Debt Affordability Committee

Meeting #3

4 December 2018

Agenda for Meeting #3

- **Determining the yield curve and rate forecast for use in modeling**
  - Current yield curve in the muni bond market
  - Massachusetts actual yield curve and rate experience in 2018
  - Muni rate forecast for 2019-2048
- **Revenue outlook for FY19 and preliminary look at FY20**
- **Improvements to the model's sensitivity tests**
- **"How to guide" for DAC members using the model for scenarios**

Current yield curve on Munis

- **Yield curve as of 30 November 2018**

Municipal Market Yields

The tables and charts below provide yield rates for AAA, AA and A rated municipal bonds in 10, 20 and 30-year maturity ranges. These rates reflect the approximate yield to maturity that an investor can earn in today's tax-free municipal bond market as of 11/30/2018.

AAA RATED MUNI BONDS

ISSUE	Maturity Range	Today	Last Week
National	10 Year	2.65	2.75
National	20 Year	3.15	3.25
National	30 Year	3.30	3.40

AA RATED MUNI BONDS

ISSUE	Maturity Range	Today	Last Week
National	10 Year	2.80	2.90
National	20 Year	3.35	3.50
National	30 Year	3.50	3.65

A RATED MUNI BONDS

ISSUE	Maturity Range	Today	Last Week
National	10 Year	3.10	3.20
National	20 Year	3.65	3.75
National	30 Year	3.80	3.95

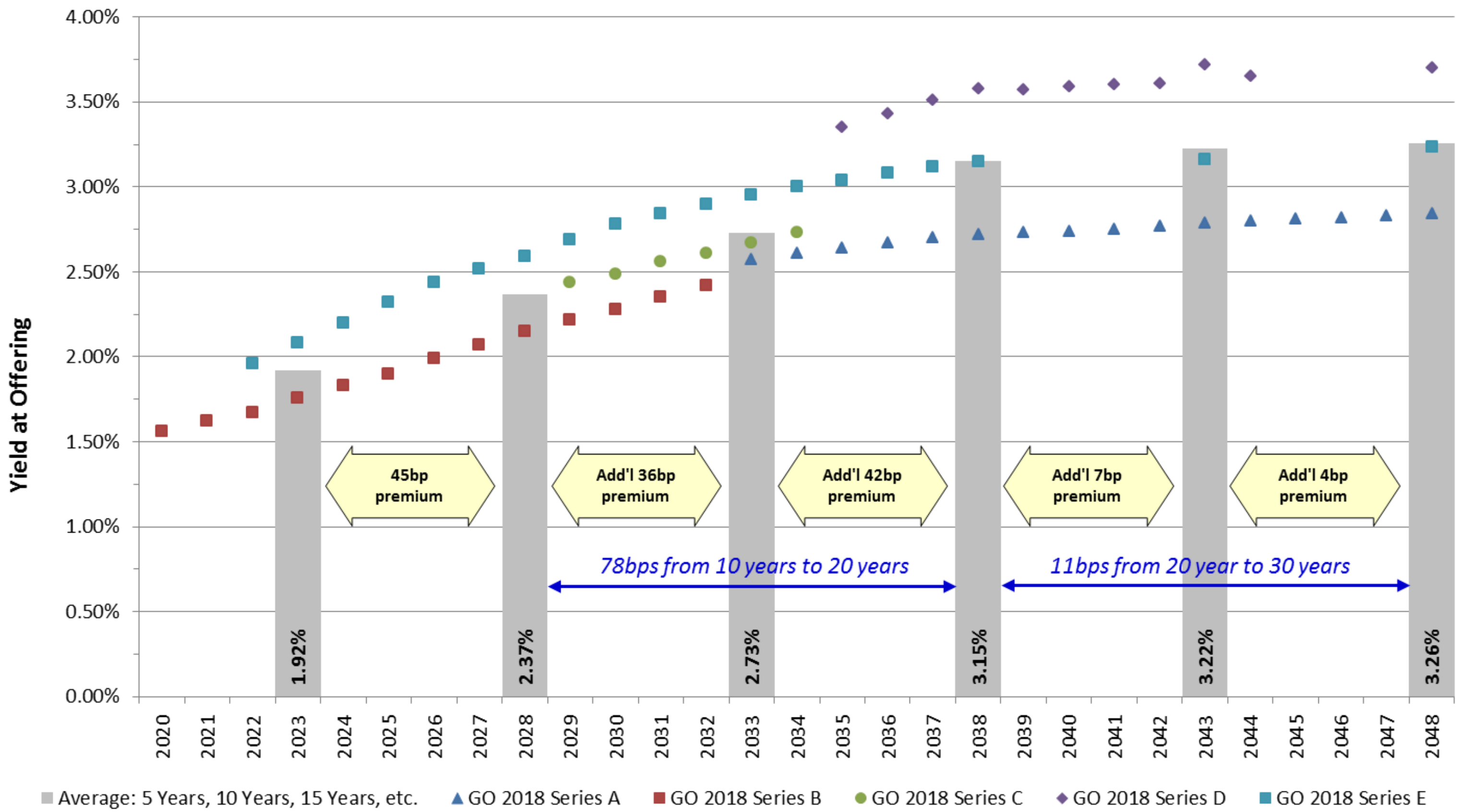
The yield curve is relative steep between 10-year and 20-year, at 55bps. The yield curve between 20-year and 30-year is much flatter, at 15bps.

