Galiano Ecological Footprint and Consumption-based Emissions Inventory Technical Memo

Prepared for Galiano Conservancy Association
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CIRM Consulting

BCIT CENTRE FOR ECOCITIES

Table of Contents

Abbreviations

BCIT	British Columbia Institute of Technology
CBEI	Consumption-based Emission Inventory
CO_2/CO_2e	Carbon dioxide / carbon dioxide equivalent
tCO_2e	Tonnes carbon dioxide equivalent
tCO_2e/ca	Tonnes carbon dioxide equivalent per capita
EF	Ecological Footprint
eF Tool	ecoCity Footprint Tool
GFN	Global Footprint Network
gha	Global hectares
gha/ca	Global hectares per capita
GHG	Greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emissions
LCA	Life Cycle Assessment
MSW	Municipal Solid Waste

Definition of Terms

CO_2e	Carbon dioxide equivalent expresses the impact of each different greenhouse gas in terms of the amount of CO_2 (carbon dioxide) that would create the same amount of warming. This enables reporting of total greenhouse gas emissions in one measurement.
Consumption-based Emissions Inventory (CBEI)	A form of greenhouse gas emissions inventory that enables a region to quantify the emissions that are attributable to activities of individuals that reside within that region. CBEIs do not replace traditional 'territorial' inventories (see below), but rather they are complementary to them. CBEIs include the emissions that are generated during the production, shipping, use and disposal of all goods consumed in the region, regardless of where they are produced, as well as the impacts of residents and local businesses while they are travelling outside the community's borders.
Ecological Footprint	An estimate of how much biologically productive land and water area an individual or population needs to produce all the resources it consumes and to absorb the waste it generates. It is measured in global hectares (gha) where a global hectare is a biologically productive hectare with globally averaged productivity for that year.
ecoCity Footprint Tool	A tool developed by Dr. Jennie Moore, with the capacity to create multiple outputs for a community using "bottom-up" data sets: a territorial greenhouse gas emissions inventory, a consumption-

	based greenhouse gas emissions inventory, and an ecological footprint. See ecocityfootprint.org
Embodied energy	Energy used in creating and delivering a material (e.g., consumable good or infrastructure), including energy used for extraction of raw materials, manufacturing and transportation of the end product.
Embodied emissions	Greenhouse gas emissions associated with creating and delivering a material (e.g., consumable good or infrastructure), including those associated with energy used for extraction of raw materials, manufacturing and transportation of the end product.
Food miles	The distance food travels from where it is grown or made to where it is purchased or consumed by the end user.
Operating energy	The energy used in the function of a product, building, vehicle, etc.
Operating emissions	The greenhouse gas emissions associated with operating energy.
Territorial inventory	Also known as a Sectoral Inventory, a territorial inventory identifies direct greenhouse gas (GHG) emissions from all sources within a region. This is the standard type of GHG emissions inventory compiled by local, regional, provincial and federal governments. A standardized approach to territorial inventories is prescribed by the GPC (Global Protocol for Community-Scale Greenhouse Gas Emissions Protocol).

Background

At the BCIT Centre for Ecocities, we help cities evaluate and act on their Consumption-based Emission Inventories (CBEI) and Ecological Footprints (EF). We help them identify policy and planning measures that can transition their communities to living within global ecological limits in a way that also advances equity and well-being.

Although climate change is arguably the most pressing environmental issue we are currently facing, we are also bumping up against a number of important planetary boundaries. Due to unsustainable levels of consumption, global society today is demanding more in a year through consumption of energy and resources than nature can provide, and polluting more than nature can assimilate.

Globally, we are exceeding our planet's ecological and climate thresholds, meaning that we are emitting more emissions than can be reabsorbed and using more resources than our planet can sustainably regenerate. In Canada, as with other affluent countries, we are taking far more than our fair share. There is also disparity within our communities, with the affluent contributing disproportionately to a community's footprint. Through a focus on 'One Planet Living' we can identify a path to living within the limits of our planet, in a fair and equitable way.

> One Planet Living refers to a lifestyle that, if adopted by everyone, could be supported indefinitely by the regenerative capacity of Earth's ecosystems.
>
> ~Wackernagel and Rees, 1996

The pioneering cities of the BCIT Centre for Ecocities' ***Ecocity Peer Network*** are seeking to tackle a root cause of global ecological overshoot and climate change: our individual and collective consumption choices and habits. This requires working across political boundaries and acknowledging that our ecological and carbon footprints extend beyond these borders.

Many cities are already climate action leaders. The Ecocity Peer Network will build upon this leadership by identifying ways to address ecological overshoot through policies and measures that will support individuals and businesses in shifting towards one-planet living lifestyles and practices. We will prioritize strategies that maximize global—not just local—footprint reductions.

A cornerstone of the work of the ***Ecocity Peer Network is the ecoCity Footprint Tool***[1] which supplies a community with some of the key information it needs to act on global climate change and ecological overshoot.

The *ecoCity Footprint Tool* is used to generate a community's ***'territorial' greenhouse gas (GHG) emissions, a CBEI, and EF***. These inventories provide critical data to inform sustainable-consumption and climate mitigation efforts.

[1] This tool was developed by Dr. Jennie Moore, with the capacity to create multiple outputs for a community using "bottom-up" data sets: a territorial greenhouse gas emissions inventory, a consumption-based greenhouse gas emissions inventory, and an ecological footprint. See ecocityfootprint.org

Territorial and Consumption-Based Emissions Inventories

Since the late 1990s, governments have typically created GHG emissions inventories using an in-boundary or ***territorial*** approach, (also referred to as a sectoral inventory). These inventories evaluate emissions from sources within a particular region, and where relevant include emissions from out-of-region grid electricity and waste management.

However, this territorial approach does not provide a complete picture of a community's impact on global climate change. It misses the climate impacts associated with the many goods a community consumes, because many of them are produced in other regions, often on other continents. It also excludes the "out of boundary" impacts residents and local businesses have while they are travelling outside of their community.

This is where the ***CBEI*** comes in; it helps us quantify all consumption-related GHG emissions attributable to a population. It remains important to track local emissions through the territorial inventory, for example, to monitor the emission intensity of local industrial and commercial activity. However, consideration of consumption-based emissions facilitates an understanding of global emissions resulting from local consumption habits. The CBEI will help encourage strategies that maximize global, not just local emission reductions. It also provides the opportunity to engage stakeholders in understanding the broader emission impacts of their lifestyles and behaviours and can thus more effectively mobilize emission reduction actions. The distinction between the territorial/sector-based inventory and the CBEI is visualized in Figure 1.

