Short Lived Climate Pollutants:

Statewide Impacts of 90% Organics Diversion by 2025

Building on AB 341 and AB 1826 to 2020

California's Air Resources Board (CARB) released its Concept Paper "Short-Lived Climate Pollutant Reduction Strategy" on May 7, 2015 in response to Senate Bill 605 (SB 605, Lara, 2014). In this paper, CARB identified Short-Lived Climate Pollutants (SLCP) such as methane, fluorinated gases, black carbon, and tropospheric ozone as priority targets for greenhouse gas abatement. Compared to carbon dioxide, these gases remain in the atmosphere for a much shorter period of time, and have a greater relative potency. CARB's Concept Paper estimates that 40% of the global warming experienced to date may have occurred as a result of SLCP.

Short-Lived Climate Pollutant Strategy

In light of climatological impact of SLCP and Governor Brown's 2030 target of reaching 40% below 1990 greenhouse gas levels, CARB has declared several SLCP reduction measures that will be included in CARB's climate strategy. Among these measures, methane is targeted specifically with the following goal:

"Identify existing and potential new measures to reduce methane emissions by at least 20% by 2020, and 40% by 2030." – CARB Short Lived Climate Pollutant Reduction Strategy Concept Paper

Towards this end, several SLCP recommendations coupled with current laws have been developed, including:

- **SB 605, 2014** - SLCP Plan - "Considering measures to meet a goal of diverting 90% of organics from landfills through source reduction and organics recycling by 2025".
- **AB 341, 2011** – Statewide goal of reaching a 75% recycling rate by 2020 not counting ADC or beneficial reuse of green waste as diversion.

- **AB 1826, 2014 –** Sets a goal of diverting half of 2014's commercial organics disposal by 2020 with phased-in collection of commercial organics.
- **AB 1594, 2014 –** No longer granting green waste alternative daily cover (ADC) diversion credit, and counting these tons as disposal after 2020. Regardless of diversion or fees, green waste in a landfill generates methane.

Greenhouse Gas Implications of a 90% Reduction in Organics Disposal

The above recommendations can be quantified in terms of greenhouse gases using the most up-to-date estimation data and metrics provided by CARB, the United States Environmental Protection Agency, CalRecycle, and the California Department of Finance. The information from these sources produces the following calculation:

Projected Generation × 50% reduction in 2020 × Organic Waste Emission Reduction Factors = Avoided Emissions

Projected Generation × 90% Reduction in 2025 × Organic Waste Emission Reduction Factors = Avoided Emissions

The projected result of this organics diversion, measured in avoided metric tons of carbon dioxide ($MTCO_2e$) is **4,383,249 $MTCO_2e$** by 2020 and **7,922,080 $MTCO_2e$** by 2025.

	AB 1826, AB 341 to 2020	**SB 605, AB 1594 to 2025**
Diverted Tons	8,162,806 tons	14,750,740 tons
$MTCO_2e$ Avoided	-4,383,249	-7,922,080

Projected Generation: Organics generation is modelled as a function of population (Department of Finance projections) and Waste Characterization by sector (CalRecycle).

CalRecycle's 2014 preliminary draft Waste Characterization estimates that 16,536,661 tons of material are disposed of in the commercial sector annually. Of this, 48.5% is organic materials. This includes material such as food, yard waste, grass, compostable paper, wood, and manure.

CalRecycle's website indicates that 29,946,958 tons were disposed of in 2013. Assuming that there has been little significant change in commercial waste characteristics from 2013 to 2014, commercial waste constitutes 55.22% of the total waste stream, with residential and self-haul making up the remaining 26.66% and 18.12% respectively. Since the 2014 Waste Characterization Study will not be finished until later this summer, CalRecycle's 2008 Waste Characterization is used to estimate the composition of residential and self-haul and waste streams. An estimate of overall statewide organics disposal can be attained. These tonnages, adjusted by population projections from the Department of Finance, are used to calculate a 2020 and 2025 business-as-usual projection of organics disposal.

Summaries of the waste characterizations used in this analysis are provided in the tables below.

