Supplementary Information Document - 2

PET and Polyolefin Plastics Supply Chains in Michigan: Present and Future Systems Analysis of Environmental and Socio-economic Impacts

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S1. Review of Material Flow Analysis (MFA) Datasets for Michigan

This section is intended to provide a summary of identified data sources and their associated data gaps for the state of Michigan. Overall, there is not a compiled state-wide MFA dataset available for the EOL management of plastic resin-specific materials, compared to what is available at a national level. Additionally, most of the studied reports provide aggregated statistics for all types of plastics without any distinction between types of plastic resins, or sometimes only provide details on certain types of plastic products. A well-documented and transparent single source of supply chain wide dataset is required at state level, which would require collaborative efforts among various stakeholders of the plastics supply chain. The following sub-sections describe our review and findings from some of the EOL MFA data sources.

S1.1 EGLE Solid Waste Landfill Report

The Michigan Department of Environment, Great Lakes, and Energy (EGLE) Materials Management Division publishes annual reports of solid waste that is disposed only to landfills in Michigan each year (Michigan Department of Environment, 2020). The scope of those reports includes the municipal and commercial waste (MCW), which is typically residential-like waste, industrial waste, construction and demolition waste (C&D), alternate daily cover (ADC), and contaminated soils (CS) waste. While those reports provide insights on the origin of the solid waste that is disposed in Michigan landfills ('in-state' and 'out-of-state'), they do not address the data on the Michigan-generated solid waste that is sent outside of Michigan for disposal. Also lacking is the data on the amounts of materials incinerated in Michigan. These reports do not provide composition of the materials, such as paper, cardboard, textiles, metals, plastics etc., disposed to landfills, further hindering the understanding of total plastics disposed. The total remaining capacity at noncaptive landfills was reported to be 522,394,891 cubic yards (1,567.2 million U.S. tons or 1,421.7 million metric tons (MMT)) in 2019 (Michigan Department of Environment, 2020). The total capacity used in 2019 was reported to be 21,463,558 cubic yards. According to the 2019 report, it represents approximately 24 years (522,394,891 / 21,463,558 = approx. 24) of the remaining capacity left, assuming there is no change in disposal rates per year (Michigan Department of Environment, 2020).

S1.2 Michigan MSW Characterization Study (2016)

We found only one Michigan state-wide MSW characterization study that utilized a professional standard ASTM D5231-92 (ASTM, 2016), which is a standard test method for determining the composition of unprocessed municipal solid waste (Michigan Department of Environmental Quality (MDEQ), 2016). The reported data was built upon the eight on-site (field) visits throughout Michigan. This report provides the material specific composition of the MSW disposed (landfilled and incinerated) in Michigan in 2015, such as paper, cardboard, organics, metal, glass, plastics etc. Based on this report, about 8,862,241 U.S. tons (or 8,039,690 MT) of MSW was disposed with 84% being landfilled and 14% incinerated with energy recovery. The report noted only two incinerators (Kent County waste to energy facility in Grand Rapids and Detroit renewable power facility in Detroit) that were active in Michigan during the time of their study. No information was found on material specific incineration rates. According to this report, the composition of plastics in MSW disposed could range between 12 to 16%, majority of which is dominated by plastics packaging (#2-5, 7; 4.9-6.1%), plastics (#3-5 and 7; 3.4-4.8%), plastics bags (2.5-3.1%), PET (0.8-1.1%), and polystyrene (0.6-0.8%). This report also compared their results with U.S. EPA statistics and some of the neighboring states to Michigan, including Illinois, Minnesota, Indiana, Wisconsin, and Ohio. The report also cited some stats related to recycling rates specific to materials (metals, paper, plastics etc.) with data coming from the Michigan Recycling Index (MRI) report. The Michigan MSW characterization report also recommended repeating characterization within three to five years. The report also provided economic value of disposed materials and employment impacts of recycling. According to the report, the total material value of MSW disposed in Michigan was estimated to be $368 million, and recovery and selling of all materials would have a total economic impact of $399 million with employment generation of 2,619 full time equivalent jobs. We also found some county-wide MSW characterization studies in Michigan (Kent County Department of Public Works, 2022, Consultants), however, were deemed to be not relevant at a state level. Another study (Nezami and Cortes, 2017), published in conference proceedings, reviewed the MSW landfill report and forecasted the flows to landfills only, due to limited availability of the data.

