CARE California Carpet Stewardship Program

MODEL TEAM UPDATE

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California Carpet Stewardship Program

An initiative of CARE:
Carpet America Recovery Effort

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Summary

The Modeling Team has done an amazing job of sorting through a myriad of issues, obstacles and uncertainty to finally distill a degree of stability in this highly volatile moment in time. A large number of scenarios were evaluated before settling on 16 for detailed analysis in early July due to the swings seen in a number of key variables. While originally planning to submit a report by June 30th, it became abundantly clear that the rate of market gyrations were such that by the time a set of scenarios came back, the conditions had changed sufficiently as to render the results out of date and unusable. In recognition of this turbulence, CalRecycle agreed to move the submission back to September 1. The Model Team greatly appreciates this decision in light of the challenges faced.

Unlike the prior report of no change recommendations (September 1, 2019), the need for changes became abundantly clear. How to analyze those changes and when to implement them, were not easy. CARE has taken 3 Covid-19 actions to date and anticipates additional actions may still -be necessary.

The modeling team has been monitoring the collapse of N6 and N66 market prices, as was projected in the September 2019 report. This development has been accelerated by the Covid-19 pandemic and the resolution of N66 supply issues. The projected N6 downward price drift resulted in an evaporation of the subsidy driven low cost 10 cent gap and now requires adjustment as prices collapsed.

Based on numerous model scenarios that have been analyzed, the current assessment level will be sufficient to maintain the projected subsidy payments needed to meet recycling rate expectations along with Program and administrative costs for the remaining life of the Plan. This can be attributed to the aggressive increase of the carpet assessment to 35 cents/yd2 and an increase in the fund account as recycled output did not accelerate at the anticipated rate. In 2019, the lower than budgeted recycled output levels were directly attributable to the delayed grant cycles and several obstacles which were beyond the control of CARE. These obstacles were documented in the 2019 CARE Annual Report to CalRecycle and have been discussed on numerous occasions.

Included in the market gyrations impacting these analyses, one must also consider the continuing acceleration of the downward trend in new carpet sales. Sales are an important factor for two reasons: a) new carpet sales drive the revenue to fund this Program and b) because carpet sales are a key variable in the formula to calculate the overall discards and thus recycling rate.

The various models, and their integration, have been reviewed by Crowe LLP in 2019. Crowe made recommendations for improvements and the modeling team has responded to their input by making changes to the Cost Conversion Model which is a key contributor for support of the subsidy and assessment calculations. The main modification of the Ost Conversion Model was incorporation of a Carpet Access Model (CAM) to include an explicit transportation cost parameter to account for the differences

in the logistics costs for carpet in different regions in CA and collected at CARE drop-off locations.

An effort has been launched by CARE to build collaboration among the Model, Differential Assessment, Highest Recyclability and Economic Study (Crowe) teams to facilitate better understanding and building on what is being learned in this complex endeavor.

In addition to the 2 cents per pound added to CSE subsidies for the period March through August, CARE increased the subsidies as shown here as a result of these model studies. The increases guided by the models are effective for Q3 and Q4 of 2020 and are not considered part of the base subsides in the approved Plan and thus are not subject to the one-year notification should decreases be anticipated.

Effective Q3 & Q4 2020

Nylon 6 Tier 2 was increased by	15 cents/lb.	(10 to 25 cents per lb.)
Nylon 66 Tier 2 was increased by	3 cents/lb.	(10 to 13 cents per lb.)
PET Tier 1 was increased by	5 cents/lb.	(10 cents to 15 cents per lb.)
PP Tier 1 was increased by	5 cents/lb.	(10 cents to 15 cents per lb.)

Modeling Team Report – August 2020

Methodology

The overall method of using the models is presented in Figure A, as has been presented previously to CalRecycle. The economic model (EM) is used to make price predictions for competitive PI polymers and calibrated using actual market data input from Woods MacKenzie and Frank Endrenyi. The CARE proprietary cost conversion model (CCM) is used to make estimates of the costs of recovering PCC materials. The subsidy justification model (SJM) is used to determine the required subsidies for the PCC materials that would make them economically attractive relative to the competitive PI materials.

The Financial Model (FM) brings together sales and outputs plus program and administrative expenses to develop budgets and cash flow analyses and projections. The FM offers the ability to run scenarios to examine a variety of parameters and their impact on financial performance while also tracking actual vs budgeted performance. Finally, the FM allows analysis and tracking of the fund balance and reserve level.

