Prices Analytical Series

Technical Guide for the Residential Renovation Price Index (RRPI)
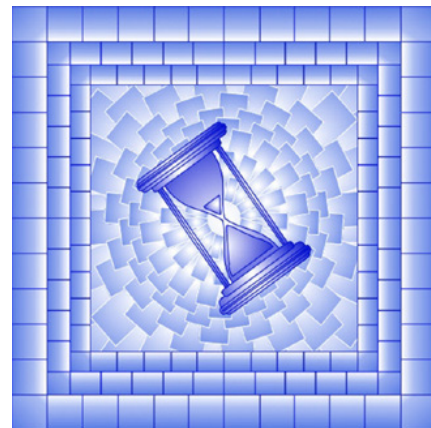
Release date: October 25, 2024

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Table of contents

Technical Guide for the Residential Renovation Price Index (RRPI)

1 Introduction

The Residential Renovation Price Index (RRPI) measures the quarterly change over time in the prices that renovation contractors charge to provide renovation services for a range of residential renovation projects. The RRPI is composed of 8 separate project groups, containing a total of 37 individual projects. The prices include the value of all materials, labour, equipment, overhead and profit required to construct each project. They exclude value added taxes and any costs for project design. The RRPI may be used by government agencies undertaking economic analyses and other users that are interested in evaluating the impact of price changes on capital expenditures. Statistics Canada, for example, may use the RRPI to deflate estimates of the renovation industry's contribution to national expenditure, output and capital stock. Other uses include making adjustments to project costs for escalation; as well as forecasting financial requirements for proposed projects and real rates of return on investment.

1.1 Concepts and definitions for the RRPI

Table 1
Key concepts and definitions used for constructing the RRPI

Concept	Definition
Price	The value of all materials, labour, equipment, overhead and profit to perform a typical renovation project represented by the price offered by the renovation contractor. It excludes value added taxes and project design.
Target population	All work put in place cost components included in contractors' prices to provide renovation services for residential projects in Canada.
Sample	General contractors that are actively bidding and winning a share of the residential building construction jobs in the following 15 Census Metropolitan Areas (CMAs): St. John's, Halifax, Moncton, Montréal, Québec, Ottawa, Toronto, London, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver, and Victoria.
Composite	The aggregated index for the 15 CMAs for each of residential renovation project; a composite is available by each project type group.
Index base period	The period for which the RRPI equals 100; currently this is the year 2023.
Collection period	Collection occurs over the second and third months of each quarter, i.e. February and March, May and June, August and September, November and December
Project Group Type	Exterior additions or improvements, Flooring, Heating and air conditioning equipment, Interior additions or remodels, Plumbing fixtures and equipment, Property improvements, Roofing, Windows and doors.
Project Type	Carport, Deck, Garage, Porch, Siding, Solar panels, Carpeting, Linoleum, Tiling, Wood floors, Conversion to gas furnace, Heat pump, Fireplace, Furnace, Aging in Place, Bathroom remodel, Bedroom remodel, Finishing basement, Kitchen remodel, Sunroom, Room extension or addition, Bathtub, Faucet, Hot water tank, Shower unit, Sink, Toilet, Water softener, Driveway, Fence, Hot tub, Interlock, Major landscaping projects, Patio, Swimming pool - in ground, Swimming pool -above ground, Complete roof re-tarring, Full shingle replacement, Metal roof, Closet doors, Exterior doors, French doors, Garage door, Interior doors, Windows.

Source: Statistics Canada, Producer Prices program.

2 Methodology

2.1 Cost component method

This approach measures the price change of standardized homogeneous components representing typical operations in the construction of representative residential renovation projects.

It begins with identifying a representative renovation project within each renovation project group. For each residential renovation project, representative cost components are identified based on defined standard services or components, and the price movements of these components are tracked over time. Price movements of the cost components are aggregated by renovation project, renovation project group, census metropolitan area (CMA), and by province to derive provincial aggregate price indices in addition to a 15-city CMA composite price index for residential renovation projects.

