	267.98
Blue water consumption [kg]	Ground and surface water	2138.83	0.00	58.04	0.85	1.38	45.04	0.16	2244.30

Source wise Life Cycle Environmental Impacts for 1 kg of Solid Dyed Towel

1kg of solid dyed towel, Anjar – Cradle to gate



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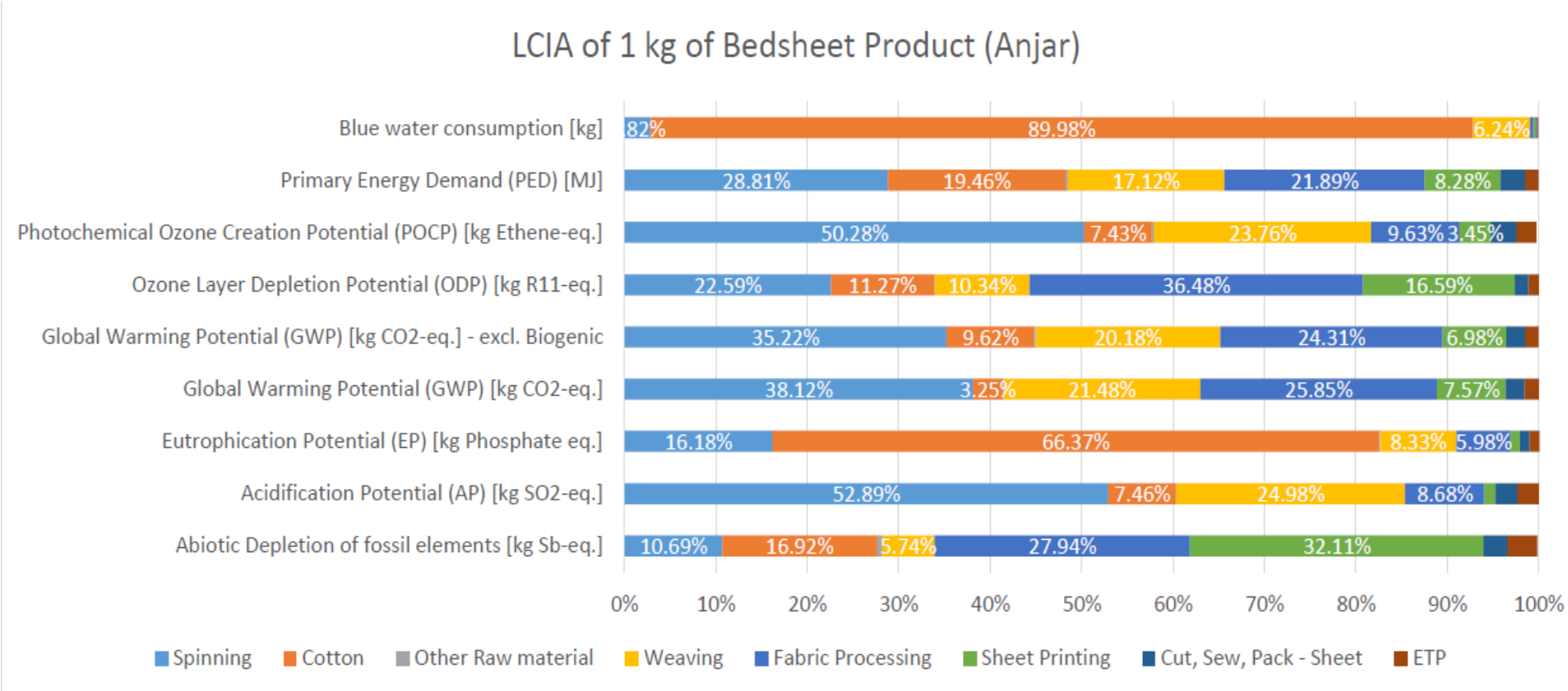
LCA – Solid dyed bedsheet (Cradle to gate)