Note the decline in yields from last week. This may reflect expectations about the timing and scale of rate rises and inflationary pressures, as well as changing opinions on the relative attractiveness of different asset classes (Treasuries versus Munis, equities versus bonds)

Source: FMS Bonds Inc. This is a representative analysis, selected for recency.

The yield curve in 2018:
Actual experience of the Commonwealth

- As on the general market data, the yield curve is steeper from 10 to 20 years and flatter from 20 to 30
- Because the issuances occurred at different periods, this chart also reflects changing yield expectations. Series A&B are dated January; Series C&D are dated May; and Series E is dated September
- Because the data covers a 9-month period (not a snapshot like prior page) the average measure in the columns is somewhat distortive



Source: yield at time of offering from EMMA. Analysis & charting by A&F.

Yield outlook from third-party sources

Calendar Year	Bond Buyer 20yr Index	Moody Aaa 20yr Muni	Moody Aa 20yr Muni	20-Year for Model (average)	Increase from 2018	YoY Increase
2018	3.67%	3.04%	3.28%	3.16%	0.00%	0.00%
2019	3.89%	3.27%	3.49%	3.38%	0.22%	0.22%
2020	4.30%	3.78%	4.00%	3.89%	0.73%	0.51%
2021	4.42%	3.98%	4.20%	4.09%	0.93%	0.20%
2022	4.44%	4.17%	4.40%	4.29%	1.12%	0.19%
2023	4.46%	4.45%	4.68%	4.56%	1.40%	0.28%
2024	4.47%	4.46%	4.68%	4.57%	1.41%	0.00%
2025	4.48%	4.48%	4.72%	4.60%	1.44%	0.03%
2026	4.49%	4.59%	4.82%	4.70%	1.54%	0.10%
2027	4.47%	4.76%	4.99%	4.87%	1.71%	0.17%
2028	**4.48%**	**4.79%**	**5.03%**	**4.91%**	**1.75%**	**0.04%**
2029		4.77%	5.01%	4.89%	1.73%	-0.02%
2030		4.74%	4.97%	4.85%	1.69%	-0.04%
2031		4.71%	4.94%	4.82%	1.66%	-0.03%
2032		4.68%	4.91%	4.79%	1.63%	-0.03%
2033		4.66%	4.89%	4.77%	1.61%	-0.02%
2034		4.64%	4.87%	4.75%	1.59%	-0.02%
2035		4.62%	4.85%	4.73%	1.57%	-0.02%
2036		4.61%	4.84%	4.72%	1.56%	-0.01%
2037		4.60%	4.83%	4.71%	1.55%	-0.01%
2038		**4.60%**	**4.83%**	**4.71%**	**1.55%**	**0.00%**
2039		4.60%	4.83%	4.71%	1.55%	0.00%
2040		4.60%	4.83%	4.71%	1.55%	0.00%
2041		4.60%	4.83%	4.72%	1.56%	0.00%
2042		4.61%	4.83%	4.72%	1.56%	0.00%
2043		4.61%	4.84%	4.72%	1.56%	0.00%
2044		4.61%	4.84%	4.72%	1.56%	0.00%
2045		4.61%	4.84%	4.73%	1.56%	0.00%
2046		4.61%	4.84%	4.73%	1.57%	0.00%
2047		4.62%	4.84%	4.73%	1.57%	0.00%
2048		**4.62%**	**4.85%**	**4.73%**	**1.57%**	**0.00%**

- Of the available sources, Moody’s provided the longest-term forecast
- Based on history, we found that GO bonds trade in the range between Aaa and Aa
- As the table shows, the outlook is for a relatively steep rise in rates in the coming five years, then a slight decline or flattening
- We do not think there is much information value in the minor fluctuations between individual years

Source: yield at time of offering from EMMA. Analysis & charting by A&F.

