8-2017

Rogue Disposal & Recycling Simplified Refuse Rate Index: Technical Report

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NeRC

Northwest Economic Research Center
College of Urban and Public Affairs

August 2017

ACKNOWLEDGEMENTS

This report was researched and produced by the Northwest Economic Research Center (NERC) with support from Rogue Disposal & Recycling.

Rogue Disposal & Recycling (RDR) has been providing innovative solid waste and recycling services in southern Oregon for 73 years.

NERC is based at Portland State University in the College of Urban and Public Affairs. The Center focuses on economic research that supports public-policy decision-making, and relates to issues important to Oregon and the Portland Metropolitan Area. NERC serves the public, nonprofit, and private sector community with high quality, unbiased, and credible economic analysis. Dr. Tom Potiowsky is the Director of NERC, and also serves as the Chair of the Department of Economics at Portland State University. Dr. Jenny H. Liu is NERC's Assistant Director and Assistant Professor in the Toulan School of Urban Studies and Planning. This report was researched and written by Peter Hulseman, with support from Emma Willingham and Peter Whitehead.

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Executive Summary

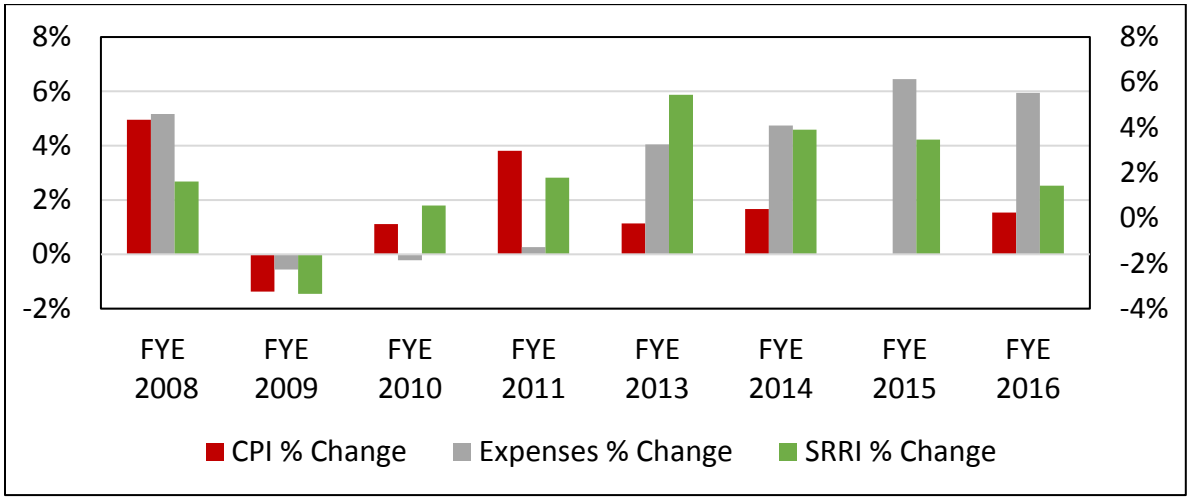
As regulated franchises, waste management services are required to have all rate adjustments approved by local governing bodies. This typically involves supporting the requested adjustment with financial and operational data. The cost-intensive nature of this process limits its frequency. Many jurisdictions conduct a formal review every five years, with interim rates set using a proxy for marginal cost changes, typically an index such as the Consumer Price Index (CPI)[1]. Rogue Disposal & Recycling (RDR) is governed in such a way in several of the jurisdictions it serves. The central reason for this report is that the CPI has not proven to be a reliable predictor of changes in expenses, often leading to significant required adjustments during the formal review period. With this in mind, RDR contracted the Northwest Economic Research Center (NERC) to construct an index that reflects the changes in RDR's expenses more accurately and reliably than the CPI.

In constructing this index, NERC took into account that the index must have a strong theoretical foundation, while maintaining the ease of implementation associated with the CPI. Accordingly, NERC constructed an index by weighting RDR's four major expense categories – vehicle replacement, equipment rentals, employee wages, and all other spending - and matching them to government published statistics to develop the Simple Refuse Rate Index (SRRI).

NERC recommends a four-step process for using this index that accounts for the net cost of recycling. Since the net cost of recycling is a major reason for a large portion of the historical discrepancy between RDR's observed expenses and the CPI, it must be accounted for in years between the 5-year rate reviews. Figure 1 shows how much RDR's expenses changed, versus how much the CPI and SRRI predicted they would change, over a given year. Over the past decade, the rate increases determined by the SRRI (while accounting for the net-cost of recycling) outperform the CPI-determined rate adjustments, especially in the last three years.

[1] The current practice is to use the Consumer Price Index for all Urban Consumers (CPI-U), which is referred to in this document as CPI for simplification.

Figure 1: Comparing CPI, Simplified Refuse Rate Index, and Actual Expenses[2]



Introduction

Rogue Disposal & Recycling (RDR) has provided waste management services to Southern Oregon since 1938, when it was founded by Anthony Boitano, grandfather of current CEO Stephen Gambee. Every year, roughly 33,000 tons of solid waste are collected by more than 40 trucks. All types of waste are collected, including medical waste, hazardous waste (in an annual two-day period), and commingled recycling. Commingled recycling in particular has substantially increased Rogue Disposal & Recycling's collection volume, and these changes have had a marked effect on the customer rates necessary to cover costs. These recent changes have resulted in fluctuations to Rogue Disposal & Recycling's costs that the current rate-setting process does not capture.