2.1.1 Representative renovation project selection

Representative projects were identified based on the most common projects reported in the Survey of Household Spending (SHS). The projects measured are residential renovation projects that might be built in any of the geographies surveyed and that have standardized designs. Each project represents the median for its class with respect to price, size, design, and construction techniques employed.

Each representative project is a typical residential renovation project in the respective region and the processes and materials used comply with the latest National Building Code of Canada and/or provincial codes (where applicable). Further, projects are chosen where the availability of prices for all project cost components within each representative project are available over time in each CMA.

The representative residential renovation projects are reviewed and replaced every 10 to 15 years, depending on the pace of structural and technological change taking place in the construction industry to ensure the relevance of the weights used to construct the residential renovation price index.

2.1.2 Representative cost component selection

Technical specifications provided by external consultants during the creation of the Building Construction Price Index (BCPI), along with further input from renovation industry experts, were used to identify the appropriate composition of materials, labor, equipment, overhead, and profit required for each selected renovation project. These cost components are the *work put in place components* for the respective project and represent all expenditures. Work put in place refers to the completed and installed construction components that would go into a construction project. For example, the construction of a fence would include all cost components that would go into building a new fence, such as the various pieces of lumber required, hardware such as brackets and screws, concrete foundations, and labour required to complete the project.

These cost components are organized using the MasterFormat classification system, an industry classification used for construction projects in Canada and the United States. The cost components are also organized by trade group classifications.

These trade group classifications include general requirements, architectural, structural, mechanical, and electrical trade groups. General requirements include building permits and insurance. The architectural trade group includes cost components for masonry, metal fabrications, wood, plastics and composites, thermal and moisture protection, openings, finishes, specialities, equipment, earthwork and exterior improvements. The structural trade group includes general site conditions (including demolition), concrete, masonry, and structural steel. The mechanical trade group includes cost components such as plumbing, heating, ventilation, and air conditioning. Electrical costs are included in the electrical trade group.

For each work put in place cost component in a representative renovation project, the description, quantity, material cost, labour and equipment cost, as well as the sum of costs represented by the unit rate are included. The unit rate is multiplied by the quantity for each item to determine the total value of work put in place. A single renovation project can include hundreds of cost components, and to track each of them all over time would be impractical and cost-prohibitive. Therefore, a sample of representative cost components are selected which target about 80% of the total value of work put in place components.

In addition to their importance by initial dollar value in the total project expenditure, representative cost components have a higher likelihood of selection if they meet the following criteria: they are standard to all residential renovation projects across geography and across time; or they are included in some of the projects used to compile other construction price indexes.

After selection, the representative cost components are assigned the total dollar value of all work put in place components for the cost component category they represent. Once the representative cost components are selected, they do not change throughout the lifespan of the respective renovation projects. These become the starting component item weights for each renovation type. These project component weights are reviewed every 10 to 15 years to ensure consistency through time.

3 Data Sources

3.1 Sampling process

A detailed explanation of the sample design is explained in the BCPI technical document. The selection of representative cost components is described in section 2.1.2. As a general overview, to collect information on the price changes in the representative cost components, a sample of active general contractors is selected for each CMA. Many of these contractors are selected since they are reporting intended building activity for residential building construction projects to Statistics Canada's Building Permits Survey. In addition, they are usually members of local construction associations who are knowledgeable of the renovation sector and capable to provide pricing information. To be included in the sample frame, the contractors must be actively bidding and winning a share of the residential construction jobs. These contractors are then surveyed to determine the price changes they are experiencing across all relevant cost components. In some cases, additional general contractors are added to the sample based on industry research.

The renovation index also uses purchased third-party data to obtain prices for some specific cost components where survey data does not provide detailed enough estimates.

3.2 Prices

The RRPI is calculated based on estimated bid prices in the real market for the representative cost components. The current price for each representative cost component is estimated by adjusting the previous quarter's price for quarterly changes in the per unit value of its material, labour rate and overhead and profit components. Information on price changes is collected from respondents or derived from administrative data or other Statistics Canada survey sources as described below. These current quarterly output prices are then used in the quarterly calculation of the RRPI.