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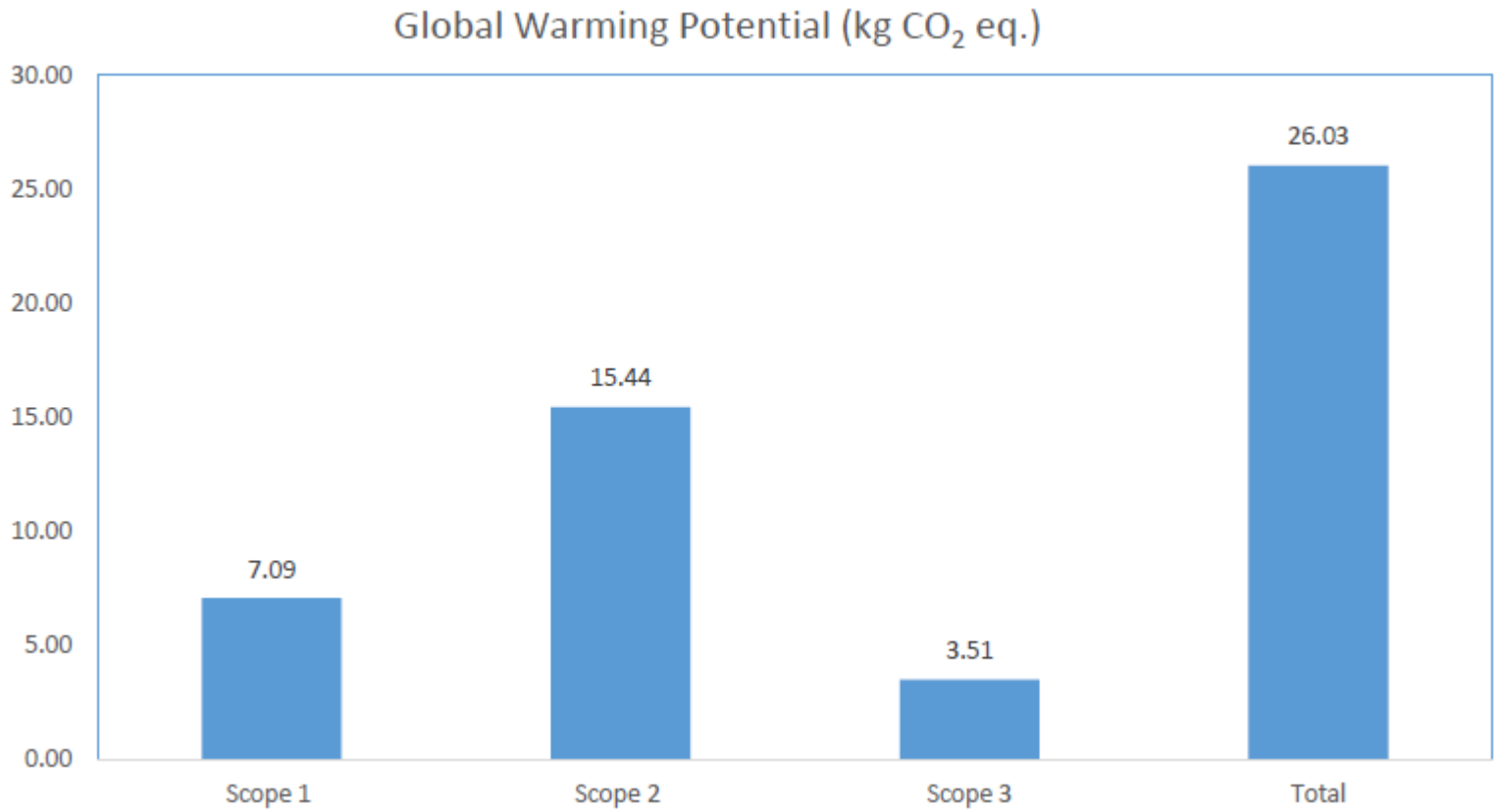
Impact wise breakup – solid dyed sheet, Anjar

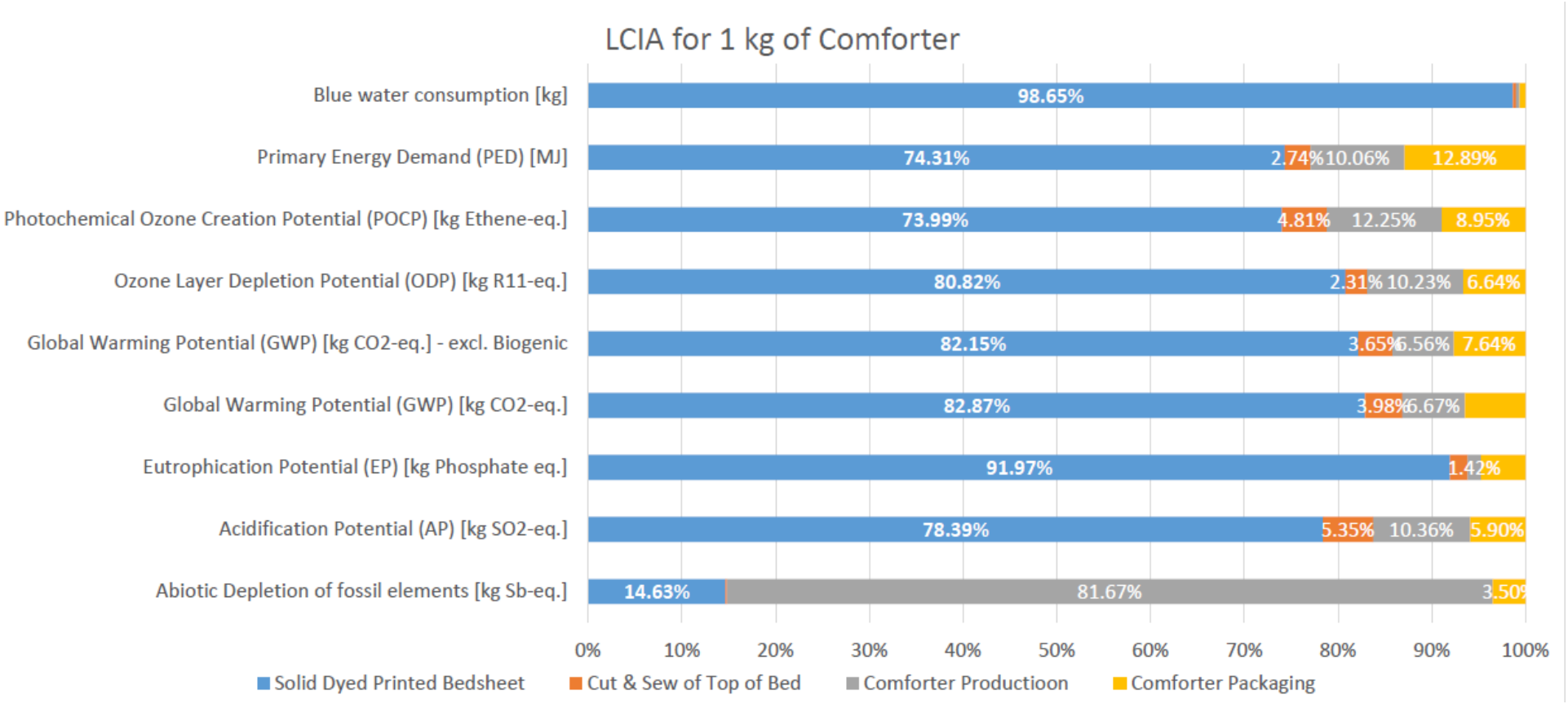
Environmental Indicator	Source of Impact	Raw Material	Disposal	Energy	Fuel	Packaging	Process Impact	Transport	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	3.27E-06	2.06E-10	6.91E-07	2.54E-08	9.06E-08	0.00	8.30E-09	4.08E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	1.91E-02	4.51E-06	1.82E-01	3.98E-03	1.64E-03	7.64E-03	2.53E-03	0.22
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	2.21E-02	1.73E-04	8.23E-03	4.91E-04	1.58E-04	9.18E-04	2.85E-04	3.23E-02
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	2.43	1.69E-02	15.44	0.73	0.21	7.09	0.12	26.03
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	4.47	1.29E-02	15.42	0.74	0.26	7.09	0.12	28.10
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	5.74E-10	3.95E-14	3.24E-10	4.36E-12	7.16E-12	0.00	5.46E-13	9.10E-10
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	1.27E-03	4.27E-06	8.64E-03	3.77E-04	1.31E-04	3.62E-04	7.66E-05	1.09E-02
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	114.20	1.68E-02	178.13	94.57	7.07	0.00	1.56	395.54
Blue water consumption [kg]	Ground and surface water	1976.27	2.14E-03	97.44	1.76	1.38	108.22	0.12	2185.20