To better capture their actual expenses, and prevent significant and unexpected rate increases during five-year rate reviews, Rogue Disposal & Recycling (RDR) contracted the Northwest Economic Research Center (NERC) to construct an index that is more closely aligned with RDR's expenses than the index currently used between 5-year rate reviews: the Consumer Price Index (CPI).

Description of Rate Setting Process and Project Motivation

Ideally rate increases would directly match the rate at which Rogue Disposal & Recycling expenses increase. However, due the large administrative burden to RDR and the regulator, the best method for capturing the entirety of RDR's expenses - yearly rate reviews - is cost prohibitive. As a result, city contracts dictate that, between five-year rate reviews, changes in the rates charged for service match changes in the Consumer Price Index (CPI) for all urban consumers. An implied assumption of this methodology is that the CPI will accurately capture

[2] The SRRI accounts for the net cost of recycling using NERC's recommended four-step method. Since 2012 is a five-year review, and a base year for the re-indexing, it is not shown.

RDR expenses. However, recent years have shown that the CPI is not a reliable predictor of said expenses, leading to significant rate changes at the time of the five-year rate review.

One part of the explanation for this is simply that the basket of goods that the CPI is based on is substantially different than the basket of goods consumed by Rogue Disposal & Recycling. The CPI was designed to track general trends in prices, and is not well suited to predicting cost variation in any specific industry. NERC handles this problem by creating a new basket, consisting of Bureau of Labor Statistics (BLS) and Bureau of Economic Analysis (BEA) indices relevant to the specific goods and services consumed by the firm, thereby better capturing Rogue Disposal & Recycling's spending.

The other part of the explanation is that there was a fundamental shift in the net cost of recycling over the past decade. Up through the late 2000s, RDR's recycling revenues surpassed their expenses. However, recycling revenues took a significant hit in 2013 when one of the major buyers of recycled goods – China – implemented a regulatory framework known as Operation Green Fence. Operation Green Fence considerably reduced the amount of recycled goods the nation purchased from the US, thus diminishing revenue from collected recyclables. With revenues falling and expenses rising at a consistent rate, recycling net costs rose considerably – pushing up total expenses at a much faster rate than the CPI. NERC recommends including the actual net costs of recycling in the formulation of the new index.

Data Description and Methodology

Rogue Disposal & Recycling provided NERC with financial information detailing all their categorized expenses since fiscal year 2007. RDR also provided NERC with data on organic growth, recycling revenues, recycling tonnages, and rate increases – which provided necessary background detail.

With the financial information, NERC grouped the expenses into relevant categories, while excluding large onetime expenses, and calculated weights relative to overall expenses[3]. Relevant BEA and BLS series were then compared to the provided expenses, and the ones that correlated best (while also being theoretically viable) were chosen. Various indices were constructed, described in Appendix B.

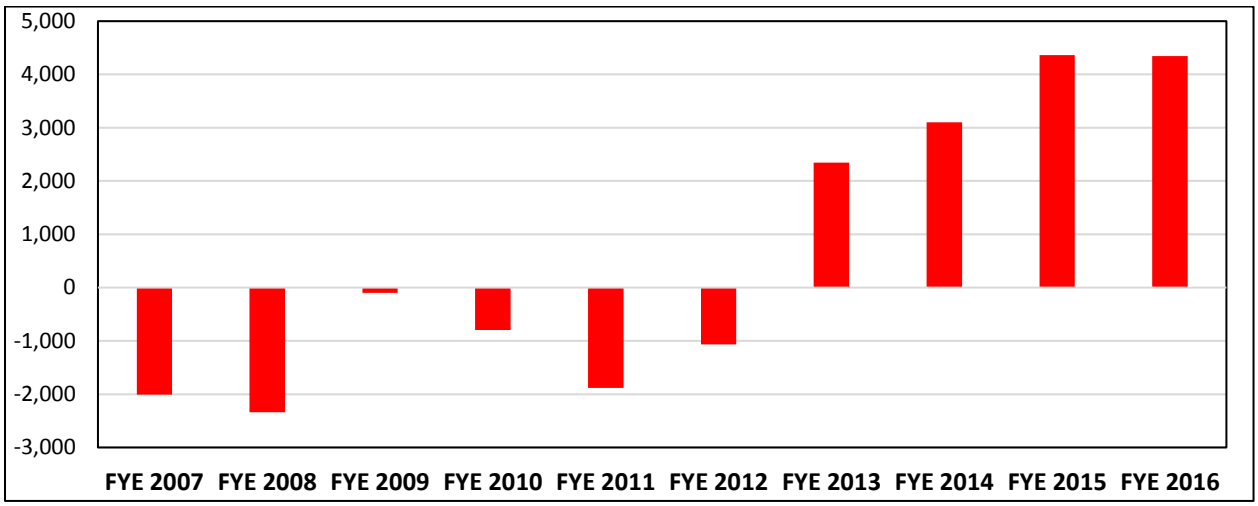
Recycling

As noted previously, a major reason for the observed disconnect between Rogue Disposal & Recycling's expenses and the CPI-U is the net cost of recycling. Unlike other series provided to NERC, the recycling series is a net cost figure (i.e. expenses less revenues) and not a simple expense. This is because RDR is required to pick up recycling, and the revenues that result are

[3] These weights are the basis for the index weighting. The formula is: (category weight) = (the sum of the expenses in a category)/(total expenses).

primarily due to the sale of recycled materials and not pickup fees[4]. Historically this has not been a problem, as the revenues from recycling surpassed all pickup and processing expenses. However, after global demand for recycled goods declined in 2013, revenues significantly declined while expenses remained steady. Figure 2 shows the net cost of recycling. The negative numbers from FYE 2007 through FYE 2012 indicate that the recycling portion of RDR's business was profitable (a negative number means revenues surpass expenses in a net cost figure). However, during FYE 2013 the global demand for recycling considerably declined. This was in part due to China's newly implemented Operation Green Fence, but also for a myriad of other reasons, including declining oil prices[5]. Due to the importance of recycling and the dramatic reduction in recycling revenues through time, NERC accounts for it separately from the other major expenses.