The SJM confirms that the subsidies satisfy the conditions to make PCC materials competitive in the marketplace and that the highest recyclable materials receive a subsidy that makes them the most attractive materials to recycle. This methodology remains unchanged from our previous report, but the extraordinary events of the past 6 months required that we modify recommended subsidies to account for short term stresses in the marketplace. Such changes will be on a temporary basis and are not permanent subsidy adjustments, which would require a 1-year change notification before any reductions could take place.

The modeling methodology outlined in Figure A serves to analyze a wide array of data from capacity surveys, sales projections, recycled output trends, Tier 1 and Tier 2 outputs, costs and estimates subsidies. It is the Financial Model (FM) which brings all the elements together to examine the cash flow, fund balance, reserve, and recycling rate. Figure B illustrates the central analytical role of the Financial Model.

Methodology - Recommendations Implemented

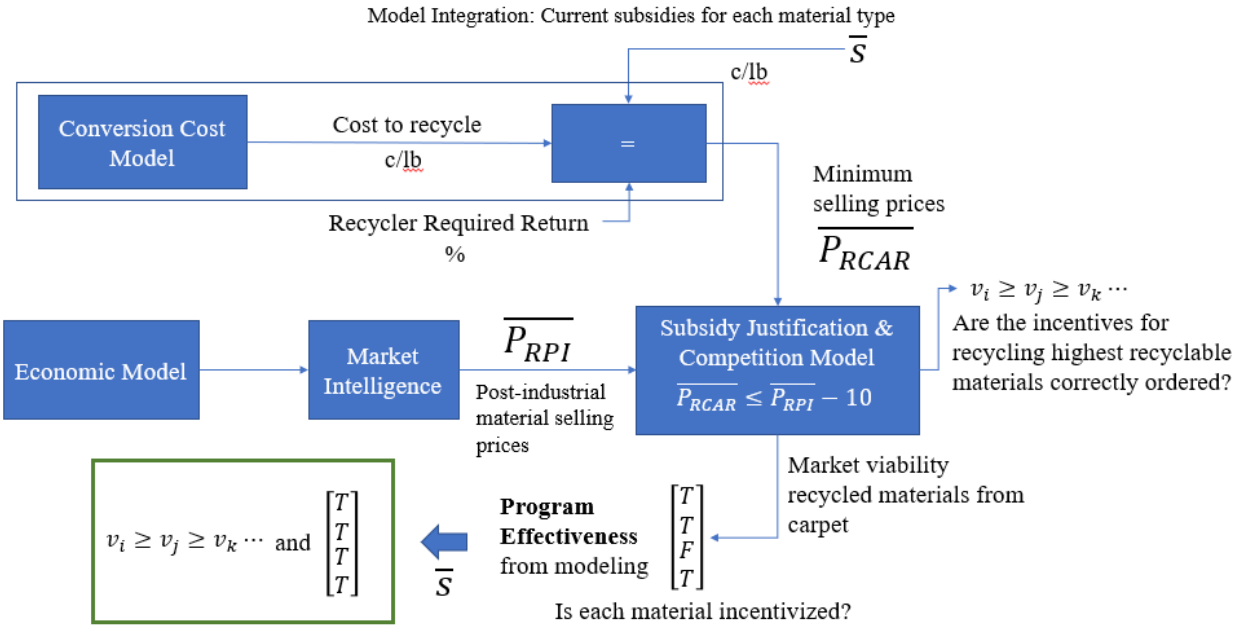
The modeling approach has been reviewed by Crowe LLP and, after consideration and dialog, we have implemented recommendations for improving the modeling methodology. One of their recommendations was to improve the representation of the costs of carpet collection and transportation in California. This was previously handled in the Cost Conversion Model (CCM) with a uniform cost of carpet acquisition.

In the future we will use an explicit cost of carpet acquisition model (CAM) component that will enable us to examine how logistics and collection costs change the conversion costs. A flexible carpet acquisition model (CAM) has been developed, rather than a

uniform payment for carpet acquisition. This change is being made to the CCM to reflect carpet acquisition cost differences between rural sites as opposed to urban centers. This method also takes into account regional logistics cost differences. The CCM will now reflect the various methods of collections.

It should be noted that the vast majority of carpet (>85%) that is currently processed does not come from CARE drop-off sites and therefore the CCM is not significantly biased by its exclusion in the earlier version for this source of material.

Figure A Modeling Methodology Background



Economic Model Results

The 2019 report predicted “slow to moderate economic growth with little change in oil prices from those of today”. No one foresaw the economic crisis arising from Covid 19.