Source wise Life Cycle Environmental Impacts for 1 kg of Solid Dyed Printed Sheet

1kg of solid dyed sheet, Anjar – Cradle to gate



LCA – Comforter (Cradle to gate)



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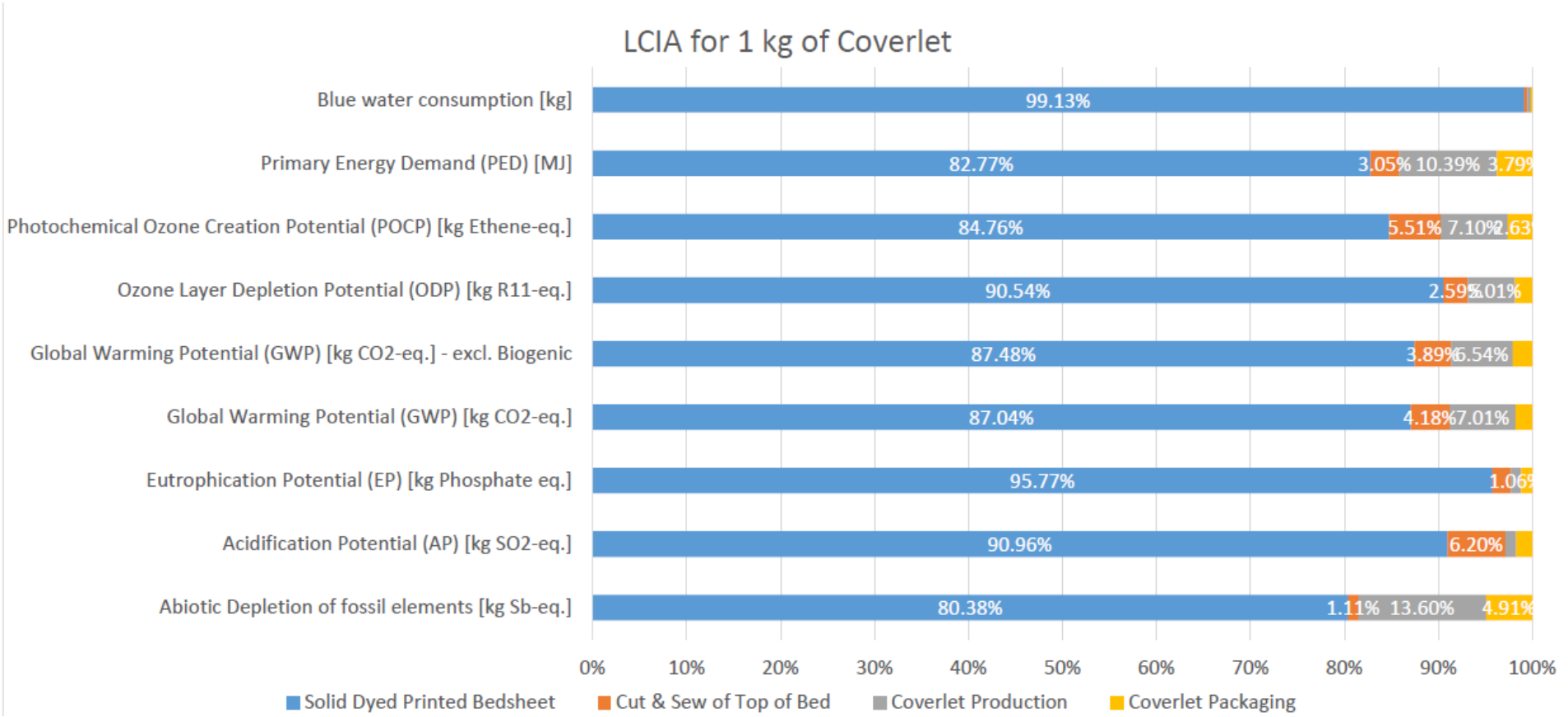
LCA – TOB, Coverlet (Cradle to gate)



