HOW MANY PLANETS?

Measuring Environmental Sustainability in Plans

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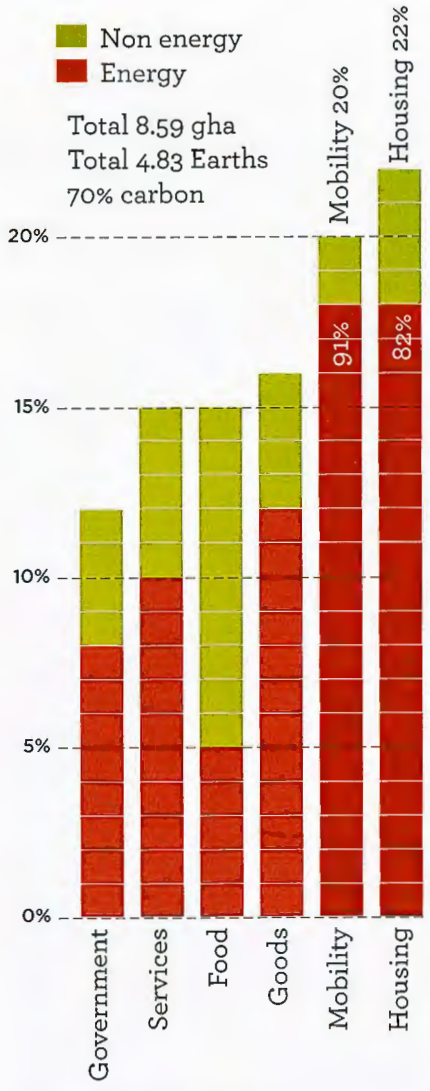
The City of Calgary has been building commitment towards sustainability for several years but the connection between day-to-day choices and longer term decision-making requires a new way of thinking to be truly sustainable in action. For planning, this means utilizing tools which help to embed sustainability in local policy that can be implemented at the development and building permit level. Urban planners have an obligation to evaluate local sustainability, which requires accurate local data and tools that assist with analysis. A unique visioning tool is required to assist both planners and the City think about the challenges of sustainable development. As an aggregate indicator, the tool must reflect the 'big picture' from a cross-cutting issues perspective, which sustainability is all about.

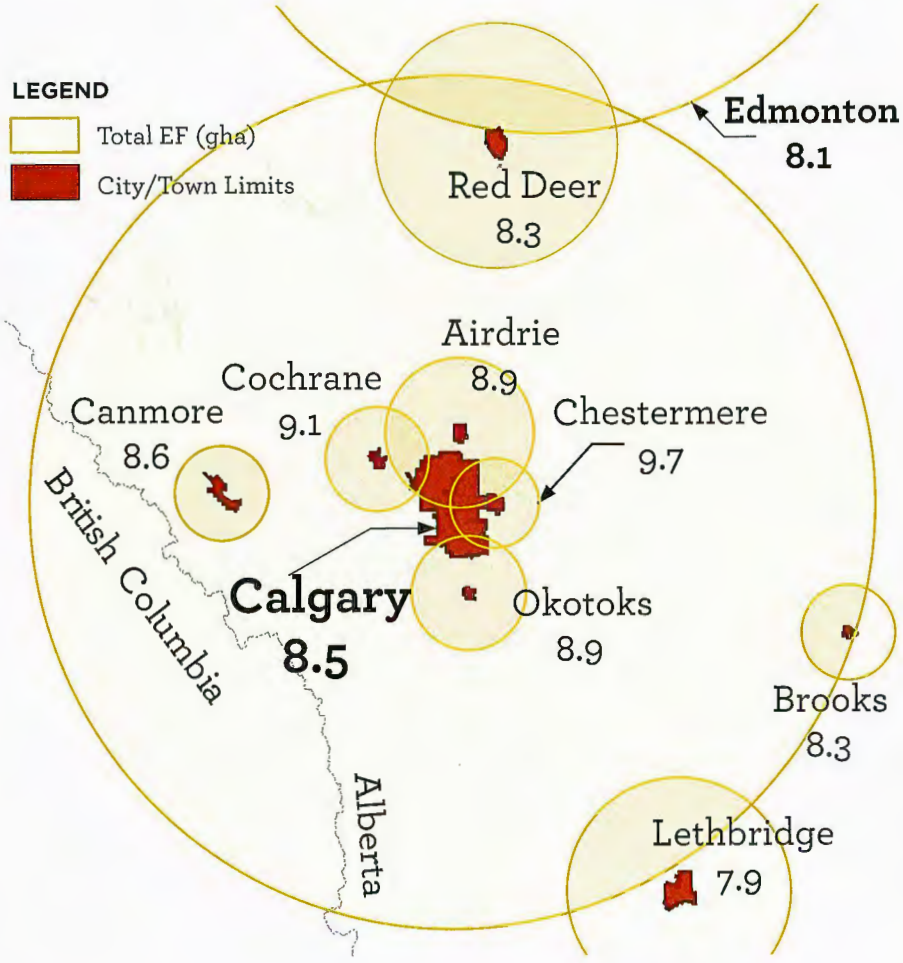
SUMMARY *Looking to quantify the environmental (planet) of the triple bottom line, the City of Calgary has integrated the Ecological Footprint into planning sustainability analysis. Allowing GIS-based measurement of the impact of proposed plans, these appraisals support decision-making towards more sustainable urban form. Ecological Footprint components include housing, mobility and the carbon footprint, while unit options allow measurement in map friendly global hectares, intuitively grasped planet Earths and CO_2 emissions in tons. Calgary planners and analysts apply this tool to both established redevelopment and greenfield development policy plans. Results speak to scenario comparisons as well as citywide policy targets.*

