One Planet Scenario
City of Nelson

Prepared by:
BCIT CENTRE FOR ECOCITIES

With funding from:
real estate foundation
BRITISH COLUMBIA

March 2022

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Acknowledgements

This work was carried out by the British Columbia Institute of Technology (BCIT) Centre for Ecocities as part of the work of the Ecocity Peer Network, with funding from the Real Estate Foundation of BC.

The authors would like to thank the participation and contribution of the City of Nelson staff, in particular Natalie Douglas, Carmen Procter and former staff, Kate Letizia.

BCIT is located on the unceded territory of the Sḵwx̱wú7mesh (Squamish), səl̓ilwətaʔɬ (Tsleil-Waututh), and xwməθkwəy̓əm (Musqueam) First Nations. BCIT has been educating and inspiring students for over half a century on their traditional lands and for that, we are grateful.

Cover image courtesy of Steve Ogle.

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
gha	Global hectares
gha/ca	Global hectares per capita
GHG	Greenhouse gas
GPC	Global Protocol for Community-Scale Greenhouse Gas Emissions Protocol
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 CO2 (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).

Introduction

This report presents a ***One Planet Scenario*** for the City of Nelson, identifying what would be required to achieve a community-wide ecological and carbon footprint commensurate with One Planet Living.

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.

This report provides:

- Contextual background on the use of CBEIs and EFs to inform local government climate and sustainability action.
- The City of Nelson's CBEI and EF results for 2016, as created by the ecoCity Footprint Tool, used as a baseline, and a 'One Planet Scenario' that identifies priorities for transitioning the city to a 'One Planet' ecological footprint.

BACKGROUND

What is One Planet Living? 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. Thus, the goal of One Planet Living is to 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

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.

The pioneering cities of the ***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.

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.

[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

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.

> 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.

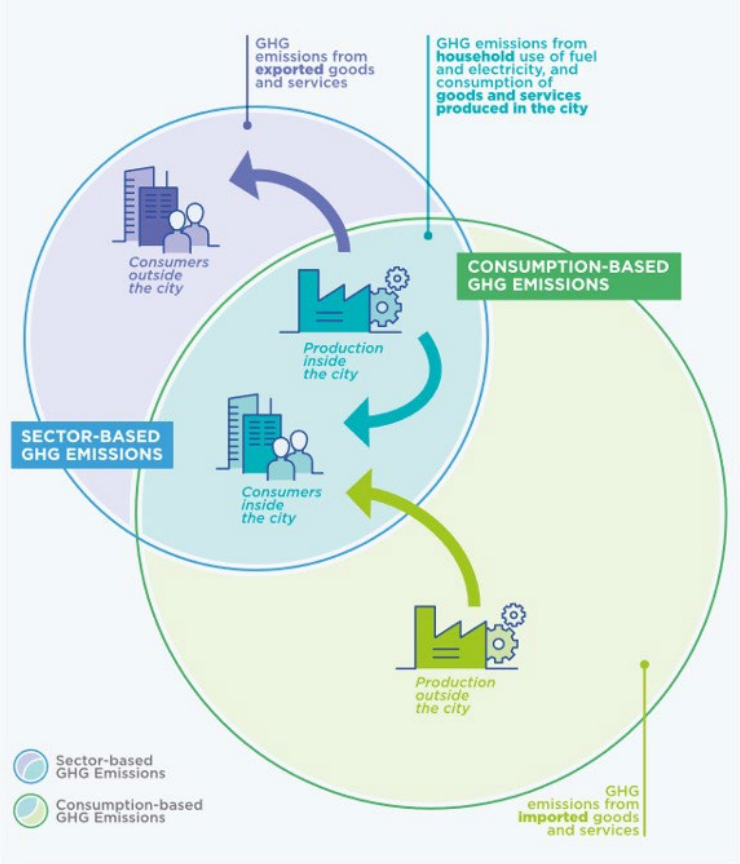

Figure 1: Comparison of Sector-based/Territorial Emissions with Consumption-Based Emissions

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 1.5 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. Nelson's results, summarized in this report, 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.