Depicted below was the oil forecast from the 2019 report.

Table 1 (Woods MacKenzie) shows the expected cost of crude oil August 2019 - June 2020 as projected in CARE’s September 2019 Model Report. Table 2 is now updated to show actual prices of crude oil from August 2019 through June 2020 and provides for a direct comparison. Finally, Table 3 (Woods MacKenzie) represent the model forecasts for oil prices through May of 2021.

Figure B Integration Role of the Financial Model

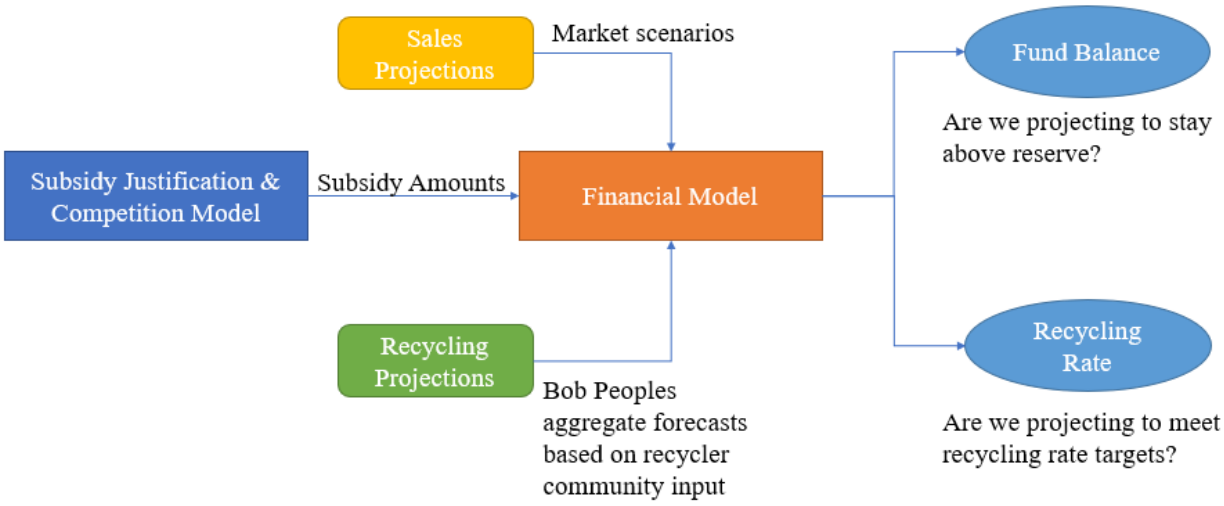


Table 1 2020 Crude Oil Prices as Projected in August 2019

Name	Spot/Contract	Unit	Aug-19	Dec-19	Mar-20	Jun-20
Crude Oil	OPEC	$/bbl	69.0	67.0	63.0	63.0
Crude Oil	WTI	$/bbl	64.2	64.5	61.6	62.8
Crude Oil	BRENT	$/bbl	72.0	70.0	66.0	67.0

Table 2 Actual cost of crude Oil in 2020

Name	Spot/Contract	Unit	Dec-19	Mar-20	Jun-20
Crude Oil	OPEC	$/bbl	63.8	28.7	37.1
Crude Oil	WTI	$/bbl	59.8	29.9	38.3
Crude Oil	BRENT	$/bbl	66.8	31.7	40.0

Table 3: Forecast Crude Oil Prices in 2021

Name	Spot/Contract	Unit	Sept-20	Dec -20	May-21
Crude Oil	OPEC	$/bbl	34.0	40.0	46.4
Crude Oil	WTI	$/bbl	33.8	40.3	46.2
Crude Oil	BRENT	$/bbl	37.0	43.0	49.0

There are many factors that affect commodity prices; one of the main influences is the price of oil. Additionally, other influences abound, and those additional influences are captured by CARE's EM (Economic Model) presented below.

Historically, in an average economy, oil prices play a large role in determining plastic commodity prices. Oil largely determines Prime Virgin prices, which then determines Post-industrial prices, which in turn, sets Post-Consumer prices. There will always be mitigating circumstances such as Force Majeures, natural disasters, etc., that may skew prices, but those events are very unpredictable and are typically short term in nature.