S1.3 Michigan Recycling Report (Part 175 Report)

As per the policy 'Natural Resources And Environmental Protection Act' (NREPA), Act 451 of 1994, Part 175 Recycling Reporting (451-1994-II-5-175) (Michigan Legislature), the total as well as material specific (plastics, metals, glass etc.,) amounts of waste recycled in Michigan are reported on an annual basis. The data is collected from the recycling facilities in Michigan, which report their data to the department of environmental quality (DEQ). As per the policy criteria, some of the recycling facilities are required to report the data, while some may voluntarily opt for reporting the data. In 2019, 73 out of 85 organizations registered with the department's online reporting module provided the recycling data (Michigan EGLE). About 47 out of 73 were mandatory reporters and the remaining 26 were voluntary reporters. It is important to note that these recycling facilities (or "recycling establishments") excludes following establishments, including but not limited to, that: 1) recycles less than 100 U.S. tons per year (Section 324.17501, f(i)); 2) retail establishments that collects returnable beverage containers for transfer to recycling establishment (Section 324.17501, f(iii)); 3) drop-off recycling locations that sends all the reportable recyclable materials to recycling establishments (Section 324.17501, f(v)) etc. Apart from these facilities, there are also other facilities that are excluded, but more information can be found on the Michigan Legislature website (Michigan Legislature). For the 2019-year, total amount of all plastics recycled were reported to be 121,675 U.S. tons (or 110,382 MT), representing about 5.7% of the total recyclable materials (2,131,793 U.S. tons). No resin-specific distinction was provided, hindering our understanding of PET and PO plastic material flows. Additionally, it was reported that about 49.5% (1,055,282 U.S. tons) of the total recyclable materials were sent to in-state locations and the remaining 50.5% were sent to out-of-state to be recycled, further highlighting the need to strengthen market development opportunities in Michigan. The recycling destination statistics are aggregated and do not distinguish by the type of material categories considered in their report.

S1.4 Additional Reports

As mentioned in the 'Material Flow Analysis - Methods' section of the main manuscript, the EOL data used in our study is mainly based on the NextCycle Michigan 2021 gap analysis report (NextCycle Michigan, 2021) and U.S. EPA waste management fact sheet report (U.S. EPA, 2020a). The NextCycle Michigan report provides information about the current (2019) as well as potential needed recovery of PET and PO plastic products to achieve the state's recycling overall recycling goal of 45%. The report also noted the amount of these products that are currently being landfilled. It also provided information on the amount of MSW incinerated in Michigan in 2019. In 2019, a total of 8,012,760 U.S. short tons of MSW was disposed with 98% being landfilled (7,830,560 U.S. tons) and 2% (182,200 U.S. tons) being incinerated. This information was used to determine the amounts of PET and PO plastics that are incinerated in Michigan in 2019.

S2. Life Cycle Assessment (LCA) Sample Calculations

For the semi-manufacturing processes, the eco-profile for electricity grid in the SimaPro software was updated to reflect the Michigan average grid mix for the year 2020 and was as follows: coal: 26.5%, petroleum liquids: 0.1%, petroleum coke: 0.6%, natural gas: 33.6%, other gases: 0.9%, nuclear: 28.7%, conventional hydroelectric: 1.6%, wind: 6.4%, solar: 0.1%, biomass: 1.4% (U.S. EIA, 2020). The GHG emission and energy demand factors of this grid were found to be 0.47 kg CO_2-eq/kWh and 11.3 MJ/kWh, respectively. These impacts were 12% and 14% higher, respectively, than the U.S. average electricity grid mix used in our national baseline analysis (Chaudhari et al., 2022).

The sample calculation and formulas can also be found in the SI-1 Excel file, which are shown by linking the appropriate cells for the material quantity and LCIA factors.

