

# Chapter 9 Gross fixed capital formation

## Introduction

9.1 In the Income and Expenditure Accounts (IEA), gross fixed capital formation is divided into three principal types of investment expenditure:

- residential structures;
- non-residential structures; and
- machinery and equipment.

9.2 Estimates of each type of investment are produced for the business<sup>1</sup> and government sectors in the IEA. The discussion in this chapter is structured around these three major categories of gross fixed capital formation.

9.3 Fixed investment expenditure is a significant part of aggregate demand. This activity is tied to economic growth through its impact on the productive stock of capital, to social welfare in relation to government infrastructure, and to business cycles in terms of the volatility of its components.

## Concepts and definitions

9.4 Defining capital and capital expenditure is increasingly challenging, given the changing nature of production. Recently, the investment boundary has shifted, resulting in the re-classification of certain types of current expenditure to capital expenditure (e.g., software). In the simplest terms, any expenditure that gives rise to an asset could be considered investment; or, spending on an item whose expected life equals or exceeds one year could be considered investment. However, investment spending must be linked to future use in production.<sup>2</sup>

9.5 Fixed capital covers tangible or intangible assets which are produced as outputs from production processes and which are themselves used repeatedly or continuously in other production processes for more than one year. Fixed assets exclude, by definition, certain non-produced intangible assets, such as non-cultivated biological resources (e.g., virgin forests).<sup>3</sup>

9.6 Generally speaking, capital formation refers to additions to the stock of the nation's non-financial assets resulting from investment activities. The scope of this investment is described in detail in the capital account chapter of *System of National Accounts 1993* (SNA 1993). The IEA closely follows this international standard, with a few exceptions, as noted in this chapter.

9.7 Gross fixed capital formation<sup>4</sup> is the total value of acquisitions, less disposals, of fixed assets during the reference period, plus the activity related to certain additions to the value of non-produced assets (such as mineral deposits or major improvements to the quantity, quality or productivity of land)<sup>5</sup> owing to the productive activity of institutional units. The word gross preceding the term fixed capital formation denotes that investment is measured before deduction of capital consumption allowances. Fixed capital formation includes many types of investment.

9.8 According to the SNA 1993, fixed capital formation includes:

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1. Includes corporations, unincorporated businesses and non-profit institutions serving households.
  2. It is on this basis that expenditure on consumer durable goods is excluded from investment in the national accounts.
  3. However the value of major improvements to such assets is included.
  4. Correspond to paragraphs 10.33 and 10.34 of *System of National Accounts 1993*.
  5. Improvements to land consists of the following kinds of activities: reclamation of land from the sea by the construction of dykes, sea walls or dams for this purpose; clearance of forests, rocks, etc., to enable land to be used in production for the first time; draining of marshes or the irrigation of deserts by the construction of dykes, ditches or irrigation channels; prevention of flooding or erosion by the sea or by rivers, by construction of breakwaters, sea walls or flood barriers. Paragraphs 10.51 to 10.54 of *System of National Accounts 1993* (SNA 1993).

- a) acquisitions, less disposals, of new or existing tangible fixed assets, sub-divided by type of asset into:
  - dwellings;
  - other buildings and structures;
  - machinery and equipment; and
  - cultivated assets – trees and livestock – that are used repeatedly or continuously to obtain products such as fruit, rubber, milk, etc.
- b) acquisitions, less disposals, of new or existing intangible fixed assets, sub-divided by type of asset into:
  - mineral exploration;
  - software;
  - entertainment, literary or artistic originals; and
  - other intangible fixed assets.
- c) major improvements to non-produced tangible assets, including land; and
- d) costs of transfers of ownership of non-produced assets.

9.9 It is recognized that the above list is not exhaustive and that capital assets should ideally include explicitly (under paragraph 9.8b) other research and development expenditure and goodwill and marketing assets, which have taken on increased importance in the modern economy. In the ongoing revision to the SNA 1993, it is proposed that the definition of non-financial assets or investment be expanded to include these increasingly important forms of intangible capital. In anticipation of this proposed change, estimates of research and development investment flows and stocks are currently under development for Canada.

9.10 Business and government gross fixed capital formation in the IEA encompasses most of the SNA 1993 recommended items. Investment in residential structures includes dwellings, structure and land improvements, as well as costs of ownership transfers. Investment in non-residential structures covers buildings and structures, mineral exploration, structure and land improvements, as well as costs of ownership transfers. Investment in machinery and equipment also covers software. Cultivated assets are largely excluded as are entertainment, literary or artistic originals which are considered negligible. Notably, the breakdown between tangible and intangible assets is not drawn in the estimates for Canada, though this distinction will likely be incorporated at the time of the next historical revision.

9.11 According to the SNA 1993 gross fixed capital formation is recorded when the ownership of a fixed asset is transferred to the institutional units that will use them, except for own-account capital formation. Canada does not always practice this convention, as with investment in residential structures. In the case of financial leasing, the SNA 1993 says that a change of ownership is imputed.

9.12 In the IEA, gross fixed capital formation is presented first as part of expenditure-based gross domestic product (GDP) and then again in the institutional sector accounts. It should be noted that, in the measurement of expenditure-based GDP, business gross fixed capital formation is the sum of investment spending for the persons and unincorporated businesses sector and the corporate and government business enterprises sector.

9.13 Illustrated in Table 9.1 and Table 9.2 are the gross fixed capital formation by component and by sector.

**Table 9.1 Gross fixed capital formation in the Income and Expenditure Accounts, 2000**

	CANSIM	Table <sup>1</sup>	Line <sup>1</sup>	Millions of dollars
<b>Gross fixed capital formation</b>				<b>206,272</b>
Government gross fixed capital formation	V498093	Table 2	Line 7	24,524
Residential structures	V498642	Table 19	Line 6	270
Non-residential structures and equipment	V498663	Table 22	Line 1	24,254
Non-residential structures	V498664	Table 22	Line 2	15,520
Building	V498665	Table 22	Line 3	7,397
Engineering	V498666	Table 22	Line 4	8,123
Machinery and equipment	V498667	Table 22	Line 5	8,734
Furniture	V498668	Table 22	Line 6	550
Agricultural machinery	V498669	Table 22	Line 7	7
Industrial machinery	V498670	Table 22	Line 8	394
Computers and other office equipment	V498671	Table 22	Line 9	2,219
Software	V1992212	Table 22	Line 10	2,809
Automobiles	V498672	Table 22	Line 11	144
Trucks	V498673	Table 22	Line 12	257
Other transportation equipment	V498674	Table 22	Line 13	241
Telecommunications equipment	V498675	Table 22	Line 14	519
Other machinery and equipment	V498676	Table 22	Line 15	1,594
Business gross fixed capital formation	V498095	Table 2	Line 9	181,748
Residential structures	V498096	Table 2	Line 10	48,572
Non-residential structures and equipment	V498097	Table 2	Line 11	133,176
Non-residential structures	V498098	Table 2	Line 12	49,826
Building	V498679	Table 22	Line 18	15,528
Engineering	V498680	Table 22	Line 19	34,298
Machinery and equipment	V498099	Table 2	Line 13	83,350
Furniture	V498682	Table 22	Line 21	3,471
Agricultural machinery	V498683	Table 22	Line 22	3,045
Industrial machinery	V498684	Table 22	Line 23	20,992
Computers and other office equipment	V498685	Table 22	Line 24	9,755
Software	V1992213	Table 22	Line 25	9,419
Automobiles	V498686	Table 22	Line 26	8,120
Trucks	V498687	Table 22	Line 27	8,466
Other transportation equipment	V498688	Table 22	Line 28	6,061
Telecommunications equipment	V498689	Table 22	Line 29	7,727
Other machinery and equipment	V498690	Table 22	Line 30	6,294

1. Refers to table and line numbers in the *National Income and Expenditure Accounts*, catalogue no. 13-001.

**Table 9.2 Gross fixed capital formation by institutional sector, 2000**

	CANSIM	Table <sup>1</sup>	Line <sup>1</sup>	Millions of dollars
<b>Gross fixed capital formation</b>				<b>206,272</b>
Government sector	V498342	Table 9	Line 27	24,524
Federal government	V498390	Table 10	Line 35	3,489
Provincial governments	V498423	Table 11	Line 33	10,961
Local governments	V498451	Table 12	Line 28	10,074
Business sector	V498095	Table 2	Line 9	181,748
Persons and unincorporated businesses	V498196	Table 5	Line 31	56,475
Corporations and government business enterprises	V498234	Table 6	Line 22	125,273
Non-financial	V498267	Table 7	Line 6	117,710
Financial	V498291	Table 8	Line 6	7,563

1. Refers to table and line numbers in the *National Income and Expenditure Accounts*, catalogue no. 13-001.

## Gross fixed capital formation in residential structures

### General concepts

9.14 Gross fixed capital formation in residential structures is often referred to as investment in residential construction. It is a key variable in any macroeconomic model, owing to its importance in explaining economic fluctuations. Residential construction tends to precede the business cycle and to react quickly to changes in employment, interest rates, inflation and consumer confidence.