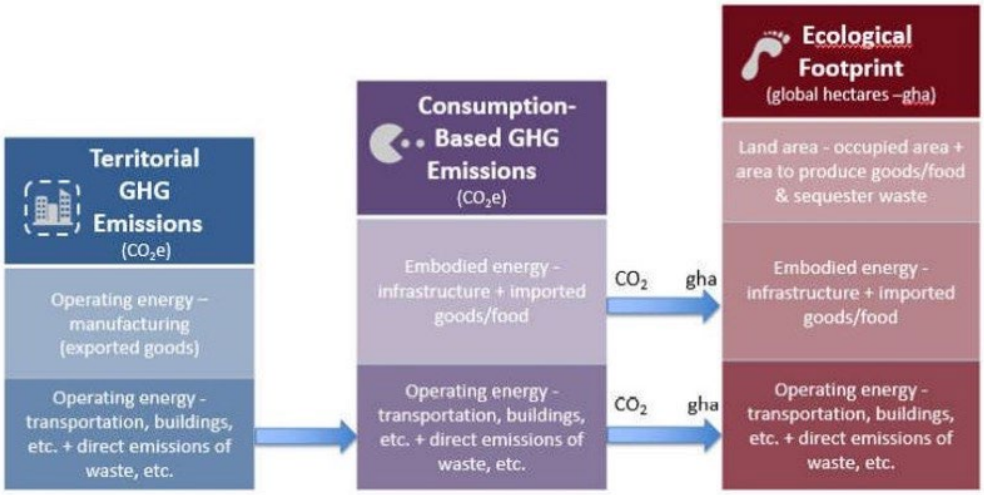

Figure 2: Comparison of the GHG Emission Inventories and Ecological Footprint Approaches

[2] We also need to set aside land for nature, thus a target of 1.5 gha/person should be considered a minimum threshold.

Carbon and Ecological Footprint Baseline for the City of Nelson

In creating a One Planet Scenario for the City of Nelson, the 2016 carbon and ecological footprint generated by City staff using the ecoCity Footprint Tool has been used as a baseline. A brief overview of this baseline is presented below.

Territorial GHG Emission Inventory and Consumption-Based Emission Inventory

In 2016, the City of Nelson's territorial GHG emissions were 76 kilotonnes of carbon dioxide equivalent (ktCO$_2$e), or ***7.1 tCO$_2$e per person***. Meanwhile, using a consumption-based approach (the CBEI), GHG emissions were 60 percent higher at 125 ktCO$_2$e, or ***11.7 tCO$_2$e per person*** (see Figure 3). As previously noted, traditional GHG emissions inventories do not fully account for the "embodied" emissions associated with "consumption" attributable to the community. That is, they miss those emissions that occurred outside the regional boundaries during the production of all the consumable goods, food, building materials, vehicles, etc., used in the community, as well as the impacts of residents and local businesses while they are travelling outside the community's borders.

The fact that Nelson has low levels of industry and is a relatively affluent, high consuming community, means that emissions from a consumption-based approach are significantly higher than a standard territorial inventory. In particular, a traditional GHG inventory does not include the impacts of food, which makes up 13% of the CBEI for Nelson, or the embodied emissions of goods and the built environment (see Figure 3).

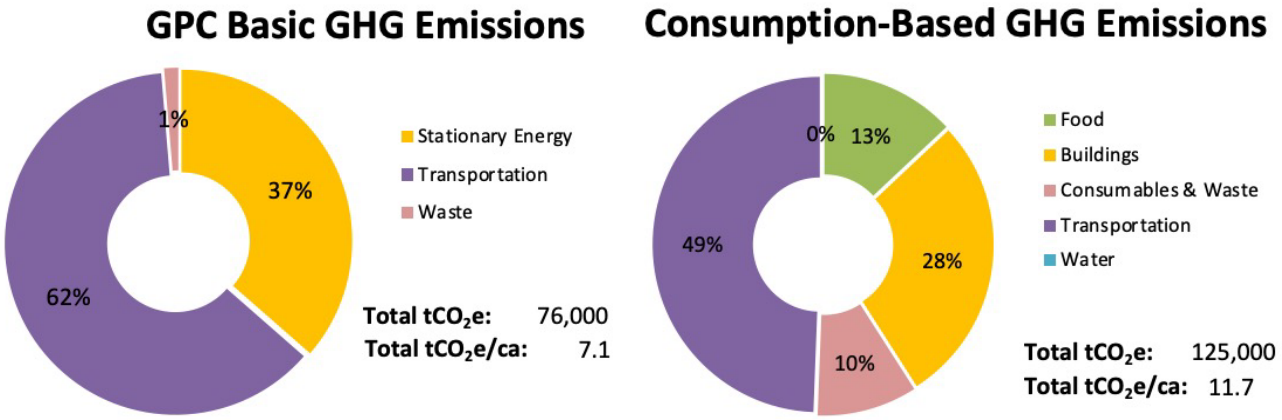

Figure 3: Comparison of City of Nelson's 2016 Territorial (GPC) and Consumption-Based GHG Emissions

Of note, nearly three-quarters of the CBEI for food is a result of animal proteins (meat and dairy), as shown in Figure 4 below.