Sample calculations for estimating GHG emissions are shown in Fig. S1

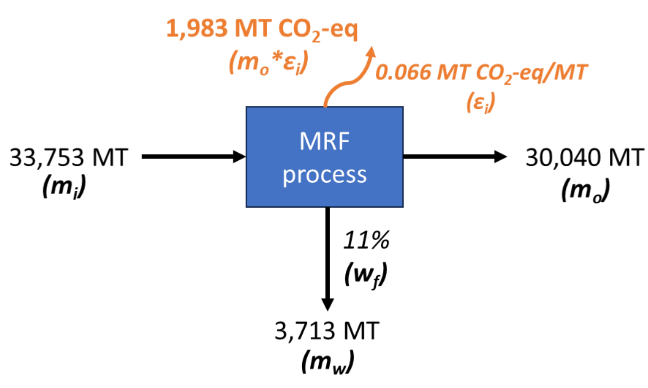

Fig. S1. Sample calculation for estimating GHG emissions at MRF for the PET supply chain. Note that the material flows shown in this example represent the base case scenario.

Total mass flow going in (m_i): 33,753 MT

Percent of waste generated at MRF (w_f): 11 % of the m_i

Total waste generated at MRF (m_w): 3,713 MT ($m_w = w_f * m_i$)

Total output from the process (m_o): 30,040 MT

Emission factor for MRF (ε_i): 0.066 MT CO_2-eq/MT

Total GHG emissions of MRF ($m_o * \varepsilon_i$): 1,983 MT CO_2-eq

The total waste generated (m_w) was assumed to be 98% landfilled and 2% incinerated with energy recovery, which is the conventional management of MSW disposal in Michigan. Therefore, 98% of the 3,713 MT was multiplied by the landfill GHG emission factor (0.022 MTCO_2-eq/MT; 'EOL_LCIA' Excel tab of SI-1 Excel file) and 2% of the m_w was multiplied by the incineration with energy recovery GHG emissions factor (1.37 MTCO_2-eq/MT; 'EOL_LCIA' Excel tab of SI-1 Excel file). Similar calculations can be carried out for estimating CED impacts by replacing GHG emission factors with respective CED factors.

S3. Socio-economic Factors

The socio-economic indicators considered in this study included employment, wages, and sales/revenues. The following paragraphs explain the socio-economic factors used in our study along with the source of data and calculating these impacts. A summary of these factors is shown in Table 2 of the main manuscript. Additionally, a brief review of literature on these factors is also provided in Section S3.1.

Sample calculations for estimating employment for the EOL processes for base case PET supply chains processes:

Total amount of PET waste collected for sorting and recycling: 61,167 MT

Total employment across collection process: $61{,}167\ MT\ \times 0.0016\,\frac{employment}{MT} = 98$

Total employment across processing and recycling processes: $61{,}167\ MT\ \times 0.0022\,\frac{employment}{MT} = 135$

Similar calculations can be carried out for other EOL processes and for other socio-economic impacts with appropriate factors as shown in Table 2 of the main manuscript. The sample calculation and formulas shown below can also be found in the SI-1 Excel file ('Socio-economic Impacts' Excel Tab), which are shown by linking the appropriate excel cells for the mass and socio-economic factors.

We found a lack of information in the literature on socio-economic factors per MT of the virgin resins. To fill this gap, we utilized "cradle-to-gate" LCI data from the Franklin Associates LCA reports to determine the total amount of natural gas and crude oil required per MT of resin produced. This information was further linked with the relevant NAICS codes with data from the IBIS World reports. The NAICS codes 21111 ('Oil Drilling and Gas Extraction in the US'), 32411 ('Petroleum Refining in the US'), OD 5404 ('Natural Gas Liquid Processing in the US'; specialized industry IBIS report), 32511 ('Petrochemical Manufacturing in the US'), and 32521 ('Plastic & Resin Manufacturing in the US') were identified for the processes involved in virgin resin production. First, the LCI data was reported in GJ of feedstock per MT of resin produced. This was then converted to MT of feedstock per MT of resin produced using the higher heating value (HHV; GJ/MT). Additionally, the total amount of natural gas and crude oil extracted (units: MT) in the US was determined from the EIA database (referenced in SI-1 Excel file under Tab 'NAICS Codes Data_2019'). The socio-economic factors per MT of feedstock then can be determined for the upstream processes such as natural gas and crude oil extraction, natural gas processing, crude oil refining using appropriate NAICS codes. Using this information, socio-economic factors per MT of virgin resins now can be determined and step by step calculations are shown below.