RÉSUMÉ *La Ville de Calgary intègre le concept d'empreinte écologique dans ses analyses de viabilité urbaine afin de quantifier le facteur environnemental du triple bilan. Les composantes de l'indicateur d'empreinte écologique— le logement, la mobilité et l'empreinte carbone—sont exprimées en hectare global, en nombre équivalent de planètes Terre et en tonne d'émissions de CO_2. En favorisant la mesure de l'impact des plans proposés au moyen de données géographiques (SIG), ces analyses facilitent la prise de décisions en faveur d'aménagements urbains plus durables. Les urbanistes et les analystes de Calgary utilisent cet outil autant pour les projets de revitalisation approuvés que pour les plans stratégiques de mise en valeur de nouveaux terrains. Et les résultats ouvrent la voie à la comparaison de différents scénarios et à l'établissement d'objectifs en matière de politiques à l'échelle de la ville.*



Source: Consumption Land Use Matrix for Calgary, 2010

Figure 1: Calgary Ecological Footprint Breakdown
Housing and Mobility, directly under the influence of policy planners, constitute the two largest components of the Ecological Footprint, and the carbon footprint of these two significantly exceeds citywide average.



Map 1: Global Hectares on a Map
The number beside each community designates Ecological Footprint in global hectares per capita (gha). The circle around each community shows total global hectares based on population. The City of Calgary's total EF is just under 100 times the area of its city limits.

APPROACH

Following in depth research, the Ecological Footprint (EF) was selected as a sustainability measurement tool originating from an academic planning faculty.[2] As a *quantitative* measure of environmental sustainability, this tool tracks peoples' lifestyle demand on Earth's biocapacity in units of biologically productive land. The total Ecological Footprint is comprised of several components including Housing and Mobility (see Figure 1), each of which has a large energy or carbon footprint. The Ecological Footprint is measured in global hectares per capita (gha) which display well on maps[3] (see Map 1), intuitively understood planet Earths or tons of CO_2 for the carbon component.

Many EF scales are available, across the spectrum beginning with national,[4] through city and municipality,[5,6,7] to postal code, or household[8] or individual. As minimized geographic area in GIS allows maximized analysis potential, yet data restrictions exist on individuals and households, the analysis referenced here is based on compromised postal code geography.[9] The footprint including all components has been calculated for postal code groups or approximate urban blocks within Calgary. The Calgary Ecological Footprint tool sources household energy use, housing type, size and residents per household for the Housing EF and bases Mobility EF on mode of travel to work, distance travelled and vehicle ownership. The basis of footprint analysis assumes what has been measured on the ground can be extrapolated to estimate the impact of proposed development

IMPLEMENTATION

Having developed the tool and method, and with the procedure reviewed by the Global Footprint Network, use of the tool has been encouraged among planners. Results including totals are based

DOWNTOWN WEST
Scenario 1: As Planned
3.80 Earths

Scenario 2: Reduced Auto Use
3.68 Earths

Scenario 3: Net Zero Housing
3.13 Earths

Scenario 4: Combined
3.02 Earths

SOUTH SHAGANAPPI
Scenario 1: Gradual shift to 90% Multi
4.41 Earths

Scenario 2: Immediate shift to 90% Multi
4.34 Earths:

Scenario 3: Gradual 90% Multi & Net Zero
4.06 Earths

Scenario 4: Immediate 90% Multi & Net Zero
4.05 Earths

Figure 2: Downtown West vs. South Shaganappi Ecological Footprint Analysis Scenarios
Planet Earth units show comparison between two redevelopment plans including scenarios.