3.2.1 Electronic questionnaire – Construction Contractors Survey

For representative cost components categorized under the general requirements, architectural and structural trade groups, price information is collected using an electronic questionnaire, initially developed for the Building Construction Price Index, called the Construction Contractors Survey (CCS). The electronic questionnaire is sent out quarterly to a sample of building contractors (see Section 2.2.1) that work on the type of projects covered by the RRPI and their response to the survey is mandatory.

The electronic questionnaire collects information on price movements in the representative cost components included in residential renovation projects in their respective CMA, the reasons for those movements, and local construction market conditions. With reference to a project built or bid-on in the previous quarter, respondents are asked to report how much the estimated costs for each representative cost component would have changed if they repeated the project or bid in the current quarter. Respondents are asked to compare the price on the 15th day of the middle month of the previous quarter to the price on the 15th day of the middle month of the current quarter (e.g. February 15th compared to May 15th) or to the nearest business day prior to the 15thof the current quarter. The details of the project are not reported and the respondent can choose different projects each quarter so long as they are representative of the work they typically do.

The prices constitute a "competitive" price that would have a reasonable chance of being the accepted price in an actual bidding process and therefore are not typical "list" prices. They reflect material, labour and equipment costs, as well as contractors' overhead and profit. They exclude value added taxes and any costs for land, land assembly, project design, land development and real estate fees.

A geometric mean is calculated for all of the price movement quotes that are reported by respondents within a CMA to represent the price movement for a representative cost component. In rare cases where a price is not reported for a given component/CMA in a given quarter, parental imputation is used, where the price change calculated in the next closest representative CMA is used. This average price movement is applied to the output price of the previous quarter to obtain the output price for the current quarter. These steps are repeated for each representative cost component within each renovation project. Since the price movements reported by contractors include labour, overhead and profit margins, no further manipulations are necessary.

As an example, assume that the arithmetic mean of all movements reported by the electronic questionnaires amounts to 3% for a particular representative cost component. If the unit output price in the previous quarter for that cost component was $5.00, with a 3% price increase, the unit output price in the current quarter would be ($5.00 x 1.03) = $5.15.

TABLE 2
Price Calculation Example

Perimeter foundation wall, 8" thick framework	Price
Q1 Initial output price (previous quarter)	$5.00
Average reported formwork output price movement - Toronto	3%
Q2 Output price (current quarter)	$5.15

Source: Statistics Canada, Producer Prices program.

3.2.2 Administrative and alternative data sources

For selected representative cost components under the mechanical and electrical trade groups, administrative data is used to collect prices. In addition, prices for certain materials, appliances, labour rates, rental of equipment and municipal charges are obtained from a variety of secondary sources. These sources include construction industry online publications and in-house data such as the Industrial Product Price Index, the Machinery and Equipment Price Index, and the Consumer Price Index. Additionally, labour rates are obtained from the Construction Union Wage Rate Indexes.

Unit prices are obtained for the labour and materials for each representative cost component by mapping to similar cost component items from the various administrative and alternative data sources. Quantity information for each product is gathered from the initial renovation project detailed specifications. Since the administrative and alternative data sources do not provide prices that are inclusive of labour, and overhead and profit, these are added to calculate the output price of each representative cost component. Initial labour estimates by cost component were obtained during the initial project specification, while labour rates are scaled using the Construction Union Wage Rate Index (CUWRI) through time to obtain more accurate estimates. For prices obtained from administrative data, Overhead and Profit are assumed to be fixed at 11% through time. It was determined based on a historical analysis of overhead and profit figures reported on the CCS and is used in the absence of more detailed OVHP estimates.