We provide a step-by-step sample calculation for estimating employment per MT factor for virgin PET resin production. The steps used in calculations are shown in the brackets on the right-hand side in italic font. The data with appropriate reference to the source and calculations are shown in the SI-1 excel file ('NAICS Codes Data_2019' Excel Tab) with appropriate excel cells linked together.

S1 Total natural gas (NG) required per MT of virgin PET resin: 0.53 MT of NG/MT resin
S2 Total crude oil (CO) required per MT of virgin PET resin: 0.60 MT of CO/MT resin
S3 Total feedstock required per MT of PET resin: 1.13 MT of NG and CO/MT of resin……… *(S1+S2)*
S4 Total NG extracted in the US: 882 MMT
S5 Total CO extracted in the US: 613 MMT
S6 Total feedstock extracted in the US: 1,495 MMT of NG and CO………. *(S4+S5)*
S7 Employment in NAICS code 21111: 162,230
S8 Employment in NAICS code 21111 per MT of total NG and CO feedstock extracted: 0.00011……… *(S7 ÷ S6)*
S9 Employment in NAICS code 21111 per MT of PET resin: 0.00012……… *(S8 X S3)*
S10 Employment in OD 5404: 12,780
S11 Employment in OD 5404 per MT of NG processed: 0.00001……… *(S10 ÷ S4)*
S12 Employment in OD 5404 per MT of PET resin: 0.00001………. *(S11 X S1)*
S13 Employment in NAICS code 32411: 64,334
S14 Employment in NAICS code 32411 per MT of crude oil consumed in the US: 0.00008……… *(S13÷ (S5+ net import of crude oil))*
S15 Employment in NAICS code 32411 per MT of PET resin: 0.00005……*(S14 X S2)*
S16 Total employment per MT of PET resin in upstream processes: 0.000178……….. *(S9+S12+S15)*
S17 Employment in NAICS code 32511: 9,966
S18 Employment in NAICS code 32521: 80,640
S19 Total plastics resin production in US: 55.09 MMT
S20 Employment per MT of all resins produced: 0.0016 *(((0.5 X S17) + S18)÷ S19)*
S21 Total virgin PET resin produced: 4.521 MMT
S22 Total employment due to virgin PET resin production only: 7,027 *(S20 X S21)*
S23 Total employment in upstream processes due to PET: 806 *(S16 X S21)*
S24 Total employment in producing virgin PET resin: 7,833 *(S22 + S23)*

S25 Total employment per MT of virgin PET: 0.0017 *(S24 ÷ S21)*

S3.1 Review of Socio-economic factors

As mentioned in the main manuscript, the purpose of socio-economic impact analysis in our study was to evaluate employment, wages, and sales/revenue generation specific to major plastics supply chain processes aligning with our material flow framework. Only a few studies report socio-economic factors that are specific to plastics and that are on a tonnage material basis: U.S. EPA 2016 Recycling Economic Information (REI) report (U.S. EPA, 2016b) (update to 2001 REI report by R.W. Beck Inc. (Beck, 2001)), U.S. EPA 2020 REI report (U.S. EPA, 2020c) (update to 2016 REI report (U.S. EPA, 2016a)), U.S. EPA 2020 WARM report (U.S. EPA, 2020b), and Tellus Institute 2011 report (Goldstein and Electris, 2011). Apart from the Tellus Institute report, none of them provide process-specific socio-economic factors per metric ton. Moreover, these reports also do not provide these factors for virgin resin production, as mentioned in the previous section. A summary of these factors in the above-mentioned literature is provided at the end of this section in Table S1 that are within the scope of our study.

