

City of Northfield, MN: Decarbonization of New Buildings

Clausell Stokes III

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Executive Summary:

Buildings contribute significantly towards the carbon footprint and energy usage.

Northfield has a stake in attempting to decrease these carbon emissions both in operation and in embodied energy, within this paper I will identify 7 general recommendations for municipalities to reduce the carbon footprints. Furthermore, of those listed, I will expand on the recommendation that would benefit Northfield most.

Through partnering with the Minnesota GreenSteps, it is assumed that several of these recommendations were considered through its best practices. However, two underscored programs, energy disclosures and carbon budgeting, offer enticing decarbonization effects through communal influence and market drive on the private sector. Energy use disclosures, of high energy intensive buildings, allow engagement amongst developers, realtors, and consumers. Benefits of this engagement will depend on current trends of consumer preference towards more sustainable buildings as well as developer preference towards building efficiency. Energy use disclosure benchmarks will encourage developers by increasing transparency between all participating parties. The most important obstacle to this policy is lack of enforcement to publicly reveal energy usage. This can be avoided by dealing directly with the local utility providing companies to give the required information, with the right preset conditions.

The next program is the adoption of a carbon budget. Northfield would take measurements of its current carbon and other GHG emissions and trends. Then based on this knowledge, it would work with local groups and communities to reduce these emissions through collaborative efforts. Typically, there is a goal with a percentage reduction of carbon by a certain time period, such as the SB 2030. However, to further incorporate buildings and their

construction process, these measurements would also include embodied energy within the construction material. Since a significant contribution of the carbon footprints released by buildings stem from its materials and its construction process, this will allow these communities and the municipality to carefully consider more efficient strategies of the building construction process rather than simply the building design. This will align both private developers, municipalities, and localities to collaborate to reduce carbon emission to an acceptable level within a given timeframe. This will be particularly useful in engaging with the pluralistic community opinions as its flexibility does not rely on mandates, but practices offered by these groups.

The usage of energy disclosures will also impact the tracking for the carbon budget for policy makers. Furthermore, both energy use disclosures and carbon budgets have the effect to enhance the Minnesota GreenSteps New Building Best Practices. As the new building practices within the GreenSteps program is being considered, these two aforementioned practices work to accomplish or enhance the best practices of private developer incentive, with energy use disclosures, as well as collaboration with local groups, with the carbon budget program.

INTRODUCTION:

The predicted lifespan of newly constructed buildings average well beyond three decades. For example, if a building were to begin construction today than they are likely to survive well past 2050¹. In consideration of this, new technology and practices related to new buildings will provide an opportunity to decrease our greenhouse gas (GHG) emissions. Primary objectives to achieve these goals include the consideration of embodied energy, maximizing energy efficiency within new buildings both residential & commercial, and the incentivization to construct more zero-energy buildings² (ZEBs). Embodied energy can be defined as the energy contained in the materials used to construct new buildings including emissions from resource extraction, processing, material production, building construction, building deconstruction, and disposal as well as transportation for those activities. Zero-energy buildings are an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy. The failure to implement change towards more sustainable new building designs would lead to significant delayed measures in constructed buildings.

Currently, there are many options to consider for new building designs in both technology implementation and local legislation. The most optimistic approach is the transition from natural gas usage to electricity. Other methods include the use of passive building or buildings designed to require less energy through improved insulation, the emulation of LEED or

¹ Paddock, Lee, and Caitlan McCoy. "Deep Decarbonization of New Buildings." *Environmental Law Reporter* 48 2, (02, 2018)

² Roger Grant et al., National Institute of Building Sciences et al., *A Common Definition for Zero Energy Buildings 2* (2015), available at https://energy.gov/sites/prod/files/2015/09/f26/bto_common_definition_zero_energy_buildings_093015.pdf.

Energy Star standards within building codes, the use of energy budgets, and the expanded use of district heating systems.