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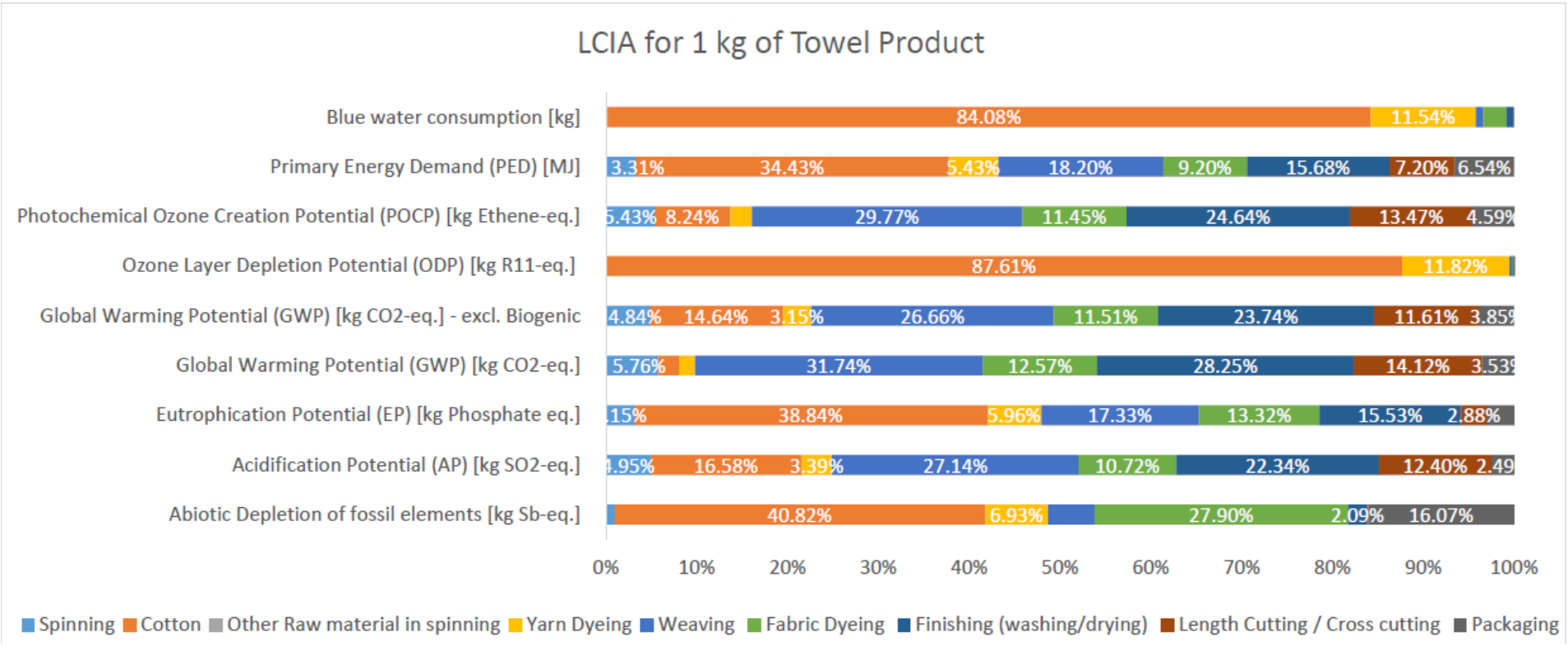
LCA – Towel, Vapi (Cradle to gate)