The U.S. EPA 2020 WARM report (U.S. EPA, 2020b) provides plastic material specific socio-economic factors such as labor hours/MT, wages/MT, and tax revenues/MT for recycling as well as disposal processes (landfilling and incineration with energy recovery). The definition of recycling in this report includes a wide range of activities such as "*collection of material, separation, cleaning and/or other processing (e.g. baled PET bottles), transformation of recyclable materials into marketable products, distribution, storage and service delivery, and transportation steps between each stage*". The employment factor reported in the U.S. EPA WARM report can be converted to employment/MT factor by using a conversion factor of 2,080 labor hours per employment, as mentioned in the WARM report (U.S. EPA, 2020b). For the recycling processes, the main source for determining these factors was based on REI studies (2001 (Beck, 2001) and 2016 (U.S. EPA, 2016b)) and Tellus Institute report. As the scope of REI studies was only limited to recycling activities, the WARM report (U.S. EPA, 2020b) relied on a combination of Tellus Institute report (Goldstein and Electris, 2011) and IMPLAN model to estimate socio-economic factors for disposal processes. As the Tellus Institute report provides only employment/MT factors, the WARM report used IMPLAN tool to generate wages per employee and tax per employee factors to generate wages/MT and tax revenues/MT factors.

Moreover, the socio-economic factors reported in the WARM report (U.S. EPA, 2020b) include only direct and indirect impacts, following the definitions based on REI studies (U.S. EPA, 2016b). The direct impacts in the WARM report (U.S. EPA, 2020b) are defined as the impacts associated with the "*actual transformation of recyclable materials in marketable products*" (e.g. plastic reclaimers and converters). The indirect impacts in the WARM report (U.S. EPA, 2020b) are defined as the impacts associated with collection, processing/sorting, and transportation of materials. It is important to note that the WARM report provides only aggregated factors for these EOL management processes (i.e. direct and indirect impacts were not distinguished), therefore were not used in our study to assess these impacts at a process level. This limitation is also acknowledged in the U.S. EPA WARM report (U.S. EPA, 2020b).

The 2016 U.S. EPA REI (U.S. EPA, 2016b) study provides description of the methodologies used to assess the economic potential of recycling materials, including plastics. Of the four approaches proposed in that study, the "direct and indirect production" approach is the most widely used as it captures both direct as well as indirect impacts of recycling activities and is also used in other reports (U.S. EPA, 2020c, U.S. EPA, 2020b). It is important to note from this report (U.S. EPA, 2016b) that the direct impacts include only plastic reclaimers and plastic converters (semi-manufacturing processes). On the other hand, the old 2001 REI report (Beck, 2001) also included the impacts of collection and processing activities under these direct impacts. This was however updated in the 2016 U.S. EPA REI study (U.S. EPA, 2016b), where indirect impacts include all of the upstream supply chain inputs and processes supporting recycling activities (e.g. electricity, transportation, chemicals, fuels, collection, sorting, etc.). The socio-economic factors per metric ton from this report are shown in Table S1. However, these factors do not provide any further information at a process level, instead provide aggregated direct and indirect impacts.

The Tellus institute report (Goldstein and Electris, 2011) provided only the employment per U.S. short ton factor for plastic materials across major supply chain processes: manufacturing of plastic products, collection for recycling, processing of plastic recyclables, collection for landfilling and incineration, landfilling, and incineration of plastics. (Goldstein and Electris, 2011) developed these factors by relying on a combination of methodologies and information based on 2001 (Beck, 2001) and 2009 REI (DSM Environmental Services Inc. and MidAtlantic Solid Waste (MSW) Consultants, 2009) studies for recycling processes, and Institute for Local Self Reliance (ILSR) study for disposal processes. (Goldstein and Electris, 2011) adopted three industry sector categories previously defined (DSM Environmental Services Inc. and MidAtlantic Solid Waste (MSW) Consultants, 2009) as: 1) Recycling industries ("Supply Side"); 2) Recycling reliant industries ("Demand Side"); 3) Reuse and remanufacturing industries. The recycling industry includes collection (e.g. public and private collection, including curbside/drop-off/commercial recycling collection programs) and processing of plastic recyclables (e.g. MRFs, plastic reclaimers, and wholesalers). The recycling reliant industry includes plastic converters only (e.g. semi-manufacturing processes for plastics such as extrusion, injection molding, etc.). The reuse and remanufacturing of plastics was not within the scope of our study and systems analysis framework. A summary of relevant socio-economic factors is provided in Table S1. Important to note from this report is that the employment per metric ton factor is an aggregated factor for MRFs and reclaimers, which is also indicated in Table 1 of the main manuscript. The limitation of using these factors from Tellus Institute report is that they do not account for all of the "indirect" impacts associated with the upstream supply chain inputs such as those due to electric utilities, chemicals, fuels, transportation, etc.