Organics % of Total Disposal	2014 data	2008 data	2008 data
	Commercial	Residential	Self-Haul
Food Waste	24.4%	25.4%	1.1%
Leaves and Grass	3.2%	6.0%	2.6%
Prunings and Trimmings	1.7%	1.9%	2.2%
Branches and Stumps	0.4%	0.1%	1.6%
Clean Dimensional Lumber	0.7%	6.7%	23.2%
Clean Engineered Wood	0.7%	x	x
Clean Pallets & Crates	4.4%	x	x
Other Wood Waste	2.3%	x	x
Other Miscellaneous Paper - Compostable	0.5%	x	x
Remainder/Composite Paper - Compostable	10.1%	x	x
* Remainder/Composite Paper	x	6.0%	1.5%
Manure	0.1%	0.2%	0.0%
TOTAL	48.5%	46.3%	32.2%

* No compostable paper category existed in 2008, however these figures are similar to waste characterizations conducted in Seattle in 2008 and San Diego in 2013, which did have specific categories for compostable paper.

Tons of Total Disposal (Base Year 2014)	2014	2014	2014
	Commercial	Residential	Self-Haul
Food Waste	4,035,748	2,029,268	61,048
Leaves and Grass	524,559	478,452	142,167
Prunings and Trimmings	274,586	150,738	117,332
Branches and Stumps	64,366	11,392	85,801
Clean Dimensional Lumber	113,949	531,654	1,258,690
Clean Engineered Wood	107,458	x	x
Clean Pallets & Crates	735,005	x	x
Other Wood Waste	387,705	x	x
Other Miscellaneous Paper - Compostable	77,929	x	x
Remainder/Composite Paper - Compostable	1,673,592	x	x
* Remainder/Composite Paper	x	478,026	82,640
Manure	14,884	13,526	0
TOTAL	8,009,781	3,693,057	1,747,679

In 2013, **29,946,958** tons of materials were disposed of in landfills.
Source: CalRecycle disposal reporting service.

AB 341 and AB 1826 to 2020:

The SLCP Plan to considering measures to meet a goal of diverting 90% of organics from landfills through source reduction and organics recycling by 2025, can be accomplished by recognizing and successfully implementing the current goals for 2020. AB 341 has set a statewide goal to recycle or compost 75% of the waste stream by 2020. AB 1826 mandates that more than half of the commercial organic waste be collected by 2020.

The projected result of this organics diversion is **8,162,806 new tons** by 2020, and measured in avoided metric tons of carbon dioxide ($MTCO_2e$) is **4,383,249 $MTCO_2e$** by 2020.

The AB 32 Scoping Plan First Update adopted in May 2014 calls for **5.0 to 7.5 million tons** of food waste and green waste be diverted by 2020 (50% to 75% diversion rate), which results in avoiding between **3.03 to 5.62 $MMTCO_2e$** being avoided (copy attached). At least 100 new or expanded compost and anaerobic digestion facilities will be needed by 2020. Note that wood (1.73 million tons) and compostable paper (1.28 million) were not included in these AB 32 calculations by CARB. As CARB updates the Scoping Plan this summer to accommodate the Governor's Executive Order B-30-15 to provide a framework for achieving the 2030 target to achieve a 40% reduction below 1990 levels by 2030, CARB should harmonize AB 341, AB 1826 and SB 605 programs into the Scoping Plan Second Update.

SB 605 - 90% Reduction by 2025: Building upon AB 341 and AB 1826 to get to the 2020 goals, and recognizing green waste alternative daily cover counting as disposal after 2020, the SLCP Plan goal of diverting 90% of organics from landfills through source reduction and organics recycling by 2025 is achievable. The organic waste disposal from the commercial, residential, and self-haul sectors when reduced to 10% of their 2014 levels reaches a total reduction of **14,750,740 tons** by 2025, and measured in avoided metric tons of carbon dioxide ($MTCO_2e$) is **7,922,080 $MTCO_2e$** by 2025.

Another 100 new or expanded compost and anaerobic digestion facilities will be needed between 2020 and 2025. With regulatory streamlining among the Air Boards and the Water Boards within Cal-EPA, and with increased cap-and-trade revenue allocation towards composting, anaerobic digestion and renewable natural gas production facilities, the industry is poised to achieve these goals much like achieving the AB 939 recycling goals of the nineties.

Organic Waste Emissions Factors: Using CalRecycle's Waste Characterization categories, organic waste is grouped into five emission factor groups to calculate avoided emissions. Each group, and its per-ton reductions in $MTCO_2e$, is listed below.