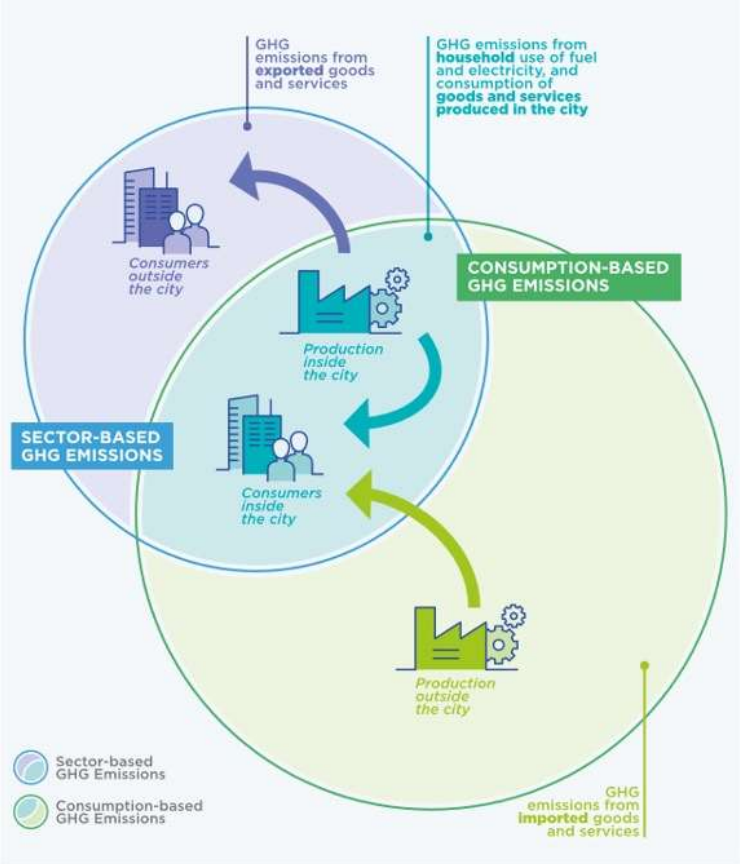

Figure 1: Comparison of Sector-based/Territorial Emissions with Consumption-Based Emissions

> CBEIs include the emissions that are generated during the production, shipping, use and disposal of all goods consumed in the region, regardless of where they are produced, as well as the impacts of residents and local businesses while they are travelling outside the community's borders.

The Ecological Footprint

In contrast to the GHG emissions inventories discussed above, the ***Ecological Footprint*** is a land-based metric measured in terms of global hectares (gha). It is an estimate of how much biologically productive land and water area an individual or population is depending upon to

produce all the resources it consumes and to absorb the wastes it generates (including CO_2 emissions). It helps us to ***estimate and visualize*** these impacts in a clear, easy to understand way. Typically, we find that Canadian communities are depending on areas hundreds of times larger than the physical space they occupy to produce all the energy, goods and other materials we use, and to handle all of the waste we are generating – which includes carbon emissions and other forms of waste.

Based on the current global population and biological productivity levels, ***an average of 1.6 gha is available for each person on the planet***.[2] But, globally we are in overshoot, using an average of 2.6 gha per person. This means we are depending on the equivalent of 1.7 planets worth of resources every year. In other words, we are drawing down the resources of the planet faster than they can be regenerated. Galiano's results, summarized in this memo, show that the community's footprint, similar to other Canadian communities, is significantly greater than the global average.

The ecological footprint and consumption-based inventory results shed a light on the impacts of outsourcing the production of goods that we consume to other regions: it evaluates the full lifecycle impacts that result from consumption within a region. Explore how these types of inventories compare in the schematic in Figure 2.

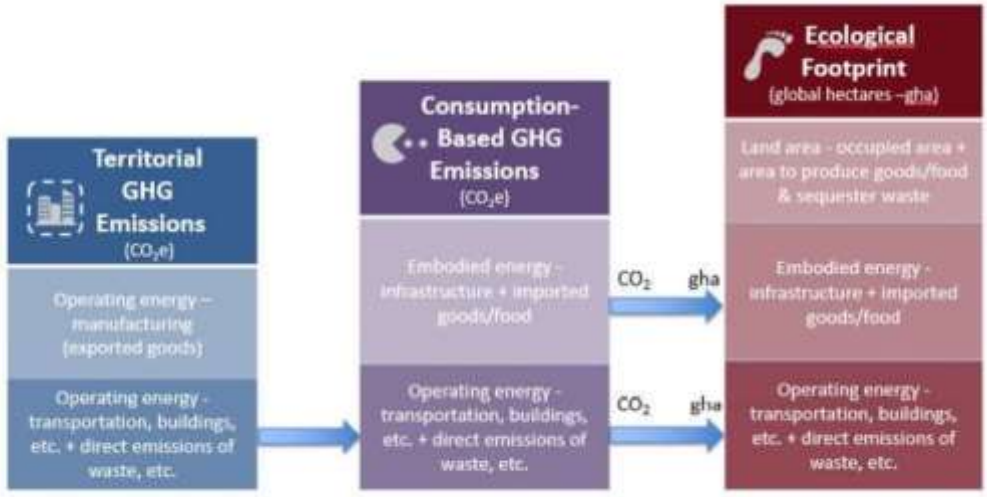

Figure 2: Comparison of the GHG Emission Inventories and Ecological Footprint Approaches

[2] We also need to set aside land for nature, thus a target of 1.6 gha/person should be considered a minimum threshold.

Overview

This memo includes the following Inventories /Scenarios:

1. Full-time Residents: includes impacts of full-time residents only for 2021
2. Baseline: includes impacts of full-time residents and adds the 'on-island' impacts of part-time residents and tourists including ferries and sea planes to Galiano, and a portion of part-time residents flights taken globally for 2021
3. One Planet Scenario (Full-time Residents): an illustrative example of measures that could be taken collectively to reduce the impacts of full-time residents to a level closer to what can be supported globally
4. One Planet Scenario (Baseline): an illustrative example of measures that could be taken collectively to reduce the impacts of full-time and part-time residents and tourists to a level closer to what can be supported globally

Galiano Full-time Residents Footprint 2021

- Overall consumption-based emissions of 11,700 tCO_2e (8.4 tCO_2e/ca), which is comparable with other jurisdictions in BC
- Overall ecological footprint of 5,900 gha (4.2 gha/ca) or including senior government services 9,700 gha (7.0 gha/ca), which is higher than other jurisdictions in BC (largely due to lower density development – i.e. a much higher built area for both roads and buildings)