We will analyze the potential challenges and impacts these seven general practices for reducing GHG emissions and energy usage within new buildings, while taking special consideration on energy use disclosures and carbon energy budgets. First, we will address the importance of lower GHG emissions from new buildings. Next, we will describe the considerations that Northfield is currently analyzing. Lastly, we will address the benefits of energy use disclosures and carbon budgets would benefit Northfield

The Importance of Reducing Our Carbon Footprint within New Buildings:

This section will focus on the current trends and impacts associated with buildings and their contribution to climate change as well as raise important questions regarding preventative measures. This part will utilize information attained from the U.S. agencies and empirical data taken from the University of Minnesota, both of which show similar trends. Within this section we will outline the

A significant portion of the global GHG emissions stem from the construction and use buildings. With the lifetime of the building in consideration, it is imperative that action be taken to prevent the lock-in of building stock that produces significant carbon emissions. According to the U.S. Energy Information Agency, nearly 40% of all U.S. energy use stemmed from buildings

within 2015.³ Approximately 9%-46% of that energy is accounted for as embodied energy.⁴ The University of Minnesota's Center for Sustainable Building Research similarly estimated a 44%-60% contribution to U.S. GHG emissions from buildings; 30-40% of those emissions are derived from building operating energy and 3-5% stem from building materials' embodied energy.⁵ Lastly and within a global scale, 9% of the global GHG emissions stem from solely U.S. buildings.⁶

Energy usage has become more efficient and GHG emissions have reduced as reflected by a reduction of 23% building energy intensity between 2003 and 2012.⁷ Yet to achieve more thorough decarbonization, there needs to be radical change and more direct action from federal, state, and local governments employing the considerations stated in the introduction. Incidentally, current efforts amongst many municipalities to reduce the energy use and GHG emissions are increasingly being centered on the concept of ZEBs. Northfield should follow this trend towards ZEBs. If not to contribute towards a more sustainable future, then for the many co-benefits such as reduced utility costs, potentially cheaper construction processes, or for consumer market drive towards sustainable products. Utilizing the best technology achieved today, it is

³ Søren E. Lutken & Per Harry Wretling, UNEP DTU Partnership, Working Paper Series No. 13, City Based Carbon Budgets for Buildings 3 (2016), http://www.unepdtu.org/-/media/Sites/Uneprioe/Working%20Papers/Working-Paper-13_LCD_final.ashx?la=da.

⁴ James H. Williams et al., Energy and Environmental Economics, Inc. et al., US 2050 Report, Volume 2: Policy Implications of Deep Decarbonization in the United States 1, 22 (2015) [hereinafter Policy Implications of Deep Decarbonization], available at http://deepdecarbonization.org/wp-content/uploads/2015/11/US_Deep_Decarbonization_Policy_Report.pdf.

⁵ <https://greenstep.pca.state.mn.us/bestPracticesDetail.cfm?bpid=3>

⁶ U.S. Department of Energy, Energy Efficiency Trends in Residential and Commercial Buildings 11 (2008), available at http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/bt_stateindustry.pdf.

⁷ EIA, Recent Energy Intensity Decline in Government Buildings Exceeds Commercial Sector Average, Today in Energy, Sept. 16, 2016, <http://www.eia.gov/todayinenergy/detail.cfm?id=27972>.

possible to reduce energy demand by up to 78% for commercial buildings and 61% for residential buildings.

Lastly, it is important to state the implicit economic incentive with decreased energy demand from buildings. Climate change notwithstanding, the energy optimization provided by ZEBs significantly reduces the total operation energy cost.

WHAT NORTHFIELD IS ALREADY DOING?

Municipality:

The issue regarding building energy use is not an extremely new topic to Northfield. At both the municipal and grass roots level, there are multiple outlets for implementing more efficient designs towards ZEBs. Regarding the municipality, Northfield has adopted the Minnesota GreenSteps Cities program. Minnesota GreenSteps is “a voluntary challenge, assistance and recognition program to help cities achieve their sustainability and quality-of-life goals” that is tailored toward the specific needs of Minnesotan cities.⁸ This program is designed for Minnesota municipalities to specifically limit their building carbon emissions and power usage. The following are the best practices within the GreenSteps program related to new building design and construction.⁹

⁸ Minnesota Pollution Control Agency. “Minnesota GreenSteps Cities.” 2018. <https://greenstep.pca.state.mn.us/>

⁹ Ibid.