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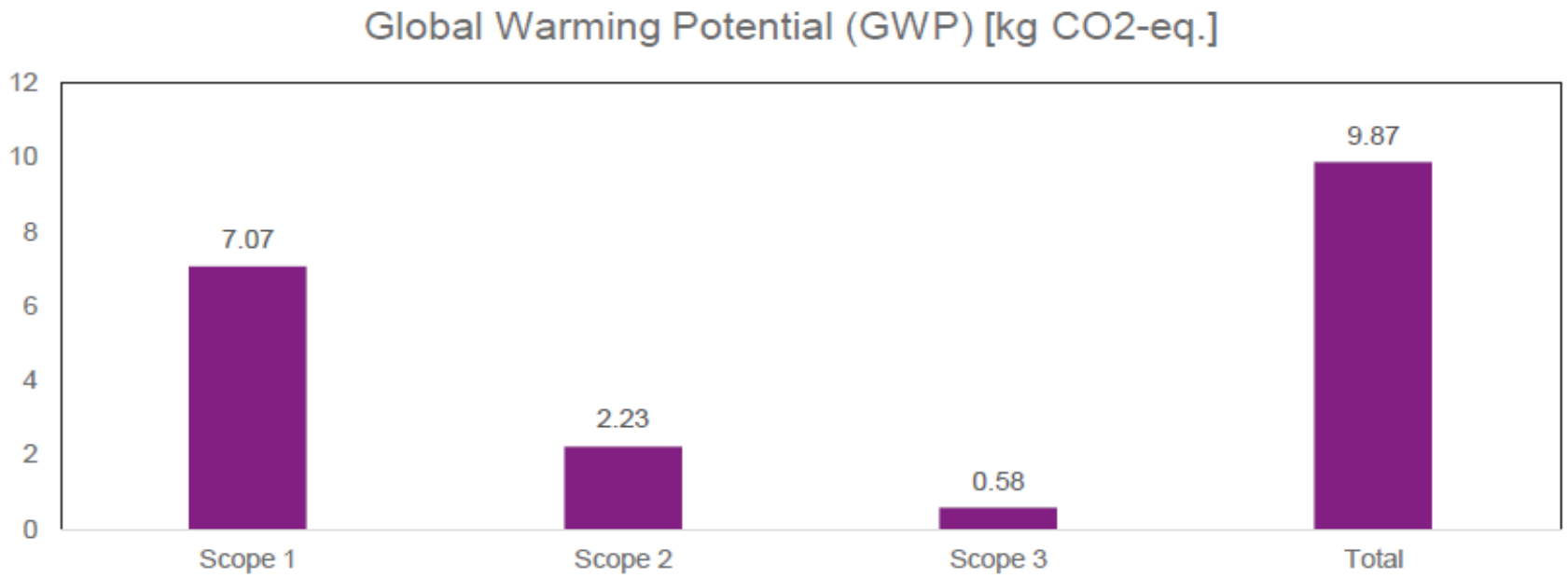
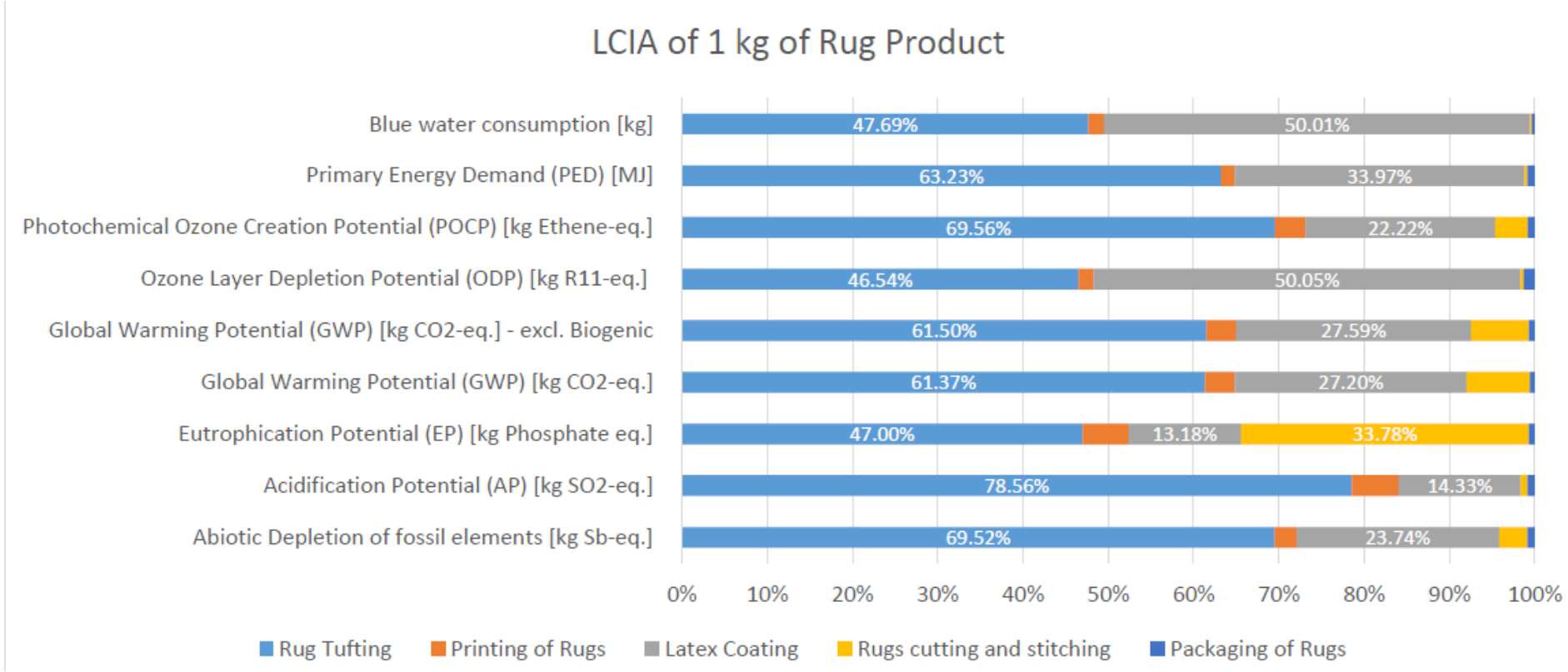
Impact wise breakup – Towel, Vapi

Environmental Indicator	Source of Impact	Raw Materials	Disposal	Electricity	Steam	Fuel (diesel)	Packaging	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	7.78E-07	-2.44E-08	1.19E-07	1.05E-08	2.35E-10	1.69E-07	1.05E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	2.18E-02	-4.57E-04	6.45E-02	2.24E-02	3.14E-04	2.76E-03	1.11E-01
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	4.79E-03	-5.09E-04	3.60E-03	1.42E-03	9.45E-06	2.88E-04	9.76E-03
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	3.11E-01	-7.62E-02	6.67E+00	2.61E+00	2.24E-02	3.47E-01	9.87
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	2.12E+00	-1.06E-01	6.66E+00	2.61E+00	2.24E-02	4.50E-01	11.75
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	8.52E-09	-1.86E-11	4.98E-11	1.30E-12	1.39E-14	1.34E-11	8.57E-09
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	4.81E-04	-2.77E-05	3.10E-03	1.09E-03	1.61E-05	2.23E-04	4.89E-03
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	75.16	-2.48	70.26	26.18	0.30	11.83	181.25
Blue water consumption [kg]	Ground and surface water	2372.10	-46.87	15.55	0.74	0.01	2.37	2443.10

1 tonne of solid dyed towel, Vapi – Cradle to gate



LCA – Rug, Vapi (Cradle to gate)



