Towards Resilience:

CHARLOTTE.SM

Strategic Energy Action Plan

December 2018

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FOREWORD

In February, the NBA All-Star game will be held here. In 2020 the Queen City will host its second major political convention. Our population is growing. Business is booming. We boast a world-class urban tree canopy. We are a welcoming and diverse city, that is resilient with beautiful community spaces, and where every person can thrive and prosper.

As a signatory to the Global Covenant of Mayors since 2015, the City of Charlotte has joined thousands of cities and regions in a commitment to accelerate ambitious, measurable climate and energy initiatives that lead to an inclusive, equitable, low-emission and climate resilient future; this will help us to meet and exceed the Paris Agreement objectives. Charlotte City Council, who voted unanimously on a resolution to direct Charlotte down this low-carbon path, and city leadership are committed to achieving our community's aspirations.

As part of our commitment to the Global Covenant of Mayors, we are pleased to introduce the City's first Strategic Energy Action Plan (SEAP) that sets out a framework to guide Charlotte's transition to a low-carbon future. By implementing this plan, Charlotte will take advantage of a unique opportunity for growth. The SEAP provides solutions for reducing our carbon emissions but will also make Charlotte a more attractive place to live and work and be globally competitive.

Charlotte is approaching the approval of the SEAP, and the associated accomplishment of the aspirational 2030 internal goal outlined in the resolution, using a two phase approach. The SEAP focuses on community based efforts, though it includes some general recommendations about how the city might strive toward zero-carbon facilities and fleet. Internal operational efforts for the transition of Charlotte's government fleet and facilities are presented as an appendix to the SEAP. The appendix contains implementation information to support short-term, mid-term, and long-term objectives recommended to move toward the accomplishment of the internal aspirational goals. More information on this can be found on charlottenc.gov. This information and data will be updated annually as the SEAP progresses.

Achieving a low-carbon future for Charlotte will require a transformational change in the way we consume and generate energy. We have set aggressive targets to achieve by 2030 and 2050. We know that this will be challenging and require new and innovative ideas, projects and collaborations. The City will provide the leadership and some of the resources, but it will take the entire community and collaborative partnerships to make Charlotte a sustainable and resilient community. It requires companies and organizations to look at their role in this, as well as citizens to look at how they are using energy each day.

The year of 2018 will go down in Charlotte history books as the year Charlotte became a globally recognized leader in resiliency. We are in the process of making an extraordinary effort to coordinate and connect a series of catalytic and integral strategies, laying a robust foundation for a resilient and sustainable future for Charlotte. This means that all our communities and neighborhoods are hubs for innovation where there is equitable access to green jobs and training, and where an atmosphere of entrepreneurship and inclusion are fostered.

Charlotte has a strong tradition of unparalleled public participation and engagement. This is not something the City of Charlotte can implement on our own – we need the community to collaborate with us and bring innovative projects and solutions to improve our neighborhoods and City and meet our targets. The City will build on the successful engagement that helped develop the SEAP, and we continue to work to engage all communities and citizens across the City as we implement the SEAP to achieve our targets. We understand the enormity of the challenge before Charlotte and the world, but together we can meet this challenge and succeed!

Vi Lyles
Mayor

Marcus Jones
City Manager

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CHARLOTTE CITY COUNCIL

Julie Eiselt, Mayor Pro Tem

Dimple Tansen Ajmera, At-large

James Mitchell Jr., At-large

Braxton Winston, At-large

Larken Egleston, District 1

Dr. Justin Harlow, District 2

LaWana Mayfield, District 3

Gregory A. Phipps, District 4

Matt Newton, District 5

Tariq Bokhari, District 6

Edmund H. Driggs, District 7

Charlotte has a council-manager form of government with a mayor and 11 council members elected every two years in November, and a professional city manager to run the day-to-day operations. The mayor and four council members are elected at-large by a city-wide vote. Seven council members are elected from districts by voters who reside in each district.

The mayor and city council are the "board of directors" for this municipal corporation. As such, they set policy, approve the financing of all city operations and enact ordinances, resolutions and orders. Their responsibilities also include appointing the city manager, city attorney, city clerk and members of various boards and commissions.

Together, the mayor and city council members are responsible for establishing the general policies under which the city operates.

These include:

- Appointing the city manager, city attorney, city clerk and members of various boards and commissions enacting ordinances, resolutions and orders.
- Reviewing the annual budget, setting the tax rate and approving the financing of all city operations.
- Authorizing contracts on behalf of the city.

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ACKNOWLEDGEMENTS

A body of work like a Strategic Energy Action Plan does not come together without a substantial amount of effort from many people over a long period of time. What started with a vision went through many iterations and changes to reach the final document before you. In addition to the people identified in the Credits, I would like to call out a few individuals who went above and beyond expectations.

Emily Yates, with Envision Charlotte, was the heart and soul of this project. The City partnered with Envision to produce the SEAP, but Emily was its constant champion, editor, and visionary. Without Emily's dedication and expertise, we would not have been successful.

Dr. Sebastian Carney has been identified as the technical expert on the SEAP, which he was, but his input went far beyond just the technical components. He shared his wisdom and experience with the team as well as strategic guidance. He also endured multiple course and scope changes as we worked through what was the right direction for Charlotte.

Finally, our internal team of Kim Eagle, Gina Shell, Erika Ruane and our newest team member, Katie Riddle, spent countless hours editing, strategizing, meeting, and envisioning the best course of action with multiple partners and stakeholders. Their dedication to this project and community has been humbling and instrumental to its success.

We have a lot of work left to do as we move into implementation, but we should all take a moment to appreciate how far we have come and the commitment we have made to a better quality of life for all Charlotteans.