- 1) Require by city policy that new city-owned buildings be built using the SB 2030^{10,11} energy standard and/or a green building framework.
- 2) Work with the local school district to ensure that future new schools are built using the SB 2030 energy standard and/or a green building framework.
- 3) Customize a model sustainable building policy that includes the SB 2030 energy standard and adopt language governing new private development projects that:
 - a) Receive city financial support, and/or
 - b) Require city regulatory approval (conditional use permit, rezoning, variance, PUD).
- 4) Provide a financial or other incentive to private parties who build new buildings that utilize the SB 2030 energy standard and/or a green building framework.
- 5) Adopt environmentally preferable covenant guidelines for new common interest communities addressing issues such as storm water, greywater, native vegetation, growing food, clothes lines, and renewable energy.

It is important to note that Northfield is only in consideration of these practices and could choose other methods to receive GreenSteps certification. Northfield, following the general guidelines as a Class A City, based upon population and size, is encouraged to complete either SB 2030 energy goals for new buildings or work with the local education system so that future schools meet SB 2030 energy goals. Following this, Northfield would complete two out of three of the remaining conditions.

¹⁰ SB 2030 is an addition to building codes that are both stricter than State building codes when it comes to energy usage and emissions. Strategies such as these generally reference and emulate LEED and Energy Star programs in terms of certification requirements. The goal of this program is to completely reduce carbon producing fuel sources for buildings by 2030 with a projected 10% reduction in carbon producing fuels every five years. Incidentally, this is based from a measures 60% reduction in carbon producing fuels following 2010.

¹¹ Minnesota SB 2030 Energy Standards. "B3 Sustainable Building 2030 Energy Standards." Minnesota B3. 2018 <http://www.b3mn.org/2030energystandard/>

Grassroots:

Outside of city government, there are numerous local grassroots groups who are attempting to influence the design of new buildings to be more sustainable. These groups include the Citizen's Climate Lobby, Clean Energy Resource Teams, ISAIAH, Northfield Area Community Solar Project, RENew Northfield, and Transition Northfield. It is important to note that most of these groups focus specifically on renewable energy and not specifically new buildings, yet each group supports and influences each other through the Greater Northfield Sustainability Collaborative which is a space for these local groups to facilitate discussion¹². Each of these groups have different strategies and methods to decrease emission and power usage of upcoming buildings and should be consulted for pluralist opinion of strategies.

RENew Northfield and Transition Northfield both give exceptional weight to more efficient building designs. RENew Northfield encourages measures to equip buildings with energy efficient appliances and materials, apply passive building techniques, and regular inspections or audits of high energy intensity buildings.¹³ Transition Northfield has notified on their website that they are researching more of the impacts and resolutions of building outputs.¹⁴ However, Transition Northfield is currently focused in on general energy efficiency and energy fuel source quality in relationship to emissions.

WHAT ACTIONS WILL YIELD THE MOST SIGNIFICANT IMPACT:

¹² <http://northfieldsustainability.org/>

¹³ http://renewnorthfield.org/?page_id=335

¹⁴ <http://transitionnorthfield.org/about-2/>

Municipalities have several methods of encouraging and driving building design within their boundaries. For Northfield municipality's intervention, most of these strategies will depend on building codes and energy use disclosure requirements. The following are ranked in order of highest feasibility to lowest:¹⁵

- 1) Local legislative bodies should adopt advanced building and energy codes that reduce carbon use.
- 2) Local legislative bodies should mandate that new commercial buildings over a specified size achieve the equivalent of at least the latest versions of LEED Gold Certification.
- 3) Local legislative bodies should adopt a citywide carbon budget that includes the carbon impact for new buildings. City carbon budgets should consider embodied energy to encourage materials substitution in a circumstance where substitution is appropriate.
- 4) Local legislative bodies should require energy use disclosure, emphasized further for larger commercial buildings. Publicly available benchmarks should be available to potential renters and buyers.
- 5) Local legislative bodies should consider or expand the use of district heating systems.
- 6) Local legislative bodies should switch when feasible to district heating and cooling
- 7) Local legislative bodies should decarbonize their utility systems, where they own or operate such systems

With regards to advanced building and energy codes, LEED Gold Certification for buildings with excessive energy demands, recommendations 1-2 are partially addressed within the Minnesota Green steps program. Recall that Green steps best practices #1 for new buildings