Oil prices have hit historic lows, but because of the Covid-19 pandemic, these historic low oil prices have been completely overshadowed by an economy that has been shuttered in various degrees since March 2020. Demand for all products are at lows not seen since the Great Depression. Demand for commodities that are the constituents of carpets have been reduced by as much as 80% to 90% during the pandemic. The Auto/Transportation sector, which utilizes the majority of high value plastics in the U.S., was closed for 2 months. Other sectors/industries were relegated to the same fate. Although the Auto sector has opened again as of Mid-July 2020, the pace of production is dramatically slower than pre-Pandemic levels. New procedures and processes due to safety and health concerns, have resulted in slower production levels. This situation has been exacerbated due to parts of the country still in partial lockdowns and new unknowns due to surging virus infections. Additionally, the high levels of unemployment created by the Pandemic have impacted demand for all transportation (cars, SUV's etc.).

Historic low oil prices combined with unprecedented lack of demand due to the Pandemic have driven prices down to historic lows. It is currently anticipated that "Normal levels" will not return until mid-2021.

Economic Model Price Predictions: 2020

There were exceptional economic and political events in early 2020 that resulted in the price of oil falling outside of forecasted levels. The spread of coronavirus (COVID-19) resulted in a worldwide pandemic, triggering mandated lockdowns and stay-at-home orders. These regulatory measures, intended to curb the spread of the disease, disrupted supply chains and reduced the demand for oil for both consumers and businesses as travel restrictions increased worldwide. To compound the reduction in

demand of oil, an economic war between Russia and Saudi Arabia over the price of oil, occurred in the spring of 2020, resulting in an accelerated drop in the price of oil worldwide. A combination of these factors resulted in oil futures going into a negative price range during April 2020. The price of oil has seen a modest recovery in May and June 2020 and observed less volatility during July and early August. However, the magnitude of these events has required extrapolating the economic model beyond the statistical evidence typically relied upon by the model.

Based on these oil prices and forecasts for low economic growth we have the following ranges for the prices of virgin, post-industrial and then post-consumer prices.

Table 4 below uses the Economic Model (EM) to predict prices of commodities from a low oil price of $28/barrel to a high price of $52/barrel. The median expected in 2020 is $40/barrel. Midrange of $40/barrel is used in the models.

Table 4 Commodity Prices based on Oil as of August 13, 2020

Expectations						
		Low Forecast		This Year		High Forecast
Oil	$ per barrel	28	34	40	46	52
Nylon 6,6						
Virgin	Cents / Lb.	92	96	100	104	107
Post Industrial	Cents / Lb.	57	59	62	64	66
Post Consumer	Cents / Lb.	51	51	52	53	53
Nylon 6						
Virgin	Cents / Lb.	70	72	75	77	80
Post Industrial	Cents / Lb.	45	46	48	50	51
Post Consumer	Cents / Lb.	34	36	37	38	40
PET						
Virgin	Cents / Lb.	29	34	40	45	50
Post Industrial	Cents / Lb.	15	17	20	22	25
Post Consumer	Cents / Lb.	9	9	10	11	11
Polypropylene						
Virgin	Cents / Lb.	32	36	40	44	47
Post Industrial	Cents / Lb.	18	20	22	24	26
Post Consumer	Cents / Lb.	11	11	12	13	13

Cost Conversion and Subsidy Justification Model

The proprietary CCM is the backbone of estimating costs associated with processing PCC. CARE is the only source for such information at this time. CARE CCM estimates will be compared to those obtained by the Crowe Economic Study due mid-year 2021. The CCM is a robust cost analysis tool and has been upgraded to further reflect PCC acquisition geographic operational costs.

The SJM (Subsidy Justification Model) was developed by CARE in order to accurately subsidize Recyclers according to 1) Type of product recycled, 2) The cost of recycling the various types of products, and 3) The price of competing materials in the marketplace. The SJM integrates these 3 main elements.

The SJM reflects the constant changes in commodity prices of raw materials (PET, Nylon 6, Nylon 66 and PP) that compete against Post-Consumer carpet materials. Those competing materials are typically Post-Industrial materials in each material category.

Table 5 shows the subsidy level that existed in August 2019.