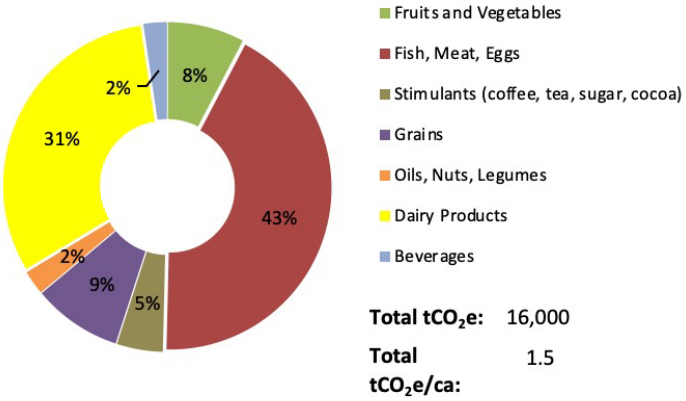

Figure 4: GHG Emissions from Food

ECOLOGICAL FOOTPRINT ASSESSMENT

The ecological footprint identifies the resource intensity of the community in terms of land and sea area that are required to supply the resources and assimilate the waste from with the community (including CO_2 emissions). As seen in Figure 5, results show that City of Nelson's ecological footprint is 3.7 gha/person. This means that residents are consuming 2.5 times more of the Earth's resources than what is currently available, if those resources were to be shared equitably across the world. Put another way, this means that ***approximately 2.5 Earths would be required*** to support the global population if everyone had lifestyles comparable to a City of Nelson resident.

Planets Required by City of Nelson: **2.5**

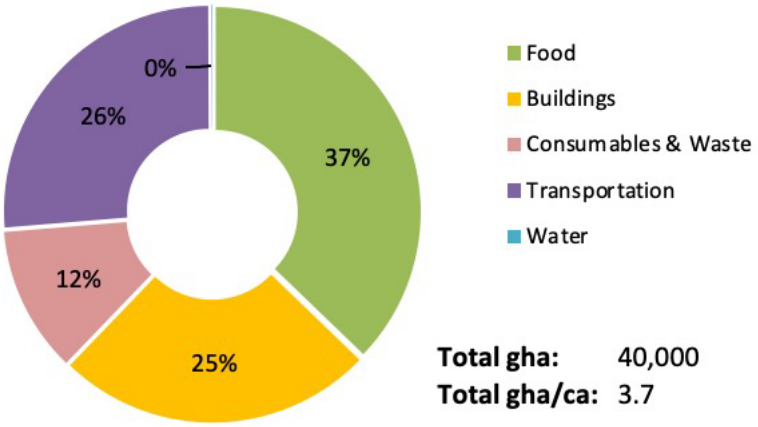

Figure 5: City of Nelson's Ecological Footprint, 2016

For the CBEI, the largest impact category is transportation followed by buildings, whereas for the EF, the largest impact categories are food and transportation. Food impacts are the category in which results vary most significantly. Food is a much higher portion of the EF, compared to the CBEI; largely because of the land intensity of food production, which drives up the ecological footprint.

The Sustainability Gap

To achieve One Planet Living, Nelson's ecological footprint would need to reduce from 3.7 gha per capita (not including national and provincial services) to 1.5 gha per capita. ***This represents a sustainability gap of 60%*** (Figure 6).