¹⁵ Paddock, Lee, and Caitlan McCoy. "Deep Decarbonization of New Buildings." *Environmental Law Reporter* 48 2, (02, 2018)

suggests the utilization of SB 2030 program. As mentioned before, SB 2030 buildings codes are emulations of LEED and Energy Star but are more tailored towards the needs Minnesotan cities. While the SB 2030 program does not emphasize stricter rules upon large commercial buildings, it would still have a significant impact in reducing their emissions. These top two practices, LEED Certification & energy and building codes, are regarded as the most effective in reducing carbon emission and energy usage as evident by the Minnesota Green Steps participants and reports. Specifically addressing advanced building and energy codes, these are typically emulated after LEED, Energy Star, or any other energy equivalent program since requirement of all buildings to achieve certification in any of these areas is potentially overstepping of municipal powers. This paper is operating under the assumption that these top two recommendations have already been considered and will instead focus on the subsequent.

Furthermore, while district heating and decarbonization of utility systems show significant impact on carbon reduction, as seen in St. Paul and Palo Alto¹⁶, these models relate more to larger, denser cities that have vastly superior capital and resources to the City of Northfield. While these are viable options, due to lack of feasibility, they are not the focus of this paper. Emphasis within this proposal will go towards city carbon budgets and energy use disclosures and their effect on the private sector.

KEY ISSUES IN PROGRAM DESIGN AND IMPLEMENTATION

Energy Use Discloses & the Private Sector:

¹⁶ *ibid*

Energy use disclosures is the practice of evaluating the energy efficiency of a home or building and making the information known to consumers.¹⁷ Using energy use disclosures, municipalities also have the option to indirectly influence the private sector within their borders. It should be noted that the private sector is increasingly pursuant in Green Building constructions. It is estimated that approximately 60% of new building construction, both commercial and institutional, shall qualify as “green” by 2018 as opposed to the 33% of 2015. Municipalities have the option to encourage, through subsidization as an example, growth of Green buildings. Furthermore, much of the demand for green buildings is coming from customer desires and better building performances as opposed to government mandates. This encourages the awareness of the impacts caused by building emission and energy use while heavily implying the importance of energy use disclosure.

Currently, there are several case studies which are attempting or have already implemented energy use disclosures for both residential and commercial buildings. They include but are not limited to New York City in New York, Austin in Texas.¹⁸ Most of these programs were to influence the private sector through the market and consumer drive. Other than private sector incentive, several of these case studies use these disclosures to determine specific categories or areas of improvement for future planning.

Within New York and under the Greater Greener Buildings Plan, the energy disclosure benchmarks which are reviewed annually applied to city owned public facilities exceeding

¹⁷ American Council for an Energy Efficient Economy. “Residential Energy Use Disclosure: A Guide for Policymakers.” American Council for an Energy Efficient Economy. 2014. 2018.
<http://aceee.org/files/pdf/toolkit/residential-energy-use-disclosure.pdf>

¹⁸Northeast Energy Efficiency Partnerships. “Building Energy Rating and Disclosure Policies Update and Lessons From the Field.” Northeast Energy Efficiency Partnerships. 2013. 2018.
https://www.energy.gov/sites/prod/files/2014/05/f15/BER%2520Supplement_FINAL%2520DRAFT_2-25-13.pdf

10,000 gross sq-ft, large commercial and residential buildings exceeding 50,000 gross sq-ft of interior space, or any two or more buildings on the same tax lot that together exceed 100,000 gross sq-ft. Failure of compliance was designated as a lesser violation under the New York City Municipality Construction Codes with a penalty of \$500. The focus on large buildings that typically have city-wide management services facilitated communication and compliance. Technical support from the utilities also served to inform clients of their reporting requirements and provide them with aggregate billing data. New York also required energy audits on top of the energy disclosure for applicable buildings. These audits were essentially used to educate and implement new strategies to reduce carbon emissions within those buildings.

Austin, Texas unlike New York only required energy use disclosures prior to any sale of a building. Under the Energy Conservation Audit and Disclosure Ordinance ECAD requires owners of single-family, multi-family, and commercial properties to perform a rating of their building's energy performances and report the results to prospective buyers at the time of sale. Commercial buildings, similar to New York, exceeding a predesignated size also had to undergo annual reevaluation of their energy use disclosure.