The employment per U.S. short ton factor from the Tellus Institute Report (Goldstein and Electris, 2011) was converted to represent it on per metric ton (MT) basis. Using this employment per MT factor and the MFA data, the total employment was estimated across each major supply chain process. Since none of the reports provided other economic factors at such a granular level of detail, the employment per MT factor for each process was the basis for generating other socio-economic factors such as total sales/revenues per MT and wages per MT. A similar approach was taken to estimate revenue/MT and wages/MT for the virgin resin production stage. Please refer to the SI-1 Excel document for additional information on estimating these metrics for the virgin resin production stage ('NAICS Codes Data_2019' Excel Tab).

Table S1. Summary of employment and wages per metric ton factors for plastics

Ref.	Employment/MT	Wages, $/MT	Comment
2016 US EPA REI Methodology Report (U.S. EPA, 2016b)	0.01314 (Direct $^{\alpha}$ only); 0.0295 (Direct and indirect)	510 (Direct only); 1,320 (Direct and Indirect)	Recycling only (base year data: 2007)
2020 US EPA REI Report (U.S. EPA, 2020c)	0.0235 (Direct and indirect)	1,047 (Direct and indirect)	Recycling only (base year data: 2012)
2020 US EPA WARM Report (U.S. EPA, 2020b)	0.0294 (Direct and indirect)	1,370 (Direct and indirect)	Recycling (base year data: 2007)
2020 US EPA WARM Report (U.S. EPA, 2020b)	0.00066	46	Disposal processes including collection step; The factors are same for both landfilling and incineration processes.
Tellus Institute Report * (Goldstein and Electris, 2011)	0.0016 (Collection); 0.0022 (Processing $^{\beta}$); 0.0114 (Manufacturing $^{\mu}$)	-	Recycling (base year data: Presumably 2007);
Tellus Institute Report * (Goldstein and Electris, 2011)	0.00073	-	Disposal processes including collection step (base year data: 1997)

*Note: α: plastic reclaimers and converters; β: MRFs and plastic reclaimers; µ: plastic converters only; * Factors from this report were used in our study*

Overall, it can be observed from Table S1 that the direct and indirect impact factors from the 2016 US EPA REI methodology report (U.S. EPA, 2016b) and 2020 U.S. EPA WARM report (U.S. EPA, 2020b) for recycling processes align well with each other. Similar observations can be made regarding the factors for disposal processes. The employment/MT and wages/MT factors from the

2016 US EPA REI report (U.S. EPA, 2016b) and 2020 US EPA REI report are within ± 25% and ± 26% of each other, respectively, which could be due to the differences in the base year data. Moreover, the 'Manufacturing' related employment/MT factor from Tellus report aligns well with 'Direct Only' factor from the 2016 US REI report, given the differences between inclusion of different processes (see note below Table S1). The 'Direct Only' factor includes both plastic converters and plastic reclaimers (U.S. EPA, 2016b), whereas the 'Manufacturing' factor includes only plastic reclaimers.

To conclude, there are only a few studies that provide socio-economic factors on a mass tonnage basis specific to plastics. Moreover, most of these studies provide aggregated factors hindering our understanding of these impacts by major supply chain activities. The factors provided in Tellus institute report seem to be aligning well with other reports when the system boundary is same. The base year of the underlying data in all of these reports is not up to date with some going back to 1997. Most of these reports used waste input output (WIO) model that builds upon the 5-year interval input output tables (IOTs) maintained by the U.S. Bureau of Economic Analysis (BEA). Moreover, some of the studies also conducted surveys, which are usually time-consuming, and are not conducted frequently to gather the relevant data.