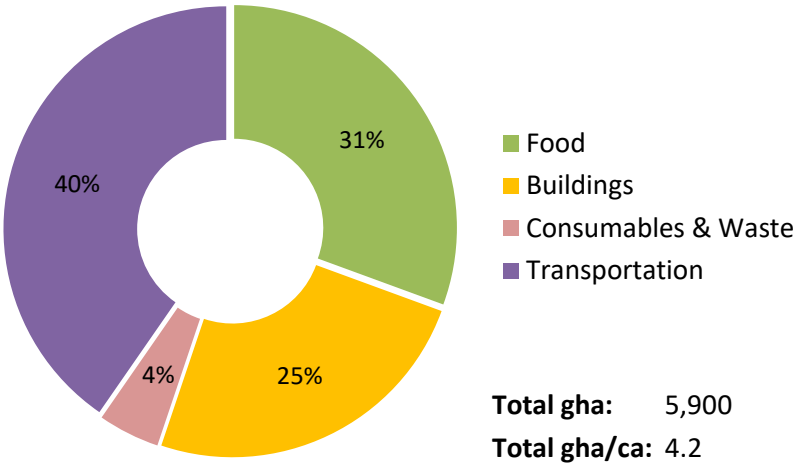

Figure 3: Galiano Full-time Residents Footprint Summary, 2021

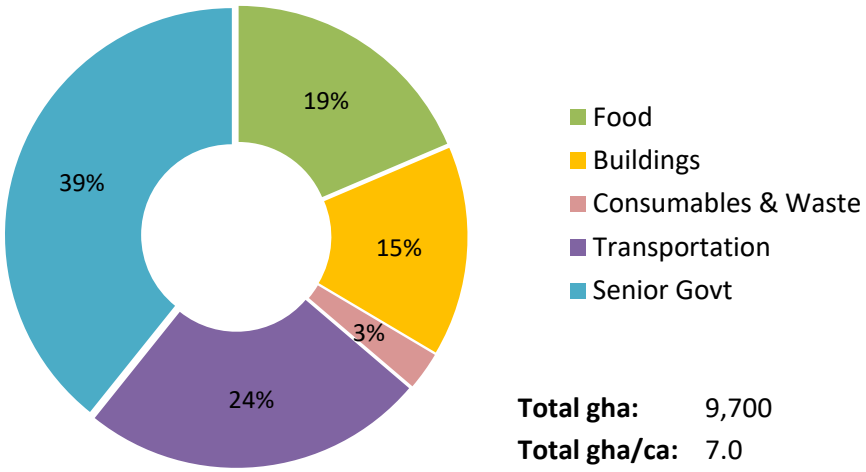

Figure 4: Galiano Full-time Residents Footprint Summary (including senior gov.), 2021

Food (Galiano Full-time Residents Footprint)

- The impact of food is lower than the Canadian average. This result is primarily due to consumption of meat products (which are very high impact) being lower than the Canadian average and legume consumption being higher
- Meat still makes up by far the largest impact of the food footprint

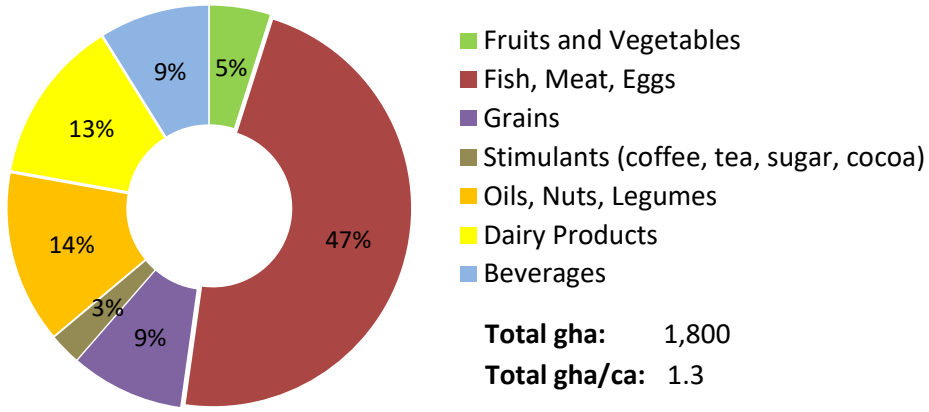

Figure 5: Galiano Full-time Residents Food Footprint by Type, 2021

- The impacts from food are almost all from production – transport impacts make up a very small contribution. However, local production can still have many benefits – e.g. lower supply chain waste (more than ½ of food grown is wasted) and potentially greater influence over production practises
- On-Island production of fruits, vegetables, and eggs is significant - reduced waste estimated from the shorter supply chain also contributes to Galiano's footprint being lower than the Canadian average

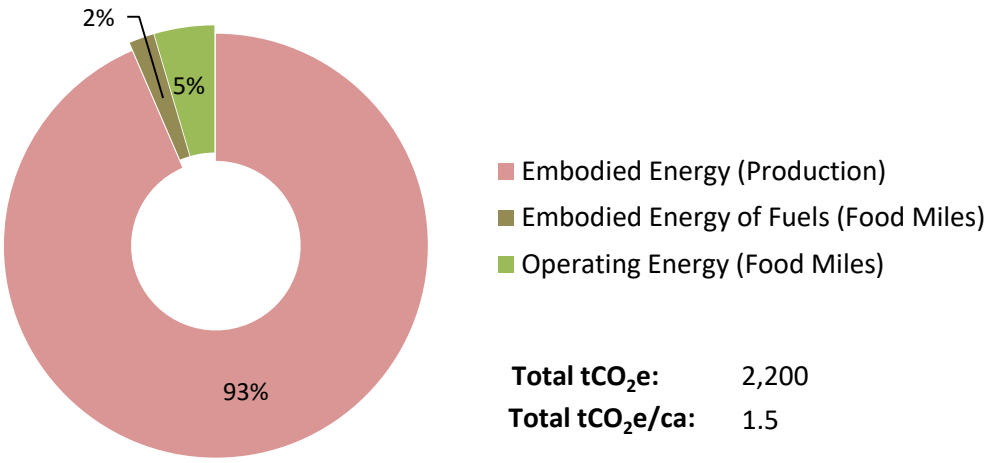

Figure 6: Galiano Full-time Residents Food CBEI, 2021

Buildings (Galiano Full-time Residents Footprint)