Figure 2: Net Cost of Recycling[6]



One of the difficulties of working with net figures is that calculated growth rates can be misleading. For example, assume that net recycling costs rose from a 'break-even' point of $0 to $100. The growth rate of this is incalculable. Even from $100 to $200, the growth rate of 100% vastly overstates the effect recycling has on overall expenses. Furthermore, while it is easy to calculate a weight for an individual expense relative to total expenses, calculating a weight for a net cost –which includes both revenues and expenses – relative to total expenses would not be comparable to the other weights used in an index. To get around these problems

[4] Even though commercial recycling contains a fee, it has been substantially below the cost of service.
[5] Plastics are made from oil, and as oil gets cheaper then new plastics also become cheaper – driving down the demand for recycled plastics.
[6] The axis on Figure 2 is an indexed number and not the actual dollar amount of Rogue Disposal & Recycling's net recycling costs. Therefore, the growth and relative magnitude of net recycling costs are the most important takeaways from this figure.

NERC recommends directly incorporating the previous year's figure into the rate calculation. More information on this can be in the section *Use of the SRRI* and in Appendix A.

Index Criteria

For an index to be selected by NERC, it must satisfy some basic requirements. The index must be theoretically sound, more accurate than the CPI-U, composed of a linear combination of government published data, and easy to replicate. Following these guidelines helps to prevent overfitting[7] to the actual expenses, and ensures that the index is both reliable and usable.

Unlike the CPI-U, which captures changes in the nation's price levels and is relatively stable, an individual firm's expenses can be highly volatile. For example, in some years Rogue Disposal & Recycling spent 13% less on equipment rentals than in the previous year, while in other years spending increased by 16% or more. While it might be feasible to find data that follows such sporadic jumps, there is no reason to believe that said data will accurately depict a change in expenses next year – unless the data is fundamentally related to the firm's actual expenses (i.e. a theoretically sound relationship). Adhering to this criteria prevents overfitting the data.

Similarly, an index constructed by weighting the components to best fit the historical data – and not by the components proportion of total expenses – could also drastically diverge from Rogue Disposal & Recycling actual expenses going forward. For example, even though equipment rentals only makes up about 6% of Rogue Disposal & Recycling expenses, since the series is so volatile a model in which it is given a higher weight appears to perform well on historical data, so a higher test score can be obtained by adding a multiplier in order to magnify the variable's impact to the model. However, while this would give the appearance of accurately describing the historical relationship, adding a multiplier would also magnify any future discrepancies and cause large divergences in subsequent periods. In short, overfitting the model would create a false sense of precision and make the index vulnerable to missing the mark (potentially by a wide margin) when actually utilized, due to the multiplicative impact of variation.

Index Selection

After considering the aforementioned criteria and checking historical performance, NERC recommends what is termed the Simple Refuse Rate Index (SRRI). Information on the other indices considered can be found in Appendix B.

[7] Overfitting is when a statistical model describes random noise instead of the underlying relationship. Such a model will describe historical data well, but will not accurately predict future values, because it incorporates random variation rather than resting on the real causes of change.

Use of the SRRI

Since NERC recommends incorporating the actual net costs of recycling, a four-step approach is required, described first in brief and then in depth below. See Appendix A for a numerical example.

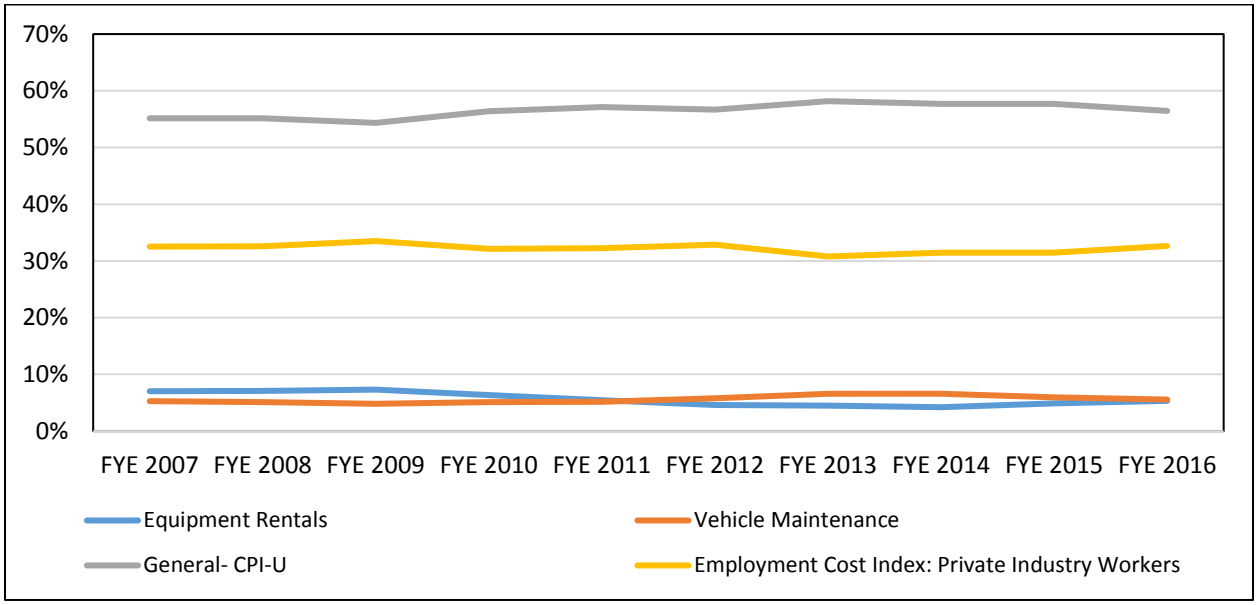
1. Re-index the SRRI component indices and calculate the SRRI and growth rate using the previous year's data.
2. Use the SRRI to calculate a 'derived expenses sans recycling' value for a given year.
3. Add the actual recycling expenses to the 'derived expenses san recycling' value to formulate a 'derived expenses' variable.
4. Calculate the growth rate from either the previous years 'derived expenses' or, if the previous year fell on a 5-year rate review, the actual expenses. This final growth rate is what will be used in the rate setting process.