PER TON AVOIDED EMISSIONS			
Material	Avoided Landfill Emissions **(EPA –WARM)**	Avoided Emissions From End Use **(CARB)**	Avoided Emissions Per Ton
Food Waste	-0.25	-0.42	-0.67
Yard Trimmings & Greenwaste ADC	-0.14	-0.42	-0.56
Lumber (wood)	-0.05	-0.21	-0.26
Compostable Paper	-0.11	-0.42	-0.53
Manure	0.00	-0.42	-0.42

*End uses of wood materials are modelled as combusted for energy rather than composted.

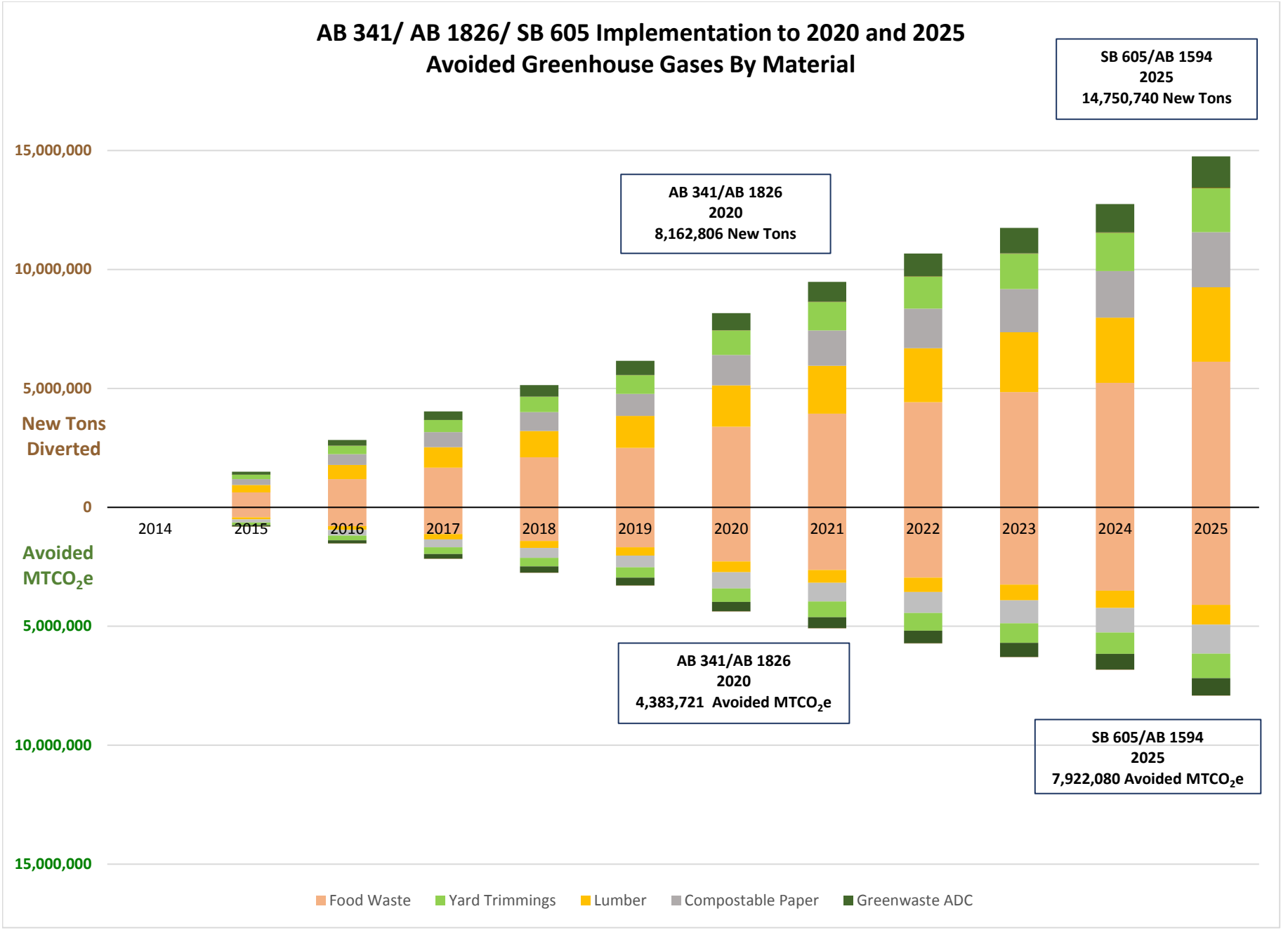
The US EPA's Waste Reduction Model (WARM) is used to calculate the avoided landfill emissions of methane of these materials, without carbon storage credit. CARB's metrics are used to estimate avoided emissions from the end use of these organics materials, either as avoided emissions from compost use or as offset energy emissions from biomass combustion. These factors are used to calculate the total emissions reductions resulting from the 90% reduction in organics disposal:

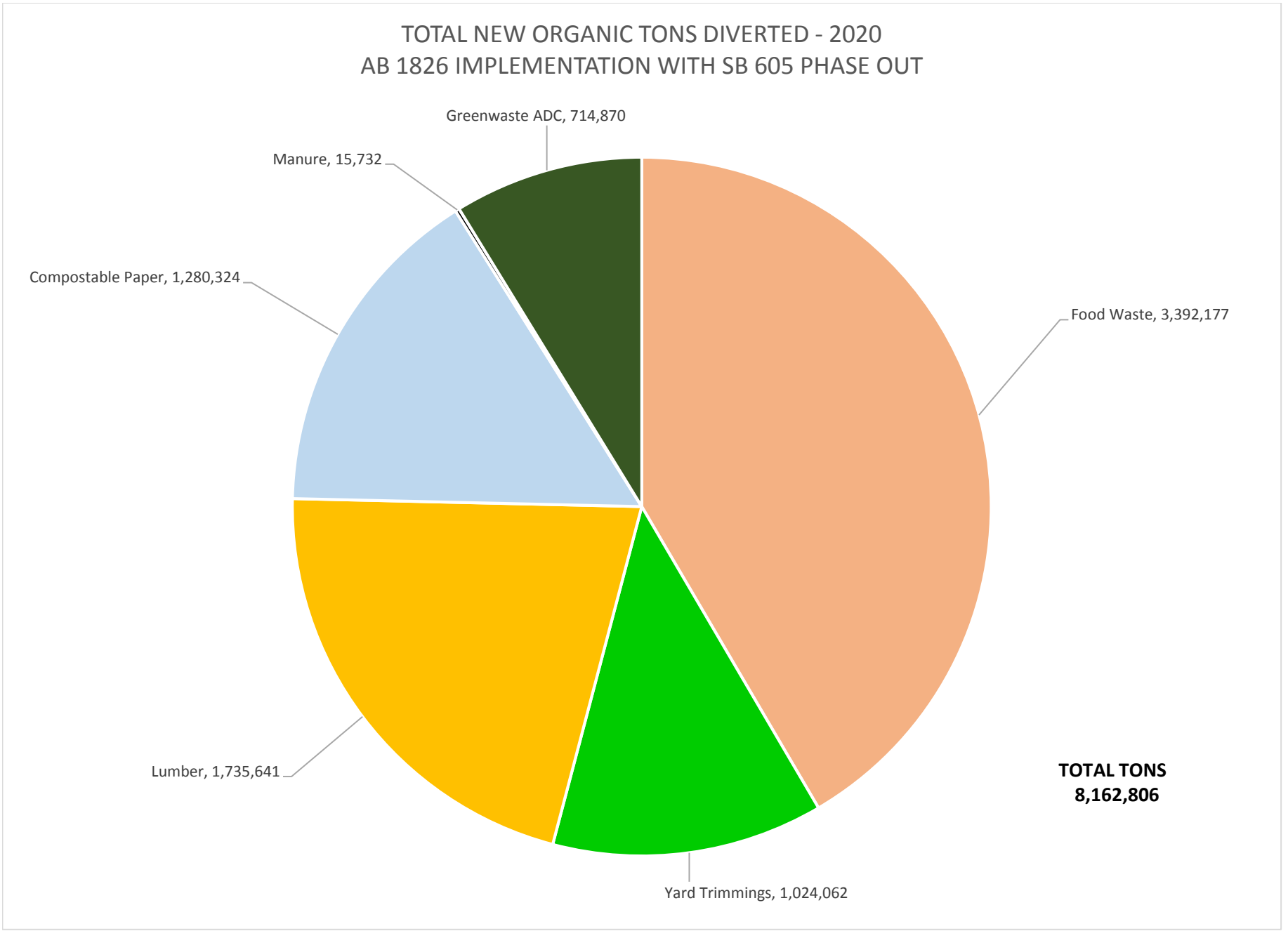
Ultimately under a 90% reduction in disposal, these sectors reduce emissions by 7,192,771 $MTCO_2e$. The remaining reduction of 729,309 $MTCO_2e$ is attributable to a similar 90% reduction in the use of green waste as alternative daily cover. The 1,310,595 tons of ADC green material diverted from landfills is modelled using the -.5565 emission factor for "yard trimmings".