Sincerely,

Rob Phocas
Sustainability Director
The City of Charlotte

The SEAP was developed in partnership with:

CHARLOTTE SEAP

carbon captured ltd

ENVISION CHARLOTTE

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LIST OF ACRONYMS

SEAP: Strategic Energy Action Plan

GCoM: Global Covenant of Mayors

GRIP: Greenhouse Gas Regional Inventory Protocol

GHG: Greenhouse Gas

CDP: Carbon Disclosure Project

GPC: Global Protocol for Cities

WRI: World Resource Institute

ICLEI: International Council for Local Environmental initiatives

CER: Clean Energy Resolution

RETI: Renewable Energy Transition Initiative

PV: Photovoltaic

CCHP: Combined Cooling Heat and Power

CHP: Combined Heat and Power

CO_2: Carbon Dioxide

CO: Carbon Monoxide

NO_2: Nitrogen Dioxide

O_3: Ozone

SO_2: Sulfur Dioxide

PM: Particulate Matter

UFMP: Urban Forest Master Plan

PSF: Policy for Sustainable Facilities

LEED: Leadership in Energy and Environmental Design

SFOT: Sustainable Facilities Oversight Team

EFAP: Environment Focus Area Plan

USGBC: United States Green Building Council

HCDT: Hybrid Collaborative Delivery Team

UDO: Unified Development Ordinance

GDP: General Development Policies

CO_2e: Carbon Dioxide Equivalent

$2TCO_2e$: Two Tons of Carbon Dioxide Equivalent

AFV: Alternative Fuel Vehicles

SWS: Solid Waste Services

CATS: Charlotte Area Transit System

EVs: Electric Vehicles

CNG: Compressed Natural Gas

FMAT: Fleet Maintenance Advisory Team

TOD: Transit Oriented Development

CGS: Charlotte Gateway Station

MSAP: Multi-Modal Station Area Plan

P.I.E.C.E: Partnership for Inclusive Employment and Career Excellence

ICE: Internal Combustion Engine

LED: Light-Emitting Diode

UNCC SIBS: University of North Carolina Charlotte Sustainably Integrated Building Systems

DOE: Department of Energy

DEC: Duke Energy Carolinas

DEP: Duke Energy Progress

CMS: Charlotte- Mecklenburg Schools

RNC: Republican National Convention

DNC: Democratic National Convention

HB 589: House Bill 589

CCS: Carbon Capture Storage

IRP: Integrated Resource Plan

ECAG: Expert Content Advisory Group

CREDIT: City Resilience Delivery Team

ESCO: Energy Service Company

SMEs: Small and Medium-Sized Enterprises

UNCC EPIC: University of North Carolina Charlotte Energy Production and Infrastructure Center

RID: Resilience Innovation District

EIZ: Energy Innovation Zone

SCDM: Smart City District Model

BRT: Building Re-tuning Training

Kw: Kilowatt

Kwh: Kilowatt Hours

BAS: Building Automation Systems

ECS: Energy Control Systems

CFMT: Charlotte Fleet and Maintenance Team

PACE: Property Assessed Clean Energy

CDOT: Charlotte Department of Transportation

CRVA: Charlotte Regional Visitors Authority

BECCS: Bioenergy Carbon Capture and Storage

IPCC: Intergovernmental Panel on Climate Change

NCUC: North Carolina Utilities Commission

DSI: Data Science Initiative

NCDOT: North Carolina Department of Transportation

EU: European Union

INTRODUCTION

This is the City of Charlotte's first Strategic Energy Action Plan (SEAP), as required by its commitment to the Global Covenant of Mayors (GCoM). The SEAP provides a framework for delivering the 'Sustainable and Resilient Charlotte by 2050' Resolution. The Resolution was championed by City Council's Environment Committee as an example of their leadership and commitment to Charlotte's low carbon future and was unanimously passed in June of 2018.

The SEAP provides a roadmap for the City's transition to a low carbon future, delivering the City Council's resolution to reduce greenhouse gas emissions to less than 2 tons of CO_2e per person across the City by 2050[1]. This target aligns the City of Charlotte with the Paris Climate Accord and the commitment made when the City signed onto the "We Are Still In"[2] coalition. The SEAP also complements Executive Order No. 80 (Appendix 1), signed October 2018 by Governor Roy Cooper.

To be a competitive city in a globally engaged era, Charlotte recognizes that the City needs to become more sustainable and resilient. This needs to be achieved by employing an integrated, inclusive, and systematic approach to urban development. The SEAP will form one part of the City's broader resiliency strategy and will be used to build stronger and more inclusive neighborhoods that can make informed decisions around the use of energy. The SEAP provides the City with the framework it needs to deliver the transition to a low carbon economy that attracts and retains talent, and grows local jobs and a green economy.

Recommendations provided by the SEAP will encourage innovative administration, organization, and mechanisms that ensure strategic alignment and efficiencies within implementation efforts. These recommendations enable the SEAP to align with other current and future City strategies, so that they are better integrated and mutually reinforcing. This includes key issues such as funding models, total costs of ownership, and policy revisions.

The City of Charlotte acknowledges that the SEAP is ambitious in documenting what the City wants to achieve, as the City seeks innovative approaches to the challenges and opportunities an energy regulated state provides. However, a key part of the SEAP is looking at recommendations and projects that are not only about energy generation, but how the City and its residents can change how they use and think of energy. The effort to successfully implement the SEAP and achieve a low carbon future lies within a citywide collaborative effort.

The Partnership

The City of Charlotte and Envision Charlotte[3] (Envision) have been working in close partnership to achieve the City's commitments to the GCoM. While both the City and Envision have local expertise, Envision Charlotte contracted with Carbon Captured, Ltd. from Manchester, United Kingdom, to bring in Dr. Sebastian Carney as a consultant with the necessary technical expertise.

Dr. Carney, CEO and Founder of Carbon Captured, Ltd. brings over 15 years of international experience in energy system modelling, carbon accounting, and greenhouse gas emissions reduction to the project. He also developed the Greenhouse Gas Regional Inventory Protocol[4] (GRIP) that was used in developing the SEAP as a mitigation project.

1 *A 2tCO_2e target was chosen as it was forward looking, required a baseline, and aligned with the Paris Accord.*

2 *"We Are Still In" is a coalition of more than 3,500 CEOs, mayors, governors, college presidents, and other leaders committed to climate action. (https://www.wearestillin.com)*

3 *A local non-partisan 501 (c)3 focused on sustainability.*

4 *A tool recognized by international organizations, like ICLEI-Local Government for Sustainability. The Greenhouse Gas Regional Inventory Process (GRIP) is a future scenario tool. It is used to inform and train city officials and staff to identify current policy options that may impact the success of delivering future greenhouse gases emissions reductions, energy security, and efficiency. GRIP is used in partnership by ICLEI. (http://urbanleds.iclei.org/index.php?id=1120)*

WHAT IS THE GLOBAL COVENANT OF MAYORS?

Charlotte committed to the GCoM for Climate & Energy in 2015. Subsequent Mayors affirmed this commitment when they took office.

The Covenant is an international alliance of cities and local governments with a shared long-term vision of promoting and supporting voluntary action to combat climate change and move to a low emission, resilient society. The signatory cities and communities are leading by example. Cities that sign on make a commitment to tackle climate change adaptation and resilience, and increase access to clean and affordable energy.