- Typically, operating emissions make up the largest impact for BC jurisdictions, not built area – even for smaller towns like Powell River the built area is only about ¼ of the footprint
- Low-density single-family homes on relatively large, developed areas of land is primarily responsible for the relatively high impact of built area
- Higher electricity use and lower fossil fuel use for home heating relative to other BC jurisdictions results in significantly lower impact from operating emissions (this also contributes to a relatively higher proportional impact from built area but the primary reason is low density)

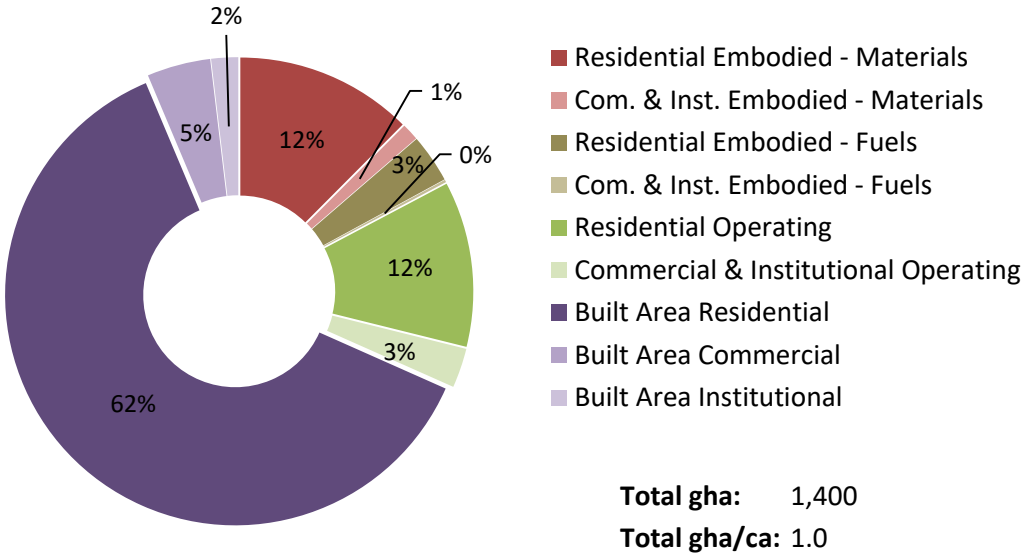

Figure 7: Galiano Full-time Residents Buildings Footprint, 2021

Consumables and Waste (Galiano Full-time Residents Footprint)

- Waste disposal rates are about half the BC average resulting in a much lower impact from consumables and waste than for other BC jurisdictions
- Consumables and waste impact areas:
    - Materials Disposed – direct landfill emissions (primarily methane which is not included in the ecological footprint because it is not readily absorbed and therefore can not be converted to a land equivalent)
    - Embodied Materials Disposed – land used for primary production (e.g. forest area for lumber, crop lands for cotton, etc.)
    - Embodied Energy of Materials – supply chain emissions (extraction, processing, transport, etc.)

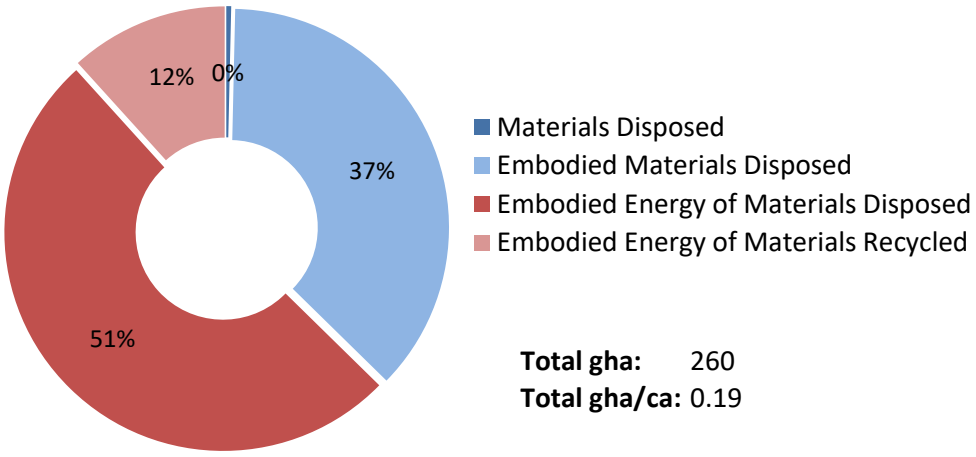

Figure 8: Galiano Full-time Residents Consumables and Waste Footprint, 2021

- The CBEI includes the impacts of methane emissions from landfilled waste (Materials Disposed) and septic systems. Septic emissions are primarily from the tank.

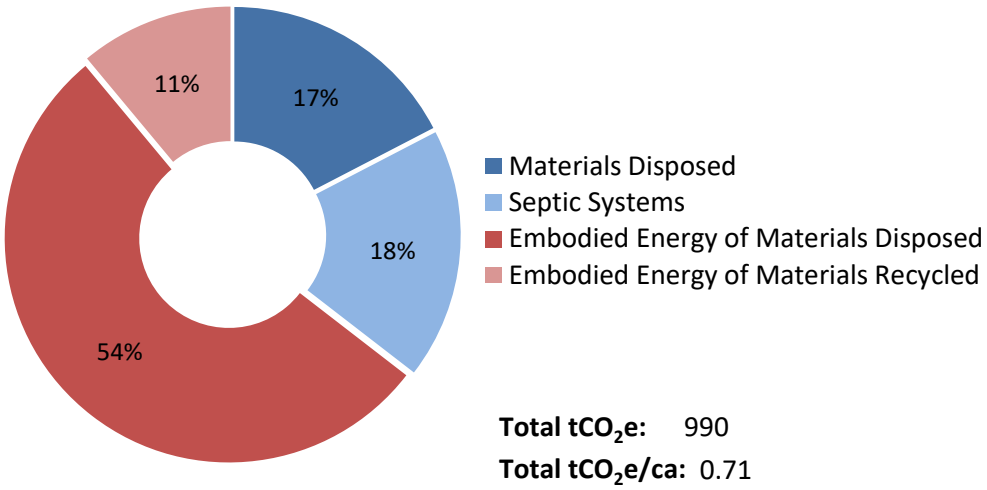

Figure 9: Galiano Full-time Residents Consumables and Waste CBEI, 2021

Transportation (Galiano Full-time Residents Footprint)

- The built area of roads is a much larger relative impact than for other BC jurisdictions (typically less than 10%). This result is primarily due to the high number of unpaved roads on Galiano.
- Embodied emissions of fuels (extraction and processing emissions) are relatively high in western Canada – fuels derived from heavy oil and fracking are about double the global average