Table 5: SJM Projections as of August 2019 (for comparative purposes)

	Subsidy Justification Model (August 2019)								
	B	C	D	E	F	G	H	I	J
	Competitive Materials Market Price	PCC Discount	PCC Materials Market Price	PCC Carpet Conversion Cost[2]	15% Return Conv. Cost[3]	Conv. Cost Plus Return	Subsidy Required to Incentivize PCC Materials	PCC Materials Subsidy[6] Table 8A	Subsidy Difference[4]
Formula >>			B-C		E*0.15	E+F	G-D		J-H
Nylon 6 pellets	$0.70	$0.10	$0.60	$0.72	$0.11	$0.83	$0.23	$0.25	$0.02
Nylon 6 Fiber	n/a	n/a	$0.25	$0.30	$0.05	$0.35	$0.10	$0.15	$0.06
Nylon 66 pellets	$1.00	$0.10	$0.90	$0.72	$0.11	$0.83	-$0.07	$0.25	$0.32
Nylon 66 Fiber	n/a	n/a	$0.25	$0.30	$0.05	$0.35	$0.10	$0.15	$0.06
PET Pellets	$0.47	$0.10	$0.37	$0.72	$0.11	$0.83	$0.46	$0.35	-$0.11
PET Fiber[1]	n/a	n/a	$0.25	$0.30	$0.05	$0.35	$0.10	$0.35	$0.26
PP Pellets	$0.35	$0.10	$0.25	$0.45	$0.07	$0.52	$0.27	$0.35	$0.08
PC4	$0.02	$0.10	-$0.08	$0.05	$0.01	$0.06	$0.14	$0.17	$0.03

Table 1 [1] Prices for PET based on Bottle Flake [2] Conversion Costs exclude shipping [3] Use 15% Recovery on Cost of Conversion based on reasonable return and shipping negotiations [4] Numbers greater than 0 mean subsidy is justified as sufficient to subsidize [5] Green cells represent highest recyclability materials [6] PCC materials subsidy is total of Process and Manufacturer [7] All costs are in $/lb. finished goods (yielded)

In CARE's 2019 report to CalRecycle we predicted that: "It is expected that prices will fall between August 2019 and March 2020 under anticipated global market/business conditions. Specifically, the N66 price margin over N6 will decline from its current 30 cents to 13 cents". CARE's prediction was very accurate as the price difference between N66 and N6 is now 14 cents as demonstrated by the SJM and EM. Obviously, Covid-19 has exacerbated the predicted economic slowdown.

Based on the changes in market prices that have been experienced due to both oil price changes, and the Covid-19 impacts on market demand and supply, the SJM and EM recommend an increase in subsidies. Below are actual and projected market prices and the accompanying proposed subsidies going forward over the next six months.

Note: There is no Table 6 in this report the number 6 was skipped). The numbering was set so that the new SJM remains Table 7, consistent with its designation in the Plan as Table 7 in hopes of avoiding confusion.

The next Table 7 shows the actual approved subsidies that went into effect as of July 1, 2020. Data from the 3rd week July 2020 was employed to create the latest update to the SJM. Market dynamics and the demand destruction due to Covid-19 have impacted all carpet recyclable materials; however, the two most impacted materials are Nylon 6 pellets and PET Pellets. The mitigation of available supply of Nylon 66 has had very little impact on potential subsidy changes as N66 was over subsidized in the past.

CARE ran a large number of CCM and EM scenarios to feed the SJM (16 after initial runs were evaluated). The impact of those scenarios was subsequently examined via the FM. The scenarios also included a range of carpet sales assumptions down to "worst case". This series of options was then taken to the SPC. The SPC suggested additional factors to model, after which the recommendations in SJM Table 7 were finalized.

After thorough analysis and discussions with the SPC, the final approved total subsidies are shown below in column L. There was one minor variation from the original recommended subsidy changes. In the case of Nylon 6 Tier 2, the SJM calculated a delta of negative 18 cents/lb. However, based on additional dialog and market understanding the subsidy was set at an additional 15 cents.

Table 7: Current SJM Results (3rd week July 2020)