Once a commitment document has been submitted, cities are required to develop a greenhouse gas (GHG) emissions inventory utilizing their reporting platform.

Cities also commit to producing a SEAP as a plan that shows how the reduction in carbon emissions will be met. This is also submitted via their reporting platform.

The final step is reporting annually on the city's progress in achieving GHG reduction.

By participating in the GCoM, Charlotte opens access to an international network of cities and best practices, as well as opportunities for additional funding streams.

LYNX Blue Line light rail.

GREENHOUSE GAS EMISSIONS + TARGETS FOR EMISSIONS REDUCTION

A core requirement of the GCoM includes the development of a baseline for GHG emissions and a SEAP based upon relevant mitigation targets. The project launched in early December 2017 with a starting point of collecting the necessary data to develop the City's most granular greenhouse gas baseline yet.

Prior baselines have been developed for Charlotte, but have lacked granularity due to difficulty in obtaining the necessary data in the right format. Through engagement and a common working goal, this data was obtained and a structure identified to continue its collection. This engagement included multiple meetings with Duke Energy leadership, which eventually culminated in a meeting with Duke Energy's CEO, Charlotte's City Manager, and Envision Charlotte's Executive Director regarding the City's vision and proposed path toward a low carbon future.

There are many ways to report on GHG emissions. However, since Charlotte has committed to report its GHG baseline and submit annual updates via CDP (formerly the Carbon Disclosure Project) Cities reporting platform[5], the City has adopted the Global Protocol for Cities (GPC) methodology. There are two components to this: 1) a BASIC inventory that covers energy and waste emissions; and 2) a BASIC+ inventory that further includes agricultural, land use change, and industrial processes and product use emissions.[6] The energy component includes buildings and transportation. By utilizing this methodology and associated reporting, the City ensures it is following an "apples to apples" comparison with other cities globally.

Utilizing the Global Protocol for Cities to Set GHG Reduction Targets

A global standard for estimating emissions at the city scale has recently been established. This is called the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)[7]. This was formed through a coalition between the World Resource Institute (WRI), ICLEI, and C40 Cities Climate Leadership Group. Through the GCoM, hundreds of cities across the globe have committed to use the GPC to report their greenhouse gas emissions. For this reason, the CDP Cities reporting platform utilizes the GPC.

As the discipline of emissions accounting is so complex and is further complicated by variations in data collection techniques, the GPC affords a consistent framework for accounting and reporting citywide greenhouse gas emissions. Importantly, it guarantees international recognition of the approach used by Charlotte.

5 CDP collaborates with the other various organizations like ICLEI, C40, and WRI to support the global efforts to provide transparency and consistency in tracking and reporting global GHG emissions. (https://www.cdp.net/en/cities-discloser)

6 This is referring to emissions released due to specific industrial processes such as cement manufacture and GHG leakage in products such as air conditioner units.

7 This methodology will be the minimum used against which progress will be measured. The project team is careful to use the words minimum here to allow for the potential to incorporate wider 'embodied carbon emissions' into the calculations in the future. This is a further example of leadership being demonstrated by the City and recognition of the changing landscape of policy in this area. (https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities)

Traffic light and sign at E. Trade Street.

CHARLOTTE'S CARBON EMISSIONS + ENERGY CONSUMPTION PROFILE

The SEAP focuses on carbon dioxide equivalent greenhouse gases, which can be expressed as a single unit associated with energy demand and generation. The following section provides context around Charlotte's greenhouse gas emissions and energy consumption profiles, as well as the targets set for 2030 and 2050.

Charlotte's GHG Baseline

While 1990 is the standard year recommended as a baseline for countries for emissions reductions, cities most often utilize 2005 due to data availability. The GCoM recommends choosing the year for which a city can get the most comprehensive and reliable data. In Charlotte's case, the baseline year for the SEAP and the determined GHGs is 2015.

Charlotte's 2015 Baseline Emissions Inventory is 12tCO_2 per capita. This covers emissions for the entire geographic area of the City of Charlotte, and includes all emissions from energy and waste. Charlotte's biggest emitter is energy at 96%, with waste emitting 4%[8]. Buildings (residential and commercial) comprise approximately 56% of the emissions, with transportation rounding out the remainder at 40%. There is a small amount of industry included in these figures. What this shows, is that tackling emissions in the building and transportation sector will make the greatest contributions to achieving the SEAP targets.

The City is using CO_2e, or carbon dioxide equivalent, as the standard unit for expressing its GHG emissions. The purpose of this is to express the impact of each greenhouse gas in terms of the amount of CO_2 that would create the same amount of global warming. In this way, a baseline consisting of many different greenhouse gases can be expressed as a single number.

8 *While agriculture is currently at 0% of Charlotte's emissions inventory, it is anticipated to grow as the Circular Charlotte strategy is implemented. A key part of developing a circular economy paradigm within a city is redesigning food systems and recognizing that growing locally is a key part to this. So, while it's anticipated that agriculture emissions might increase minimally by growing locally, other emissions, like transportation, will subside.*