References:

- California Air Resources Board, "Method for Estimating Greenhouse Gas Reductions from Compost from Commercial Organic Waste", November 14, 2011.
- California Air Resources Board, "Method for Estimating Greenhouse Gas Emissions Reductions from Recycling", November 14, 2011.
- California Air Resources Board, "Projection from Staff Report - California 1990 Greenhouse Gas Emissions Level and 2020 Emissions Limit", November 16 2007
- California Department of Finance, Demographic Research Unit, "State and County Total Population Projections by Race/Ethnicity and Detailed Age", December 15, 2014. http://www.dof.ca.gov/research/demographic/reports/projections/P-3/
- California Department of Resource Recovery (CalRecycle), Data Central: Statewide Disposal Amounts, http://www.calrecycle.ca.gov/DataCentral/Materials.htm
- California Department of Resource Recovery (CalRecycle), "California 2008 Statewide Waste Characterization Study", November 10, 2009. http://www.calrecycle.ca.gov/Publications/Detail.aspx?PublicationID=1346
- California Department of Resource Recovery (CalRecycle), "California 2014 Statewide Waste Characterization Study", Summary Table from Monthly Public Meeting held May 19, 2015.

- United States Environmental Protection Agency, “Waste Reduction Model” (WARM), March 2015.


AB 341/ AB 1826/ SB 605 Implementation to 2020 and 2025
Avoided Greenhouse Gases By Material
SB 605/AB 1594
2025
14,750,740 New Tons
AB 341/AB 1826
2020
8,162,806 New Tons
15,000,000
10,000,000
5,000,000
New Tons Diverted
0
Avoided MTCO2e
5,000,000
10,000,000
15,000,000
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
AB 341/AB 1826
2020
4,383,721 Avoided MTCO2e
SB 605/AB 1594
2025
7,922,080 Avoided MTCO2e
Food Waste
Yard Trimmings
Lumber
Compostable Paper
Greenwaste ADC


TOTAL NEW ORGANIC TONS DIVERTED - 2020
AB 1826 IMPLEMENTATION WITH SB 605 PHASE OUT
Greenwaste ADC, 714,870
Manure, 15,732
Compostable Paper, 1,280,324
Food Waste, 3,392,177
Lumber, 1,735,641
Yard Trimmings, 1,024,062
TOTAL TONS
8,162,806