9.15 Gross fixed capital formation in residential structures originates in the corporate, government and persons and unincorporated business sectors. Most of the activity in any given quarter is recorded in the persons and unincorporated business sector, largely reflecting the acquisition of newly constructed houses by households. Capital formation excludes the cost of land, since land is not a produced asset. Associated residential land flows are therefore excluded from GDP but are included as part of existing assets in the sector account's total non-financial capital acquisition.

9.16 Residential structures are assets that produce housing services. Where dwellings are used as a principal residence by individual owners – the case for the majority of the housing stock – those individuals are considered (in national accounting) to be unincorporated businesses producing housing services for their own final consumption (see 5.53 to 5.66).

9.17 On average, gross fixed capital formation in residential structures accounted for 24% of investment, or 5% of GDP in 2000. It includes three major elements:

- new residential construction;
- renovations; and
- ownership transfer costs.

### New residential construction

9.18 New residential construction is the largest element of gross fixed capital formation in residential structures, encompassing single-family dwellings, semi-detached dwellings, row houses, apartments, condominiums, cottages, mobile homes as well as dwelling conversions and other costs (e.g., the value of acquisition costs).

9.19 In the IEA, productive activity is recorded at the time it takes place, commonly known as work in progress. Therefore, new residential construction is recorded on the basis of work put in place (WPIP), that is, the value of construction that took place during the reference period (quarter or year). It does not represent the value at the

time of acquisition, but rather the volume of work completed during a given period, regardless of whether the final product is purchased or not. This is important, as the construction of a residential structure may extend over several months.

9.20 In the SNA 1993 it is recommended that newly constructed dwellings for sale be recorded as capital only when ownership is transferred, and prior to this point should be recorded as a work in progress inventory change. In the IEA the newly constructed dwellings for sale are classified to gross fixed capital formation in residential structures, under the sub-category change in work in progress inventory. In fact, the value of new housing construction item is categorized into three components: Change in work in progress inventory, change in inventory of completed dwellings and sales of new dwellings excluding land. On this point IEA differs only in presentation from the SNA 1993. This treatment was deemed to be both more useful to the user community and more consistent with associated financing activity.

9.21 In addition to the construction of new buildings, dwelling conversions are also included in new residential construction. Examples would be the conversion of a single-family dwelling into multiple dwellings, and additional housing units created from non-residential buildings or other types of residential structures.

9.22 New residential construction also includes all costs associated with the construction and sale or purchase of a building. These costs are as follows:

- federal and provincial taxes on new buildings;
- land preparation and development costs;
- engineering, architectural and development fees;
- builders' administration costs (including marketing and insurance costs) that are passed on to the purchaser;
- mortgage costs assumed by the purchaser (for example, mortgage insurance costs); and
- other costs (including acquisition costs).

## Renovations

9.23 Renovations to existing residential structures are the second largest element of gross fixed capital formation in residential structures. Renovations, also known as alterations and improvements, are made up of spending on additions, renovations and alterations, new installations and replacement of equipment.

- Additions are structural extensions to property (such as rooms, decks, garages, car ports, garden sheds) and swimming pools, fences, patios, driveways and major landscaping;
- Renovations and alterations involve work intended to upgrade the property to acceptable building standards, rearrange the interior space and modernize existing facilities without changing the type of occupancy such as remodelling rooms, adding or replacing doors and windows, renovating exterior walls, upgrading insulation and adding eaves trough;
- New installations involve the installation of equipment not previously in existence, for example, the installation of fixed electrical home appliances;
- Replacement of equipment is the installation of equipment that replaces an existing unit. It includes upgrading to a superior quality and conversion from one type to another (for example, the replacement of a roof, carpet, heating system or air conditioning system).

9.24 All of these activities change the value of assets or extend their service life.

9.25 The value of renovations to residential structures encompasses all costs associated with the work, including margins and taxes.

9.26 Renovations exclude repairs and maintenance. These items are included in personal expenditures on consumer goods and services. The difference between ordinary repair and maintenance work and improvement or renovation of dwellings is not always clear. According to national accounting concepts, ordinary maintenance and repair work merely serves to maintain capital in working order, without improving the performance or, in the case of dwellings, the overall quality of the dwelling. Renovation work constitutes an increase in the value of capital. In the case of dwellings, such work is intended to improve the overall quality of the dwelling or its service life. The enlargement of a dwelling is an improvement and a major change.

## Ownership transfer costs

9.27 The category ownership transfer costs is the third element of gross fixed capital formation in residential structures. It includes all costs associated with the transfer of a residential asset from one owner to another. These costs are as follows:

- real estate commissions;
- land transfer taxes;
- legal costs (fees paid to notaries, surveyors, experts, etc.); and
- file review costs (inspection and surveying).

9.28 Table 9.3 shows the working level detail for investment in residential structures

**Table 9.3 Gross fixed capital formation in residential structures, 2000**

	CANSIM	Table <sup>1</sup>	Line <sup>1</sup>	Millions of dollars
<b>Gross fixed capital formation in residential structures</b>	<b>V498634</b>	<b>Table 19</b>	<b>Line 4</b>	<b>48,842</b>
Value of new housing construction	V498635	Table 19	Line 1	23,676
Value of work put in place				19,410
Single houses				13,401
Semi-detached houses				1,260
Row houses				1,678
Apartments and condominiums				3,071
Other new construction				4,266
Cottages				296
Mobile homes				199
Conversions				167
Value of acquisition costs				3,604
Federal tax on goods and services				1,304
Provincial sale taxes				284
Land developer fees				733
Other acquisition costs				1,283
Renovations	V498639	Table 19	Line 2	17,549
Ownership transfer costs	V498640	Table 19	Line 3	7,617
Real estate commissions				5,837
Land transfer tax				792
Legal fees				719
Appraisal and inspection fees				269

1. Refers to table and line numbers as they appear in the *National Income and Expenditure Accounts*, catalogue no. 13-001.

## Annual estimation methods and data sources

9.29 Estimates for benchmark years (t-4 and t-3) and non-benchmark years (t-2 and t-1) for gross fixed capital formation in new residential construction are produced using the same methods and data sources. Only renovations and ownership transfer costs (see paragraphs 9.32 through 9.36) use different sources of information for the two periods. It should also be noted that estimates for the current years (t-2 and t-1) are not subject to the Input–Output Tables balancing process.

9.30 Gross fixed capital formation in residential structures is estimated for both the business and government sectors. The government share accounted for less than 0.6% of the total in 2000. New residential construction is first estimated for the economy as a whole. The availability of detailed data on the government sector allows for the direct estimation of new residential construction for government and the balance is allocated to the business sector.<sup>6</sup> Government data are taken directly from government financial statements obtained from the Public Institutions Division. Included in this item are expenditures on non-profit housing.<sup>7</sup>

### New residential construction

9.31 New residential construction consists of two sub-elements: work put in place (WPIP) and other new construction. Each item has its own estimation method. In 2000, the value of WPIP represented 82% of the value of new residential construction and 40% of total gross fixed capital formation in residential structures. Other new construction consists of new residential construction of cottages, mobile homes, building conversions and acquisition costs such as taxes and land development costs.