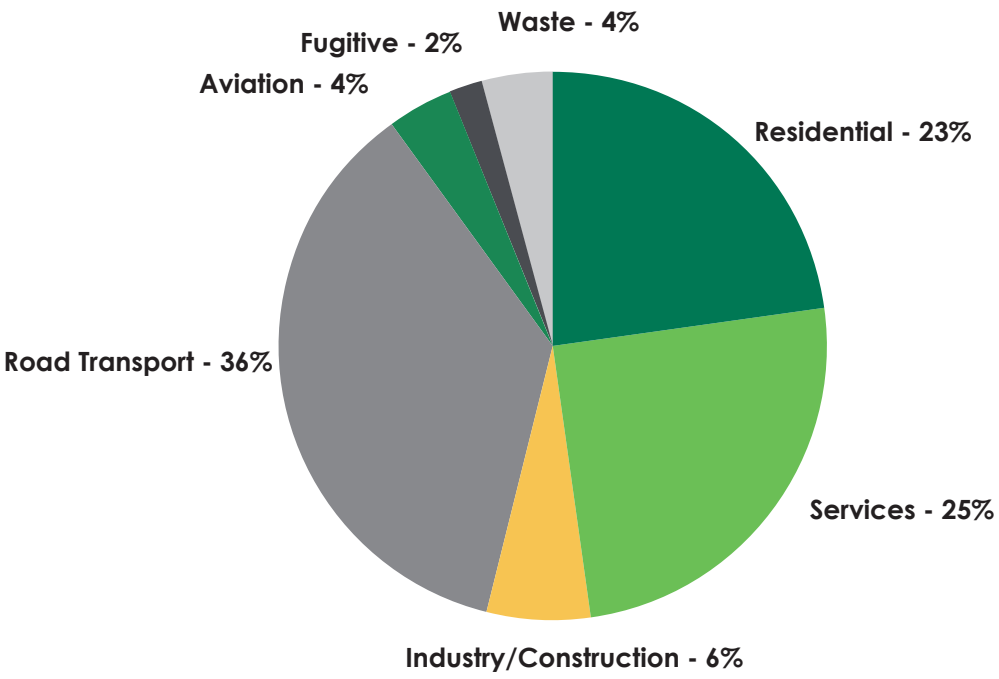


Figure 1: 2015 Baseline Greenhouse Gas Emissions for Charlotte, North Carolina

A Science-Based Target

A science-based target requires an awareness of how much carbon dioxide and other greenhouse gases are being pumped into the atmosphere because of human activity (both within Charlotte and beyond). To meet the goal of the Paris Climate Accord – to stay below a temperature increase of 2°C globally - the global community must reach peak global GHG emissions by 2030 and reduce them by at least half by 2050. It is important to understand that these targets for 2050 represent mid-points, as the reductions of GHG emissions must continue beyond this point.

Climate change is caused by global warming and global warming is caused by a buildup of greenhouse gas emissions in the atmosphere. This concentration of gases in the atmosphere is built up over time for differing periods – for example, carbon dioxide lasts for 100 years, while methane[9], which is 28 times more potent than CO_2, lasts for 10 years in the atmosphere. It is therefore the total amount of greenhouse gases released, between now and 2050, that will determine the level of global warming that cities around the world will experience.

A per capita target helps to address many of these concerns. The concept of a per capita target is displayed in Figure 2, alongside the targets for the Paris Climate Accord. The use of a per capita target allows for a forward-looking approach, as well as setting the pathway for a carbon budget (should one be set in the future by Charlotte).

The concept of using a per capita target was discussed and presented to the community at one of the Stakeholder Meetings and was widely endorsed. Bilateral meetings also took place with a range of advocacy groups, government departments, and businesses within Charlotte to further discuss the approach and assess support. The per capita target of $2tCO_2e$ was subsequently unanimously supported by City Council on June 25, 2018.

To achieve the $2tCO_2e$ per capita target, Charlotte's City government needs to 'show the way'. The City, therefore, adopted higher targets for its own buildings and fleet. These commitments extend far beyond that of the original resolution. The City ultimately committed to 'striving to source 100% of its energy use in [City of Charlotte] buildings and fleet from zero carbon sources by 2030' via a unanimous vote by City Council.

9 *Emissions of methane in the energy sector come from leakage of natural gas when it is distributed and extracted. The level of methane released when extracting 'fracked' gas is significantly higher than from conventional techniques. The total amount of emissions across the USA associated with the extraction of natural gas (whether conventional or fracked) is 2%. This can be compared to emissions of methane from agriculture which amount to 4% (https://tinyurl.com/y9br7pl7). This highlights the damaging amounts of emissions associated with extraction of natural gas. There is a wider issue attached to 'fracked gas,' which is associated with how it may hinder renewable deployment and encourage longer term use of fossil fuels. This has a far more damaging impact in the long-term. This is because demand for fracked gas has come about because of the price of conventional natural gas. This makes renewables less cost competitive in the short-term, which may in turn lead to further investment in natural gas infrastructure (for homes, businesses, industry and power stations) which has long-term lock-in implications and will lead to long-term issues associated with greenhouse gas emissions reduction brought about by short-term cost influenced energy investment decisions.*

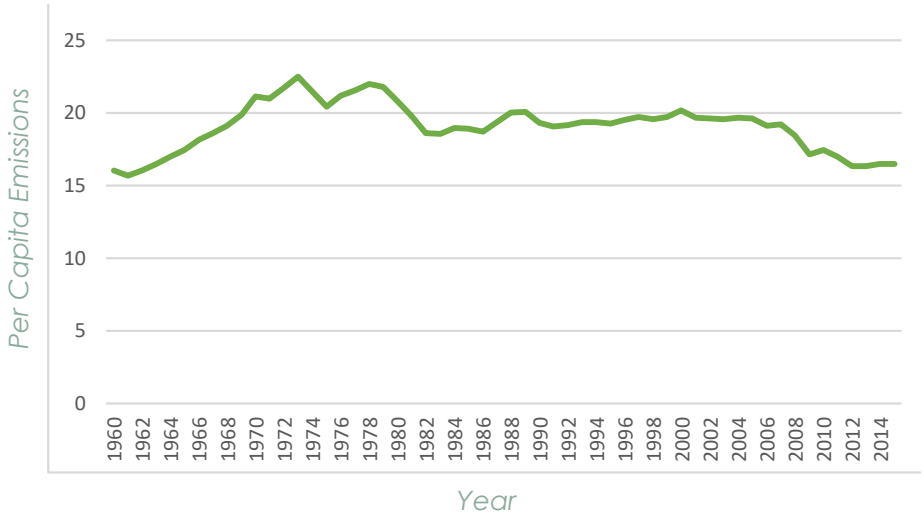


Figure 2: USA Emissions of CO_2 Per Capita 1960-2015

The Paris Climate Accord commits signatory countries to keeping global temperatures "well below" 2.0°C (3.6°F) above pre-industrial times and "endeavour to limit" them even more, to 1.5°C (2.7°F). This is to prevent dangerous climate change. Increased temperatures will cause increases in severe weather events. This would lead to considerable negative impacts on our health and economies.