Building owners would consider the total embodied energy of their designs as well as energy efficiency with the aim of reducing embodied carbon and overall environmental impacts. Lastly, trade associations, such as the Builders Association of Minnesota or Minnesota Construction Association, involved in the training of future designers and architects would be encouraged to increase training opportunities for passive buildings and LEED certification building designs.

Property owners will be able to identify energy priorities for building energy improvements. Prospective buyers will gain more information about the operational costs of

owning the buildings under their consideration. This also has added benefit on local energy budgets as policymakers will get more access to data on the energy use of the existing building stock, to both inform future policy development and track progress toward meeting local climate or energy reduction goals for buildings. The cross marketing of utility and disclosure programs can encourage prospective buyers and renters to leverage energy efficiency programs to make improvements, helping utilities and other developers to increase participation in energy efficiency programs, helping them to achieve program goals. In other words, this will encourage the private sector's architects, designers, and developers to produce greener and cleaner buildings^{19,20}.

Energy use disclosure benchmarks have been traditionally developed from the Energy Star Portfolio Manager. The program assigns an Energy Star score between 1 and 100, based the correlation between actual data to model predictions with the same ratio for samples of buildings of its type across the country. A score of 50 would be equivalent to the median in this case and 75 would be Energy Star certified.²¹ The enforced score for the City of Northfield would depend on a variety of factors which would require more in-depth research.

Encouragement of the private sector, through energy use disclosure, could lead to several positive effects on both individual planners as well as associations. Theoretically, Northfield would only require the public knowledge and easy access of energy use disclosures, particularly for large buildings. Market drivers would assume the regulatory role, encouraging greener

¹⁹ Paddock, Lee, and Caitlan McCoy. "Deep Decarbonization of New Buildings." *Environmental Law Reporter* 48 2, (02, 2018)

²⁰ American Council for an Energy Efficient Economy. "Residential Energy Use Disclosure: A Guide for Policymakers." American Council for an Energy Efficient Economy. 2014. 2018. <http://aceee.org/files/pdf/toolkit/residential-energy-use-disclosure.pdf>

²¹ Ibid.

practices with new building designs. This could be an effective “no risk” practice with proper implementation. For example, if publicly show the citizens the extended benefits of green buildings, support the best practices for new buildings within the GreenSteps program, and give them knowledge on current building emission and energy trends, then building developers and purchasers would commit to building with SB 2030 standards. This also highlights the importance of climate change awareness and education within Northfield. Collaborative efforts with local groups, schools, and public gatherings to reinvigorate the charge against climate change will influence the masses to sympathize more and consequently lead the market.

Building owners would consider the total embodied energy of their designs as well as energy efficiency, with the aim of reducing embodied carbon and overall environmental impacts. Lastly, trade associations and other organization involved in training building professionals would increase training opportunities for architects, developers, and builders on passive buildings and LEED certification qualities.

Another way of obtaining energy use disclosure data from citizen if participation is lacking is to partner with electricity companies who will willingly give energy budget information to authorized requestors. The use of this method was illustrated in Seattle, New York, and Washington where property owners were unable to get specific information from their tenants.²² These case studies partnered with their local electricity providers and under a set of condition would hand over information. For example, Pepco in Washington would “provide building-level billing data to authorized requestors—namely, building owners and their agents—when five or more accounts are present in a building and a single account does not represent

²² Ibid.

more than 80 percent of total energy consumption for the building.” Seattle similarly has obtained whole building data by installing an automated upload of energy use data by utilities into the portfolio manager software.²³

One major implication on the use of energy disclosures is that the lack of enforcement. It is important to note that as a municipality, the city of Northfield is mainly attempting to increase transparency between planners, developers, and consumers. Ultimately, municipality would be relying on the consumer driven pressure for more sustainable buildings. To reinterpret this practice, this is not a regulation on building emissions but a regulation on the public knowledge of building emissions. This is to shift the role of regulator from municipality to the citizens and not limit municipal resources through constant and extraneous regulation. In other words, as this program becomes more widespread, consumers will demand, if not already expecting, energy use disclosures from developers or realtors.

Carbon Budgets:

This is generally used in conjunction with city wide carbon budgets. A carbon budget is a tolerable quantity of greenhouse gas emissions that can be emitted in total over a specified time.²⁴ The local government and the needs of the municipality would determine the exact quantity. Carbon budgets should consider both the operational budget that aligns with building codes as well as the embodied energy.

