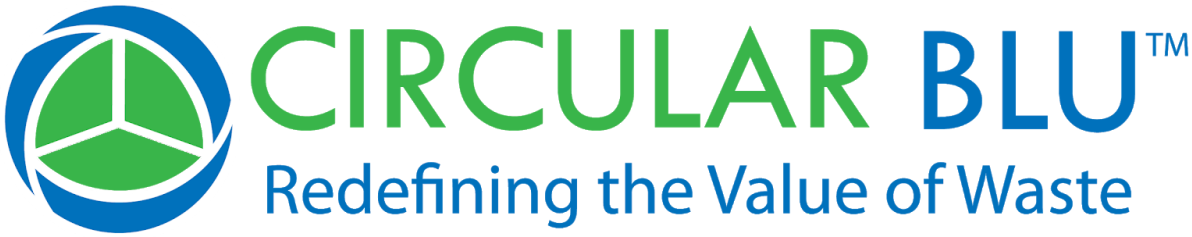

Circular Fabrics Impact Metrics

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Results:

1) Attributes *Determined from results of study minus the totals from the analysis parameter *PC Resin Collection and Sorting*, as it was determined to be inapplicable to Circular Blu's collection process.
    a) 100% PCR Content
    b) 90% Reduction in Energy Consumption when compared to a similar product made from Virgin resin (adjusted from 88%)
    c) 51% reduction in water use when compared to virgin resin (adjusted from 46%)
    d) 77% reduction in contribution to global warming (adjusted from 71%)
    e) 64% reduction in acidification (adjusted from 58%)
    f) 44% reduction in Eutrophication (adjusted from 43%)
    g) 62% reduction in Smog creation (adjusted from 50%)

Source:

LIFE CYCLE IMPACTS FOR POST CONSUMER RECYCLED RESINS: PET, HDPE, AND PP (Released 12/2018))
https://plasticsrecycling.org/images/apr/2018-APR-Recycled-Resin-Report.pdf

The above study was chosen for it's recency and the credibility of the authoring agencies. It is the most comprehensive study available. This analysis is based solely on the findings of the above study, with slight adjustments made to the results to be more applicable to the Circular Blu process.

Analysis:

1. The study involved a detailed LCA of the entire process of municipal recycling of a variety of resins, including polypropylene.
    a. The study analyzed curbside collection to procure the plastic waste for recycling.
2. Information from the source study was taken and adjusted to more accurately reflect our plastic recycling process, due to the following:
    a. The study analyzed the collection of single stream recycling from municipal consumers, and the aggregation and sorting of the mixed recycling to homogenous plastics by type.
    b. Circular Blu collects homogenous sterilization wrap in large amounts from fewer point sources, therefore, the metrics associated with curbside collection and sorting are not applicable to our process.

3. Circular Blu only collects polypropylene, so the data taken from the study is all based on PP data.
4. The Cut-off method of analysis was used for the results (see *General Notes About the Study* below for description of cut-off method).
5. The study analyzes the production of recycled resin vs virgin resin, which becomes the feedstock for product creation. The study does not analyze the steps of turning plastic resin into products.

Table 3-9. Savings for Recycled Resins Compared to Virgin Resins

	Recycled PET		Recycled HDPE		Recycled PP	
	Recycled % of Virgin	Recycled Resin % Reduction from Virgin	Recycled % of Virgin	Recycled Resin % Reduction from Virgin	Recycled % of Virgin	Recycled Resin % Reduction from Virgin
CUT-OFF						
Total Energy	21%	79%	12%	88%	12%	88%
Water Consumption	104%	-4%	41%	59%	54%	46%
Solid Waste*	42%	58%	101%	-1%	77%	23%
Global Warming	33%	67%	29%	71%	29%	71%
Acidification	30%	70%	53%	47%	42%	58%
Eutrophication	54%	46%	102%	-2%	57%	43%
Smog	25%	75%	63%	37%	50%	50%
OPEN LOOP						
Total Energy	61%	39%	56%	44%	56%	44%
Water Consumption	102%	-2%	71%	29%	77%	23%
Solid Waste*	71%	29%	100%	0%	88%	12%
Global Warming	66%	34%	65%	35%	64%	36%
Acidification	65%	35%	77%	23%	71%	29%
Eutrophication	77%	23%	101%	-1%	79%	21%
Smog	63%	37%	82%	18%	75%	25%

*Solid waste excluding contaminants removed from incoming material. These contaminants are not caused by recycling and would have been disposed as waste regardless of whether postconsumer plastic recycling takes place.

The table shows that savings for recycled resins are greatest when using the cut-off recycling methodology. For open-loop methodology, the addition of an allocated share of virgin resin burdens increases the results for recycled resins. As a result, open-loop savings compared to virgin resin are lower.

Table 3-9 shows the unadjusted results of the study.