9.32 WPIP corresponds to the value of construction of single-family dwellings, semi-detached dwellings, row houses, apartments and condominiums realized during a given period. The construction of those residential buildings may have started a month ago, six months ago or even two years ago (to a maximum of 21 months). As an example, the estimation of WPIP in June 2005 included the value of construction realized in June 2005 for all residential buildings for which the construction started between October 2003 and June 2005. However, not much of the October 2003 vintage construction would be reflected in the data by June 2005, except in the case of large multiple housing projects, (such as apartment buildings).

9.33 The Investment and Capital Stock Division (ICSD) is responsible for calculating WPIP based on housing starts, the average value of building permits and WPIP coefficients. The value of starts in a given period is estimated by combining housing starts from the *Starts and Completions Survey* of the Canada Mortgage and Housing Corporation (CMHC) and the average value of starts using the reported value from the *Building Permits Survey*. The value of building permits includes material, labour and overhead costs. It excludes the cost of land but may include some acquisition costs. This value is corrected to account for the fact that building permits systematically underestimate the final value of the dwelling.

9.34 The value of starts does not only correspond to the construction activity in the current month, but also to the progress of construction projects launched in previous months. The work may extend over a period of 21 months. The Investment and Capital Stock Division (ICSD) distributes the value of starts over these months. This operation is made using a vector of WPIP coefficients which combines the number of months needed to complete each start<sup>8</sup> with the percentage of construction added during the construction period.<sup>9</sup>

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6. Expenditures other than those on new residential construction (e.g., renovations) are all drawn from the business sector, owing to the lack of data.
  7. The construction of residences and dormitories for universities, houses and sleeping cabins in public parks and for coast guards, as well as embassies, consulates, government properties and barracks are part of government non-residential construction.
  8. For example, for starts of single-family dwellings in Ontario in June 2005, 4% of the work is completed in the first month, 8% of the work is completed in the second month, etc.
  9. For example, for the construction of a single-family dwelling being built over three months, 35% of the value of construction is completed in the first month, 37% in the second month and 28% in the third month. It is possible that the total construction period may extend over 21 months.

9.35 For the estimation of the vector of WPIP coefficients, information from CMHC on completed dwellings by construction duration is used. The distribution of work completed by construction duration is derived using a special data compilation from the CMHC (Flows and Stocks of Fixed Residential Capital).

9.36 Other new construction also has several sub-categories, all prepared monthly by province and territory by ICSD. Estimates for cottages, conversions and mobile homes are calculated using data from the *Building Permits Survey*.

9.37 Acquisition costs include the federal tax on goods and services, provincial sales taxes, land developer fees and other acquisition costs.

9.38 The Goods and Services Tax (GST), applies to sales of dwellings, conversions, cottages and mobile homes. This federal tax on sales of new dwellings (single-family, semi-detached, row houses, apartments and condominiums) is calculated using data from the Canada Mortgage and Housing Corporation (CMHC) and the tax rebate file (from the Canada Revenue Agency). The value of new home sales is the product of the number of houses sold and CMHC prices, adjusted to the fair market value from the GST rebate file. The federal tax on conversions, cottages and mobile homes is obtained by applying the GST rate to their respective values.

9.39 The second item in acquisition costs is the Provincial Sales Tax (PST), calculated in the same way as the GST for provinces, where a tax equivalent to the GST applies.

9.40 Thirdly, land development costs are associated with the development of infrastructures that make the land usable, such as new streets and electrical power, water and sewage systems. These data are obtained annually, by province or territory, from the Public Institutions Division, which obtains them from provincial and local governments.

9.41 Finally, other acquisition costs include a range of expenditures related to the construction of new dwellings. These include mortgage-related costs (such as the cost of mortgage insurance), promotion and marketing costs and other administrative costs incurred by the contractor (insurance, maintaining an office, etc.) as well as architectural and engineering fees. These data are supplied by ICSD on a monthly basis, and are based on the *Building Permits Survey* and the *Starts and Completions Survey* from CMHC.

## **Renovations**

9.42 Renovations include expenditures on structural modifications which do not create a separate dwelling but which prolong the service life of a building or add to its quality. Renovation expenditures are calculated for owner-occupants, landlords, cottage owners and renters.

9.43 Until 2002, estimates of spending on renovations were drawn from the *Homeowner Repair and Renovation Survey* (HRRS) results. This survey was discontinued and the *Survey of Household Spending* (SHS) is now the main source of information used to produce estimates for benchmark years and for the first projection year (t-2). The results from this survey are examined in light of other indicators such as renovation permits and sales of building materials. Finally, estimates for the last projection years (t-1) are obtained by summing quarterly estimates (see paragraph 9.47).

## **Ownership transfer costs**

9.44 Ownership transfer costs include several sub-categories. The largest consists of real estate commissions, which are commissions paid to real estate brokers and agents. A value was established in 1992 by analysing the GST file obtained from the Tax Data Division. Since 2000, annual benchmarks have been established using the *Annual Survey of Service Industries: Real Estate Agents, Brokers, Appraisers and Other Real Estate Activities* and the *Survey of Household Spending*. Estimates of real estate commissions are also based on the monthly report of listings through the Multiple Listing Service (MLS) of the Canadian Real Estate Association. This report provides monthly data, by province, on the number of houses sold and their average selling price.



9.45 Land transfer taxes which are real estate taxes levied by provincial or local governments, are produced on an annual basis by the Public Institutions Division, which obtains them from those governments.

9.46 Legal costs include professional fees or commissions paid by the dwelling purchaser (fees paid to notaries, surveyors, experts, etc.). File review costs are the inspection and surveying costs borne by the purchaser. In both cases, these costs are calculated as a proportion of real estate commissions, the proportions being drawn from the *Survey of Household Spending*.

## Quarterly estimation methods and data sources

9.47 For most of the above categories, the quarterly methodology is identical to that for benchmark years, since the information sources are readily available on a monthly basis. However, there are some exceptions. Land development costs are estimated quarterly following the trend in housing starts. Renovations are based on sales of building supplies from the *Quarterly Retail Commodity Survey* (QRCS), building permits for alterations from the *Building Permits Survey* and building materials from the *Wholesale Trade Survey (Monthly)*. Finally, quarterly land transfer taxes are obtained by applying the rate of growth of real estate commissions to the last quarterly benchmark.

## Provincial and territorial estimation methods and data sources

9.48 Provincial and territorial estimates are produced at the same level of detail as the estimates for Canada as a whole. In fact, in most cases the national estimate is built up from provincial estimates. The exceptions are renovation expenditures and ownership transfer costs.

9.49 For renovation expenditures, three sources of information are used to produce provincial and territorial estimates. These are the *Survey of Household Spending*, the *Building Permits Survey* and a provincial allocator of renovation expenditures produced by the Investment and the Capital Stock Division (ICSD). The advantage of the ICSD allocator is that it allows for exceptional events such as the implementation of a government incentive. It combines two elements:

- the importance of the housing stock of each province and territory relative to the total; and
- the value of renovation permits in each province and territory coming from the *Building Permits Survey*.

9.50 As to ownership transfer costs, data from the Multiple Listing Service (MLS) of the Canadian Real Estate Association, the *Survey of Household Spending* and the *Survey of Annual Real Estate Agents, Brokers, Appraisers and Other Real Estate Activities* serve as provincial and territorial distributors.

## Deflation – Estimates in real terms

9.51 The new construction series are deflated using price indexes reflecting the price paid by purchasers. Expenditures on renovations are deflated using an index of the cost of renovation work (price of materials and labour costs). Ownership transfer costs are deflated using price indexes constructed from the average sale price of existing homes sold, based on data from the Multiple Listing Service (MLS) of the Canadian Real Estate Association. Table 9.4 provides details on the deflation method by category.