As an example, assume that the previous quarter unit input price is determined to be $3.33 for a certain amount of PEX piping material and $2.22 for the plumber needed to install the piping, respectively. This unit output price is determined from the contractor's initial detailed specifications for the project. Then, administrative or alternative data sources are searched to find appropriately similar products and their corresponding prices for both the previous and current quarters. In this case, a previous quarter material price of $350.80 and a current quarter material price of $361.30 may be available for a different amount of the same type of PEX piping material. Similarly, a previous quarter wage rate index of 130.20 and current quarter wage rate index of 134.10 may be available from the Toronto Plumber construction union wage rate index. From the latter sources, a price movement can be calculated between the relevant quarters as 3% for both the material price and labour wage rate. This price movement can then be applied to the previous quarter unit input price to determine the current quarter unit input price for the material and labour costs being $3.43 and $2.29, respectively. Finally, an overhead and profit rate of 11% is added to calculate the total current quarter output price for the relevant cost component: ($3.43 + $2.29) x 1.11 = $6.34.

Table 3
¾" PEX piping example

Admin data material price change	Price
Q1 ¾" 100' PEX piping material price	$350.83
Q2 ¾" 100' PEX piping material price	$361.36
Material price change	3%
Cost component price change	
Q1 initial material price	$3.33
Quarterly price movement	3%
Q2 material price	$3.43
CUWRI labour wage rate change	**Index Value**
Q1 Toronto plumber wage rate index	130.2
Q2 Toronto plumber wage rate index	134.1
Labour wage rate change	3%
Labour component price change	
Q1 initial labour wage rate for plumber	$2.22
Quarterly labour wage rate movement	3%
Q2 labour wage rate for plumber	$2.29
Overhead and profit	11%
Q2 Output price = (Q2 material price + Q2 labour wage rate) x overhead and profit ($3.43 + $2.29) x 1.11	$6.34

Note: This example illustrates the calculation of a project's second quarter output price, which is the summation of all material and labor expenses required to complete the project in the second quarter, multiplied by an overhead and profit margin. A project's output price is then compared to the project's output price in the previous quarter to calculate the price index
Source: Statistics Canada, Producer Prices program.

3.3 Weights

The RRPI utilizes three sets of weights. Cost component weights are used for representative cost components within each individual project (Fence, Garage, Siding, etc.), the Survey of Household Spending weights are used to aggregate renovation project groups (Property improvements, Flooring, etc.), and building permit weights are used to aggregate by geography.

Cost component weights are derived from the detailed costs originally provided by cost consultants when the residential renovation projects were chosen (see Section 2.1.2). The weight assigned to each representative cost component reflects the share in the total project cost that was attributable to the sampled component and the other components that it represents. The weight for the same representative cost component will vary by individual project and by city. For example, some projects will require lumber to complete, while others may not require any lumber at all, and as such a weight will be attributed to lumber in various residential renovations projects, while others won't attribute any weight. The cost components weights of each individual project remain unchanged through time, with individual project indices within each CMA calculated using a cost component weighted geometric average.

To aggregate individual renovation projects into their respective project groups, an unweighted geometric mean of each individual renovation project's price relatives are taken each quarter. This gives each individual renovation project equal weight when aggregating up to each renovation project group.

The relative renovation project group weights are derived from the Survey of Household Spending (SHS), a biennial survey tracking the spending habits of Canadians. One aspect the SHS collects is renovation spending data, which is used to derive the relative importance of each renovation project group through time. Since the survey is biennial, renovation project weights are recalculated every two years. For the first iteration of the RRPI, 2017 SHS weights were used, as renovation related questions were removed in later years. Upon consultation with the SHS survey team, renovation spending will be included in future surveys, enabling a biennial weight update beginning 2025.

Building permit weights are used to reflect the relative importance of renovations across CMAs and provinces. The unadjusted annual estimates of the value of residential renovation permits by CMA and type of work are provided by Statistics Canada's Investment, Science and Technology Division. The residential renovation CMA weights are derived from the values of alterations and improvements, garage and carports, and inground swimming pools approved in each CMA. New CMA weights are updated biennially with the SHS project weights as part of the second quarter release.

4 Aggregation Structure

The RRPI is aggregated into one top-level index that is intended to inform on residential renovation price changes across the country each quarter. This index is subdivided by eight different renovation project groups, and then again into 37 individual projects. Furthermore, the index is classified by geography at the project group type and individual project type levels first by province, and then by each of the 15 surveyed CMAs included within each province. In cases where only one CMA falls under the provincial grouping, the CMA and province level indices will mirror each other.