New Table 7

Subsidy Justification Model - Effective July 1 2020

	B	C	D	E	F	G	H	I	J	K	L
	Competitive Materials Market Price	PCC Discount	PCC Materials Market Price	PCC Carpet Conversion Cost[2]	15% Return Conv. Cost[3]	Conv. Cost Plus Return	Subsidy Req'd to Incentivize PCC Materials	PCC Materials Subsidy[6] Table 8A	Subsidy Difference [4]	New Subsidy Total SJM Proposed	New Subsidy Total APPROVED
Formula >>			B-C		E*0.15	E+F	G-D	Actual Present Subsidies	J-H (Indicated by CCM and SJM)	Indicated by CCM & SJM	Approved by SPC 7-20-20
Nylon 6-Tier 2	$0.48	$0.10	$0.38	$0.70	$0.11	$0.81	$0.43	$0.250	**-$0.18**	$ 0.43	$ 0.40
Nylon 6-Tier 1	n/a	n/a	$0.25	$0.33	$0.05	$0.38	$0.13	$0.15	$0.02	$ 0.15	$ 0.15
Nylon 66-Tier 2	$0.62	$0.10	$0.52	$0.70	$0.11	$0.81	$0.29	$0.25	**-$0.03**	$ 0.29	$ 0.28
Nylon 66-Tier 1	n/a	n/a	$0.25	$0.33	$0.05	$0.38	$0.13	$0.15	$0.02	$ 0.15	$ 0.15
PET - Pellets	$0.20	$0.10	$0.03	$0.43	$0.06	$0.49	$0.46	$0.35	**-$0.11**	$ 0.46	$ 0.51
PET- Tier 2	$0.20	$0.10	$0.10	$0.70	$0.11	$0.81	$0.71	$0.35	**-$0.36**	$ 0.35	$ 0.40
PET - Tier 1	n/a	n/a	$0.20	$0.30	$0.05	$0.35	$0.15	$0.10	**-$0.05**	$ 0.15	$ 0.15
PP - Tier 2	$0.22	$0.10	$0.12	$0.45	$0.07	$0.52	$0.40	$0.35	**-$0.05**	$ 0.40	$ 0.40
PP -Tier 1	$0.15	$0.10	$0.05	$0.30	$0.05	$0.35	$0.30	$0.10	**-$0.20**	$ 0.30	$ 0.15
PC4	$0.02	$0.10	**-$0.08**	$0.05	$0.01	$0.06	$0.14	$0.17	$0.03	$ 0.17	$ 0.17

Table 8 Synopsis: August 2019 vs. July 2020 Approved Subsidies

Material	August 2019	July 2020
Nylon 6 pellets	$ 0.25	$ 0.40
Nylon 6 Fiber	$ 0.15	$ 0.15
Nylon 66 pellets	$ 0.25	$ 0.28
Nylon 66 Fiber	$ 0.15	$ 0.15
PET Pellets	$ 0.35	$ 0.51
PET Fiber	$ 0.10	$ 0.15
PP Fiber	$ 0.10	$ 0.15
PP Pellets	$ 0.35	$ 0.40

Economic Model

The Economic Model (a higher-level macro model) and the prices used in the SJM for July 2020 are compared in Table 9. CARE believes the SJM, which is based on actual market intelligence for PCC value and accounts for market demand conditions as well as oil supply, offers a more realistic result over the EM forecasts.

Table 9 Economic vs Subsidy Justification Model Price Comparisons

Material	SJM Prices	Economic Model Predictions
Nylon 6 pellets	$0.48	$0.62
Nylon 66 pellets	$0.62	$0.79
PET Pellets	$0.51	$0.52
PP Pellets	$0.15	$0.26

CARE Financial Model Results

The projected pounds of recycled output and recycling rates for the revised model are show below in Figure C.

In general, it is the opinion of the Model Team that the Revised Model is now the best estimate of the likely trajectory over the next 6 months. However, given the major uncertainties that still exist around the rate of economic recovery, the potential for instability in oil markets and the potential for continued virus hot spots, confidence remains relatively low in trying to forecast the next 6-12 months.