Calculating the SRRI

The SRRI index is composed of four BLS and BEA categories weighted by RDR's actual expenses. The four indices were selected because they best described RDR's three largest spending components – vehicle maintenance, equipment rentals, and wages – with a fourth index to capture all other spending. The indices were selected based on theoretical validity and historical fit. NERC used the ten-year average proportion of expenses to weight the index. As Figure 3 shows, the proportion of expenses is stable over time, so it is reasonable to expect the ten-year average to remain valid.

Although Refuse Rate Indices used by other jurisdictions combine component indices regardless of their base date, this methodology results in an additional, arbitrary weighting. In other words, the component index that has an earlier base date is likely to be the largest number. The reason for this is that generally speaking, goods cost more as time progresses, so an earlier date means more of this general increase is present in the index, giving it a larger weight in the SRRI. To prevent this, NERC recommends re-indexing the component industries at the beginning of each five-year review. So, in 2012, the value of the component industries will each be 100. The mechanics of this are shown in Appendix A.

Figure 3: Proportion of RDR's expenses by category



The component indices and their weights (according to the percentages shown above in Figure 3) are shown below. The frequency of all indices is monthly. The numbers in parentheses are the widely-used identifying numbers for the series, allowing the user to make sure that the right series is downloaded.

5.6% - Vehicle Maintenance: Consumer Price Index for all Urban Consumers: Motor vehicle maintenance and repair (CUSR0000SETD)

5.7% - Equipment Rentals: Producer Price Index for Motor Vehicle Body Manufacturing (PCU336211336211)

32.2% - Employee Wages: Compensation of Employees, Received: Wage and Salary Disbursements: Private Industries (A132RC1)

56.5% - All other spending: CPI for all Urban Consumers (CPIAUCSL)

The SRRI is derived by combining the above indices in accordance with their corresponding weights (after they are re-indexed to the same base year). The SRRI growth rate used in the following step is year-over-year from the month of September (the beginning of RDR's fiscal year).

Calculating the 'Derived Expenses, sans Recycling'

If the previous year was a rate review year, take the expenses less recycling and apply the SRRI growth rate to that number to get the 'Derived Expenses, sans Recycling' for the current year.

If a rate review did not take place in the previous year, take the previous year's 'Derived Expenses, sans Recycling' and apply the above growth rate to that to get the current years 'Derived Expenses, sans Recycling'.

Formulating the 'Derived Expenses'

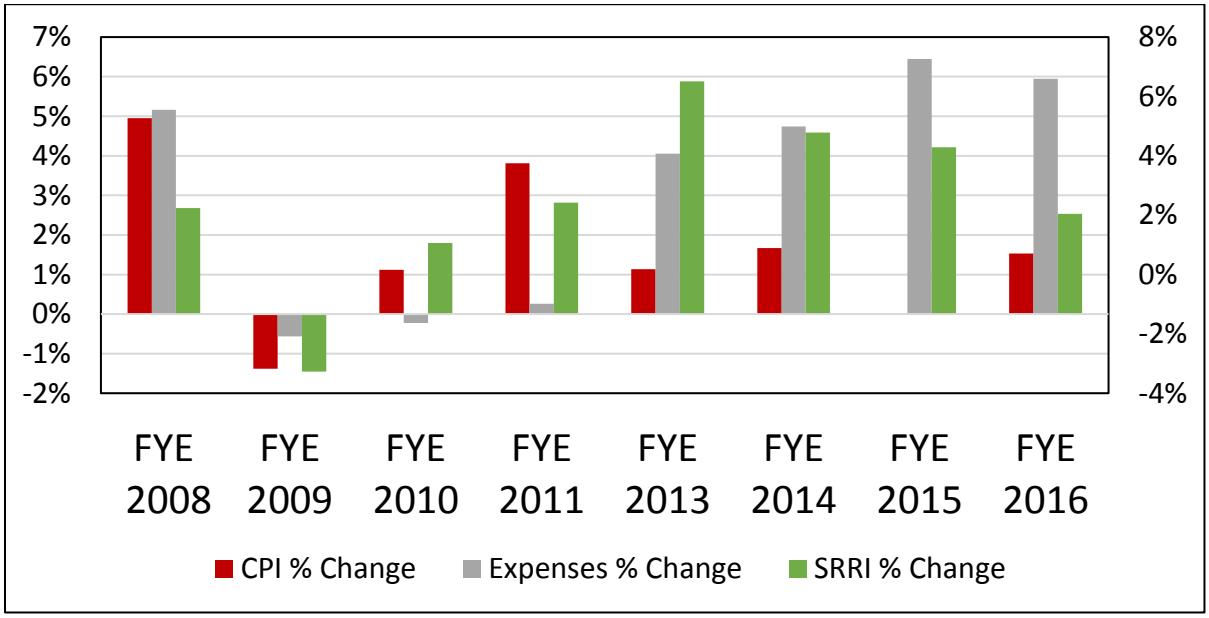
To calculate the current year's 'Derived Expenses', add the actual net cost of recycling to the current years 'Derived Expenses, sans Recycling'.