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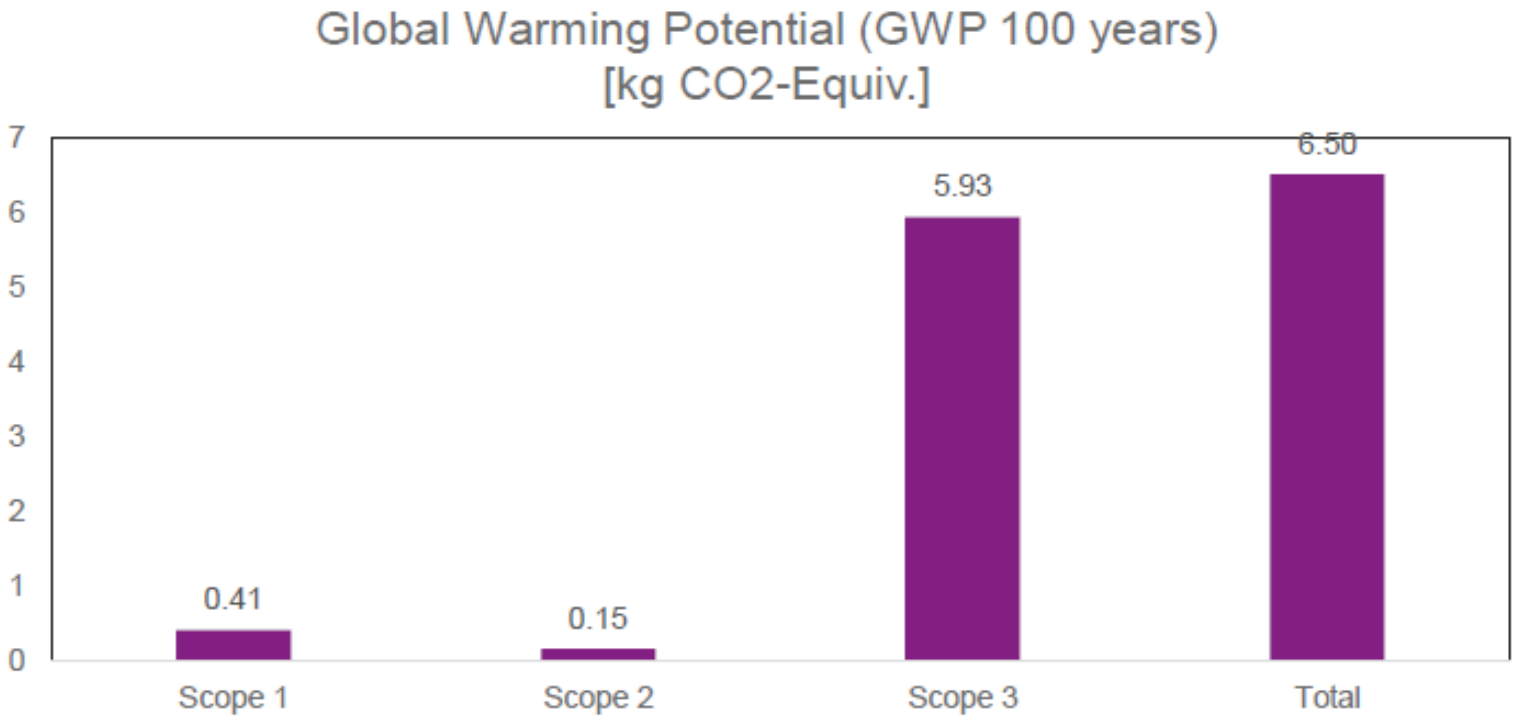
Impact wise breakup – Rugs, Vapi

Environmental Indicator	Source of Impact	Rug Tufting	Printing of Rugs	Latex Coating	Rugs cutting , stitching	Packaging of Rugs	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	1.10E-06	4.08E-08	3.76E-07	5.23E-08	1.35E-08	1.58E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	2.53E-02	1.77E-03	4.61E-03	2.48E-04	2.71E-04	0.03
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	1.80E-03	2.07E-04	5.06E-04	1.30E-03	2.46E-05	3.84E-03
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	3.99	0.23	1.77	0.48	0.03	6.50
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	3.97	0.22	1.78	0.44	0.04	6.45
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	4.25E-11	1.60E-12	4.57E-11	3.84E-13	1.13E-12	9.13E-11
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	1.87E-03	9.67E-05	5.96E-04	1.02E-04	2.14E-05	2.68E-03
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	84.33	2.15	45.31	0.44	1.14	133.38
Blue water consumption [kg]	Ground and surface water	32.13	1.21	33.70	0.11	0.22	67.38

1kg of Rug, Vapi – Cradle to gate



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Equivalent results

Environmental Indicator /Product	Equivalents						
	Towel Vapi	Rug	Towel Anjar	Sheet	Top of Bed (Comforter)	Top of Bed (Coverlet)	Unit
Acidification Potential (AP) [kg SO2-eq.]	7	3	8	8	22	5	MJ of energy generated from hard coal
Eutrophication Potential (EP) [kg Phosphate eq.]	5	2	11	12	9	9	gram of Phosphorus emission to freshwater
Global Warming Potential (GWP) [kg CO2-eq.]	139	63	171	210	161	155	km distance travelled by a BS IV diesel vehicle (<1600 CC)
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	275	131	341	438	404	358	gram of CO emission to air
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	265	127	329	423	389	345	gram NOx emission to air
Primary Energy Demand (PED) [MJ]	489	242	610	663	535	487	hrs of lightning a 60W bulb
Blue water consumption [kg]	1920	197	1792	1423	843	852	days of human drinking water needs

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Cradle to grave – 1kg towel, Anjar

Environmental Indicator	Source of Impact	Production	Use Phase	Transport (outbound)	End of life	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	2.30E-06	2.43E-06	1.08E-09	2.73E-09	4.73E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	1.36E-01	1.71E-02	1.82E-03	9.55E-04	0.16
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	2.99E-02	1.09E-03	1.99E-04	2.24E-03	3.34E-02
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	14.49	5.10	0.09	0.75	20.43
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	17.01	4.96	0.09	0.59	22.64
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	6.23E-10	1.60E-09	6.13E-14	-2.83E-11	2.19E-09
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	6.70E-03	1.10E-03	5.32E-05	3.46E-04	8.19E-03
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	267.98	86.79	1.19	-1.03	354.94
Blue water consumption [kg]	Ground and surface water	2199.30	603.22	0.01	0.07	2802.60