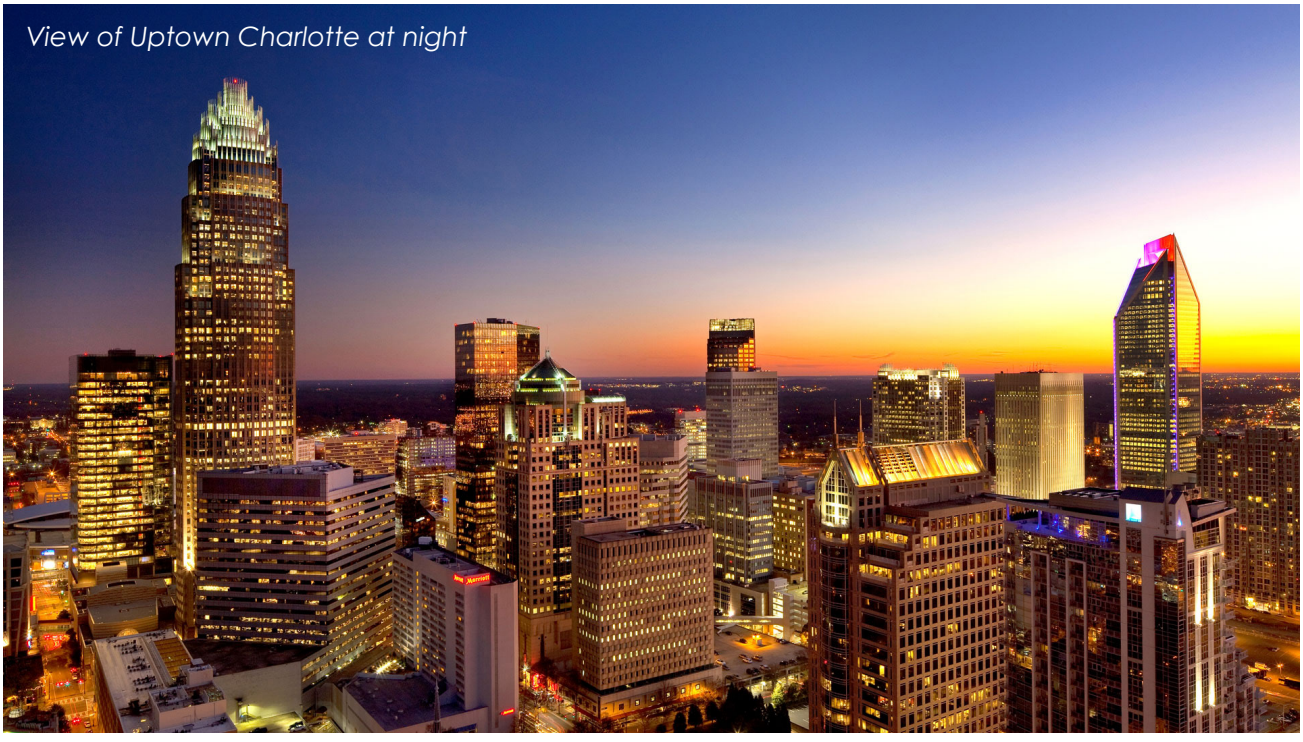
Delivering such a target is not a small undertaking and will require City Council commitment, innovative thinking on behalf of City staff, changes to procurement approaches, and a desire to be an international leader. This will require strong internal leadership, including forward-thinking, acceptance, engagement, and experimentation.

Is it Possible to Reduce to 2tCO_2e by 2050?

To effectively achieve the 2050 target, collaboration and innovative approaches are required. More importantly, if Charlotte wants to remain economically competitive and play its part in mitigating climate change, then it is a necessity.

Urban density presents opportunities to create a greener way to live by creating the possibility for a better quality of life and a lower carbon footprint through more efficient infrastructure and planning. This affords significant opportunities for efficiency improvements through promoting public transportation opportunities and accelerating the transition to electric vehicles. There are also real opportunities for on-site energy generation. These, together, provide real opportunities for change that can accelerate Charlotte's transition to a low carbon future.

In addition, Charlotte is home to the largest U.S. energy utility, Duke Energy, and the third-largest U.S. banking sector, with both Bank of America headquarters and Wells Fargo corporate offices located within City boundaries. By having these three corporations located within the City, opportunities for partnerships and innovative financing prospects are created that can allow Charlotte to leapfrog other cities in urban innovation and action.



View of Uptown Charlotte at night

THE SUSTAINABLE AND RESILIENT CHARLOTTE BY 2050 RESOLUTION

In November 2017, City Council considered a Clean Energy Resolution (CER) that would, among other items, commit the City to 100% renewable energy by 2050. City Council voted to send the resolution back to the Environment Committee for further discussions and asked that the Committee draft a resolution appropriate and tailored to Charlotte, as well as develop an action plan for the goals that would be achieved. City staff worked in close partnership with stakeholders and drafted a new resolution that encompassed the City's commitment to the GCoM and broadened the target to a low carbon future, while also specifying that the SEAP would provide the action plan for achieving the goals. City staff presented the final resolution to City Council on June 25, 2018 and received widespread support from community stakeholders and a unanimous vote by City Council[10]. The stakeholder engagement required to develop the Resolution gave clear insights into the kind of structures and understandings that need to be put in place to realize change.

10 *The full 'Sustainable and Resilient Charlotte by 2050' resolution can be found here: https://tinyurl.com/yclmboqn*

RESOLUTION OF THE CITY OF CHARLOTTE CITY COUNCIL IN SUPPORT OF A SUSTAINABLE AND RESILIENT CHARLOTTE BY THE YEAR 2050

WHEREAS, the Charlotte City Council committed in the FY 2018-2019 Environment Focus Area plan to "become a global leader in environmental sustainability, balancing economic growth with preserving our natural resources;" and,

WHEREAS, Charlotte will strive to become a low carbon city by 2050, spanning all sectors, to bring city-wide greenhouse gas emissions to below 2 tons CO_2e per person annually; and,

WHEREAS, Charlotte is currently developing a Strategic Energy Action Plan (SEAP), which will contain short, medium and long term actions to deliver deep reductions in carbon emissions spanning all sectors so that the CO_2e targets can be met; and,

WHEREAS, a low carbon city is delivered through processes, strategies, practices, tools, and institutional structures that promote collaboration between city, public, private, academic, and nonprofit constituencies to develop and implement long-term, deep reductions in carbon emissions, and,

WHEREAS, these processes, strategies, and collaborations will balance economic considerations with advancement towards the 2050 goal, and

WHEREAS low carbon cities improve their environmental sustainability, social capital and economic mobility through growth in clean energy industries and workforce development opportunities; and,

NOW, THEREFORE, BE IT RESOLVED that the City of Charlotte will strive to become a low carbon city by 2050 and will develop a Strategic Energy Action Plan to be presented to City Council.

NOW, THEREFORE, BE IT FURTHER RESOLVED that the City of Charlotte will continue the work currently under way to advance short term goals for reductions in energy consumption in city operations as a first step on the path towards a low carbon future.