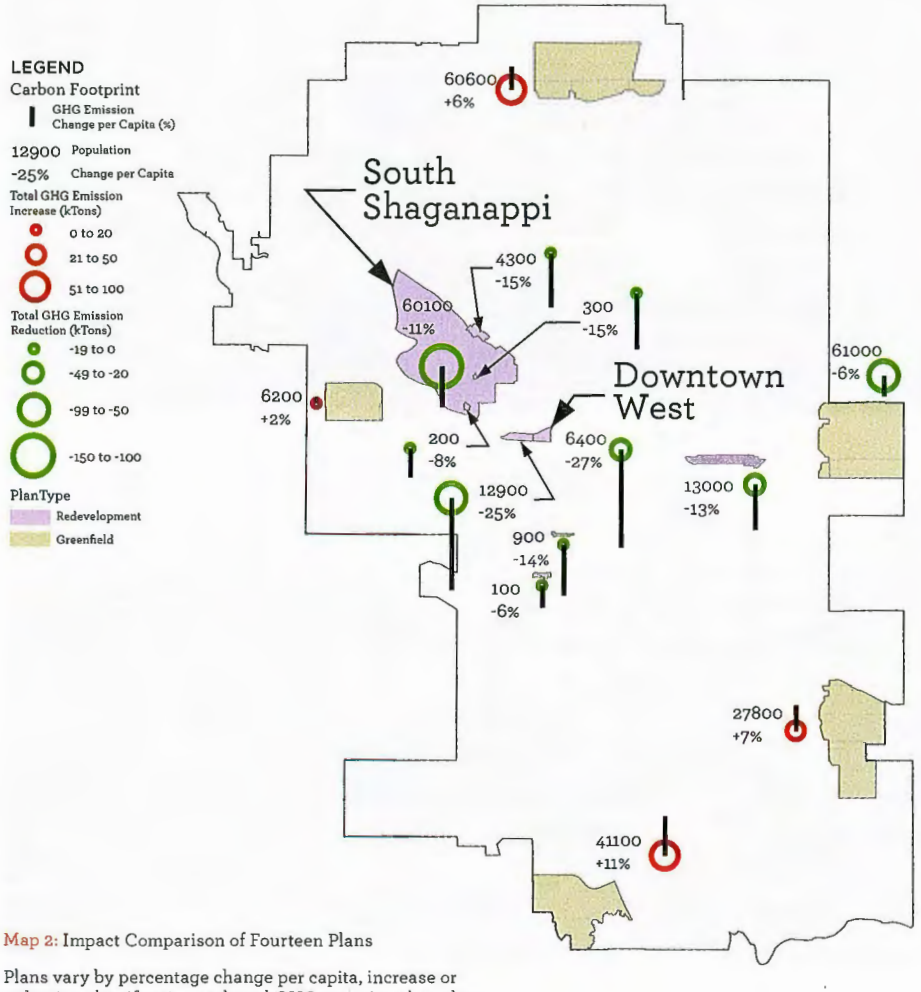
only on the increase or reduction within the Housing and Mobility EF components.

We have applied the Ecological Footprint Analysis tool to the development of 14 plans to date including a proposed downtown redevelopment plan highlighted in comparison here with an approved built suburban redevelopment. Each EF analysis was reviewed against the Calgary Community GHG Reduction Plan[10] target: requiring the *reduction to 20% below 2005 levels by 2020 and 80% below 2005 levels by 2050*, a portion of which is expected from policy plans. The imagineCALGARY[11] Ecological Footprint target requires the *reduction of Calgary's EF to the Canadian national average of 7.25gha by 2036*, which falls in line with the GHG targets.

REDEVELOPMENT OPTIONS COMPARED

The South Shaganappi Communities Area Plan is an approved sustainability-focused plan for 1500 hectares of suburban redevelopment in northwest Calgary, anticipated to house over 60,000 additional residents upon full build-out. An EF analysis was conducted to assist with design and policy formulation with a goal of maximizing the environmental outcomes associated with redevelopment. The four scenarios we explored are outlined in Figure 2 and included both a gradual and an immediate shift to 90% multi-family housing, and a gradual and overnight shift to 90% multi-family housing including energy efficient net zero housing construction.