Calculating the Growth Rate of the 'Derived Expenses'

Now, simply calculate the growth rate of 'Derived Expenses' from September of last year to September of this year. This growth rate best tracks RDR's derived expenses, and is therefore the number NERC recommends to guide intermediate rate increases.

SRRI Performance

Figure 4 shows how much RDR's expenses changed, versus how much the CPI and SRRI predicted they would change in each year, 2008-2016. Note how much more closely the green bars (SRRI) match the grey bars (RDR Expenses), in comparison to the red bars (CPI) - especially since 2013, when recycling net costs changed substantially. *Figure 4: Comparing CPI, Simplified Refuse Rate Index, and Actual Expenses*[8]



For example, in FYE 2016 RDR's expenses grew by 5.9%, while the CPI increased by only 1.5%, and in the same period SRRI increase would have been 2.55%. See Figure 5 for an illustration of

[8] The SRRI accounts for the net cost of recycling using NERC's recommended four-step method. Since 2012 is a five-year review, and a base year for the re-indexing, it is not shown.

this point, and see Figures 6-9 for the performance of the remaining four years of the 5-year period.

Figure 5: Comparing CPI, Simplified Refuse Rate Index, and Actual Expenses in FYE 2016

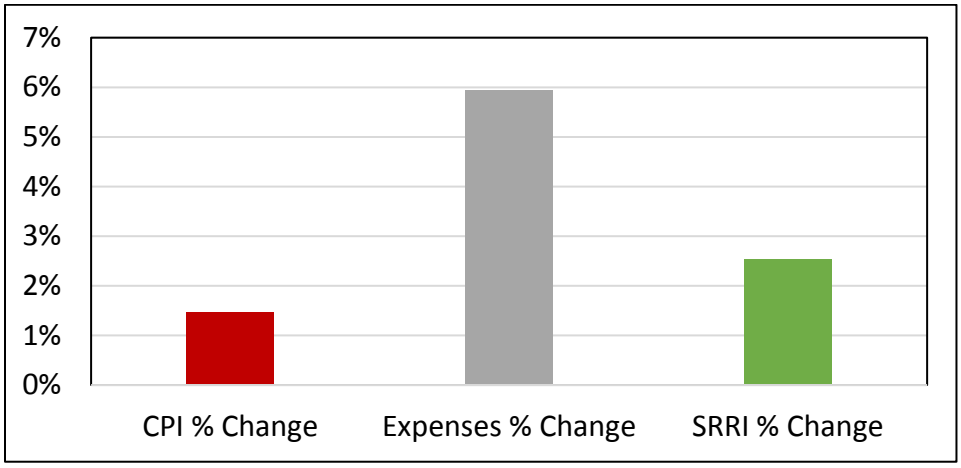


Figure 6: Comparing CPI, Simplified Refuse Rate Index, and Actual Expenses in FYE 2015

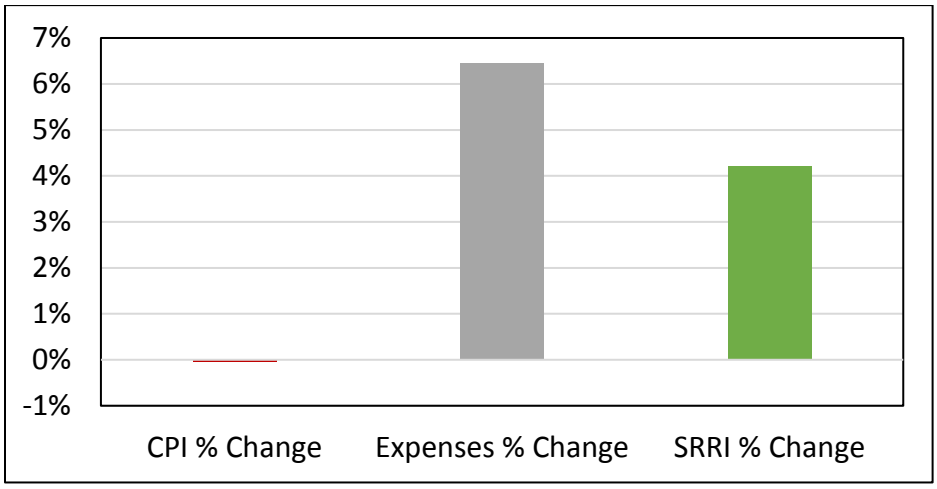


Figure 7: Comparing CPI, Simplified Refuse Rate Index, and Actual Expenses in FYE 2014