Figure 1 presents the aggregation structure from the elementary aggregates at the representative cost component level, up to the total residential renovation price index.

Figure 1
RRPI aggregation structure
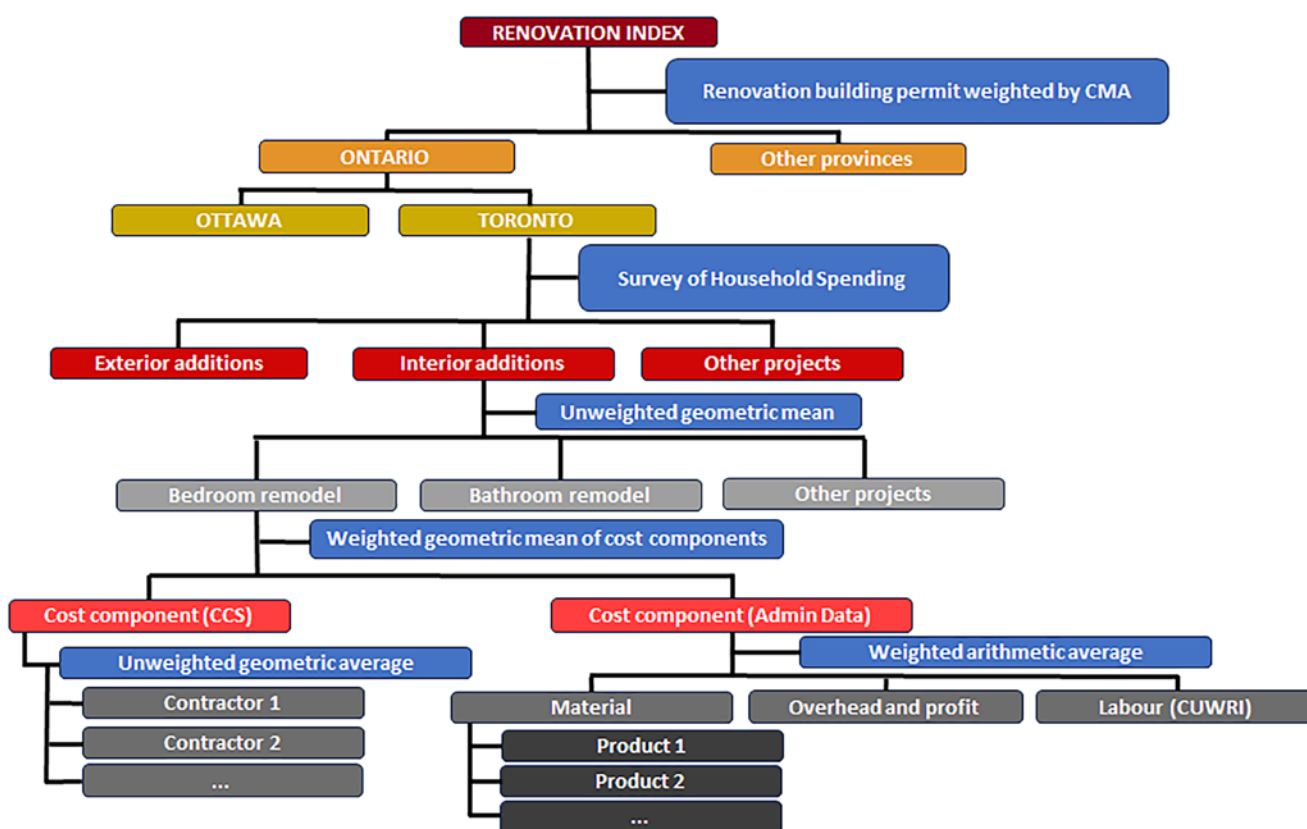
5 Index Estimation and Aggregation

The RRPI is based on a fixed sample, where quarterly price changes to complete renovation projects are measured over time by using a fixed set of representative cost components that are used in the construction of each respective renovation project. The RRPI is calculated for the current period and compared to the previous period to measure price change. Estimates are calculated using a weighted average of price relatives by representative cost components which are chained together to form an index series. The RRPI are Laspeyres chain linked indexes available at the CMA, Provincial, and the 15-CMA composite levels.