Figure C Recycled Output & Recycling Rate Projections

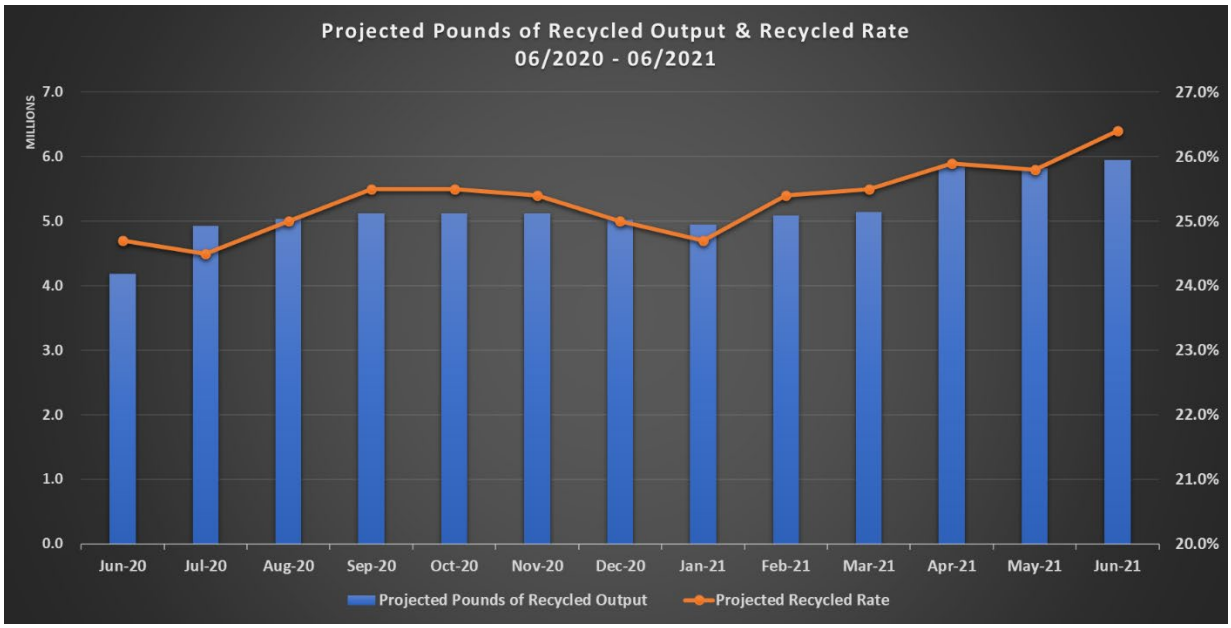
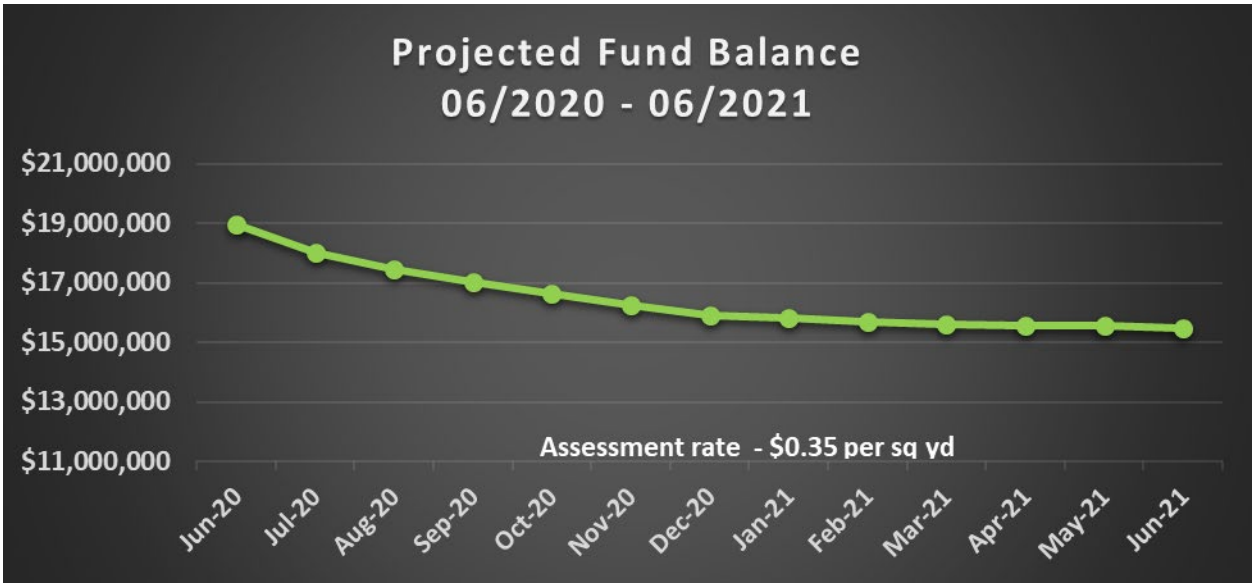


Figure D Projected Fund Balance



Independent Analysis for Perspective (Woods MacKenzie)

CalRecycle is aware that CARE subscribes to Woods MacKenzie proprietary petrochemical update services. Below is a verbatim excerpt from the August 2020 Coronavirus and polymers Q3 outlook report. [Note: This report comes out of Europe so in this case fibre means fiber.]

What do these sectorial impacts mean for key polymer and fibre markets?

To understand how these sectorial impacts roll back into polymer and fibre demand, our model applies the sectorial impact directly to the polymers and fibres that go into each sector (in each region), and then compare the output to our pre-coronavirus forecast for 2020 demand in each of these segments.