The Adjustment Methodology:

Table 3-1. Total Energy Results for Recycled Resin Compared to Virgin, With and Without Feedstock Energy

	PC Resin Collection & Sorting	PC Resin Transport to Reclaimer	Process Water & Chemicals	Process Energy, Bale to Flake	Process Energy, Flake to Pellet*	Process Emissions & Wastes	Recycled Resin Pellet Total**	Virgin Pellet (including Feedstock Energy)	Recycled % of Virgin	Recycled Resin % Reduction from Virgin	Virgin Pellet (excluding Feedstock Energy)	Recycled % of Virgin	Recycled Resin % Reduction from Virgin
CUT-OFF													
MJ per kg of resin													
Recycled PET	1.19	0.87	0.21	6.44	6.14	0	**14.8**	**69.8**	21%	79%	**33.3**	45%	55%
Recycled HDPE	1.52	0.92	0.13	2.55	3.57	0	**8.69**	**75.3**	12%	88%	**25.0**	35%	65%
Recycled PP	1.64	1.04	0.11	6.09		0	**8.89**	**74.4**	12%	88%	**25.1**	35%	65%
Million Btu per 1000 lb of resin													
Recycled PET	0.51	0.37	0.089	2.77	2.64	0	**6.38**	**30.0**	21%	79%	**14.3**	45%	55%
Recycled HDPE	0.65	0.40	0.058	1.10	1.53	0	**3.74**	**32.4**	12%	88%	**10.8**	35%	65%
Recycled PP	0.71	0.45	0.049	2.62		0	**3.82**	**32.0**	12%	88%	**10.8**	35%	65%
OPEN LOOP													
MJ per kg of resin													
Recycled PET	0.60	0.43	0.10	3.22	3.07	0	**42.3**	**69.8**	61%	39%	**33.3**	72%	28%
Recycled HDPE	0.76	0.46	0.067	1.27	1.78	0	**42.0**	**75.3**	56%	44%	**25.0**	67%	33%
Recycled PP	0.82	0.52	0.057	3.04		0	**41.6**	**74.4**	56%	44%	**25.1**	68%	32%
Million Btu per 1000 lb of resin													
Recycled PET	0.26	0.19	0.044	1.38	1.32	0	**18.2**	**30.0**	61%	39%	**14.3**	72%	28%
Recycled HDPE	0.33	0.20	0.029	0.55	0.77	0	**18.0**	**32.4**	56%	44%	**10.8**	67%	33%
Recycled PP	0.35	0.22	0.024	1.31		0	**17.9**	**32.0**	56%	44%	**10.8**	68%	32%

*For PP, only combined results for bale to pellet are shown in order to protect confidential data from participating reclaimers.
**In Open-loop results, recycled resin total includes allocated share of virgin resin impacts.

The above table shows the itemized energy consumption results for each step of the recycling process. The unadjusted figure was determined by taking the *Recycled Resin Pellet Total*** and comparing it to the *Virgin Pellet (including Feedstock Energy)* figure:

8.89 MJ / 74.4 MJ = 0.119 x 100 = 11.9%
100% - 11.9% = 88 % (rounded)

The energy input from *PC Resin Collection and Sorting* was subtracted from the total because it is not applicable to our process. Making the adjustment results in the following:

8.89 MJ - 1.64 MJ = 7.25 MJ
7.25 MJ / 74.4 MJ = 0.0974 x 100 = 9.74%
100% - 9.74% = 90% (rounded)

The same adjustment was made for each of the analysis criteria. The above calculation for the energy consumption is detailed above as an example of how each adjustment was made. There is a table for each analysis criteria within the source study detailing the data contribution. For each parameter, *PC Resin Collection and Sorting* input data was removed to make the adjusted figures.

General Notes About the Study:

- This analysis is an update and expansion of a recycled resin study completed in 2011 that quantified the total energy requirements, energy sources, atmospheric pollutants, waterborne pollutants, and solid waste resulting from the production of recycled PET and HDPE resin from postconsumer plastic.
- This analysis has been conducted following internationally accepted standards for LCI and LCA methodology as outlined in the ISO 14040 and 14044 standard documents
- **The focus of this study is production of recycled resins that can be used in a variety of product systems; therefore, converting of resins into any specific product(s) is excluded from the analysis.**
- Results are presented for two commonly used recycling allocation methodologies, cut-off and open-loop
    - **Cut-off:** all virgin material production burdens are assigned to the first use of the material, and all burdens for material recovery, transport, separation and sorting, and reprocessing are assigned to the recycled material.
    - **Open Loop:** Half burdens for virgin resin production, collection, sorting, and reclaimer operations.
        - For the purposes of presenting cradle-to-gate open-loop results for recycled resin, this analysis uses an assumption of two useful lives of the material (resin used in a virgin product, then in a recycled product, with no projections about any further recycling after the second use).
        - For two useful lives of the resin, half of the burdens for virgin material production, postconsumer recovery, and reprocessing are assigned to the first use of the resin and half is assigned to its recycled use. When recycled resin data are used for open-loop modeling of product systems, the number of useful lives of the material should be adjusted as appropriate if there is recycling of the secondary product at the end of its useful life.
    - Because virgin resin impacts are generally greater than impacts for collection and recycling processes, results for the open-loop method with an allocated share of virgin resin production burdens are generally higher than results for the cut-off method.