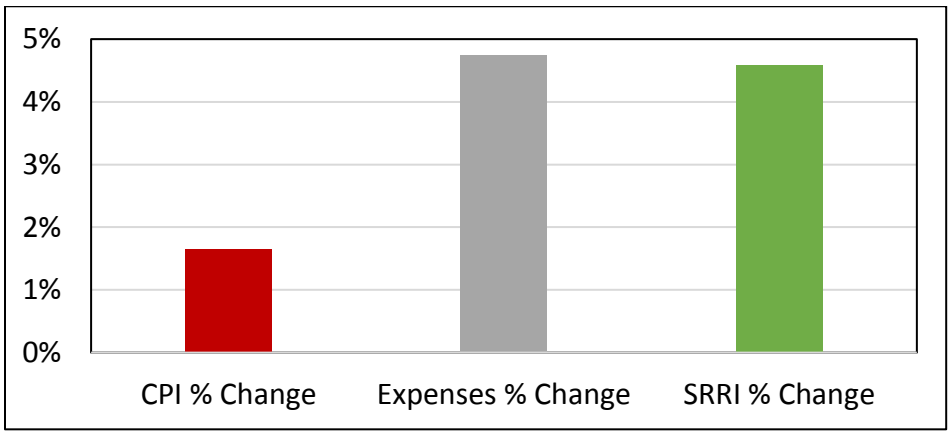


Figure 8: Comparing CPI, Simplified Refuse Rate Index, and Actual Expenses in FYE 2013

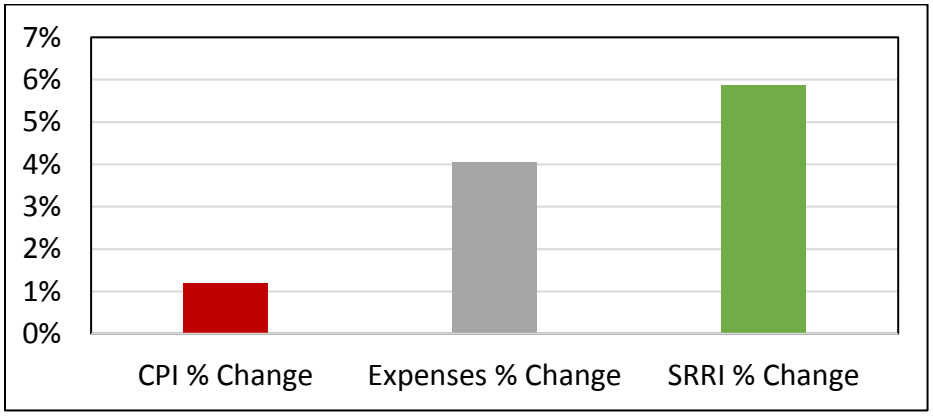
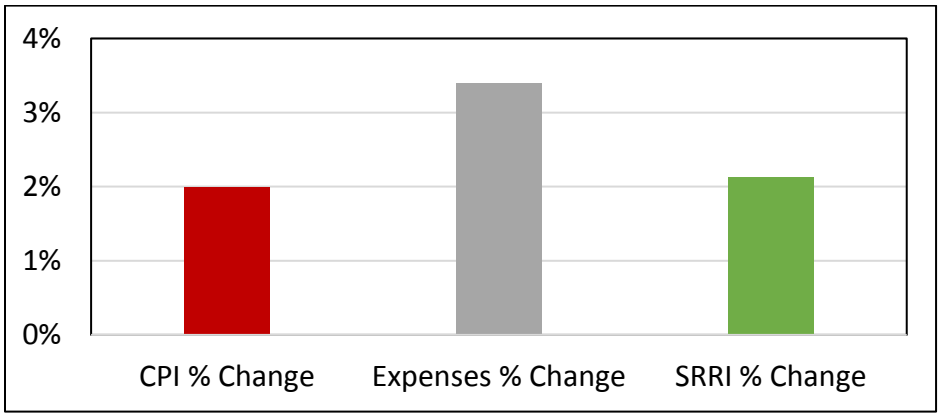


Figure 9: Comparing CPI, Simplified Refuse Rate Index, and Actual Expenses in FYE 2012



The SRRI more closely follows the operating expenses of RDR. Over the past decade, rate increases determined by the SRRI (while accounting for the net-cost of recycling) would have similarly been much closer to RDR's actual costs versus the CPI-determined rate adjustments, especially in the last three years.

Another way to gauge the accuracy of the indexes is to see what the CPI and SRRI would have predicted total expenses to be at the end of the two five year periods (FYE 2007-2011, and FYE 2012-2016), when actual expenses are known due to the full assessment of revenues and costs conducted in 2012 and 2016, and compare the prediction using the SSRI to what the actual expenses turned out to be. During the first 5-year period the SRRI would have overestimated actual expenses by 1.25%, and underestimated the actual expenses during the second 5-year period by 3.72%. This is a significant improvement over the CPI-U, which overestimated the actual expenses by 4.03% in the first period, and under estimated by 15.11% in the second

period (see Table 1, below). The SSRI is a more accurate way to predict RDR's expenses than the CPI-U.