The chart below (Figure E) shows the outcome of the (Woods MacKenzie) model. The most salient points that we would highlight include:

• Polymers and fibres that are heavily exposed to either the automotive or textiles and apparels sector have been hardest hit. PA66 – a key engineering plastic – is facing the biggest challenge, forecast to lose 16% of 2020 demand as a result of its exposure to the automotive sector. PET fibre and PA6 are heavily exposed to both sectors. [CARE note: this is a big outlet sector for PCC polymers]

• Diversification can be a real benefit. While polypropylene is the single biggest plastic going into the automotive sector, its exposure to other sectors means it avoids the scale of the problem faced by PA66 producers.

• Flexible packaging is the ‘winner’. The data show it rises slightly above the ‘0.00%’ line in the chart below and consists of packaging polymers (PP) that have flexible

applications. LDPE, LLDPE and PA6 all go into film and flexible packaging applications; PET, PS and HDPE primarily go into rigid applications, and are seeing more negative outcomes. [CARE note: LDPE, LLDPE, PS and HDPE are not relevant to PCC polymer consideration]

Figure E 2020 Updated Change in Demand from pre-Virus Outlook

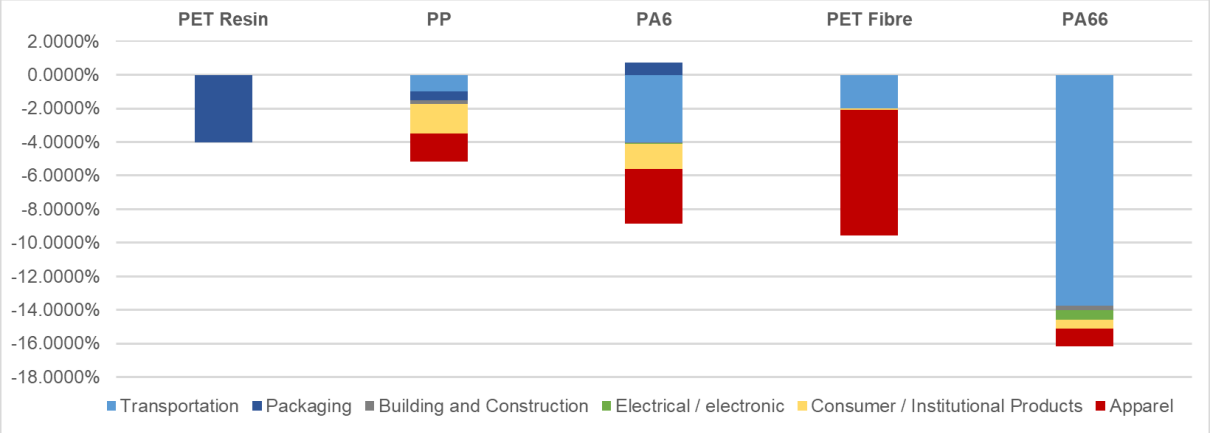


Figure E: Sourced from more expanded chart found in the August 2020 Coronavirus and polymers Q3 outlook report (Woods MacKenzie)

[CARE note: Transportation and Apparel are most relevant to PCC market outlets.]

Conclusions

CARE anticipates continued economic pressures to exist thru mid-2021. As a result, market volatility makes projections much more problematic. Layered upon this is the uncertainty of the unknown trajectory of virus spread and the current surges being seen around the world and their concomitant impact on the global economy.

1. CARE believes the Revised Model is the best case that represents the highest probability for the next 12 months
2. Current subsidies were found to be less than required in most cases to support the sale of PCC materials – thus additional increases were made under the Covid-19 Action Plan effective July 1, 2020 (Q3)
3. Changes recommended are short-term adjustments and not meant as permanent or long-term changes to Plan approved guaranteed subsidies
4. Given higher than budgeted fund balance, the current assessment is sufficient to see the Plan through the end of term, December 2022
5. Barring any unforeseen changes, CARE anticipates being able to achieve Plan Recycling Rates in 2021 and beyond.
6. Prior statements of no expected excursions in the price of oil, virgin or PI materials turned out to be incorrect – volatility has been extreme
7. Modifications to the CCM have been made to account for Crowe feedback, especially as it relates to cost of acquisition of PCC

8. CARE remains the leading authoritative source of PCC materials intelligence on flows, pricing, and technology evaluations

Thus, CARE recommended subsidy adjustments as outlined in Table 7, column L. These subsidy changes were implemented effective Q3 (July 2020) and will run through December 2020. Future adjustments up, down or elimination will be determined in Q4 2020. These subsidy adjustments are the 3rd action in a series taken by CARE in response to the Covid-19 pandemic. CARE will target the next Model update for April 2021.

End Report