A new Downtown West Area Redevelopment Plan is currently being written. This statutory plan will provide a long range vision for this unique community located immediately west of Calgary's central business district. Currently, there is a mix of newer high density residential development and older low density commercial and residential development in the community. There is significant redevelopment opportunity in the area. We conducted an Ecological Footprint analysis of four different scenarios for this plan (See Figure 2). The best scenario for minimizing the Ecological Footprint of the community into the future is the combined scenario of reducing auto use by 50% and future housing developed with net zero energy systems.



Map 2: Impact Comparison of Fourteen Plans

Plans vary by percentage change per capita, increase or reduction classification and total GHG emissions based on projected population at full build out.

With a focus on future residential and employment intensification, South Shaganappi measures an as planned scenario (Scenario 1) at -8.6% below the City average. Should Calgary introduce mandatory net zero carbon building energy performance standards, this would result in a -15.9% reduction in EF (Scenario 3). The Ecological Footprint Analysis demonstrated that mobility is the greatest challenge and highlights the need for a multi-modal transportation system and improved jobs to housing balance to reduce EF. Improved sustainability in redevelopment plans can help offset measurements of other plans towards a citywide target.

The design of Downtown West easily exceeds the 2020 carbon target with all scenarios, optimizing improvement when the combined reduced auto use and net zero scenario is considered. Close proximity to employment opportunities within the adjacent central business district and a light rail transit station within the community also contribute to the lower Ecological Footprint. Improvements within the community alone, however, will not achieve a one Earth, sustainable Ecological Footprint level. Combined improvement of many local to global factors will be necessary to achieve a sustainable result.

EVALUATING A CITYWIDE TARGET

When addressing the Calgary carbon reduction target, the impacts of 13 plans analyzed to date and the proposed Downtown West are analyzed together. The projected populations of each built out plan suggest a bias towards greenfield development (see Map 2) confirmed by the Calgary 2013 projected development report which estimates 94% of population growth and 77% of housing units over the next five years will occur in the new suburbs.[12]

The Calgary Community GHG Reduction plan includes reduction contributions from institutions other than urban planning. External factors such as the provincial electricity grid energy source have a huge impact on the Ecological Footprint of the community and province wide. The 14 plans analyzed on their *as planned* scenarios along with citywide built form change shows a -0.2% reduction in carbon footprint. The built form change is based on population redistribution by community during the four years since official agreement on GHG reduction targets. Although this analysis component shows a reduction in Housing EF of -0.5%, the Mobility EF increase of 2.1% nets a carbon increase of 0.4%. A *net zero housing* scenario reveals a -21% reduction in GHG emissions. With some additional planning challenges met, the required reduction of -4% for 2020 and -8% for 2050 represented by the Transportation Choices & Compact Development factor of the GHG Reduction plan is shown to be within reach.

CONCLUSION

The Ecological Footprint in a Geographic Information System (GIS) has become a planning tool for decision support. Utilizing ecological footprint analysis has made it possible to understand and compare the varying environmental impacts of different development scenarios with the long range policy planning for the South Shaganappi and Downtown West areas in Calgary. There is a general municipal desire for sustainability but it is often difficult for planners and decision makers to assess if proposed planning and regulatory changes are effective for attaining sustainability. An Ecological Footprint analysis and testing of different scenarios shows the effectiveness of environmentally friendly initiatives, such as net zero housing. This allows planners and decision makers to make informed decisions with numerical comparisons of proposed environmental initiatives against the status quo, or the cumulative positive impact of multiple environmental initiatives together.

Along with those described here, and others published,[13] several lessons can be taken from this process. Other tools such as FAR, density and intensity have been assessed for sustainability measurement. It was found caution needed to be exercised when using density based measure beside per capita based measure. Previous to inclusion of civic census allowing footprint per capita, housing type as well as density showed a significantly more varied impact.[14] With a per capita rather than housing unit measurement, the EF is more similar to intensity than density.

Narrative can be developed around the outcome of this tool. For example, if everyone on the planet lived like the average Calgarian, we would need 4.8 planets to sustain current lifestyle. Or six hectares of forest are required to offset the carbon footprint of each Calgary resident. Planner-friendly hectares and people- friendly planets translate well into storyline for internal or public engagement.