The RRPI encompasses both elementary and higher-level aggregate indexes. Elementary aggregates measure the price movements at the renovation project group level by CMA, which are aggregated from price movements of

representative renovation projects using unweighted geometric mean. For higher level indexes, Survey of Housing Spending and building permit weights are applied to each renovation project group to aggregate up to both the CMA and national index level.

5.1 Price relatives

The starting point in the estimation of the index is to determine the initial output price and the current output price in unit terms. This calculation differs between the cost components derived from the Construction Contractors Survey (CCS), and the various administrative data sources.

5.1.1 Construction Contractors Survey (CCS)

For the cost components price movements derived from responses to the building construction contractors survey (see section 3.2.1), these reported price movements are aggregated using an unweighted geometric mean for each CMA and representative cost component as follows:

$$\frac{p_{mc}^t}{p_{mc}^{t-1}} = \prod_{n=1}^N \left(1 + \Delta_{nmc}^t\right)^{\frac{1}{N}}$$

$\dfrac{p_{mc}^t}{p_{mc}^{t-1}}$: The current output price relative for the representative cost component m for CMA c at time t (current quarter).

Δ_{nmc}^t : the aggregated price movement obtained from general contractor n for the representative cost component m for CMA c at time t.

5.1.2 Administrative Data Sources

For the cost components derived from administrative data sources, each representative cost component is mapped to a similar product/job from the administrative data source. The previous quarter and current quarter prices are obtained for this similar item and a price movement is then calculated for the representative cost component.

These cost components are split up into material and labour factors and price movements for each individual factor are determined. The labour wage rates and the material prices from the previous quarter are then multiplied by the respective price movements for each factor in the current quarter, and aggregated:

$$\frac{p_{mc}^t}{p_{mc}^{t-1}} = \frac{p_{material\_mc}^t}{p_{material\_mc}^{t-1}} w_{material\_mc}^t + \frac{l_{mc}^t}{l_{mc}^{t-1}} w_{labor\_mc}^t + \frac{V_{OVHP\_mc}^t}{V_{OVHP\_mc}^{t-1}} w_{OVHP\_mc}^t$$

$\dfrac{p_{mc}^t}{p_{mc}^{t-1}}$: The current output price relative for the representative cost component m in CMA c at time t.

$\dfrac{p_{material\_mc}^t}{p_{material\_mc}^{t-1}}$: The relative of material price for cost component m in CMA c at time t.

$w_{material\_mc}^t$: The weight of material cost in the total prices for cost component m in CMA c at time t.

$\dfrac{l_{mc}^t}{l_{mc}^{t-1}}$: The relative of wage rate for cost component m in CMA c at time t.

$w_{labor\_mc}^t$: The weight of labour cost in the total prices for installing cost component m in CMA c at time t.

$\dfrac{V^t_{OVHP\_mc}}{V^{t-1}_{OVHP\_mc}}$: The relative of overhead and profit for cost component m in CMA c at time t. Currently, we lack information on overhead and profit, which are imputed based on hard cost (material and labor cost) and a fixed markup rate.

$w^t_{OVHP\_mc}$: The weight of overhead and profit in the total prices for cost component m in CMA c at time t.

5.1.3 Overhead and Profit

Overhead and profit is included in the price movements derived from the CCS, while a fixed value of 11% is applied to all cost component calculations derived from administrative data sources. Since the overhead and profit are derived from the corresponding material and labour cost for the same cost component, the utilization of a fixed markup rate in the current stage makes the overhead and profit have no impact on the final index estimation.

5.2 Elementary aggregate

The estimation of elementary aggregates is the first step in index aggregation. An elementary aggregate is the price index for the renovation project group by CMA, which aggregates price indexes of all the representative renovation projects in each group.