**Table 9.4 Deflation procedures for gross fixed capital formation in residential structures**

Description	Deflation method
<b>Gross fixed capital formation in residential structures</b>	
Value of new residential construction	
Value of construction work put in place	
Single-family dwellings	Work put in place for single family dwellings is deflated monthly, by province, using the <i>New Housing Price Index</i> <sup>1</sup> (NHPI).
Semi-detached dwellings	Work put in place for semi-detached houses is deflated monthly, by province, using the <i>New Housing Price Index</i> <sup>1</sup> (NHPI).
Row houses	Work put in place for row houses is deflated monthly, by province, using the <i>New Housing Price Index</i> <sup>1</sup> (NHPI).
Apartments and condominiums	Work put in place for apartments is deflated monthly, by province, using the <i>Apartment Building Construction Price Index</i> <sup>2</sup> (ABCPI). This index is compiled by the Prices Division.
Other new construction	
Cottages	New construction of cottages is deflated monthly, by province, using the <i>New Housing Price Index</i> <sup>1</sup> (NHPI).
Mobile homes	The mobile home series are deflated with the industry price indexes for machinery and equipment - mobile homes (CANSIM vector no. V1575570), compiled by the Prices Division as part of survey no. 2318, <i>Industrial Product Price Index</i> (IPPI).
Conversions	Conversions are deflated using the renovation price index described under renovations.
Value of additional costs	
Federal tax on goods and services	Federal tax, in real terms, on new dwellings, conversions, cottages and mobile homes is obtained by applying the GST rate to their respective values.
Provincial sales tax	Provincial taxes, in real terms, on new dwellings, conversions, cottages and mobile homes are obtained by applying the different provincial tax rates to their respective values.
Land development costs	Average land development costs per dwelling are calculated for the base year (2000), then multiplied for the base year and subsequent years by the number of housing starts.
Other acquisition costs	Other acquisition costs are deflated using the average weekly earnings for advertising and related services from the <i>Survey of Employment, Payrolls and Hours</i> (SEPH).
Renovations	
A price (cost) index is created using wage and cost of materials indexes. The deflator for the labour component is average weekly earnings for the residential construction industry from the <i>Survey of Employment, Payrolls and Hours</i> (SEPH). The cost of construction materials index is compiled by the Prices Division and is partially adjusted for the GST. A weight of 60% is applied to materials whereas the cost of labour accounts for 40%.	
Costs of ownership transfer	
Real estate commissions	Deflation is based on the indexed average selling price of existing homes sold, according to listings in the Multiple Listing Service (MLS) of the Canadian Real Estate Association.
Land transfer taxes	The deflator for real estate commissions is used.
Legal costs	These costs are calculated in proportion to real estate commissions (12.3% in 2000), on a provincial and monthly basis. This ratio is drawn from the <i>Survey of Household Spending</i> (SHS).
File review costs	These costs are calculated in proportion to real estate commissions (4.6% in 2000).
Government sector	Government new residential construction is deflated monthly, by province using the <i>New Housing Price Index</i> <sup>1</sup> (NHPI).

1. The *New Housing Price Index* (NHPI) is a monthly series that measures changes over time in the contractors' selling prices of new residential houses, where detailed specifications pertaining to each house remain the same between two consecutive periods. The "house only" component of the index is used. The land portion is excluded. The index is compiled by the Prices Division.

2. The *Apartment Building Construction Price Index* (ABCPI), survey no. 2330, CANSIM table 327-0040, measures changes in the contractors' selling price of a representative apartment building. The index relates to both general and trade contractors' work and excludes the cost of land, design and real estate fees. The index is compiled by the Prices Division.

## Gross fixed capital formation in non-residential structures

### General concepts

9.52 Gross fixed capital formation in non-residential structures represents about 32% of investment or 6% of GDP (in 2000). It is a key variable in the macroeconomic system. It tends to be cyclical, as business investment in non-residential structures tends to lag the business cycle, largely because of its long-term nature involving major contractual commitments. The time that elapses between a businesses' decision to invest and the deployment of new capital results in a cascading lag.

9.53 When the economy is expanding, businesses make profits and begin to consider increasing their capacity either by building new plants, purchasing equipment or by improving existing facilities to meet growing demand. Before new capital can go into operation, there is the planning and design phase, followed by the construction phase. Depending on the nature and size of the investment, this process can take anywhere from a few months to many years, even as much as a decade. This cascading lag is a major determinant of the cyclical nature of investment and many economists argue that it is a major determinant of the cyclical nature of the economy.

9.54 The component non-residential structures includes the gross value of:

- all new non-residential construction put in place with the exception of defence installations (treated as government current expenditure on goods and services);
- all additions and major renovations; and
- all conversions and alterations that extend the life of an existing asset.

9.55 In the IEA, these estimates are grouped into two categories. The first category, building construction, refers to investment in industrial, commercial and institutional buildings. It includes any permanent structure with walls and a roof, any attachment that forms part of the structure, plumbing, electrical wiring, air conditioning or elevator installations. It covers hotels, office buildings, railway stations, schools and shopping centres.

9.56 The second category, engineering construction, includes all capitalized costs: legal fees, engineering and architectural fees, capitalized interest and work completed for the business by its own employees. It includes items such as bridges, roads, highways, waterworks, sewage systems, airports, seaways, power line construction, oil well drilling, mine development, dams, street lighting, railway tracks and pipelines.

9.57 The estimates include both contract work and work completed by the firm's own employees. The cost of site preparation and land improvement is included; however the purchase value of land is excluded. Transfer costs associated with the purchase of existing fixed assets are included. The estimates cover the value of work put in place (WPIP) during the reference period.

**Table 9.5 Gross fixed capital formation in non-residential structures in the Income and Expenditure Accounts, 2000**

	CANSIM	Table <sup>1</sup>	Line <sup>1</sup>	Millions of dollars
<b>Non-residential structures</b>				<b>65,346</b>
Government non-residential structures	V498664	Table 22	Line 2	15,520
Building	V498665	Table 22	Line 3	7,397
Engineering	V498666	Table 22	Line 4	8,123
Business non-residential structures	V498678	Table 22	Line 17	49,826
Building	V498679	Table 22	Line 18	15,528
Engineering	V498680	Table 22	Line 19	34,298

1. Refers to table and line numbers in the *National Income and Expenditure Accounts*, catalogue no. 13-001.

## Annual estimation methods and data sources

9.58 The annual benchmark estimates (for t-4 and t-3 years) for gross fixed capital formation in non-residential building and engineering construction are reconciled to the final demand matrix of the Input-Output Tables (IOT). The Industry Accounts Division (IAD) primarily uses information from the Investment and Capital Stock Division's *Capital Repair Expenditures Survey*<sup>10</sup> (CES) by asset type. This information is based on the North American Industry Classification System (NAICS). The data are produced on a January-December basis and are consistent (in most cases) with national accounts' concepts.

9.59 The CES totals are not identical to IEA's gross fixed capital formation measures because a number of adjustments are made to ensure consistency with the CSNA definitions. One difference between the survey and IEA data is related to sectoring. The survey data are reclassified because the business and government sectors are defined differently in the CSNA.

9.60 In addition, IEA totals are based on other sources of information, such as the *Quarterly Survey of Financial Statistics for Enterprises*.<sup>11</sup> This survey focuses on revenues, profits and assets, but also includes a number of questions on capital spending. It differs from the CES in coverage (based on enterprises rather than establishments) and content (e.g., includes the purchase price of land and used buildings).

9.61 Information is also taken from ICSD's *Investment in Non-residential Building Construction* data based on the *Building Permits Survey* for comparison with CES data on the value of some investment projects.

9.62 The Input-Output supply-disposition framework, which is used to refine the estimates for the benchmark years, and the values for the various sub-items that are generated with the methodologies developed for the production of quarterly estimates, also contribute to the accuracy or completeness of the investment estimates.

9.63 As in the case of the annual benchmark estimates, the CES is the main source of information. For the t-2 period, actual data<sup>12</sup> from the survey are used whereas for the t-1 period, the preliminary actual estimates are used as the main indicator along with the quarterly estimates based on related indicators.

## Quarterly estimation methods and data sources

9.64 In the absence of a quarterly capital expenditure survey, related indicators must be used. Non-residential building and engineering construction estimates are published separately on a quarterly basis. The methodologies used to produce these aggregates are closely related.

9.65 There are essentially two approaches: a detailed approach and a global approach. The results of both approaches are carefully examined and analysed in order to arrive at an acceptable estimate. In this process, we also take into consideration the annual forecasts of the *Capital Expenditure Survey* (CES) for the current year (spending intentions released each February).