Developing model input on rates – see next page for explanation

Calendar Year	20-Year for Model (average)	Increase from 2018	YoY Increase	Simplifed increase to model	Resulting 20-Year	Simple higher/ (lower)	Discount for 10-Year Maturity	Resulting 10-Year	Increase from 2018	Premium for 30-Year Maturity	Resulting 30-Year	Increase from 2018
2018	3.16%	0.00%	0.00%		3.20%	0.04%	0.50%	2.70%	0.00%	0.15%	3.35%	0.00%
2019	3.38%	0.22%	0.22%	0.32%	3.52%	0.14%	0.50%	3.02%	0.32%	0.15%	3.67%	0.32%
2020	3.89%	0.73%	0.51%	0.32%	3.84%	-0.05%	0.50%	3.34%	0.64%	0.15%	3.99%	0.64%
2021	4.09%	0.93%	0.20%	0.32%	4.16%	0.07%	0.50%	3.66%	0.96%	0.15%	4.31%	0.96%
2022	4.29%	1.12%	0.19%	0.32%	4.48%	0.19%	0.50%	3.98%	1.28%	0.15%	4.63%	1.28%
2023	4.56%	1.40%	0.28%	0.32%	4.80%	0.24%	0.50%	4.30%	1.60%	0.15%	4.95%	1.60%
2024	4.57%	1.41%	0.00%	0.00%	4.80%	0.23%	0.50%	4.30%	1.60%	0.15%	4.95%	1.60%
2025	4.60%	1.44%	0.03%	0.00%	4.80%	0.20%	0.50%	4.30%	1.60%	0.15%	4.95%	1.60%
2026	4.70%	1.54%	0.10%	0.00%	4.80%	0.10%	0.50%	4.30%	1.60%	0.15%	4.95%	1.60%
2027	4.87%	1.71%	0.17%	0.00%	4.80%	-0.07%	0.50%	4.30%	1.60%	0.15%	4.95%	1.60%
2028	**4.91%**	**1.75%**	**0.04%**	**0.00%**	**4.80%**	**-0.11%**	**0.50%**	**4.30%**	**1.60%**	**0.15%**	**4.95%**	**1.60%**
2029	4.89%	1.73%	-0.02%	0.00%	4.80%	-0.09%	0.50%	4.30%	1.60%	0.15%	4.95%	1.60%
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Source: yield at time of offering from EMMA. Analysis & charting by A&F.

Model input on rates: Notes related to prior page

- **The first three columns pick up the data from page 6**

- **The columns with green headings show the creation of simplified assumptions for use in the model**
  - Essentially, we smoothed the rate increase data to create model inputs
  - Our approach: simplifying assumptions are OK, as long as they are conservative. Generally, we show rates rising slightly faster and slightly higher.
  - On the shape of the yield curve (as opposed to projection of yields), we are currently modeling the current shape out into the future. We believe that this is conservative, as future changes may reduce the premium on 20-year over 10-year.

Quick check-in on revenue outlook

- **FY19 benchmark revenue is 2.1% more than FY18, which was an extraordinarily strong year**
- **DOR is not advising that the FY19 benchmark be revised upward, but the outlook for achieving the benchmark is certainly favorable**
- **On December 5th, the Consensus Revenue hearing will provide outlooks for FY20 from DOR and a number of outside experts**
- **Although most economic forecasters believe an economic recession is on the horizon, few seem to be predicting that it will arrive in the FY20 period**
- **Conclusion: projecting revenue in the 3.0% - 3.3% range over the long term appears appropriate, subject to stress-testing of less favorable growth**

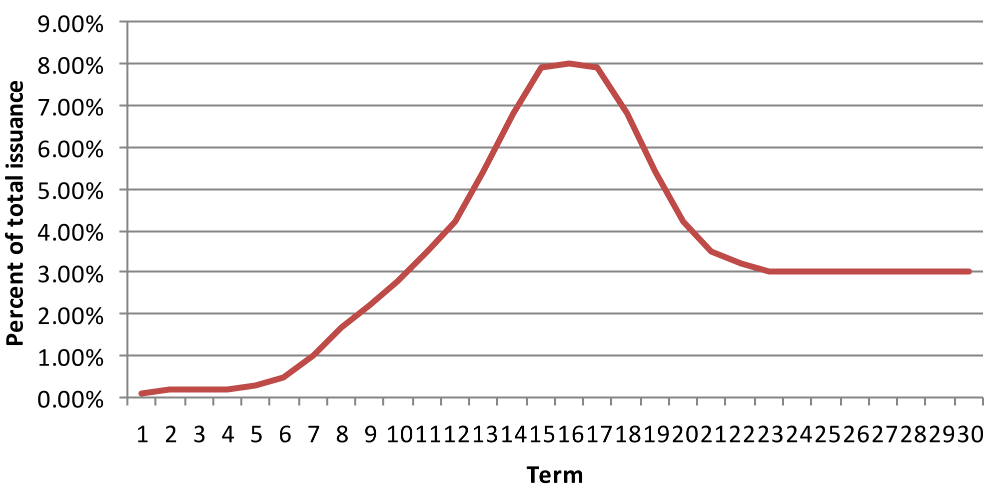
Improvements to the model's sensitivity tests