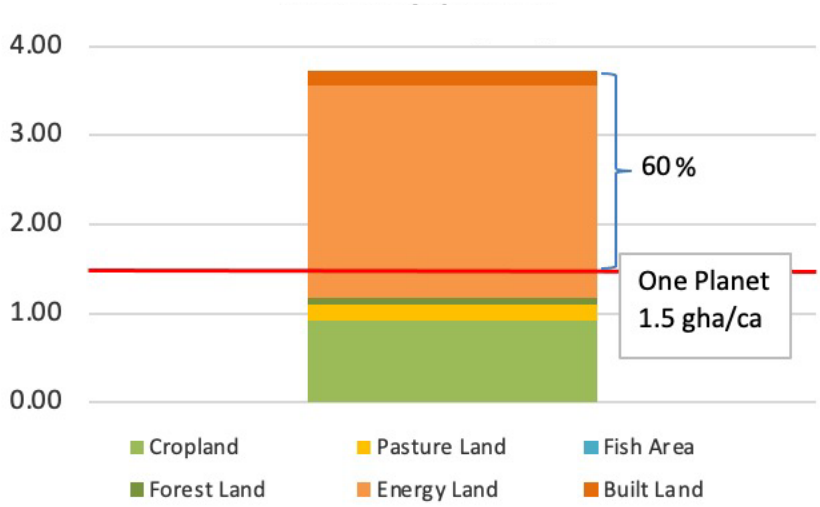

Figure 6: Sustainability Gap, 2016 (excluding national and provincial services)

One Planet Scenario & Policy Interventions

While a typical territorial GHG inventory identifies the emissions that are occurring within a community's borders, the ecological footprint and consumption-based approach to GHG emissions inventories broadens the analysis to consider *global* ecological and carbon impacts. Local government staff can use data from the ecoCity Footprint Tool to ***identify activities and consumption habits*** that are having the ***greatest impact on their community's contribution*** to global climate change and ecological overshoot. They can then implement informed policy interventions to best reduce these impacts.

A One Planet Scenario for Nelson is proposed for the portion of the city's footprint that is a direct result of local activity (excluding national and provincial services). However, to achieve the 1.5

gha per capita target, ***the actual reductions would need to be greater*** to account for national and provincial services and to include setting aside land for nature.

A series of measures are proposed for food, buildings, consumables / waste and transportation, that are aimed at achieving One Planet Living from an Ecological Footprint perspective. However, we know that to avoid the most severe impacts of climate change, GHG emissions must reach 'net zero' as soon as possible and that CO_2 must also be drawn from the atmosphere.

Finally, it is also important to note that the scenario is based on current population levels.

The One Planet Scenario measures are described below, while Figure 7 summarizes the impact of these measures and further detail is provided in Appendix A.

Table 1: Summary of Impacts of One Planet Scenario Measures on the City of Nelson's 2016 Ecological Footprint and Consumption-Based GHG Emissions

Measures	EF Reduction (gha/ca)	CBEI GHG Reduction (tCO2e/ca)
Food • 90% reduction of food waste • 50% reduction of beef/lamb through substitution with legumes, chicken, pork, and fish • 50% reduction of cheese consumption (no substitution)	0.6	0.4
Buildings • 50% reduction in embodied emissions of materials • 100% conversion to renewable energy • 90% reduction in energy consumption	0.7	2.9
Consumables and waste • 50% reduction of municipal solid waste (MSW) through reduced consumption and improved circularity (sharing, repair, reuse)	0.2	0.6
Transportation • 50% decrease in light duty (LD) fleet • 50% of LD trucks/SUV, switched to small cars • 70% of gasoline/diesel vehicles switched to EVs across fleet, with remaining 30% being hybrid vehicles (including commercial) • 100% EV transit	0.8	4.6
Total	2.2	8.5

Achieving Climate Stabilization

While this package of measures achieves the ***One Planet Scenario target of 1.5 gha per capita and lowers the CBEI GHG emissions - to 3.2 tCO2e per capita*** – emissions remain higher than what is likely needed to achieve climate stability. (Note: in this scenario, the territorial GHG emissions would be reduced to 0.5 tCO_2e per capita – not shown on the table). Further emissions reduction activities would be needed to meet climate stabilization goals, particularly those that target emissions from aviation, vehicle-based mobility, consumables, farming practices and the materials used for buildings and infrastructure such as roads; as well as measures to sequester CO_2 from the atmosphere.

ONE PLANET SCENARIO MEASURES

Further detail on the measures included in the One Planet Scenario are elaborated, below, and Figure 7 summarizes the collective impact of the measures, comparing the baseline ecological footprint with the One Planet Scenario (OPS).