The price relatives of all cost components for each individual renovation project are aggregated to form price index for these projects by CMA using weighted geometric mean as follows:

$$I^{t-1:t}_{RP\_jc} = \prod_{m=1}^{N} \left(\frac{p^t_{mc}}{p^{t-1}_{mc}} \right)^{w^t_{mc}}$$

where:

$I^{t-1:t}_{RP\_jc}$: the index of the representative renovation project j in CMA c at time t.

$\dfrac{p^t_{mc}}{p^{t-1}_{mc}}$: The current output price relative for the representative cost component m in CMA c at time t.

w^t_{mc} : The fixed weight of cost component m in the total output price of renovation project j in CMA c at time t.

The price indices of all the representative renovation projects are then aggregated across each renovation project group by CMA using an unweighted geometric mean. This can be shown as:

$$I^{t-1:t}_{EA\_rc} = \prod_{j=1}^{N} \left(I^{t-1:t}_{RP\_jc} \right)^{\frac{1}{N}}$$

where:

$I^{t-1:t}_{EA\_rc}$: the elementary aggregate for the renovation project group r by CMA c level at time t.

$I^{t-1:t}_{RP\_jc}$: the price index of the representative renovation project j in the renovation project group r by CMA c at time t.

5.3 CMA level indexes

The estimation of CMA level aggregates is achieved by weighting the elementary aggregate level indices (project group) by renovation expenditure weights derive from the Survey of Household Spending (SHS). The Survey of Household spending is conducted biennially and asks respondents within each CMA to note their renovation expenditures across each renovation project group. These weights are then used to create weighted arithmetic relatives by CMA. This can be shown as:

$$I_c^{t-1:t} = \sum_{r=1}^{N} \left(I_{EA\_rc}^{t-1:t} w_{rc}^t \right)$$

$I_c^{t-1:t}$: the price index for CMA *c* for the period going from *t-1* to *t*.

$I_{EA\_rc}^{t-1:t}$: the elemental price index for renovation project group *r* in CMA *c* at time *t*.

w_{rc}^t : the SHS renovation expenditure weight for renovation project group *r* in CMA *c* at time *t*.

5.4 Provincial and National level indexes

The estimation of provincial and national level aggregates is achieved by weighting the CMA level indices by renovation building permit expenditure weights. Building permit data collect the expenditure on residential renovation projects across the country, stratified by CMA. From this we can derive provincial and national indices as:

$$I_p^{t-1:t} = \sum_{c=1}^{N} \left(I_c^{t-1:t} w_c^t \right)$$

$I_p^{t-1:t}$: the price index for province for the period going from *t-1* to *t*.

$I_c^{t-1:t}$: the renovation price index at the CMA level in CMA *c* for the period going from *t-1* to *t*.

w_c^t : the residential renovation building permit expenditure weight in CMA *c* at time *t*.

5.5 Index Aggregation

The Chain-Laspeyres index formula is used to chain the elementary aggregate with the previous period index to arrive at CMA level indices. This same logic is used to aggregate up to the national level index.

$$I_x^{0:t} = I_x^{0:t-1} \times I_x^{t-1:t}$$

$I_x^{0:t}$: the index of level *x* for the period going from *0* to *t*.

$I_x^{0:t-1}$: the index of level *x* for the period going from *0* to *t-1*.

$I_x^{t-1:t}$: the index of level *x* for the period going from *t-1* to *t*.

Since the Laspeyres index is consistent in aggregation, at all aggregation levels higher than the elementary aggregate, the elementary aggregate can be weighted and aggregated as necessary to compile higher level indices.

5.6 Linking of indexes

With the introduction of a new basket, historical estimates will be linked to the new basket by maintaining the same historical period-to-period changes. This is done by calculating a link factor for each index series as the ratio of the new index series (20XX=100) in the overlap period to the old/current index series (2023=100). This link factor is then applied to the old index series to bring it up or down to the level of the new index series. The historical continuity of the residential renovation price indices will be maintained wherever possible by linking the new residential renovation price indices with comparable historical indices where they exist.