### The detailed approach

9.66 The detailed approach consists of multiplying the most recent quarterly estimate of capital spending for each component by the percentage change in a related indicator, and then summing the results to produce an overall estimate. This method is used for building and engineering construction expenditures for both the government and business sectors.

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10. Survey no. 2803. The data are published in *Private and Public Investment in Canada, Intentions*, catalogue no. 61-205. This survey is often referred to as *Private and Public Investment* or PPI.

11. Survey no. 2501. The data are published in *Quarterly Survey of Financial Statistics for Enterprises*, catalogue no. 61-008.

12. For more information on the CES concepts of intentions, preliminary actual and actual expenditures, see Appendix 1: A Brief Description of the *Capital Expenditure Survey*.

## Government sector

9.67 For building construction, the quarterly indicator used is the investment in non-residential institutional building construction, produced by ICSD. It is based on the *Building Permits Survey* of municipalities, which provides information on construction intentions for this type of building. Work put in place (WPIP) patterns are assigned to this category of structure. The patterns which are used to distribute the value of building permits according to project length, differ by type and value of construction project— a project worth millions of dollars will usually take longer to complete than a project worth \$100,000.

9.68 Engineering construction expenditures are calculated for highways, bridges, railways and other engineering. Material costs (asphalt purchases in cubic metres multiplied by the *Industrial Product Price Index* (IPPI) price for asphalt) and labour costs based on earnings in the highway, streets and bridge industry, from the *Survey of Employment, Payrolls and Hours* (SEPH) make up the highways' estimator. This same estimator is used to estimate expenditures on the other, less important, components.

## Business sector

9.69 For the buildings category, the quarterly indicators are the investment in non-residential industrial and commercial buildings, produced by ICSD.

9.70 The business sector's engineering expenditures are made up of two categories: private roads and other engineering. The private roads estimator is the same one used for public highways described in paragraph 9.68. One of the estimators used for other engineering is based on capital spending (reported in the *Quarterly Survey of Financial Statistics for Enterprises*) by large companies, in mining, telecommunications, railways, etc., which invest mainly in engineering. Other information used includes such items as capital spending by provincial electric utilities and the value added in drilling and rigging services<sup>13</sup> in the oil and gas industry.

9.71 Finally, qualitative information on major construction projects is extracted from budget documents, newspapers articles, specialized publications and project inventories maintained by private consulting firms, etc.

## The global approach

9.72 The global approach consists of constructing an overall indicator of capital spending on construction. This indicator or estimator is also used to derive quarterly estimates of investment in non-residential construction. Total construction spending<sup>14</sup> is estimated primarily by combining data on employment, wages and shipments of various materials used in construction. Other variables, such as profits in the construction industry and inventories of building materials are also taken into account.

9.73 Employment in construction is taken from the *Labour Force Survey* (LFS). Average hourly earnings are pulled from the monthly *Survey of Employment, Payroll and Hours* (SEPH). Another key monthly indicator, the value added in drilling and rigging services, is obtained from provincial ministries in oil and gas producing provinces. These indicators are combined to obtain an overall level of construction activity for each quarter. The quarterly estimate for residential construction (new construction, alterations and improvements) is then subtracted from the total, yielding an estimate of spending on non-residential construction. The resulting estimates are then compared with the annual estimates from the *Capital Expenditure Survey*. The allocation of expenditures between the government and business sectors<sup>15</sup> is based on *Private and Public Investment Intentions*.<sup>16</sup>

13. Drilling activity is measured in metres, while rigging is measured in rig operating days by depth (in metres).

14. Includes both residential and non-residential expenditures.

15. Some government enterprises are transferred from the government to the business sector to maintain consistency with the CSNA.

16. Survey no. 2803. The data are published in *Private and Public Investment in Canada, Intentions*, catalogue no. 61-205. This survey is often referred to as Private and Public Investment or PPI.

9.74 Little information is available on the supply side, other than data on building materials from various monthly surveys, such as the production of cement and asphalt, sales of lumber, and imports and exports of other building materials. Supply based estimates for the construction industry tend to be lower than the demand-side estimates incorporated into the National Accounts.

9.75 Finally, the quarterly data are benchmarked to the annual levels at the time of the production of the annual estimates. These annual estimates reflect the most recent aggregates from the Input-Output Tables, data from the *Capital Expenditure Survey by Type of Asset*<sup>17</sup> and the latest *Capital Expenditure Survey*.

9.76 For the quarters of the current year, the series are built on the basis of the movement of the specially constructed indicators discussed previously, of which inputs are all available up-to-date on a sub-annual basis.

## Provincial and territorial estimation methods and data sources

9.77 The provincial distribution of non-residential construction investment comes from the *Capital Expenditure Survey*. Note that the provincial estimates are benchmarked to the most recent provincial Input-Output Tables (for t-4 and t-3 years).

## Deflation – Estimates in real terms

9.78 Estimates are produced for each component at current prices and then deflated at the following levels of detail:

- Non-residential buildings
- Engineering
  - Highways and roads
  - Railways
  - Other engineering

9.79 Both output and input price indexes are used. Output price indexes produced by the Prices Division are used to deflate building investment, while input prices indexes, most of them produced within the IEA, are used to deflate engineering construction. The input price indexes are based on:

- average earnings for the labour component;
- IPPI for the materials; and
- a mix of average weekly earnings indexes and consumer price indexes for overhead costs.

9.80 These price indexes are then weighted together on the basis of detailed annual estimates from the Input-Output Tables.

9.81 The non-residential buildings deflator is based on non-residential building construction price indexes, with contracted investment by industry having a weight of 90% and own-account work having a weight of 10%.

9.82 Output price indexes measure the variation in contractors' selling prices for non-residential structures (i.e., commercial, industrial and institutional buildings). These indexes relate to both general and trade contractors' work and exclude land improvement costs and real estate fees. Prices for work put in place (WPIP) are provided by the Prices Division, which surveys subcontractors and general contractors whose bids are based on specifications and quantities set by real estate markets. The latter survey covers such items as overhead and profits that reflect market conditions. Prices for certain materials, labour rates, equipment rental costs, municipal charges and sales taxes are obtained from a variety of secondary sources.

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17. This information is also produced by the *Capital Expenditure Survey* (CES). Previously published in *Capital Expenditures by Type of Asset*, catalogue no. 61-223, now available only on CANSIM.

9.83 Prices for own-account work are obtained from a fixed-weighted composite index of average hourly earnings for the construction sector, based on the *Survey of Employment, Payrolls and Hours* (SEPH) data; materials prices, based on the *Industrial Product Price Index* (IPPI); and overhead costs, based on various price indexes, such as average weekly earnings indexes and various consumer price indexes.

9.84 The highways and roads, railways and other engineering deflators are all input price indexes based on a fixed-weighted composite of wages, materials and overhead costs. Table 9.6 shows the relative weights of the deflators, derived from the 1997 Input-Output Tables. Indexed average weekly earnings from SEPH are used for the wages portion. The materials component of the deflator is based on IPPIs. The overhead costs share is based on a mix of average weekly earnings indexes and consumer price indexes.

**Table 9.6 Relative weights of engineering deflators**

	Weights of indexes			Total
	Labour	Materials	Overhead costs	
	percent			
Transportation	37	39	24	100
Other engineering	34	43	23	100

## Gross fixed capital formation in machinery and equipment

### General concepts

9.85 Gross fixed capital formation in machinery and equipment, is a key component of investment, accounting for 45% of gross fixed capital formation in 2000. It enhances productivity and potential output and contributes to economic growth. It is also one of the more cyclical components of GDP, as in an expansion and strong profit period when businesses consider modernizing or increasing their capacity either by purchasing equipment or by improving existing machinery to meet growing demand. In addition, since a large proportion of investment goods are imported, machinery and equipment has a substantial impact on the merchandise trade balance.

9.86 Table 9.7 presents the value of gross fixed capital formation in machinery and equipment for both the business and government sectors for the year 2000.