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Cradle to grave – 1kg solid dyed printed sheet

Environmental Indicator	Source of Impact	Production	Use Phase	Transport (outbound)	End of life	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	4.33E-06	2.51E-06	1.33E-09	-1.86E-10	6.84E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	2.14E-01	1.10E-02	2.03E-03	8.92E-04	0.23
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	3.24E-02	8.48E-04	2.27E-04	1.83E-03	3.53E-02
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	25.83	4.56	0.11	0.69	31.19
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	27.87	4.42	0.11	0.54	32.94
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	9.06E-10	1.52E-09	7.57E-14	-4.38E-11	2.38E-09
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	1.07E-02	8.18E-04	3.71E-05	3.10E-04	1.18E-02
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	388.74	89.03	1.49	-1.89	477.37
Blue water consumption [kg]	Ground and surface water	2095.60	608.45	0.01	0.12	2704.20

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Cradle to grave – 1kg TOB- Coverlet

Environmental Indicator	Source of Impact	Production	Use Phase	Transport (outbound)	End of life	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	3.69E-06	1.12E-06	7.71E-10	5.89E-09	4.82E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	1.64E-01	1.15E-02	1.45E-03	9.43E-04	0.18
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	2.35E-02	6.59E-04	1.53E-04	2.87E-03	2.72E-02
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	20.66	2.53	0.06	0.86	24.12
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	22.18	2.46	0.06	0.69	25.39
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	6.96E-10	6.83E-10	4.33E-14	-9.79E-12	1.37E-09
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	8.76E-03	6.71E-04	6.11E-05	3.82E-04	9.87E-03
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	326.81	40.77	0.81	-0.03	368.35
Blue water consumption [kg]	Ground and surface water	1471.70	289.72	4.73E-03	0.01	1761.40

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Cradle to grave – 1kg Solid dyed towel, Vapi

Environmental Indicator	Source of Impact	Production	Use Phase	Transport (outbound)	End of life	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	1.05E-06	2.43E-06	8.61E-10	2.73E-09	3.48E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	1.11E-01	1.71E-02	1.72E-03	9.55E-04	0.13
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	9.76E-03	1.09E-03	1.80E-04	2.24E-03	1.33E-02
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	9.87	5.10	0.07	0.75	15.80
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	11.75	4.96	0.07	0.59	17.37
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	8.57E-09	1.60E-09	4.85E-14	-2.83E-11	1.01E-08
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	4.89E-03	1.10E-03	8.04E-05	3.46E-04	0.0064
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	181.25	86.79	0.91	-1.03	267.92
Blue water consumption [kg]	Ground and surface water	2443.10	603.22	0.01	0.07	3046.40

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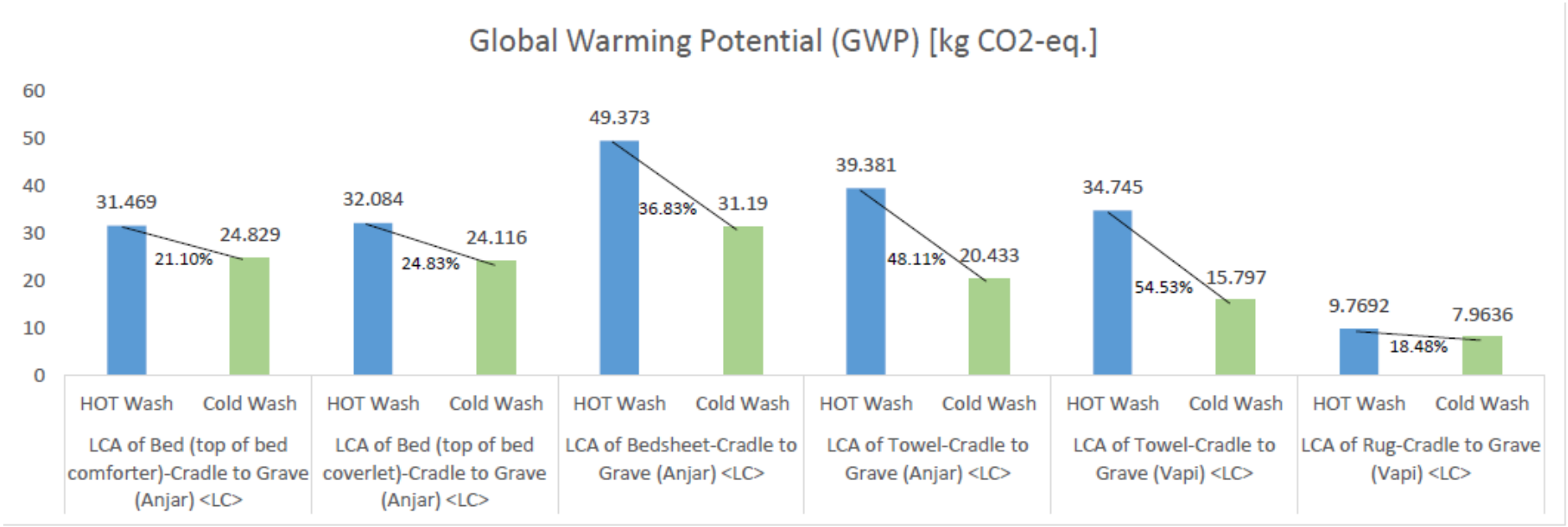
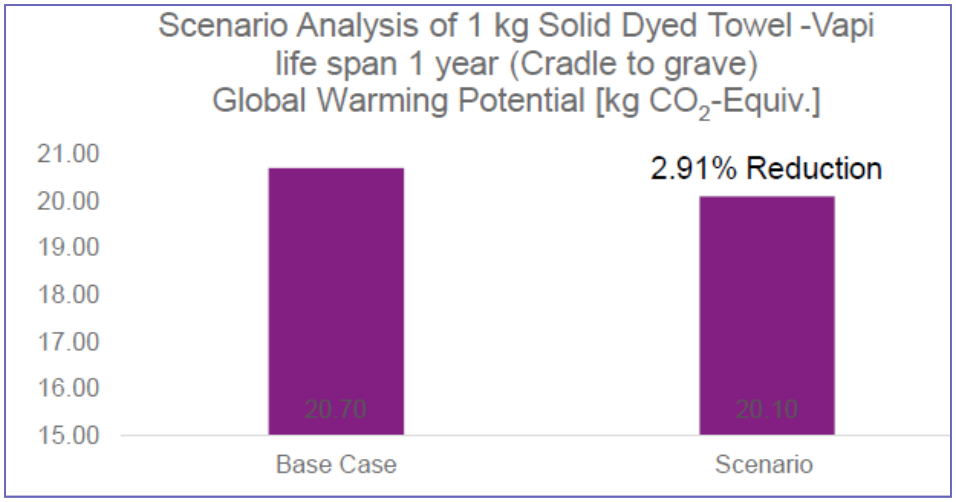
Cradle to grave – 1kg Printed rug, Vapi