NOW, THEREFORE, BE IT FURTHER RESOLVED that the City of Charlotte will strive to source 100% of its energy use in its buildings and fleet from zero carbon sources by 2030.

Adopted on this 25th day of June, 2018.

The 'Sustainable and Resilient Charlotte by 2050' Resolution language

A PLAN FOR ALL: FORMING AN ACTION PLAN

The SEAP is an ambitious, aggressive action plan for delivering a low carbon, resilient Charlotte. While the plan has been promulgated by City management, and the City is responsible for leading its implementation, the plan is a citywide strategy. It is intended to improve the quality of life for all citizens of Charlotte. While there are recommendations and projects that fall to the responsibility of the City to implement, there are many that require public-private-plus-partnerships[11] as well as collaborative approaches with community stakeholders.

Charlotte is fortunate to have many community stakeholders that are actively engaged and knowledgeable in topics relevant to a resilient future. The SEAP's recommendations set out a framework in which collaboration with Mecklenburg County, the community, and other key stakeholders can be leveraged. This facilitates access to additional expertise, innovation, and engagement opportunities. Together, these enable the implementation of SEAP recommendations that drive the adoption of the resilient energy solutions required by the Resolution.

Through its implementation and updates, the SEAP will support locally led efforts to deliver solutions that enable Charlotte to transition to a low carbon future. A key goal of the SEAP is to enable and empower Charlotteans to make informed decisions regarding energy generation and consumption. As part of the data exercise for the strategy and the Resolution's production, the project team identified and engaged with many community groups and organizations. Many of these are actively engaged in moving forward low carbon initiatives. This wealth of knowledge and experience provides an excellent foundation from which to begin implementing the SEAP's Action Areas.

Vision

A vision for sustainability and resilience has been produced for the City. This was produced in partnership with the community. The purpose of the vision was to provide a common goal under which sustainable and resilient projects can sit. This vision was developed across multiple workshops and culminated in the following:

"Charlotte will lead, as a global city, by continuously improving, protecting, and preserving the environment, its community, and economy, while ensuring equity and resilience - for today's and future generations."

This vision is intended to be used by all stakeholders in Charlotte when promoting their work and attracting funds for initiatives that they want to undertake.

11 A public-private-plus-partnership or P4 is defined as a cooperative agreement between public and private sectors in addition to universities and utilities.

EXAMPLES OF GREAT PROJECTS ALREADY HAPPENING IN CHARLOTTE:

RETI: Renewable Energy Transition Initiative- is working to sustainably decrease the energy costs of families with high energy burdens. RETI's mission is carried out through their outreach, education, and strategic partnerships.

RETI is a partner with the City Of Charlotte on the Smart Homes Kickstart, which is part of the North End Smart District, The kickstart uses technology and equitably works with the community to decrease the energy costs and provide quality of life improvements for the 33 participant households. RETI provides energy education and training to lower their energy burdens in conjunction with smart technology.

The City of Charlotte's Statesville Avenue Landfill property operated as a municipal landfill from the 1940's until 1970. The property is now vacant and fenced. The City has been seeking suitable redevelopment options for the property. A Solar Energy Feasibility Study done in 2013 indicates that property could support up to a 10 MW solar panel array on the 60 acres deemed desirable for solar development.

5 STAGES TO ZERO CARBON ENERGY

The Five Stage Approach to Zero Carbon Energy is a logical and clearly described tool that can be applied to buildings or transportation. It is a continuous approach that consists of five repeating stages:

1. Shifting energy demand
2. Reducing energy consumption
3. Changing energy we consume away from fossil fuels
4. Generating energy on-site
5. Meeting the remainder through energy purchases

By following this tool, the City of Charlotte and its citizens can identify cost-effective and realistic paths to delivering the GHG reductions sought. This tool is being applied by the City to identify and communicate how it is delivering zero carbon solutions to non-experts.

Shifting Energy Demand

The biggest challenge to energy planning is ensuring peak demand is predicted and met through supply. This challenge becomes more complex with the introduction of intermittent renewables into the energy system. Because the production of electricity from intermittent renewables is partially unpredictable, the goal of this stage is to shift when, during the day, electricity is being demanded. This requires moving certain energy consuming activities like hot water production to when renewable energy production is at its highest. It may mean ensuring the City's electric vehicle fleet is charged overnight when zero carbon electricity may be cheaper to procure. It may require weekends to be used to provide power for weekdays. It can also mean shifting electricity demand in buildings where solar PV[12] exists to maximize the use of the renewable electricity produced. These are called demand side responses and they are key to a cost-effective system. Being able to shift when electricity is demanded means there is a need for less power generation, less need for storage, and a smaller infrastructure footprint resulting in efficiency and potential cost savings.

Using Less Energy

Reducing the amount of energy consumed is nearly always the most efficient way to meet a zero carbon target. This is because the less energy required on the demand side, the less zero carbon energy that is required on the production side. Reducing energy consumption can come in many forms including switching lights off, turning the thermostat down, and increasing space density. There is also the opportunity for behavioral changes such as eco-driving, which may result in lower energy consumption in current fleets of fossil-fueled vehicles. This presents a good habit for driving bioenergy[13], electric, or hydrogen-based vehicles.

Changing the Energy we Consume

The next step to consider is to change the types of energy we consume toward lower carbon alternatives. This step does not have to be immediate; for example, the transition away from fossil fuel-based vehicles to electric vehicles can be started now and extend over many years. However, the structures should be in place to facilitate the transition. Changing the energy we consume could also result in moving from fossil fuels to bioenergy, or indeed natural gas to biogas[14].

Generating Energy On-Site

The generation of energy on-site includes, but is not limited to, electricity. On-site generation may also include heat produced from geothermal heat pumps, air pumps, or solar thermal. It may also include heating and cooling produced by a boiler or an on-site combined cooling, heat, and power[15] (CCHP) system running on zero carbon energy. It may also be

12 Solar PV references solar photovoltaic (PV) cells that convert sunlight directly into electricity (https://www.nrel.gov/workingwithus/rephotovoltaics.html)

13 Bioenergy is classified as a form of renewable energy derived from biomass—organic material—that can be used to produce heat, electricity, transportation fuels, and products. https://www.energy.gov/eere/bioenergy/bioenergy-basics)

14 Biogas is derived principally from the anaerobic fermentation of biomass and solid wastes and combusted to produce heat and/or power. Included in this category are landfill gas and sludge gas (sewage gas and gas from animal slurries) and other biogas. Liquid biomass, which includes bio-additives such as ethanol, is also included in this category. (https://stats.oecd.org/glossary/detail.asp?ID=4585)

15 Combined cooling, heat & power (CCHP), also known as tri-generation, is an extension of combined heat & power (CHP). While CHP only generates electricity and heat, CCHP adds cooling to the list, which means some of the heat that is produced is also used to generate cooling energy.

supplemented by storage opportunities. These options each reduce reliance on the grid.