**Table 9.7 Gross fixed capital formation in machinery and equipment, 2000**

	Business	Government	Total
	millions of dollars		
Gross fixed capital formation in machinery and equipment	83,350	8,734	92,084
Furniture	3,471	550	4,021
Agricultural machinery	3,045	7	3,052
Industrial machinery	20,992	394	21,386
Computers and other office equipment	9,755	2,219	11,974
Software	9,419	2,809	12,228
Automobiles	8,120	144	8,264
Trucks	8,466	257	8,723
Other transportation equipment	6,061	241	6,302
Telecommunications equipment	7,727	519	8,246
Other machinery and equipment	6,294	1,594	7,888

Source: *Guide to the Income and Expenditure Accounts*, Statistics Canada, catalogue no. 13-017.

9.87 In the Canadian System of National Accounts (CSNA), gross fixed capital formation in machinery and equipment comprises spending on produced durable goods that have a productive life of one year or more. Purchase, construction and installation costs are included for both the replacement and addition of assets. Assets are recorded as gross fixed capital formation in machinery and equipment whether they are owned or leased. The following costs are capitalized:

- feasibility studies<sup>18</sup>
- exploration and development costs;
- tooling;
- progress payments;
- the net portion of purchases of used assets (vehicles, aircraft, other assets); and
- an adjustment for scrap and salvage.

9.88 By definition, investment in machinery and equipment can be moved without altering the structure in which it is housed. Otherwise, it is regarded as an integral part of the structure itself and is included in gross fixed capital formation in non-residential structures.

9.89 Machinery and equipment investment is valued at purchaser prices (including taxes) and includes spending on smaller goods such as hand tools and office furniture, even though firms often treat these as current expenditures. Non-military investment expenditures for national defence are included in gross fixed capital formation in machinery and equipment, however strictly military expenditures such as tanks, are considered part of government current expenditure. In 2001, business and government investment in software was included in gross fixed capital formation in machinery and equipment, with estimates beginning in 1981.

9.90 Estimates published by the IEAD cover ten major groups for both the business and government sectors (see tables 22, 23 and 24 in the *National Income and Expenditure Accounts*). The categories for which data are published are as follows:

- Furniture: office furniture and special-purpose furniture;
- Agricultural machinery: tractors and other agricultural equipment;
- Industrial machinery: industrial machinery such as pumps, compressors, furnaces and electric turbines;
- Computers and other office equipment: computers and peripheral equipment and other office machines;
- Software: own-account, pre-packaged and custom design software;
- Automobiles: passenger cars;
- Trucks: trucks and tractor trailers;
- Other transportation equipment: locomotives, boxcars, ships, aircraft, buses, parts and equipment;
- Telecommunications equipment: radar and equipment related to telephone systems and radio and television transmission systems;
- Other machinery and equipment: other investment goods such as hand tools and medical and electric equipment.

## Annual estimation methods and data sources

9.91 The annual benchmark estimates for gross fixed capital formation in machinery and equipment are obtained from the final demand matrix of the Input-Output Tables (IOT). The Industry Accounts Division (IAD) primarily uses information from the Investment and Capital Stock Division (ICSD) *Capital Expenditure Survey* (CES) by asset type.<sup>19</sup> Analysts also draw on various annual industry surveys to calibrate the information. A comparison of the

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18. In theory, feasibility studies, exploration and development costs are all capitalized. In practice, some of these costs are recorded as current expenditure by businesses. They then become intermediate rather than final expenditure.



main information sources with all secondary sources, both at the industry and commodity level (a process known as balancing the Input-Output Tables), involves more than 100 investment goods. In the event of a significant imbalance between inputs or outputs, the source data and estimation methods are re-examined.

9.92 The CES and the most recent Input-Output Tables are the main sources of information for the non-benchmark (t-2, t-1) years. Table 9.8 displays a reconciliation of the CES machinery and equipment estimates and those published by IEAD. The following adjustments are made:

- net additions;
- sectoring;
- software adjustments; and
- Canadian System of National Accounts adjustments.

9.93 Net additions refer to investment capital projects not captured by the CES. This small adjustment only accounts for about 1% of the CES estimates.

9.94 The CES data are subject to sectoring adjustments to ensure consistency with the CSNA definitions. These adjustments involve a reclassification from the private to the public sector (for example, universities and hospitals).

9.95 Another adjustment is made for software expenditures. The CES provides a part of software investment – the already reported portion – while Industry Accounts Division calculates the comprehensive estimate. Due to different production deadlines, the CES data need to be adjusted by the difference between IAD's final and IEAD's preliminary estimates.

9.96 Canada System of National Accounts adjustments are also made to CES data. One adjustment stems from a comparison of Public Accounts data for government investment estimates with the CES data, which leads to corrections to the survey data. A second, more conceptual adjustment involves eliminating used machinery and equipment from the survey data, as these were already included in the GDP when first produced. Specifically, this means removing business spending on scrap and salvage, used motor vehicles and used aircraft.<sup>20,21</sup>

9.97 Another modification is based on the comparison of the value of certain investment projects according to the CES and to other information sources. For passenger cars and trucks, for example, a more direct approach is taken in conjunction with personal expenditure estimation on motor vehicles.

9.98 An adjustment is also made to compensate for CES's underestimation of investment in aircraft. Information from the International Trade Division provides coverage of aircraft leasing contracts missed by the survey.

9.99 Lastly, on the basis of the Input-Output Tables, an adjustment is made to offset under coverage in a number of commodities including agricultural machinery and motor vehicles.

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19. A brief description of the survey is provided in Appendix 1: A Brief Description of the Capital Expenditure Survey.

20. The value of capital formation is equal to acquisitions less disposals. As the data on disposals is not available by industry, the estimate is made at the total level.

21. Sales of used cars are included in personal expenditure and are therefore not deducted from capital.

**Table 9.8 Reconciliation statement between Private and Public Investment and Income and Expenditure Accounts estimates of machinery and equipment, 2003**

	Government	Business	Total
Machinery and equipment, <i>Private and Public Investment in Canada</i> <sup>1</sup>	4,916	83,170	88,086
+ sectoring <sup>2</sup>	4,062	-4,062	0
+ software adjustment <sup>3</sup>	542	852	1,394
- exclusion of used equipment and scrap estimates <sup>4</sup>		2,455	2,455
+ net additions and other adjustments <sup>5</sup>	545	3,326	3,871
= machinery and equipment, Income and Expenditure Accounts	10,065	80,831	90,896

1. CES, *Private and Public Investment in Canada, Intentions*, Table 1, Summary by sector.

2. The public and private sectors are defined differently in the CSNA, where government includes not only public administration as defined in NAICS, but also other elements primarily in the health and education sectors.

3. A part of the software number is measured directly by the CES survey, while the rest is estimated in the CSNA. IEAD provides preliminary estimates of total software to the CES due to timing constraints. The number that appears as software adjustment is simply the difference between the final and preliminary estimates of software.

4. GDP measures current production; as such all production from previous periods must be excluded. In the case of machinery and equipment, spending on scrap and salvage, used motor vehicles and used aircraft are removed.

5. Net additions correspond to projects that were missed by the CES. Other adjustments are made to remove vehicles used for personal use and include the business use of personal vehicles. Also adjustments are made because after confrontation with the IOT, an adjustment is made for the underestimation of certain commodities such as agricultural machinery and motor vehicles.

## Quarterly estimation methods and data sources

9.100 In the absence of a quarterly survey of capital expenditures, the annual series are distributed into quarters using related indicators. For the current year, data are estimated on the basis of the rate of change in quarterly indicators.

9.101 Due to timing and data constraints a supply-disposition approach is used to determine the final demand for 39 of the more than 100 Input-Output machinery and equipment commodities,<sup>22</sup> which are then used to develop estimates for seven of the ten major groups. More direct approaches are used to measure spending on passenger cars, trucks and software.

## The supply-disposition model

9.102 The supply-disposition model provides an estimate of components of final demand (domestic supply<sup>23</sup> less intermediate consumption and change in inventories).