S4. Additional Results

S4.1 Comparison of Baseline Recycling Rates by Plastic Products

A recent report (The Recycling Partnership (TRP), 2024), by The Recycling Partnership (TRP), published national as well as state-specific recycling rates of various recyclable materials, including plastics, that are collected via residential collection programs, drop-off collection programs, and state bottle deposit container collection programs. The residential recycling rate in the TRP report was defined based on the total recyclables sold by MRFs to end markets, including that collected through state bottle deposit programs. It is important to note that the recycling rate for different plastic products shown in Fig. 2 of the main manuscript are not directly comparable with the recycling rates from TRP report due to differences in definition of the recycling rates.

To compare and validate the baseline EOL material flow data from our study, we estimated the recycling rates as defined in the TRP report and provide a side-by-side comparison of plastic product-specific recycling rates with the TRP report in Fig. 3 of the main manuscript. The TRP report only provided residential recycling rates by different commodities and lacked waste generation and recycled data (in tonnages) at a state level. Therefore, only the recycling rates from the TRP report can be compared with that calculated from our study.

Sample calculation for PET bottles:

The baseline data from our study for PET bottles can be found in the SI Excel file ('PET_MFA' Excel Tab).

Total PET bottle waste generated in Michigan (our study): 111,793 MT

Total baseline PET bottle waste collected via curbside collection programs (our study): 31,822 MT

MRF capture rate for PET bottles (TRP report): 85%

Total baseline baled PET bottles as commodity from MRF: 0.85 * 31,822 = 27,049 MT

Total baseline PET bottles collected via state bottle deposit program (our study): 26,419 MT

Recycling rate of PET bottles based on our baseline material flow data (as defined in TRP report): (27,049 + 26,419) / 111,793 = 48%

S4.2 Socio-economic Impacts Results

Fig S2-4 shows the "attributional" socio-economic impacts by the EOL supply chain processes in Michigan, without accounting for any avoided impacts. The NextCycle scenario showed increased socio-economic impacts among recovery and recycling processes in Michigan and reduced impacts among disposal processes due to lower disposal rates in the NextCycle scenario.

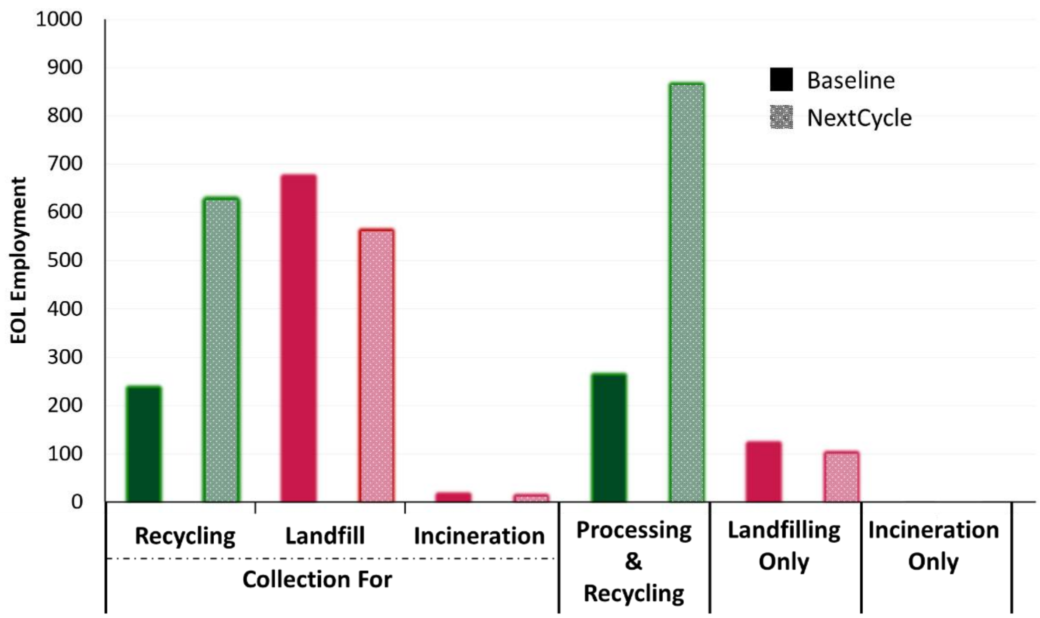

Fig.S2. Employment by EOL processes across PET and PO plastics supply chains in Michigan.