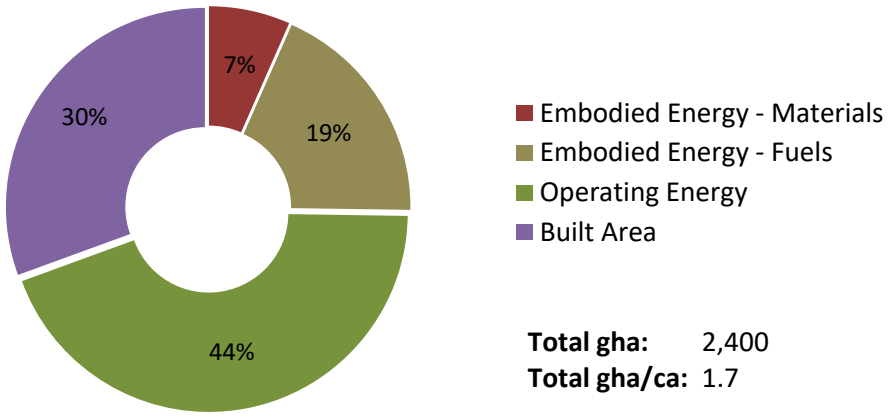

Figure 10: Galiano Full-time Residents Transportation Footprint, 2021

- Reviewing embodied and operating emissions by travel mode shows vehicles, BC Ferries, and air travel account for about 1/3 of emissions each
- Vehicle impacts are about 1/3 of other BC jurisdictions
- BC Ferries impacts as expected are much higher than other BC jurisdictions

- Air travel impacts are about double that of other BC jurisdictions (this increase could be in part because the Galiano travel survey captured full trip details whereas the airport data used for other jurisdictions typically only includes the first flight leg)

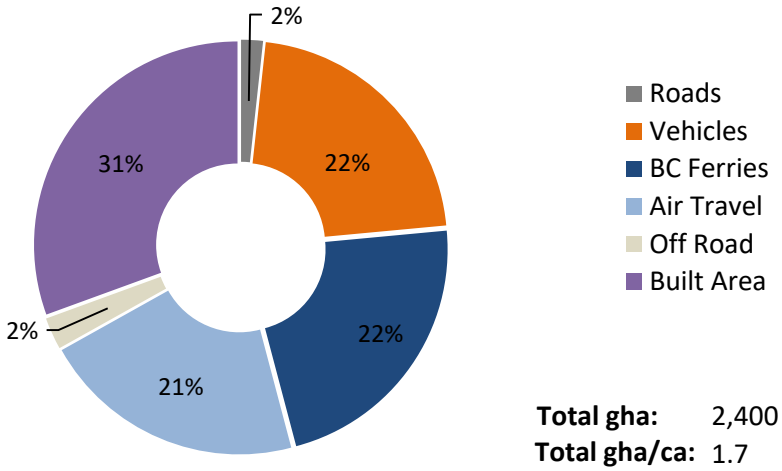

Figure 11: Galiano Full-time Residents Transportation Footprint by Type, 2021

Galiano Baseline Footprint

This scenario includes impacts of full-time residents and adds the 'on-island' impacts of part-time residents and tourists including ferries and sea planes to Galiano, and a portion of part-time resident's flights taken globally.

- Overall consumption-based emissions are 24,600 tCO_2e
- Overall ecological footprint is 11,100 gha, or including senior government services is 18,600 gha
- The 1,327 part-time residents and about 80,000 tourists have a combined impact about on par with the full-time residents roughly doubling the footprint
- Relative impacts from food and waste go up slightly from full-time residents as a result of the assumption that tourist's diets and disposal rates will be more inline with higher regional/national averages
- Relative impacts from buildings go down slightly from full-time residents as a result of a higher density of tourists per dwelling

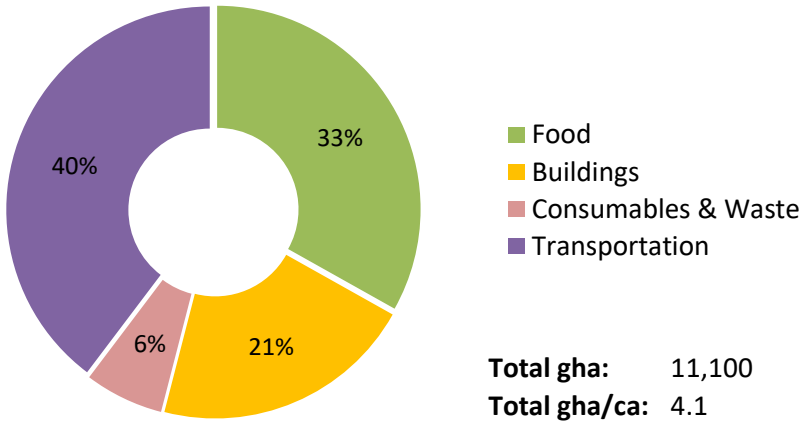

Figure 12: Galiano Baseline Footprint Summary, 2021

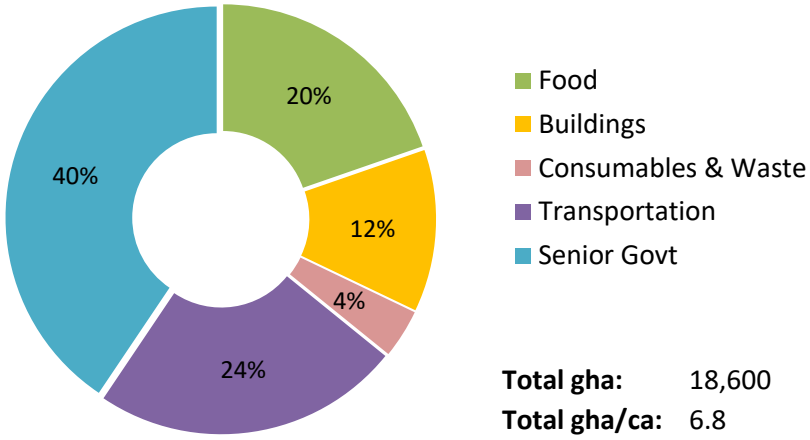

Figure 13: Galiano Baseline Footprint Summary (including senior gov.), 2021

Transportation (Baseline)

- Relative impact of built area goes down significantly as a result of all the additional travel emissions from part-time residents and tourists