Table 1: Predicted vs. Actual Expenses over 5-year Periods

Index (less Actual Expenses)	FYE 2007-2011	FYE 2012-2016
SRRI Predicted Expenses less RDR Actual Expenses	1.25%	-3.72%
CPI Predicted Expenses less RDR Actual Expenses	4.03%	-15.11%

Figures 10 and 11 shows the yearly error (difference between index predicted expenses and actual expenses) and the cumulative error for the FYE 2012-2016 period. The final cumulative errors are shown in Table 1 above. Figure 7 shows the cumulative error for CPI, while Figure 8 shows the cumulative error for the SRRI.

Figure 10: Comparing the errors for CPI and the Simplified Refuse Rate Index, FYE 2012-2016

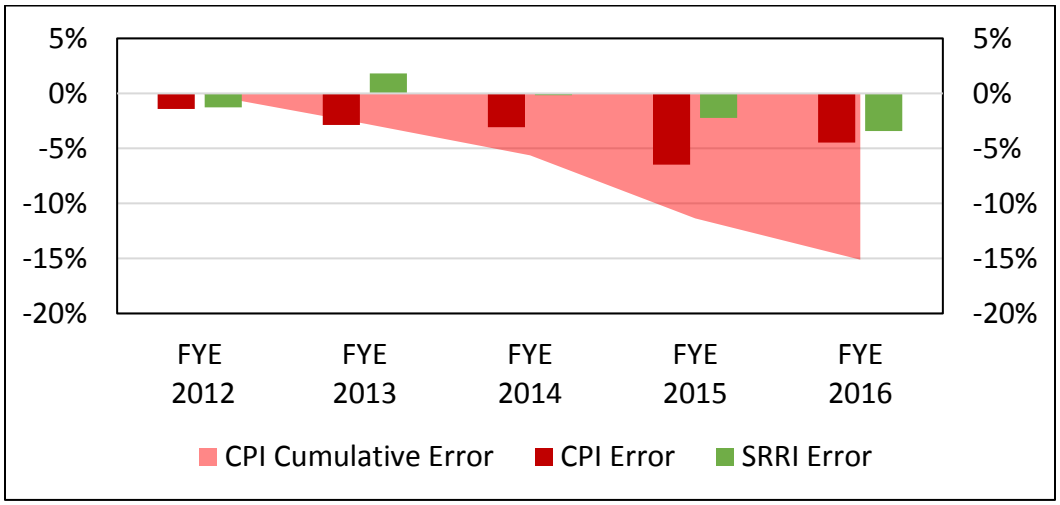
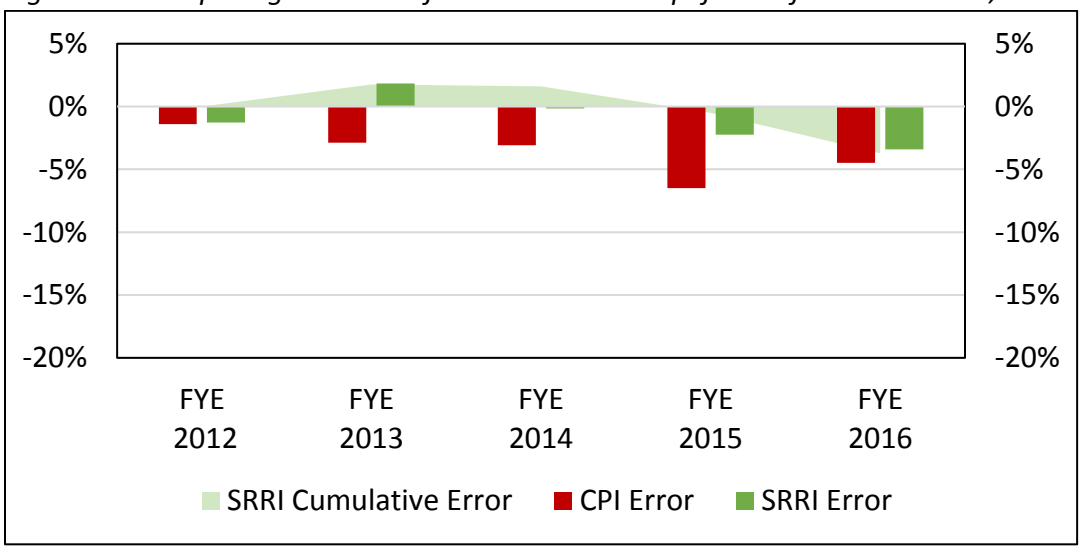


Figure 11: Comparing the errors for CPI and the Simplified Refuse Rate Index, FYE 2012-2016



Conclusion

The SRRI is a marked improvement over the simple CPI-U for tracking RDR's expenses and for the rate setting process. Importantly, there are theoretical justifications for its components, implying that it will remain a viable tool going forward. Although the four-step methodology for applying the SRRI adds complexity to the rate-setting process, it is necessary in order to accurately adjust the index for the net-cost of recycling.

Performance of this index should be monitored, and NERC recommends revisiting the index weights during the 5-year rate reviews.

Appendix A: SRRI Example

This is an example of how to calculate the rate increase using the SRRI from FYE 2013 to FYE 2014. Table A1 shows the component indices for each year during the 2012-2016 period.

Table A1: SRRI Component Indices

	9/1/2012	9/1/2013	9/1/2014	9/1/2015	9/1/2016
Vehicle Maintenance	258.024	262.96	267.26	271.119	275.331
Equipment Rentals	227.1	228	231.7	235.8	237.9
Employee Wages	5770.8	5962.2	6300.5	6623.7	6855.8
All Other Spending	231.015	233.632	237.486	237.467	241.006

The formula for re-indexing is [(value for year)/(value for base year)]*100. So for vehicle maintenance in 2014 it would look like: [(267.26)/(258.024)]*100 = 103.5795. Table A2 shows the re-indexed values for all series.