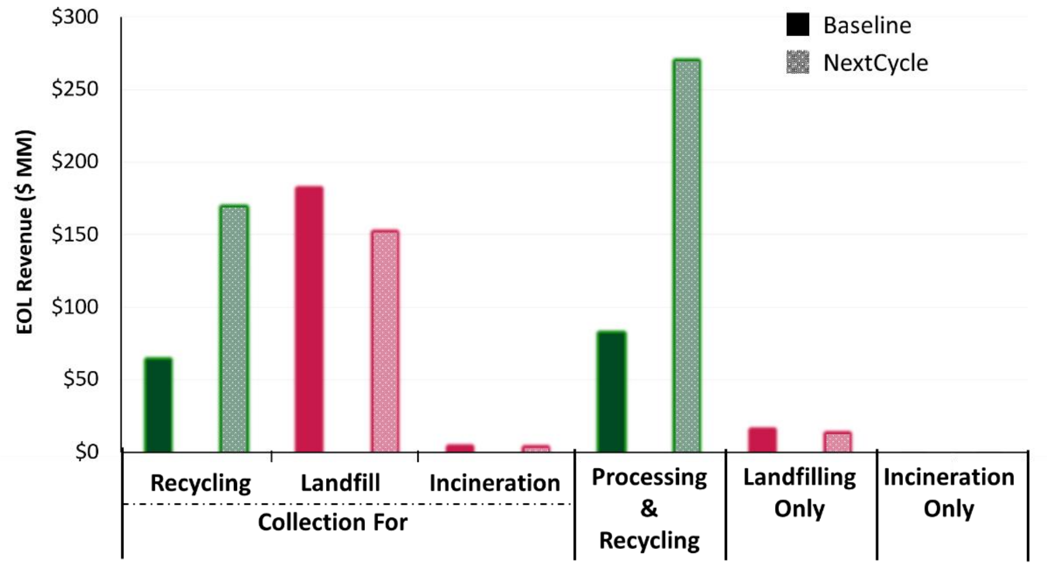

Fig.S3. Revenue by EOL processes across PET and PO plastics supply chains in Michigan.

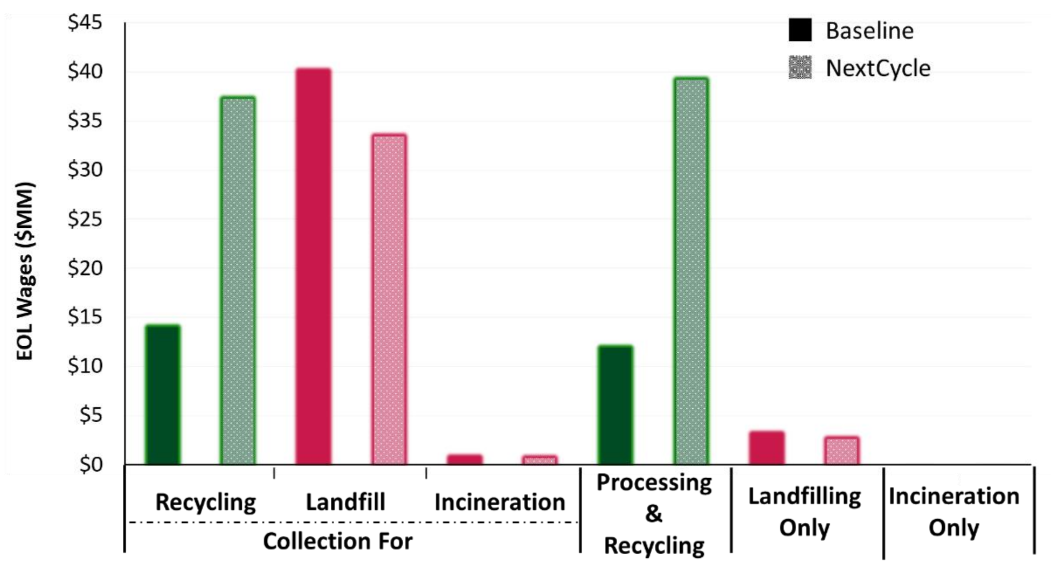

Fig.S4. Wages by EOL processes across PET and PO plastics supply chains in Michigan.

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