The Ecological Footprint is a useful tool to appraise plans, and helps to bridge the gap between strategic high-level targets and implementing an important element of sustainability on the ground. The Footprint is also useful as an indicator, particularly as unlike other indicators it can help assess the global environmental impacts of local policies. It can also provide baseline data to inform policies and projects; analyze scenarios to determine targets and predict footprint reductions; be used as a means to integrate commitment to sustainable development within plans; assist in sustainable development and environmental strategy formation; be adopted as a key performance indicator; and provide information for public awareness and education.

In conclusion, EF analysis allows an element of the environmental impact of planning policy to be quantified, which stimulates debate and allows suitable policy and design amendments. It is an effective tool to help those involved in preparing plans to communicate the link between local awareness and global impact and strengthens Calgary's ability to make the connection between policy commitments and sustainable development. ■

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REFERENCES AND NOTES

1. Kuzyk LW, Rockley M. Video presentation at CIP INFUSE Conference Vancouver 2013. Available at: http://www.youtube.com/watch?v=mlJ4bQpV1m4&feature=em-upload_owner
2. Wackernagel M, Rees WE. Our Ecological Footprint: Reducing Human impact on the Earth. British Columbia: New Society Publishers; 1996. Professor William Rees of the UBC School of Community and Regional Planning and then PHD student, now president of Global Footprint Network, Mathis Wackernagel coauthored this book.
3. Kuzyk LW. Ecological and carbon footprint by consumption and income in GIS: down to a census village scale. *Local Environment* 2011;16(9):871 [online]. See Figures 4 to 7 for maps displaying global hectares. Available at: http://www.tandfonline.com/doi/abs/10.1080/13549839.2011.615303
4. Global Footprint Network. GFN maintains updated Ecological Footprint and biocapacity calculations for each country. The State of the States project will calculate these for each American state soon. Available at: http://www.footprintnetwork.org/en/index.php/GFN/
5. Anielski M, Wilson J. Ecological Footprints of Canadian Municipalities and Regions, The Canadian Federation of Canadian Municipalities; 2005. Available at: https://www.fcm.ca/Documents/reports/Ecological_Footprints_of_Canadian_Municipalities_and_Regions_EN.pdf
6. Global Footprint Network, Footprint for Cities, Case Studies. The City of Calgary is one GFN partner. Available at: http://www.footprintnetwork.org/en/index.php/GFN/page/case_stories/#calgary
7. The City of Cardiff, Wales, City Development, Sustainable Planning. Cardiff uses the Ecological Footprint as a sustainability measure for urban planning. Available at: http://www.cardiff.gov.uk/content.asp?Parent_Directory_id=2865&nav=2870,3148,6218,6224
8. Kuzyk LW. Infill Housing Sustainability Analysis. *AACIP Journal* 2010;4:19 [online]. Available at: http://www.albertaplanners.com/sites/default/files/PDFS/APPIJournalSpring2010.pdf
9. Postal codes were grouped to ensure a minimum count of 10 residents according to the City of Calgary civic census. This is the minimum level at which civic census data can be released for this tool.
10. Calgary Community Greenhouse Gas (GHG) Reduction Plan. Available at: http://www.calgary.ca/UEP/ESM/Pages/Climate-change/Community-Greenhouse-Gas-Plan.aspx
11. ImagineCALGARY, Target 77. Available at: http://www.imaginecalgary.ca/what-imaginecalgary/plan
12. The City of Calgary, Suburban Residential Growth 2013-2017: Monitoring Growth and Change Series. Available at: http://www.calgary.ca/PDA/LUPP/Documents/Publications/suburban-residential-growth-2013-2017.pdf
13. Climate Change Planning: Case Studies from Canadian Communities 2012, Ecological Footprint and Land Use Scenarios, (Key Lessons pg 29). This publication suggests procedure of implementation of the Ecological Footprint as a sustainability measure. Available at: http://www.planningforclimatechange.ca/wwwroot/dsp_Library.cfm
14. Kuzyk LW. The ecological footprint housing component: A geographic information system analysis. *Ecological Indicators* 2012;16:31 [online]. See Figures 7 and 8 for Ecological Footprint based on housing type and density BEFORE conversion of data to per capita. Available at: http://www.sciencedirect.com/science/article/pii/S1470160X11000628