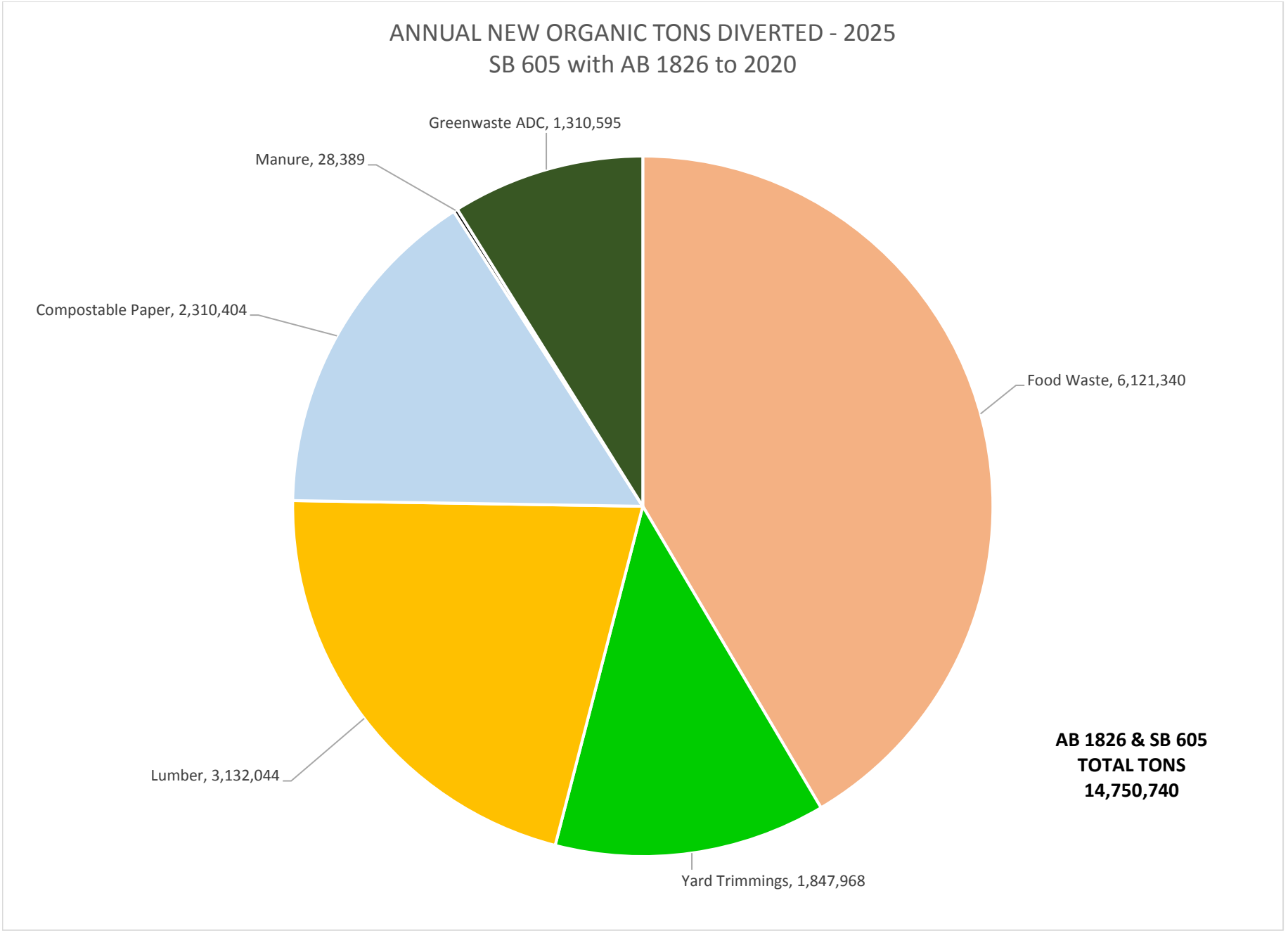

ANNUAL NEW ORGANIC TONS DIVERTED - 2025
SB 605 with AB 1826 to 2020
Greenwaste ADC, 1,310,595
Manure, 28,389
Compostable Paper, 2,310,404
Food Waste, 6,121,340
Lumber, 3,132,044
Yard Trimmings, 1,847,968
AB 1826 & SB 605
TOTAL TONS
14,750,740

Table 2. Assessment of GHG Emission Benefits from Diverting Organics from Landfills

Process	**Organics Disposed in Landfills** (tons/year)	**Annual Tons Diverted** (50% of total disposed in years 2015 - 2020)	**Resulting GHG Emissions Benefits from 50% Diversion MMTCO2e per year** (2015 -2020)	**Annual Tons Diverted** (75% of total disposed in years 2020 and beyond)	**Resulting GHG Emissions Benefits from 75% Diversion MMTCO2e per year** (2020 and beyond)
Composting		2.5 million	1.65[1] – 2.38[2]	3.75 million	2.48[1] – 3.56[2]
Anaerobic Digestion		2.5 million	1.38[3]	3.75 million	2.06[3]
Total	10 million	5 million	3.03 - 3.76	7.5 million	4.54 – 5.62

[1] Estimated using Emission Reduction Factor (ERF) of 0.42 MTCO2e/ton material processed (ARB draft Mandatory Recycling Report) plus adjusted avoided landfill ERF of 0.24 MTCO2e/ton material processed (adjusted by ARB)

[2] Estimated using ERF of 0.42 MTCO2e/ton material processed (ARB draft Mandatory Recycling Report) plus avoided landfill ERF of 0.53 MTCO2e/ton material processed (CalRecycle)

[3] Estimated using ERF of 0.55 MTCO2e/ton material processed by HSAD (ARB LCFS report). As noted in the Follow Up Actions, additional work is on-going to include the downstream process emission benefits in the AD ERF in addition to the avoided landfill methane emissions benefits of AD that are included here.