9.103 The model's starting point is the accounting identity below, which states that for the economy as a whole, the supply or availability of a commodity is necessarily equal to its disposition or use, see equations 9.1, 9.2 and 9.3 below. Supply is the sum of what is produced domestically (gross output) and what is imported. The result is expressed in market prices, therefore transport, trade, sales tax and tariff margins are added. Disposition includes final demand, taking into account international exports, intermediate consumption and changes in inventories.

### General equations in the supply-disposition model

#### Equation 9.1

Supply = disposition

#### Equation 9.2

22. For a list see Table 9.9.

23. Domestic supply is equal to output plus imports minus exports.

$$GO + II + MA = FD + ID + \Delta inv$$

and since

$$FD = FDD + IX = \text{Final demand}$$

### Equation 9.3

$$GO + II + MA = (FDD + IX) + ID + \Delta inv$$

where,

GO = gross output,

II = international imports,

MA = transport, trade, sales tax and tariff margins,

FD = FDD + IX = final demand,

FDD = final domestic demand,

IX = international exports,

ID = intermediate demand,

$\Delta inv$  = change in inventories

9.104 This model is applied to machinery and equipment investment goods. Final domestic demand (FDD) corresponds to gross fixed capital formation in machinery and equipment (GFME) in the measurement of expenditure-based GDP.

### General equations in machinery and equipment investment<sup>24</sup>

#### Equation 9.4

$$GO + II + MA = GFME + IX + ID + \Delta inv$$

where,

GFME = gross fixed capital formation in machinery and equipment

#### Equation 9.5

$$GFME = GO + II + MA - IX - ID - \Delta inv$$

9.105 To obtain a quarterly estimate of gross fixed capital formation in machinery and equipment with Equation 9.5, the model uses several datasets.

9.106 Gross output (GO) is estimated using manufacturing shipments by industry, obtained from the *Monthly Survey of Manufacturing*. This industry-based information is converted to a commodity classification using an Input-Output matrix which shows the proportion<sup>25</sup> of output attributable to each commodity group in each industry.

9.107 International exports (IX) and international imports (II) are obtained from the International Trade Division. The data, classified according to the Harmonized System, are converted to the Input-Output classification system.

9.108 Data from the most recent Input-Output Tables are used to calculate margin rates, which in turn, are used to convert supply at basic prices to total supply. The margin rates are calculated from annual Input-Output data by taking the ratio of total supply to supply at basic prices Equation 9.6.

24. Equation specification differs by commodity.

25. Each component of the conversion matrix is calculated as follows: (Output of commodity i by industry j) / (Output of industry j).

**Equation 9.6**

Margin rates = total supply at market rates ÷ total supply at basic prices = (output + imports + margins) ÷ (output + imports)

9.109 As shown in the following equations, total supply is obtained by multiplying output and imports by the margin rates.

**Equation 9.7**

Total supply at basic prices = GO + II

**Equation 9.8**

Total supply at market prices = (GO + II) x margin rate

9.110 The result of Equation 9.8 is the same as the first three terms of Equation 9.5.

9.111 The next step is to estimate domestic supply at market prices, that is, total supply at market prices Equation 9.8 minus exports. This leads to Equation 9.9, which is the same as the first four terms of Equation 9.5.

**Equation 9.9**

Domestic supply at market prices = total supply at market prices - exports

9.112 Since there are no quarterly estimates of final demand for each commodity, the most recent data from the Input-Output Tables are used to compute final demand ratios. These ratios are obtained by dividing final demand for machinery and equipment investment goods by domestic supply. Structural changes are taken into account via the use of *Capital Expenditure Survey* (CES) data for non-benchmark years.

9.113 Final demand is then obtained by multiplying the domestic supply at market prices by the final demand ratios, as shown in Equation 9.10.

**Equation 9.10**

Business GFME = business final demand ratio x domestic supply at market prices

9.114 The IAD produces monthly data on changes in inventories by industry. Changes in inventories, particularly at the wholesale level, are also available by commodity and institutional sector in the estimate of the business and government investment in inventories component of expenditure-based GDP.

9.115 The derived estimators are used to produce quarterly estimates from the annual Input-Output data, using a quadratic minimization procedure known as the Denton-Cholette<sup>26</sup> method. This procedure adjusts the sub-annual data so that the annual totals (or averages) match the annual benchmarks while keeping the adjusted sub annual variations as close as possible to the original sub-annual variations by minimizing the sum of the squares of the differences between them.

9.116 For the current quarters, the same supply-disposition model is used, as all the inputs are available on a monthly basis up to date. The 39 commodities are then regrouped into 7 major groups (i.e. furniture, agricultural machinery, industrial machinery, computers and other office equipment, other transportation equipment, telecommunications equipment and other machinery and equipment). Their movements are used to project investment in these categories.

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26. For more detail about the method, see Cholette, P.A. (1984): Adjusting sub-annual series to yearly benchmarks. *Survey Methodology*, 10, 35-49.

## Passenger cars and trucks

9.117 For passenger cars and trucks, there are direct estimates of final demand made in conjunction with personal expenditure estimates. Total sales by type of vehicle are provided by the *New Motor Vehicle Sales Survey*. The government and business sectors' shares of passenger car sales are based on data from the Motor Vehicle Manufacturers Association (MVMA); for trucks, the shares are estimated on the basis of buyer profiles. Sales of car or truck fleets are treated separately and allocated entirely to the business and government sectors.

## Software

9.118 Investment in software was incorporated into GDP and gross fixed capital formation in machinery and equipment in the first quarter of 2001 (backdated to 1981), in response to the SNA 1993 recommendation that business and government acquisition of software be treated as investment instead of current expenditure.<sup>27</sup> Investment in pre-packaged and custom design software is determined residually as the total supply of software (domestic production plus imports plus margins) less personal consumption less exports to non-residents. Estimates for own-account software (software developed by in-house employees to meet specific organization's needs) are based on the labour costs for computer programmers and systems analysts and other costs (non-salary) of in-house software development.<sup>28</sup>

## Provincial and territorial estimation methods and data sources

9.119 As in the case of non-residential structures, national totals for gross fixed capital formation in machinery and equipment are distributed among the provinces and territories using information from the *Capital and Repair Expenditures Survey*.

9.120 It should be noted that the provincial and territorial distribution of investment in mobile assets, such as aircraft, locomotives, trucks, ships and satellites, presents some difficulties. In principle, investment should be distributed according to the place of consumption. In practice, the distribution is based on the limited amount of data available, and there is no guarantee that it is always consistent and uniform. The various distribution methods used in the *Capital Expenditure Survey* are also employed in the *Provincial Economic Accounts*.

## Deflation – Estimates in real terms

9.121 Gross fixed capital formation in machinery and equipment is deflated at the same level of detail as the compilation of current-price estimates, using, for the most part, machinery and equipment price indexes from the Prices Division.

9.122 For computers and other office equipment, a weighted index is calculated using export and import price indexes. For software, the Prices Division's price index for pre-packaged software, average hourly earnings indexes for programmers and systems analysts, and non-labour input costs are used.

27. Statistics Canada, Capitalization of Software in the National Accounts, catalogue no. 13-604, issue no. 37.

28. Quarterly sources of data include earnings of computer system designers from the *Survey of Employment, Payrolls and Hours* (SEPH) and employment, and hourly earnings of software publishers, data processors and system designers from the *Labour Force Survey* (LFS).