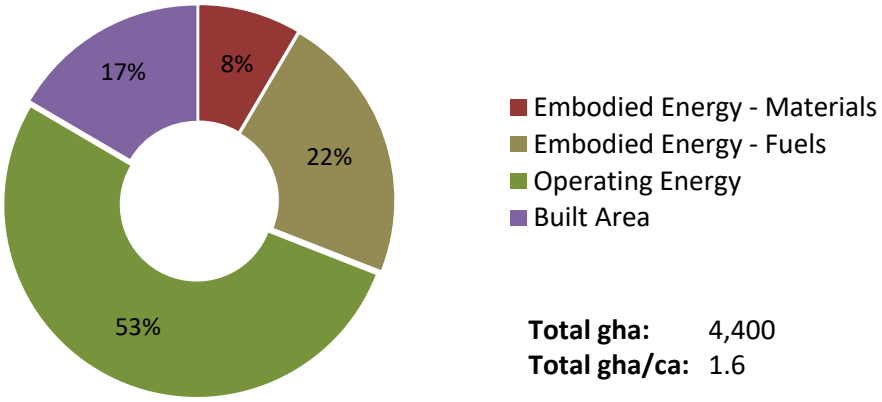

Figure 14: Galiano Baseline Transportation Footprint, 2021

- Vehicle and ferry use by tourists (about 80,000 annually) significantly increases the relative impacts of both these categories, with rates of use also being much higher than full-time residents
    - Daily vehicle use by tourists is estimated to be 3 times higher
    - Average trip lengths of just over 4 days on average results in far more frequent ferry use

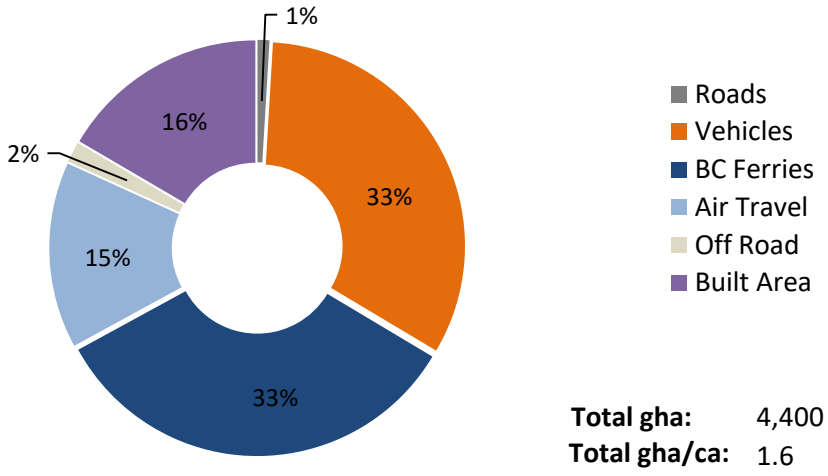

Figure 15: Galiano Baseline Transportation Footprint by Type, 2021

One Planet Scenario (from Full-time Residents)

At 9,700 gha (5,900 gha excluding senior government services), Galiano's Full-time Residents ecological footprint (accounting for full-time residents only) is under Galiano's biocapacity as estimated by GFN (14,800 gha). However, the average global biocapacity, as estimated by GFN, is much lower than Galiano's biocapacity (1.6 gha/ca Vs 5.4 gha/ca respectively).

This scenario is an illustrative example of measures that could be taken collectively to reduce the impacts of full-time residents to a level closer to what can be supported globally – i.e. if everyone on the planet had an equal impact and equal share of the remaining biocapacity.

The scenario is limited to the portion of the island's footprint that is a direct result of local activity (excluding national and provincial services). The actual reductions would need to be greater to account for national and provincial services and to include setting aside land for nature.

Also, while this package of measures lowers the ecological footprint close to a 'One Planet' target – 1.6 gha/ca (2,000 gha) and lowers the CBEI GHG emissions – to 2.7 tCO2e/ca (3,700 tCO2e) – emissions remain higher than what is likely needed to achieve climate stability. Further emissions reduction activities would be needed to meet climate stabilization goals, particularly those that target remaining emissions from aviation, supply chain (embodied emissions of materials – building materials, consumables, vehicles, etc.), and farming practices; as well as measures to sequester CO_2 from the atmosphere. To avoid the most severe impacts of climate change, GHG emissions must reach 'net zero' as soon as possible and CO_2 must also be drawn from the atmosphere.

Table 1 Reduction Measures from Full-time Residents (per capita):

Measures	EF Reduction (gha/ca)	CBEI GHG reduction (tCO2e/ca)
Food • 80% reduction of food waste	0.54	0.64
Buildings • 85% reduction in residential developed area, 50% in commercial/institutional • 100% conversion to renewable energy	0.72	0.60
Consumables and waste • 50% reduction of municipal solid waste (MSW) through reduced consumption and improved circularity (sharing, repair, reuse) • 50% reduction in septic system emissions	0.09	0.33
Transportation • 80% reduction in non-paved roads • 50% decrease in vehicle fleet • 100% conversion to electric vehicles, ferries, and personal watercraft • 80% reduction in air travel	1.41	4.17
Total	2.76	5.74

Table 2 Reduction Measures from Full-time Residents (total):

Measures	EF Reduction (gha)	CBEI GHG reduction (tCO2e)
Food • 80% reduction of food waste	750	900
Buildings • 85% reduction in residential developed area, 50% in commercial/institutional • 100% conversion to renewable energy	1,010	840
Consumables and waste • 50% reduction of municipal solid waste (MSW) through reduced consumption and improved circularity (sharing, repair, reuse) • 50% reduction in septic system emissions	130	470
Transportation • 80% reduction in non-paved roads • 50% decrease in vehicle fleet • 100% conversion to electric vehicles, ferries, and personal watercraft • 80% reduction in air travel	1,970	5,820
Total	3,860	8,010

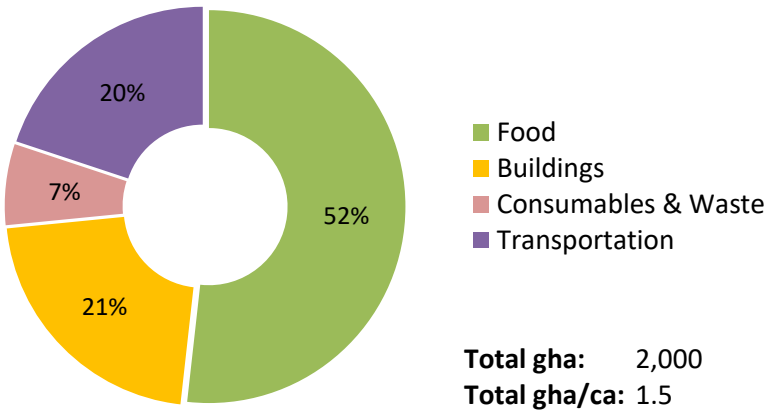

Figure 16: Galiano One Planet (from Full-time Residents) Footprint Summary

One Planet Scenario (from Baseline)

At 18,600 gha (11,100 gha excluding senior government services) the Baseline ecological footprint exceeds Galiano's biocapacity as estimated by GFN (14,800 gha). However, the average global

biocapacity, as estimated by GFN, is much lower than Galiano's biocapacity (1.6 gha/ca Vs 5.4 gha/ca respectively) and therefore the average global biocapacity will still be used as the target in this scenario.