- The most notable change to the model is that it now models debt as municipal bonds (interest payments for the life of the bond with principal paid at the end) rather than on an amortization schedule (equal payments of principal and interest for each period of the life of the bond
    - This creates a bigger gap between projections and 8% of revenues in the short term, but a smaller gap in the long term
    - This also requires more detailed assumptions about the issuance terms. The current modeling of issuance terms is shown below, but can be adjusted:

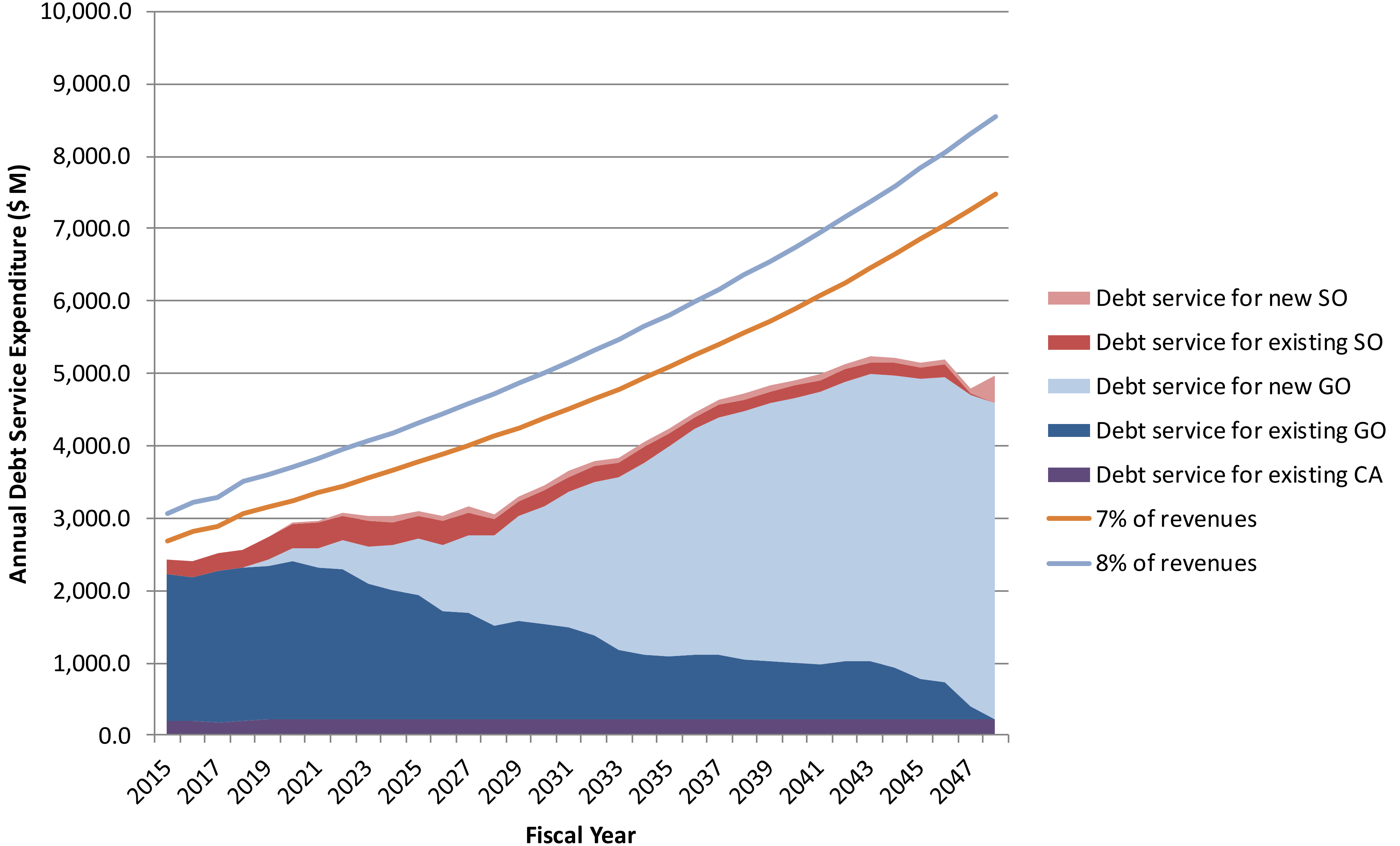
Old

Term	Percent of total issuance
10	10
20	60
30	30

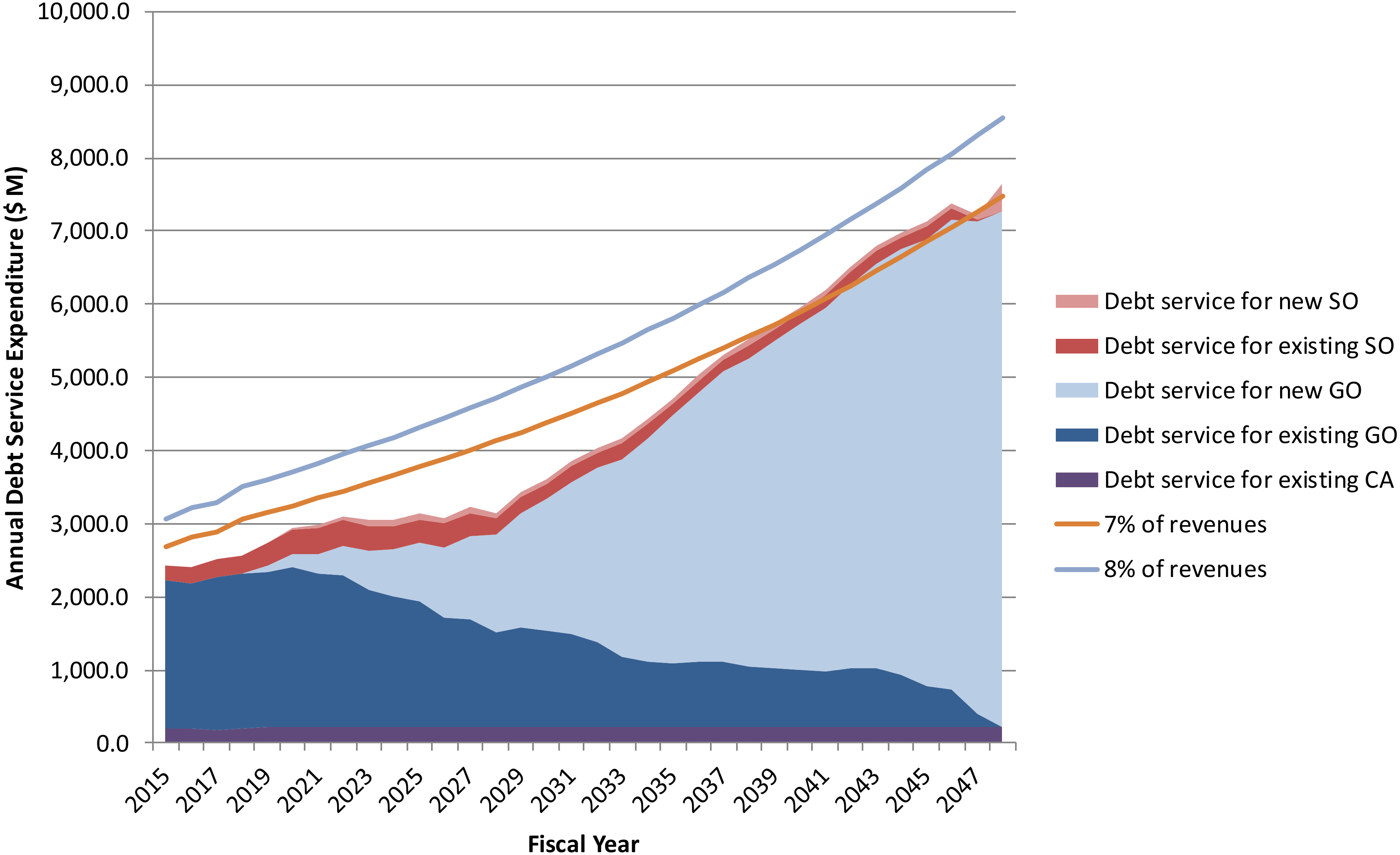
New



$0 increase vs. FY19 and 0% growth FY25+



$90 M increase vs. FY19 and 3.85% growth FY25+



$125 M increase vs. FY19 and 5.34% growth FY25+