Environmental Indicator	Source of Impact	Production	Use Phase	Transport (outbound)	End of life	Total
Abiotic Depletion of fossil elements [kg Sb-eq.]	Depletion of fossil elements (metals, non-metals etc.)	1.58E-06	3.13E-07	8.39E-10	-4.52E-09	1.89E-06
Acidification Potential (AP) [kg SO2-eq.]	SO_2, NOx, NH4	3.22E-02	3.91E-03	1.72E-03	6.15E-04	3.84E-02
Eutrophication Potential (EP) [kg Phosphate eq.]	P, PO_4	3.84E-03	2.18E-04	1.80E-04	1.70E-03	5.93E-03
Global Warming Potential (GWP) [kg CO2-eq.]	CO_2, CH_4, N_2O	6.50	0.71	0.07	0.69	7.96
Global Warming Potential (GWP) [kg CO2-eq.] - excl. Biogenic	Biogenic carbon stored during photosynthesis	6.45	0.69	0.07	0.57	7.77
Ozone Layer Depletion Potential (ODP) [kg R11-eq.]	ODS i.e. CFC etc.	-9.13E-11	1.56E-10	4.80E-14	6.28E-11	1.84E-10
Photochemical Ozone Creation Potential (POCP) [kg Ethene-eq.]	Non-methyl VOC	2.68E-03	2.19E-04	8.11E-05	2.50E-04	3.23E-03
Primary Energy Demand (PED) [MJ]	Non-renewable and renewable energy	133.38	12.68	0.91	3.01	143.96
Blue water consumption [kg]	Ground and surface water	67.38	77.53	0.01	0.20	145.12

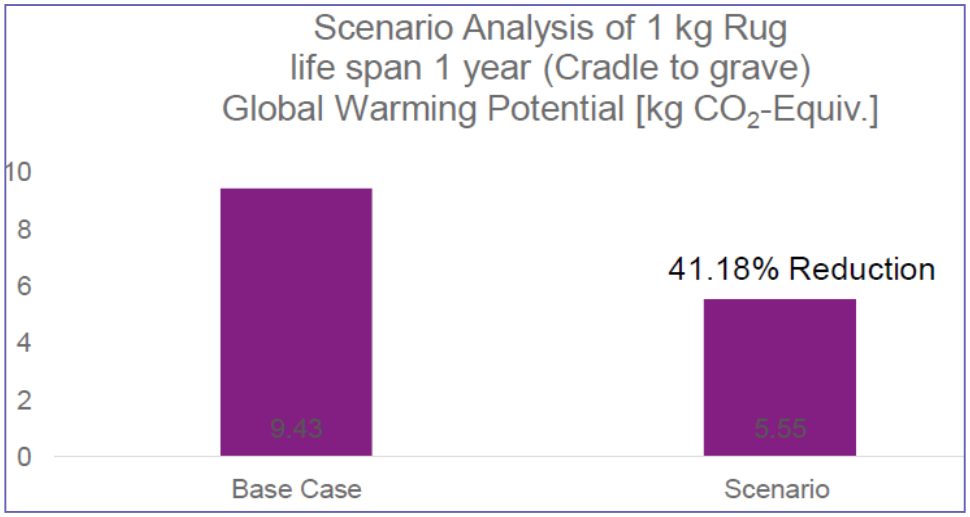
Comparison – Hot wash v/s cold wash



Scenario analysis – Vapi



20% energy reduction in weaving



Substitution of PET with recycled PET

Life Cycle comparisons

Type of material	GWP (kg of CO_2)	Blue water consumption
BCI Cotton	0.977 / kg of cotton	0.18 kl/ kg of cotton
Organic cotton	0.35/ kg of cotton	0.89 kl/ kg of cotton
Conventional cotton	2.77/ kg of cotton	2.1kl/ kg of cotton
Recycled cotton fiber	**0.1 – 0.9/ kg of cotton**	**0 – 0.04 kl/kg of cotton**

Type of material	GWP (kg of CO_2)
Virgin PET	4.6 / kg of PET
Recycled (Post consumer)	**2.6 – 3 kg/ kg of Re PET**

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THANK YOU