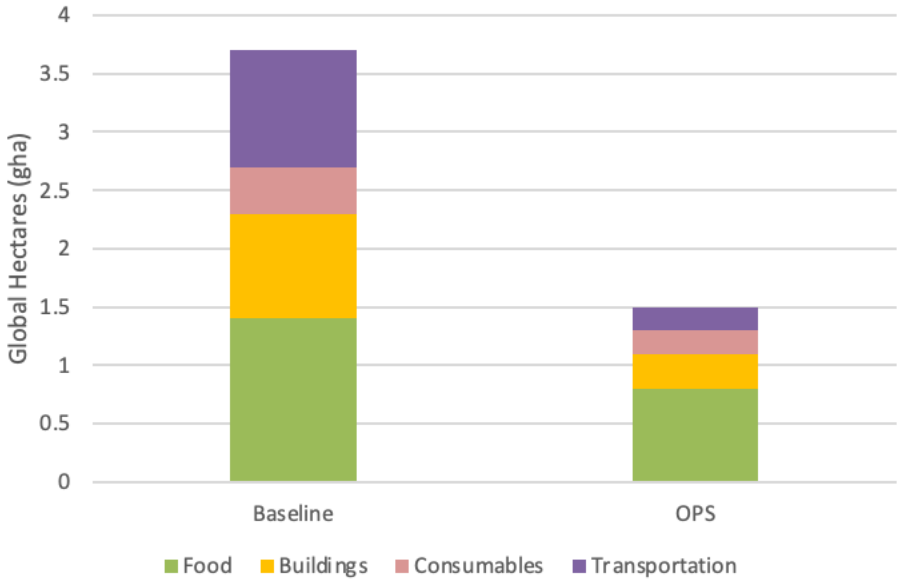

Figure 7: Comparison of One Planet Scenario (OPS) with Baseline, 2016

Food

The One Planet Scenario includes reductions from the top impact areas associated with food. 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 (e.g., reduce land impacts with widespread urban/rooftop farming).

For **food**, the One Planet Scenario includes:

- a 90% reduction of food waste
- a 50% reduction of beef/lamb through substitution with legumes, chicken, pork, and fish
- a 50% reduction of cheese consumption (without caloric substitution)

Buildings

For **buildings**, the One Planet Scenario includes:

- a 50% reduction in embodied emissions of materials
- conversion to 100% renewable energy
- a 90% reduction in energy consumption

Although the proposed measures for a One Planet Scenario are aggressive, examples of buildings that are achieving this performance level are growing around the world. Guidance and standards are already available which articulate how these objectives can be met, for example:

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

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 Scenario focuses 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 scenario includes a 50% reduction of municipal solid waste (MSW).

Transportation

The One Planet Scenario depends upon reducing vehicle ownership, and achieving a high percentage of active transportation and transit along with the electrification of commercial and private fleets. The reduction of the light duty fleet numbers and transition to a higher percentage of smaller vehicles drastically reduces the total embodied emissions of materials, which would otherwise start to dominate the footprint as the fleet is electrified. The transition to smaller vehicles 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.

For **transportation**, the One Planet Scenario includes:

- a 50% decrease in light duty (LD) fleet
- a 50% of LD trucks/SUV, switching to small cars
- switching of 70% of gasoline/diesel vehicles to EVs across the entire fleet, with the remaining 30% being hybrid vehicles (including commercial)
- a 100% EV transit

Implementation Actions

Consideration of the CBEI and EF results can shift key areas of policy and planning decision-making for governments. For example, they highlight the necessity to target the resource and climate impacts of food production and disposal and shift the focus from waste reduction to consumption reduction.

Actions by governments, are key determinants of a communities' ecological and carbon footprint, but also important are the actions by businesses and individuals. These entities interact as a system, and each can be their own driving force. Importantly, local governments can have great influence over each of these spheres.

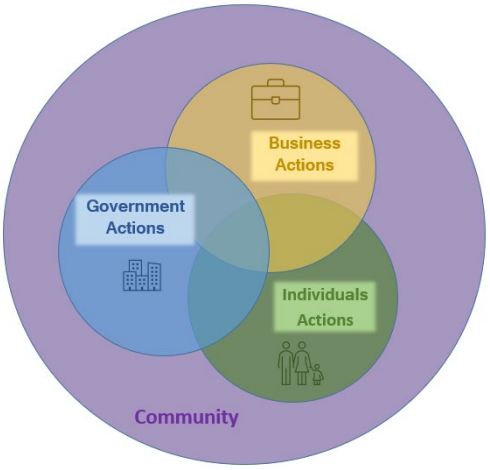

Figure 8: Determinants of community ecological and carbon footprints

Local governments can build from their sphere of influence by ***building a supportive ecosystem*** to empower individuals and businesses to adopt lower footprint lifestyles and practices. Key opportunity areas for local governments to expand from traditional roles and deepen action on the ecological footprint and consumption-based emissions are summarized below.