Procure the Rest through Contracts

When steps have been taken to shift energy demand, reduce the amount of energy consumed, and switch the type of energy being used, and current on site generation options have been exploited, the remainder should be purchased from zero carbon sources – in the form of a tariff from a utility[16]. This is meant to be a last resort when the other four options are not able to reach the desired result at the desired time.

16 *This could include Duke Energy, Energy United, or a Landlord depending on who is involved.*

Figure 3: 5 Stages to Zero Carbon Energy Diagram

THE STARTING POINT IN THE CITY

This section provides an overview of the current situation regarding governance, procurement, transportation, and buildings in Charlotte through a lens of carbon emissions impacts, and will provide the basis for the recommendations in the Action Areas. Like any city, Charlotte will face obstacles in the implementation of the Action Areas. However, as this section points out, Charlotte already has many things happening, which through further coordination, provide a solid foundation to guide the transition to a low carbon, resilient Charlotte.

City Government – Sustainability & Resilience

There is currently a sustainability team that is comprised of a Director, a sustainability coordinator, and a sustainability analyst. The role of this department is to provide oversight and coordination on all sustainability and smart city projects and issues within the City. In addition, there is a wealth of City staffers that are personally passionate and engaged around sustainability issues. Finally, some departments have individual staff members that have specific sustainability responsibilities as parts of their role.

General Procurement Practices

There is opportunity within the City to develop and improve current procurement practices to give a greater sustainability focus. While current procurement policy does have some green procurement requirements and recommendations, strengthening and enhancing current policy can be used to stimulate a local green economy and with it associated jobs. It can also be used to address wider supply chain requirements with service providers that relate to sustainability.

Charlotte's Urban Forest

When viewed from above, Charlotte's tree canopy covers 47% of the City, which makes Charlotte one of the highest canopy cities in the U.S. On top of the aesthetic benefits Charlotte's trees provide, the City receives over $335 million in real benefits and services from these trees every year. Charlotte's trees provide a cooling effect to the City, helping to drop temperatures caused by the Urban Heat Island Effect. The canopy also acts as a carbon sink; this means it helps to reduce emissions of CO_2 globally. If these trees are cut down and not treated appropriately, they could increase emissions in Charlotte. Their removal would also mean that they no longer reduce emissions, ultimately resulting in an overall increase in time. The tree canopy therefore has a significant impact on both mitigating and adapting to climate change.

Despite these valuable benefits, the City's tree canopy is at risk. The two most pressing concerns are a large population of mature trees reaching the end of their natural lifespan, along with significant losses from development as the City grows. Loss of tree canopy results in serious public health issues, including poor air and water quality, and declining communities and wildlife habitats. To ensure that this canopy is preserved and maintained for generations to come, in 2017, the City completed an Urban Forest Master Plan (UFMP) with the goal of preserving and enhancing Charlotte's urban forest. The UFMP outlines twelve steps for the community to take to achieve City Council's goal of a 50% tree canopy by 2050. Charlotte's Urban Forest Master Plan provides the blueprint for the engagement and purposeful action of community leaders, residents, and organizations in sustaining Charlotte's tree canopy.

For more information about Charlotte's Urban Forest Master Plan, see charlottetreeplan.weebly.com.

BENEFIT	QUANTITY	UNIT	ANNUAL VALUE
ENERGY: Savings from Avoided Cooling	112M	*kWhs*	$15.4M
PROPERTY: Increases in Property Values	-	*$*	$286.5M
AIR: Carbon Monoxide (CO) Removed	135,000	*lbs.*	$90,000
AIR: Nitrogen Dioxide (NO2) Removed	681,000	*lbs.*	$116,000
AIR: Ozone (O3) Removed	4.4M	*lbs.*	$3M
AIR: Sulfur Dioxide (SO2) Removed	145,000	*lbs.*	$10,000
AIR: Dust, Soot, Other Particles Removed (Particulate Matter, PM10)	5.3M	*lbs.*	$3.7M
RAIN: Rainfall Intercepted	1.2B	*gallons*	$10M
Carbon Sequestered	470,000	*tons*	$17M
	Potential Total Annual Benefits		***$335M+***

Figure 4: Potential Annual Benefits from Charlotte's Urban Forest

Freedom Park in Charlotte, NC.

Buildings

Buildings are significant energy consumers through demand-side practices of space conditioning and appliance use and charging; we consume energy through them for our daily activities. They are also rapidly becoming the places where we charge our cars. A significant transportation impact occurs because of their location. Therefore, buildings and facilities are fundamental components of how and when the City uses energy, both today and in the future.

There are two primary considerations for the SEAP: municipally owned buildings and non-municipal buildings. The Sustainable and Resilient Charlotte Resolution has a specific target for municipal buildings run on zero carbon energy by 2030.

Municipally Owned Buildings

Like the citywide emissions of Charlotte, the largest source of greenhouse gas emissions within the City Government comes from its buildings. This is through the direct combustion of natural gas in these buildings for heating and, indirectly, the fossil fuels used to produce electricity. The Policy for Sustainable Facilities (PSF) is a plan that will see all new and existing government buildings (over 5000 sq. ft.) upgraded to LEED[17] Certified requirements, with an additional requirement to achieve Energy Star certification[18] by 2026. The implementation of this plan is overseen by the Sustainable Facilities Oversight Team (SFOT)[19].

The PSF is comprised of 13 points and a detailed list of actions. The policy encompasses the "fix-it-first" approach of the City government and contains provisions for incorporating publicly accessible electric charging points. This policy is in support of the City's Environment Focus Area Plan (EFAP) that charges Charlotte with becoming a global leader in environmental sustainability which includes a requirement to increase renewable energy usage within City facilities.

LEED and Energy Star certification logos

Non-City Owned Buildings

Charlotte has strong building stock of existing buildings and is adding new buildings to the skyline daily. Currently, building permitting and code enforcement sits with Mecklenburg County and the State, the entities responsible for issuing building, electrical, plumbing, and mechanical permits. The City of Charlotte helps in the review process, but does not control it, which poses policy challenges. The County has developed a new Hybrid Collaborative Delivery Team (HCDT)[20] that is designed to review projects via 3-D and digital renderings and make the process more efficient and effective.