This scenario is an illustrative example of measures that could be taken collectively to reduce the impacts of full-time and part-time residents and tourists to a level closer to what can be supported globally – i.e. if everyone on the planet had an equal impact and equal share of the remaining biocapacity.

The scenario is limited to the portion of the island's footprint that is a direct result of local activity (excluding national and provincial services). The actual reductions would need to be greater to account for national and provincial services and to include setting aside land for nature.

Also, while this package of measures lowers the ecological footprint close to a 'One Planet' target – 3,700 gha (1.6 gha/ca) and lowers the CBEI GHG emissions – to 6,900 tCO2e (2.5 tCO2e/ca) – emissions remain higher than what is likely needed to achieve climate stability. Further emissions reduction activities would be needed to meet climate stabilization goals, particularly those that target remaining emissions from aviation, supply chain (embodied emissions of materials – building materials, consumables, vehicles, etc.), and farming practices; as well as measures to sequester CO_2 from the atmosphere. To avoid the most severe impacts of climate change, GHG emissions must reach 'net zero' as soon as possible and CO_2 must also be drawn from the atmosphere.

Table 3 Reduction Measures from Baseline (total):

Measures	EF Reduction (gha)	CBEI GHG reduction (tCO2e)
Food • 80% reduction of food waste	1,520	1,830
Buildings • 85% reduction in residential developed area, 50% in commercial/institutional • 100% conversion to renewable energy	1,640	1,320
Consumables and waste • 50% reduction of municipal solid waste (MSW) through reduced consumption and improved circularity (sharing, repair, reuse) • 50% reduction in septic system emissions	340	1,180
Transportation • 80% reduction in non-paved roads • 50% decrease in vehicle fleet • 100% conversion to electric vehicles, ferries, and personal watercraft • 80% reduction in air travel	3,840	13,330
Total	7,340	17,660

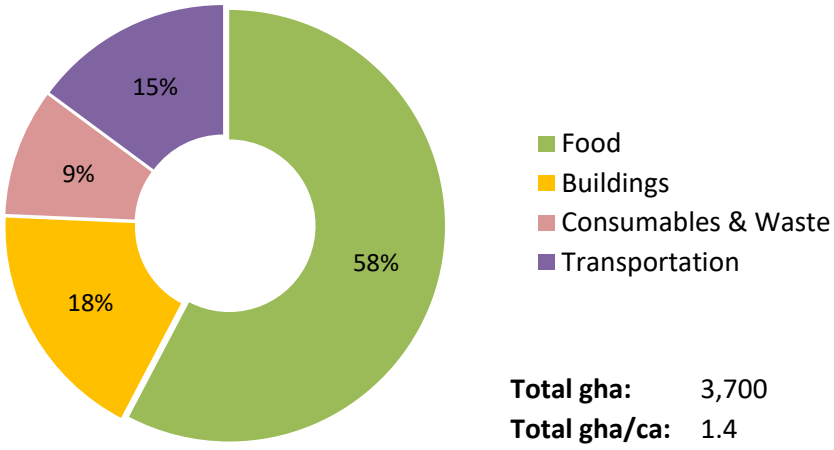

Figure 17: Galiano One Planet (from Baseline) Footprint Summary

Reduction Measures for One Planet Scenarios

This section describes the reduction measures and potential actions for each category to achieve the targets.

Food

The One Planet Scenarios include reductions from the top impact area associated with food – waste. Typically, meat consumption would also be reduced, however, Galiano residents already consume less meat than average. Actions to reduce waste include:

- Meal planning and rescue to reduce spoilage
- Local production to reduce distribution losses from damage, spoilage, and appearance
- Use everything – carrot tops, etc.

For **food**, the One Planet Scenarios include:

- a 80% reduction of food waste

While it represents what would be a massive achievement in reducing the impacts from food – food would remain by far the largest contributor to the ecological footprint and one of the top contributors to the CBEI. This highlights the need for *additional* systemic change in agricultural practises – particularly in the highest impact areas (adopting regenerative agriculture practices, managing soil, manure, and fertilizer) and land use.

Buildings

For **buildings**, the One Planet Scenarios include:

- a 85% reduction in residential developed area, 50% reduction in commercial/institutional developed area
- conversion to 100% renewable energy

For Galiano, low density development is driving the ecological footprint impact from buildings. Reducing the developed area is essential to lower impacts to the average level needed to be achieved globally. To support higher density development on Galiano, rainwater collection would be needed to meet demand. Additionally, guidance and standards are already available to lower embodied emissions of buildings, fuel switching, and energy efficiency (which are the reductions typically focussed on), for example:

- The Zero Carbon Building Standard (www.cagbc.org/zerocarbon)
- Passive House Standard (www.passivehousecanada.com)

Residents can also choose low carbon options (low embodied emissions) when doing renovations – e.g. spray foam insulation has relatively high GHG emissions whereas organic material based insulations (straw, hemp, cellulose, etc.) actually sequester carbon.

Consumables and Waste

CBEI and EF results highlight the need for the municipality, and other levels of governments, to support a shift to a more sustainable pattern of consumption. Many jurisdictions already have zero waste targets, but this could be achieved theoretically without reducing consumption. The One Planet Scenarios focus rather on minimizing the need for production of new goods and reducing the resource intensity of goods production. This can be achieved with high adoption of shared goods, goods designed for durability/repairability, and reuse of goods.

For **consumables**, the one planet scenarios include:

- a 50% reduction of municipal solid waste (MSW).
- a 50% reduction of septic system emissions

Septic systems typically have conditions in which solids decompose without oxygen. This causes methane gas to be produced in the process which is 28 times more potent as a GHG than CO_2. Methane emissions can be reduced by using a septic system that supplies air to the tank or by switching to a composting toilet.