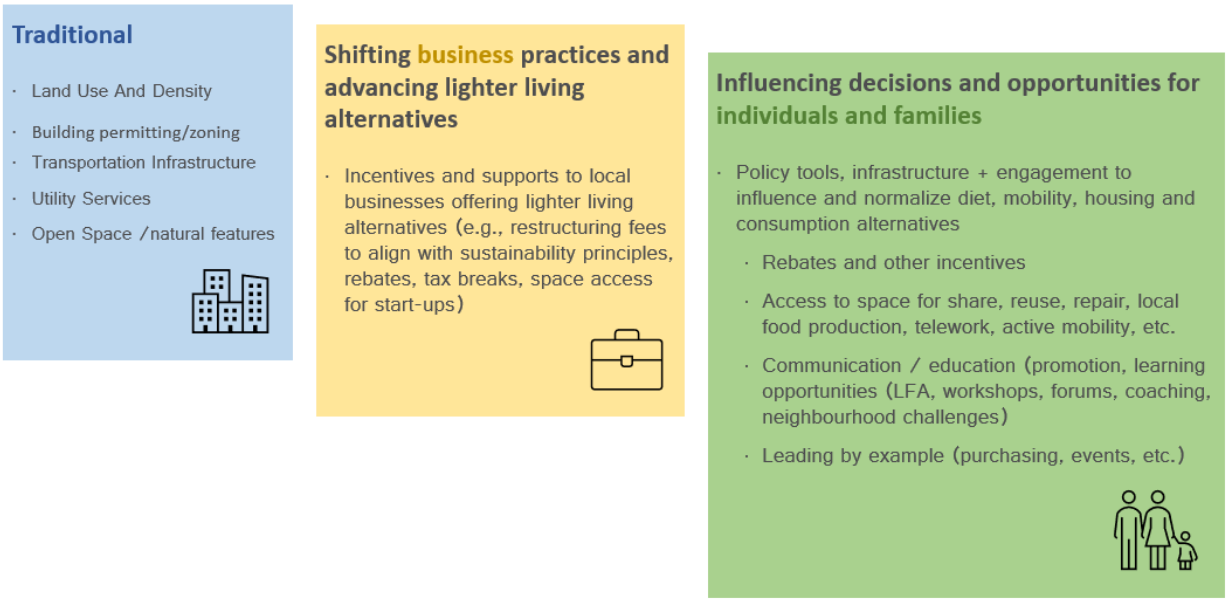

Figure 9: Opportunities for Deepening Local Government Action

PRIORITY ACTIONS

Priority actions for addressing CBEI and EF results include:

- Update goal and target setting: consider adjusting emission reduction goals to reflect these new metrics and commit to updating the CBEI and EF at least every five years.
- Integrate EF and CBEI results into reporting: include these results alongside the traditional territorial GHG emission inventory.
- Incorporate sustainable consumption principles into high level strategic plans such as the economic and community development strategies and Official Community Plan; and focus on implementing policies and bylaws that would attract low-carbon producers, promote work force development in the repair and reuse industries, and drive community investment in shared public goods such as arts, libraries, parks and recreation.
- Engage with other levels of government to encourage and promote policies and regulations to shift to more sustainable patterns of consumption; in particular:
    - Design for the Environment practices that increase the longevity and reduce the resource intensity of products, and expand the potential for product reuse and recycling.
    - Product labelling to encourage the purchase of lower impact goods.
    - Expand extended producer responsibility programs to reduce waste disposal.
- Local governments are uniquely positioned to reach and influence these key stakeholders with the goal of building awareness, changing attitudes, and shifting consumption patterns. Consider building a community mobilization initiative. In building these initiatives:
    - Explore what is happening elsewhere and build from existing resources (see the additional resources section of this report).
    - Use accessible framing, communications and metrics to advance sustainable consumption objectives as a means of engaging residents and businesses to shift to more sustainable consumption habits (e.g., 'One Planet Living' framing and metrics).