9.123 Table 9.9 outlines the machinery and equipment price indexes used to deflate each of the projection series.

**Table 9.9 Deflators used in machinery and equipment**

Major group / Input-Output commodity code		Estimator level	Deflator <sup>1</sup>
<b>G1. Furniture</b>			
2050	Office furniture	W205000	MEPI, office furniture
2069	Commercial and institutional furniture	W206900	MEPI, commercial and institutional furniture
<b>G2. Agricultural machinery</b>			
3149	Bulldozers, farm and garden tractors	W314900	MEPI, bulldozers, farm and garden tractors
3150	Other agricultural machinery	W315000	MEPI, other agricultural machinery
<b>G3. Industrial machinery</b>			
2961	Machine tools	W396100	MEPI, machine tools
2962	Tool accessories	W396200	MEPI, tool accessories
3170	Pumps, compressors, fans and blowers	W317000	MEPI, pumps, compressors, fans and blowers
3180	Conveyors, elevators and hoisting machinery	W318000	MEPI, conveyors, elevators and hoisting machinery
3190	Industrial trucks and material handling equipment	W319000	MEPI, industrial trucks and material handling equipment
3211	Packaging and bottling machinery	W321100	MEPI, packaging and bottling machinery
3212	Air purification equipment	W321200	MEPI, air purification equipment
3213	Other general purpose machinery	W321300	MEPI, other general purpose machinery
3231	Construction, mining and oil and gas machinery	W323100	MEPI, construction, mining and oil and gas machinery
3232	Logging, pulp and paper industry machinery	W323200	MEPI, logging, pulp and paper industry machinery
3233	Metal working machinery	W323300	MEPI, metal working machinery
3234	Other industry specific machinery	W323400	MEPI, other industry specific machinery
3235	Service industry machinery	W323500	MEPI, service industry machinery
3650	Welding machinery and equipment	W365000	MEPI, welding machinery and equipment
3661	Power generation and marine propulsion, non-electric	W366100	MEPI, power generation and marine propulsion, non-electric
3662	Electrical generators and motors	W366200	MEPI, electrical generators and motors
<b>G4. Computers and other office equipment</b>			
3291	Computers, video units, printers, etc.		The deflator for computers and other office equipment is a weighted average of import and export computer prices, from International Trade Division (ITD). The export price of office machines and equipment is an implicit price index including computers, printers, monitors, bank ATM machines, photocopiers, fax machines, etc. It is built largely from Canadian producer price indexes. The import price of office machines and equipment is an implicit price including mostly computers. ITD uses three sources to obtain its electronic computer index: the US Bureau of Economic Analysis, the US Bureau of Labor Statistics, and Japanese export price indexes.
3292	Office equipment, excluding photocopy and facsimile		

1. Machinery and equipment price indexes (MEPI's) are used in the deflation process of all commodities with the exception of computers and other office equipment and software. MEPI's measure price change for annual gross additions to capital for machinery and equipment by industry of purchase.

**Table 9.9 Deflators used in machinery and equipment (concluded)**

Major group / Input-Output commodity code	Estimator level	Deflator <sup>1</sup>
<b>G5. Software<sup>2</sup></b>		
52011 Recorded media (including music and movies), musical instruments and artists' supplies		Pre-packaged software: <i>Commercial Software Price Index</i> from the Prices Division
5554 Royalties and licence fees (excluding natural resource)		Own-account software: The price index used to deflate own-account software is a fixed-weighted average of an index of the average hourly earnings of programmers and systems analysts and an index of the costs of non-labour inputs of the computer services industry. The hourly earnings index is derived from and benchmarked to <i>Census of Population</i> data on derived hourly earnings of programmers and systems analysts. Fixed-weighted average hourly earnings indexes from <i>Survey of Employment, Payrolls and Hours</i> (SEPH) are used to interpolate and extrapolate the benchmarks. Average hourly earnings indexes from the <i>Labour Force Survey</i> (LFS) are used to project the current year data. It is assumed that there is no change in the productivity of programmers and systems analysts. The price index for non-labour inputs is a weighted price of intermediate inputs, built up using consumer price indexes, industrial product price indexes and personal expenditure deflators.
5751 Software products development		Custom design: following the U.S. Bureau of Economic Analysis (BEA) practice, the price index for custom-designed software is a weighted average of the pre-packaged and own-account software price indexes.
<b>G6. Automobiles</b>		
3340 Automobiles, including passenger vans	W334000	MEPI, automobiles, including passenger vans
<b>G7. Trucks</b>		
3350 Trucks, road tractors and chassis	W335000	MEPI, trucks, road tractors and chassis
<b>G8. Other transportation equipment</b>		
3300 Aircraft	W330000	MEPI, aircraft
3392 Commercial trailers and semi-trailers	W339200	MEPI, commercial trailers and semi-trailers
3409 Truck and bus bodies and cargo containers	W340900	MEPI, truck and bus bodies and cargo containers
3459 Locomotive, railway and urban transport rolling stock	W345900	MEPI, locomotive, railway and urban transport rolling stock
3489 Ships, boats and parts, excluding pleasure	W348900	MEPI, ships, boats and parts, excluding pleasure
<b>G9. Telecommunications equipment</b>		
3580 Telephone and related equipment, including facsimile	W358000	MEPI, telephone and related equipment, including facsimile
3599 Broadcasting and radio communications equipment	W359000	MEPI, broadcasting and radio communications equipment
3600 Radar and radio navigation equipment	W60000	MEPI, radar and radio navigation equipment
<b>G10. Other machinery and equipment</b>		
2979 Hand and measuring tools	W297900	MEPI, hand and measuring tools
3262 Air conditioners and refrigerator equipment, commercial and transport	W326200	MEPI, air conditioners and refrigerator equipment, commercial and transport
3672 Transformers and converters	W367200	MEPI, transformers and converters
3689 Industrial electrical equipment, including safety	W368900	MEPI, industrial electrical equipment, including safety
4989 Laboratory and scientific instruments, and flight simulators	W498900	MEPI, laboratory and scientific instruments, and flight simulators
4999 Measuring and controlling instruments	W499900	MEPI, measuring and controlling instruments
5001 Medical and dental equipment and supplies	W500100	MEPI, medical and dental equipment and supplies
5032 Photocopy and microfilm equipment	W503200	MEPI, photocopy and microfilm equipment

1. Machinery and equipment price indexes (MEPI's) are used in the deflation process of all commodities with the exception of computers and other office equipment and software. MEPI's measure price change for annual gross additions to capital for machinery and equipment by industry of purchase.

2. The sub categories are different, however the totals match.

## Appendix 9A A brief description of the Capital Expenditure Survey

9A.1 The Capital Expenditure Survey has a sample of some 27,000 establishments, both private and government-owned. The industry sectors are based on the North American Industry Classification System (NAICS). Even though the survey covers all industries, some industries are not actually surveyed. For instance, estimates for agriculture and fishing are produced with survey data and indirect indicators. For certain industries, estimates come from other sources or the survey is conducted separately from the main survey. A case in point is the Local Government Capital Expenditure Survey, which asks respondents to provide a specific breakdown of assets and spending by government function. Similarly, not all establishments are covered. The survey is sent to all establishments above a certain threshold, which varies by industry and province (take-all portion). Below the threshold, a sample is selected (take-some portion), and the results are blown up. For small establishments (take-none portion), tax data are used to produce estimates, which are included in the totals.

9A.2 The survey collects three sets of annual data (intentions, preliminary actual investment and actual investment) during two survey periods, and the results are released as shown below.

**Table 9A.1 Release dates**

Release date	Data	Collection period
February ( <i>t</i> )	Intentions ( <i>t</i> )	November ( <i>t-1</i> ) to February ( <i>t</i> )
February ( <i>t</i> )	Preliminary actual ( <i>t-1</i> )	November ( <i>t-1</i> ) to February ( <i>t</i> )
February ( <i>t</i> )	Actual ( <i>t-2</i> )	March ( <i>t-1</i> ) to October ( <i>t-1</i> )

Note: *t* = current calendar year or fiscal year closest to current calendar year

9A.3 Establishments receive the regular questionnaire (long or short form), a specialized questionnaire (long or short form) or the new project questionnaire. The regular short questionnaire collects basic information on capital spending and changes in capital expenditure plans. The regular long questionnaire, used only in the survey on actual spending (i.e., *t-2*), is sent to establishments that previously reported large capital expenditures. In addition to basic data, it asks for a breakdown by type of asset, capitalized interest payments, asset lives, leasing, etc., and, every five years, the proportions of own-account work and contract work. Specialized questionnaires go to the mining and oil and gas industries. New-project questionnaires are sent to establishments not yet in the survey frame. Spending on repair and maintenance is requested only in the survey on actual investment.

9A.4 Additional information is available on the mining industry. The federal Department of Natural Resources collects the required data annually for mining operations, including general exploration expenditures (part of capital formation in SNA 1993), and the Industry Division does the same for the oil and gas industry, including geological and geophysical expenditures (part of capital formation in SNA 1993).