Transportation

The One Planet Scenarios depend upon reducing vehicle ownership and achieving a high percentage of active transportation and transit along with electrification. The reduction of the vehicle fleet numbers drastically reduces the total embodied emissions of materials, which would otherwise start to dominate the footprint as the fleet is electrified. A transition to e-bikes or transit (or even smaller electric cars) also improves energy efficiency – a driver might only make up 2% of the vehicle weight in a truck whereas that could increase to 4% in a smaller car, meaning more energy is going into moving the driver instead of the vehicle. Comparing this to a fully loaded e-bus where passengers weigh about the same as the vehicle, or an e-bike where the rider makes up the majority of the weight, it is clear that transit and active transportation are vastly superior choices from a system efficiency perspective (energy consumed per person-km) than electric cars and trucks. Transit may not be an option for Galiano, but e-bikes would work well. Any investment in infrastructure – particularly for active transportation and electric ferries - would also benefit emissions reductions from tourists. With a network of safe riding routes and collaboration with local business owners – Galiano could lower its footprint and be promoted as a 'low carbon' destination.

For **transportation**, the One Planet Scenarios include:

- a 80% reduction in non-paved roads
- a 50% decrease in vehicle fleet
- a 100% conversion to electric vehicles, ferries, and personal watercraft
- a 80% reduction in air travel

As with buildings, reducing the developed area for transportation is essential to lower impacts to the average level needed to be achieved globally – specifically non-paved roads.

Methodology

Galiano Full-time Residents Footprint 2021

Population

1. Full-time population for 2021 is reported by Statistics Canada under "Galiano Island Trust Area"

Sources:
Statistics Canada. 2022. (table). Census Profile. 2021 Census. Statistics Canada Catalogue no. 98-316-X2021001. Ottawa. Retrieved from https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

Food (Production)

1. One week food consumption diaries are conducted by food type in servings
2. Food data is converted from servings to weight
3. Consumption data is scaled by national food system waste estimates
    - Consumption data is scaled for retail and household waste by food type
    - Consumption data is scaled for other sources of waste – farm, processing, transport, restaurants/hotels – by the average of all food types
4. Life Cycle Assessment data was obtained from the CleanMetrics calculator. The data is 'cradle to farm gate', including, for example, emissions from soil management, fertilizer, and enteric fermentation. A more comprehensive methodology writeup is available at https://www.cleanmetrics.com/carbonscopedata/methodology.aspx

Sources:
Agriculture and Agri-Food Canada. (2015). An Overview of Canadian Food Loss and Waste Estimates.

CleanMetrics, Food Carbon Emissions Calculator. http://www.foodemissions.com/Calculator

Food (Miles)

1. Operating emissions are estimated based on Canadian averages for imported food using a similar methodology as outlined in Dr. Meidad Kissinger's "International Trade Related Food Miles – The Case of Canada" (2012).
2. Embodied emissions for fuels are estimated using 'Well to Tank' (WTT) emission factors published by the UK government for international shipping

Buildings

1. Dwelling counts are reported by Statistics Canada under "Galiano Island Trust Area"
2. Gross floor area and developed area is provided by GCA. Residential developed area is allocated to full-time/part-time residents by dwelling counts.
3. Utility data is provided by GCA and allocated to full-time/part-time residents by dwelling counts
4. Embodied emissions factors are derived internally (Centre for Ecocities, BCIT) and operating emission factors are reported by BC Ministry of Environment

Sources:
Statistics Canada. 2022.

Consumables and Waste

1. Solid waste reported by private haulers is assumed to be ½ of disposed waste from full-time residents
2. Solid waste composition studies are used to estimate the tonnage of waste by material type from the total disposed waste reported
3. Recycling and compost data is collected by survey
4. LCA data is used to estimate the embodied emissions associated with the disposed and recycled solid waste by material type
5. Septic system emissions are estimated using CIRIS Standard v2.4 embedded liquid waste model following IPCC guidelines and reduced by approximately 50% based on numerous research papers stating the IPCC guidelines result in emissions estimates about double what is actually measured

Transportation

1. Embodied emissions of paved roads are estimated using total material and LCA data
2. The built area of both paved and non-paved roads is provided by GCA
3. Full-time resident vehicle numbers are reported by ICBC
4. Vehicle embodied emissions are estimated from LCA studies
5. Usage data for all modes (odometer readings, litres of fuel, flight destinations, etc.) is collected by survey
6. BC Ferries emissions are estimated in an internal BCIT study – total fuel use for route 5 and route 9 as reported by BC Ferries is allocated based on: winter/summer passenger trips differential (to estimate tourist use) and local population of islands on each route. Survey data is then used to allocated fuel use based on full-time resident trips (and part-time)
7. Fuel embodied emissions factors are derived internally (Centre for Ecocities, BCIT) and operating emission factors are reported by BC Ministry of Environment and for air travel, by the UK government

Galiano Baseline Footprint

Population

1. Part-time population for 2021 is estimated by GCA
2. Days on Galiano for part-time population is determined by survey
3. Tourist visits annually and length of stay are estimated from a CRD tourism study based on 2007 data

Sources:
Ecoplan International. 2008. Southern Gulf Islands Community Tourism Study. Retrieved from https://www.crd.bc.ca/docs/default-source/salt-spring-island-ea-pdf/cedc/part_one-tourism_profile.pdf?sfvrsn=2

Food

1. Part-time residents are assumed to have a similar diet to full-time residents
2. Tourists are assumed to have a diet comparable to the Canadian average which has significantly higher meat consumption
3. Impacts are allocated based on total ‘person days’ on-island

Buildings

1. Total residential developed area is used
2. Total utility data numbers for Galiano are used

Consumables and Waste

1. Part-time residents are assumed to have similar solid waste disposal rates as full-time residents (196 kg/ca)
2. Tourists are assumed to have similar solid waste disposal rates equal to the average Metro Vancouver and CRD resident (432 kg/ca)
3. Yard waste is scaled by dwelling counts
4. Food waste is scaled by total 'person days' on-island for part-time residents and tourists
5. Septic emissions are scaled by total 'person days' on-island for part-time residents and tourists

Transportation

1. Part-time residents are assumed to have similar vehicle use rates as full-time residents
2. A daily vehicle use profile was estimated for tourists and the CRD tourism study reports vehicle count and trip length to estimate total on-island vehicle use by tourists
3. Personal watercraft fuel use is scaled by dwelling count
4. Sea-plane fuel use is all allocated to part-time residents and tourists
5. Other air travel is scaled by total 'person days' on-island for part-time residents
6. BC Ferries emissions are estimated in an internal BCIT study – total fuel use for route 5 and route 9 as reported by BC Ferries is allocated based on: winter/summer passenger trips differential (to estimate tourist use) and the tourist visits by island reported in the CRD tourism study.