Targeted opportunities associated with individual spheres of municipal planning are also presented below.

Table 2: Targeted Opportunities for Municipal Planning

Planning Sphere	Key Objectives	Instrument
Food	Reduce food waste Reduce meat and dairy consumption Obtain local data on food consumption impacts	Promote sharing economy opportunities (e.g., community gardens). Promote diet shifts (e.g., 'Meatless Mondays' Oregon; Celebrate the Harvest campaigns). Implement food waste reduction campaigns (e.g., Canada's Love Food Hate Waste; US EPA's Food too Good to Waste; NRDC Save the Food Campaign). Undertake a food survey to gain knowledge about local food consumption and impacts so as to track progress toward goals. Adopt advanced purchasing standards (e.g., Emeryville Good Food Purchasing Program, EPA West Coast Forum on Materials and Climate's Climate Friendly Purchasing Toolkit).
Buildings & Infrastructure	Increase efficiency (envelope 1st approach) Use building materials with lower embodied energy	Provide incentives for smaller and more energy efficient homes, and renewable technology incentives for homes and business. Accelerate adoption of building codes that promote energy and material efficiency. Implement government purchasing policies to favour recycled content/reused building materials.
Consumables	Reduce the volume of individually owned goods Increase reuse	Stakeholder mobilization: Neighbourhood challenges (like Vancouver's Green Bloc), Saanich's One Planet Saanich. Access to public space, funding and incentives to support sharing economy opportunities (e.g., tool libraries, community swaps, repair clubs).
Transportation	Reduce vehicle ownership Decrease vehicle travel Improve efficiency of vehicle fleet Better understand inter-urban transportation demand	Continue to expand Active Transportation Develop/support/promote bike-sharing and car-sharing programs Expand active transportation options Ensure neighbourhood plans contribute to compact urban development, smaller homes and walkable neighborhoods Transportation Demand Survey (+expand to include out of boundary + other modes of transport (ferries, flights, etc.)) Increase electrification of corporate fleet

Appendix A

Table A - 1: Comparison of City of Nelson's Baseline and One Planet Scenario, and overall reductions in terms of the Ecological Footprint and Consumption-Based Emissions (2016)

Comparison Category	CBEI (tCO2e)			EF (gha)		
	Baseline	OPS	Reduction	Baseline	OPS	Reduction
Food	1.5	1.1	0.4	1.4	0.8	0.6
Buildings	3.3	0.4	2.9	0.9	0.3	0.7
Consumables	1.1	0.6	0.6	0.4	0.2	0.2
Transportation	5.8	1.2	4.6	1.0	0.2	0.8
Total	11.7	3.2	8.5	3.7	1.5	2.2

Additional Resources & Tools

Although the use of ecological footprint and CBEI results to inform community planning is a new and emerging area, there are some useful resources to guide governments and community builders in this work, for example:

BCIT Centre for Ecocities:

- Lighter footprint App – lighterfootprint.org
- ecoCity Footprint Tool – ecocityfootprint.org

OneEarth (https://www.oneearthweb.org/resources.html):

- **Neighbourhood Guide:** A compendium of actions that neighbours can take to have the highest impact to advance lighter living. 7 action packs including Good Stuff and Life Transitions.
- **Motivations For Lighter Living Action in BC**: A guide that sheds light on what motivates people to engage in sustainable living actions in British Columbia, including and beyond environmental motivations.
- **Sustainable Lifestyles Options and Opportunities**: Action-oriented ideas for supporting sustainable living. Including ideas for doing this in the workplace with examples from around the world. Prioritization is according to the ecological footprint.

One Planet BC (oneplanetbc.ca): An approach to engage organizations in collective action on carbon and ecological footprint and advances progress on broader sustainability objectives.

USDN Sustainable Consumption Toolkit:

Launched in 2015, it includes a conceptual overview and a database of local actions. A refresh/update is planned for early 2018 (see: http://sustainableconsumption.usdn.org/)

Saanich's Residents' Climate Action Guidebook:

The District of Saanich has produced a comprehensive guidebook for residents focused on climate action from a consumption-based perspective see: https://www.saanich.ca/EN/main/community/sustainable-saanich/climate-action-guidebook.html