The goals of carbon budgets can be summarized into two points, the reduction of carbon emissions and the substitution of carbon intensive construction material with less intensive ones.

²³ Ibid.

²⁴ WWF “UNDERSTANDING CARBON BUDGETS.” 2018.
http://awsassets.wwf.org.za/downloads/understanding_carbon_budgets_final.pdf

It is important to note that the objective is not to replace the current building code requirements on energy efficiency, but to provide a context under which the materials used to achieve a given level of energy efficiency are also considered.

First, the industry can respond to high emission, through captive power production or the use of energy policies towards greater adoption of emissions-free energy. Captive power production would be defined as energy produced by an industrial or private enterprise for their own personal use. Furthermore, within this context captive power production is recommended to be renewable energy such as wind or solar. Secondly and more relevantly, carbon budgets can be focused on processed carbons such as cement and steel which cannot be influenced easily. Excessive production should be avoided by product substitution or increased efficiency in material usage. Substitution plans should include a construction materials recycling program which would make the construction process more efficient by decreasing the amount of newly made processed carbons.

Whereas energy use disclosures allowed consumers to determine new building efficiency, energy budgets will give special attention towards community preference²⁵. The city carbon budgets concept aligns local powers regarding land use, zoning, transport programs and investments, and building codes with efforts at the state and national levels to reduce greenhouse gas emissions. The policy would assign responsibility to localities for reducing the emissions from local transport and buildings energy use. Cities, counties, & localities with a carbon budgets program would be self-responsible for reducing their per capita carbon footprint by a predetermined percent over a given time and technical assistance. Ultimately, this would

²⁵ Salon, Deborah & Sperling, Dan & Meier, Alan & Murphy, Sinnott & Gorham, Roger & Barrett, James. (2008). City carbon budgets: Aligning incentives for climate-friendly communities. Institute of Transportation Studies, UC Davis, Institute of Transportation Studies, Working Paper Series.

encourage solutions that are tailored to the communities where they will be implemented.

Different local groups and communities will make different local policy and investment choices to reach climate goals. These policies should stem from real differences between communities in the costs and emissions benefits of different strategies. Furthermore, due to this flexibility, it is likely that many of the resulting local initiatives will not only reduce greenhouse gas emissions but will also make these communities more attractive places to live and work.

First, it is necessary to establish the correct budget from the outset. A highly rigid budget would hamper construction activity, too lax would have negligible influence on the industry. Carbon budget allocation for construction may then be grandfathered or charged for²⁶. Grandfathering means that the budget is allocated for free or that persons or entities can continue with activities or operations that were approved before the implementation of new rules, regulations, or laws. This approach thus provides no income opportunity for the city, leaving the developers with only the budget challenge to comply with and not an additional cost to purchase the required carbon budget. The alternative is that the city charges a fee for the budget, which beyond the possible income generation for the city may also have developers to consider how small of a budget they can deal with. In other words, after a certain amount of predicted carbon emissions past the predetermined municipal rate, any extra emissions would be measured, tallied, and priced for the developer from the city. This might also inspire a desirable race to the bottom in terms of emission to avoid exorbitant developmental costs

While there are two options for the allocation of initial budgets, there are also two optional approaches for extending them. First, carbon budgets are set without allowing topping

²⁶ Lütken S, Wretling PH. 2016. City-based Carbon Budgets for Buildings. UNEP DTU Partnership. (UNEP DTU Partnership Working Paper Series 2017; No. 13).

up, or a fixed budget that is enforced through strict penalties. Second, the city establishes a pricing policy for adding a new carbon budget to the account once the initial assigned budget is depleted. The former is more desirable for several reasons including the technicalities of setting up the initial budget. Furthermore, it is the preferable option due to the traditional owner and tenant conflict of interest.

Conclusion:

One major impact of both energy use disclosures and carbon budgets is that they can enhance a program of which the City of Northfield is already engaged with, Minnesota GreenSteps. Whether or not new buildings best practices were considered with the trajectory of Northfield, the programs laid out in this paper directly offers or enhances two of the five requirements of new buildings within GreenSteps. They offer an indirect incentive for developers to go green with the energy disclosure. Secondly, they offer a situation for the formation of a collaboration between municipality and locality with the carbon budget to consider practices that best helps the different communities.