Table A2: SRRI Component Indices, re-indexed to 2012

	9/1/2012	9/1/2013	9/1/2014	9/1/2015	9/1/2016
Vehicle Maintenance	100	101.913	103.5795	105.0751	106.7075
Equipment Rentals	100	100.3963	102.0255	103.8309	104.7556
Employee Wages	100	103.3167	109.179	114.7796	118.8016
All Other Spending	100	101.1328	102.8011	102.7929	104.3248

The weights for the index are shown below.

5.6% - Vehicle Maintenance: Consumer Price Index for all Urban Consumers: Motor vehicle maintenance and repair (CUSR0000SETD)

5.7% - Equipment Rentals: Producer Price Index for Motor Vehicle Body Manufacturing (PCU336211336211)

32.2% - Employee Wages: Compensation of Employees, Received: Wage and Salary Disbursements: Private Industries (A132RC1)

56.5% - All other spending: CPI for all Urban Consumers (CPIAUCSL)

Here are the calculations for each year's SRRI.

2013: SRRI = (101.91)*(.056) + (100.40)*(.057) + (103.32)*(.322) + (101.13)*(.565) = 101.84

2014: SRRI = (103.58)*(.056) + (102.03)*(.057) + (109.18)*(.322) + (102.80)*(.565) = 104.85

The SRRI growth rate from 2013 to 2014 calculation is:

SRRI YoY Growth Rate: ((104.85-101.84)/(101.84))*100 = 2.96%

Table A3 shows the results of the above calculations

Table A3: SRRI

	Sep-13	Sep-14
SRRI	101.84	104.85
YoY Growth Rate	--	2.96%

Table A4 shows fabricated expense data. The net cost of recycling for both FYE 2013 and FYE 2014 is reported by RDR. 'Derived Expenses sans Recycling' and 'Derived Expenses' would have been calculated during the previous year's rate increase process. The highlighted region is what remains to be calculated.

Table A4: RDR Fabricated Expenses and Derivations

	FYE 2013	FYE 2014
Net Cost of Recycling	10	11
Derived Expenses sans Recycling[9]	80	
Derived Expenses	90	

Using the growth rate of the SRRI (2.96%) and applying it to FYE 2013's 'Derived Expenses sans Recycling', FYE 2014's 'Derived Expenses sans Recycling' is calculated:

FYE 2014 Derived Expenses sans Recycling = 80 + 80*(.0296) = 82.37

Table A4.1: RDR Fabricated Expenses and Derivations

	FYE 2013	FYE 2014
Recycling	10	11
Derived Expenses sans Recycling	80	82.37
Derived Expenses	90	

Adding the first two columns of FYE 2014 – Recycling and 'Derived Expenses sans Recycling' – determines the 'Derived Expenses' for FYE 2014:

FYE 2014 Derived Expenses = 82.37 + 11 = 93.37

Table A4.2: RDR Fabricated Expenses and Derivations

	FYE 2013	FYE 2014
Recycling	10	11
Derived Expenses sans Recycling	80	82.37
Derived Expenses	90	93.37

[9] In the year following a 5-year rate review, deriving the previous year's expenses is not necessary. In lieu of 'Derived Expenses sans Recycling' and 'Derived Expenses', actual expense data would be used.

Finally the growth rate of 'Derived Expenses' from FYE 2013 to FYE 2014 – the number used for the rate adjustment – is calculated as:

Growth Rate of Derived Expenses = ((93.37-90)/90)*100 = 3.74%. This would be the SRRI used for FYE 2014.

Appendix B: Other Indices

NERC considered several methodologies for formulating an index to track Rogue Disposal & Recycling's expenses:

1) Regression Analysis – Regression Analysis is a statistical technique that estimates the relationship among variables. In this case, the relationship estimated was between Rogue Disposal and Recycling's actual expenses and wide variety of BLS produced price series. Only the series with significant relationships, expected signs, and reasonable coefficients would be a part of this index.
2) Refuse Rate Index (RRI) – An RRI is constructed from a weighted average, based on a firm's actual expenses, of five price indices for each of the firm's major expenses. The five major expenses are: vehicle maintenance, equipment rentals, fuel, employee wages, and all other spending.
3) Expanded RRI (ERRI) – An RRI with five more indices added, with the goal of constructing an index that tracks more closely than the RRI. The five additional expense categories beings tracked are: utilities, tires, professional services, commercial rent, and freight.
4) Simplified RRI (SRRI) – An RRI constructed without separating out the fuel expense. By grouping fuel in with 'all other spending', this approach lent greater stability and accuracy to the index.

Indices constructed from Regression Analysis performed worst in back testing, and ascribed coefficients with no theoretical validity. The added expenses tracked in the ERRI reduced historical accuracy. This is because of the 'low trading volume' problem – when there are few data points, random individual shocks have more of an effect.

A normal Refuse Rate Index includes a component to track fuel expenditures. However, this again proved to underperform over previous years. Also, the current movement to compressed natural gas fuel means that the proportion of expenses on standard fuel should decrease going forward. Because of this, and since fuel is the fifth largest expenditure, NERC recommends dropping it from the RRI and using the SRRI – which performs the best historically, is theoretically viable, and is easier to use than the other indexes.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