Charlotte is currently going through the process of developing a Comprehensive Plan which would then inform the regulations laid out in an updated Unified Development Ordinance (UDO). These documents will provide a regulatory mechanism that provides a vision and regulates public policies not related to building codes, such as transportation, land use, and housing, among other areas. A key part of updating these two critical land use documents is to drive greater urban density, address issues of walkability, and improve the quality of life for the residents of Charlotte which help reduce overall energy consumption. Like the SEAP, this process will be informed by other City strategies like Charlotte Bikes, Charlotte Walks, and the 2040 Transportation Action Plan.

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17 There are four levels of LEED certification: certified, silver, gold, and platinum. The levels refer primarily to the building design. Additional accreditations using the same levels refer to the building's ongoing use. The LEED certification goes beyond energy, encompassing water, materials and waste, and human & health experience. (https://new.usgbc.org/leed-v4) Departments can also pursue other third-party certifications like Green Globes. (http://www.gsa.gov/gbcertificationreview)

18 The use of LEED and Energy Star provides a standardized set of guidelines that address all environmental issues. The intention is to minimize the environmental impact of these buildings while also conserving and protecting all resources – therefore extending beyond energy.

19 They are tasked with providing reporting metrics that are included in the Internal Environmental Operations Plan (IEOP). The team is partly guided by the 'Policy for Sustainable Facilities' (PSF). This team spans seven City departments.

20 https://www.mecknc.gov/LUESA/CodeEnforcement/permitting/Pages/Special-Projects-Team.aspx

Retail and Mixed-Use Buildings

The General Development Policies (GDP)[21] set requirements for mixed-use development, and includes the need for transportation networks that provide a variety of travel choices. These mixed-use centers have a requirement to include key retail and service outlets in one location to reduce transportation requirements and increase livability. The GDP recognizes the importance of an ecological footprint and includes a requirement to reduce ground temperatures (heat island effect), to minimize impacts to natural environment, to use water efficiently, and to improve the quality of storm water run-off.

Transportation

Transportation, in an emissions inventory, is comprised of four modes: road, rail, aviation, and marine. Road transportation is one of the largest sources of emissions globally, along with aviation. There are no marine emissions[22] attached to Charlotte under the emissions reporting structure as it has no inland waterways or maritime borders. Together, these emissions form a significant opportunity for reduction and require putting the right mechanisms in place to achieve it.

Road transportation is the second largest source of emissions in Charlotte, while aviation is the third largest source. Road transport emissions are caused by vehicle ownership and their use for business, private, and social means. These vehicles are owned by private citizens, businesses, and governments and span all vehicle types from motorcycles through to tractor-trailers. Aviation emissions are also particularly significant due to Charlotte Douglas International Airport, ranked seventh[23] in the world for aircraft movements. This accounts for a reasonable proportion of emissions, even just accounting for domestic flights. This proportion will make up a large component of the 2tCO2e per capita target unless planning is made to address these emissions.

Uptown Charlotte skyline and aircraft from Charlotte Douglas International Airport

City Government Owned Fleet

The second largest source of City government emissions comes from the vehicles that it owns. These heavy-duty vehicles are mostly run on petroleum, although alternative fuel vehicles (AFV) have been incorporated, for example, within Solid Waste Services (SWS)[24] as well as in Charlotte Area Transit System (CATS)[25].

For light-duty fleet, the City has a fleet of electric vehicles (EVs) based largely at the Charlotte Mecklenburg Government Center. These are complemented by charging points at many City-owned buildings. The City also offers a motor pool service that includes EVs and hybrids that are available to all City staff. One of the challenges that the City[26] currently faces with the motor pool is range anxiety, largely brought about because lack of education around how to effectively drive an electric vehicle to maximize driving range. Internally, departments determine which make of vehicle is driven by their staff, further developing cultural associations between vehicles, types, and

21 *http://charlottenc.gov/planning/AreaPlanning/Plans/GDP/Pages/Home.aspx*

22 *There are emissions attached to the goods that rely on the boats that bring them to the ports. In addition there are emissions associated with boat trips that Charlotteans take. These are, however, not included in a GPC inventory.*

23 *https://aci.aero/news/2018/04/09/aci-world-releases-preliminary-2017-world-airport-traffic-rankings-passenger-traffic-indian-and-chinese-airports-major-contributors-to-growth-air-cargo-volumes-surge-at-major-hubs-as-trade-wars-thre/*

24 *These vehicles run on Compressed Natural Gas (CNG). This is still a fossil fuel, albeit less carbon intensive and more efficient than petroleum. These vehicles get a 'clean image' as the local air emissions (the pollution that affects breathing) are significantly lower than their petroleum counterparts. This often causes confusion with greenhouse gas emissions.*

25 *This largely refers to hybrid vehicles, although these are not plug-in hybrids and are therefore mostly targeted at reducing local air emissions. They may actually cause higher CO_2 emissions than the more efficient buses that are available.*

26 *The PSF extends to consider the link to wider infrastructure specifying the need for rapid charging based on proximity of the building to the interstate. The SFOT is required to review its policy annually recognizing the changing direction of Council's sustainable priorities and goals.*

positions[27].

The long lifespan of vehicles means that their procurement today to meet the resolution's requirements is critical. The Fleet Maintenance Advisory Team (FMAT) guides the procurement process to reduce maintenance costs[28]. However, the budget for maintenance comes from the general fund[29], making it harder to demonstrate potential cost savings. There is a fuel efficiency recommendation as part of the fleet policy, but it has had limited success.

Transportation Strategies

The City has a set of strategies that are targeted at reducing the use of automobiles. These include Charlotte Bikes, Charlotte Walks, and the 2040 Transportation Action Plan. These strategies identify ways to facilitate the use of alternative means of transportation. Consequently, they identify ways to make it safer to walk and cycle around the city, which has a positive effect on reducing carbon emissions by reducing automobile trips.

Electric Vehicle charging station at the Charlotte-Mecklenburg Government Center parking deck

The various plans that the City has developed to facilitate use of alternative modes of transit all support the concept of Transit Oriented Development (TOD). The intent is to create livable communities where people can get to the office, grocery store, restaurants, libraries, and parks without requiring the use of a car. The TOD approach makes provisions for providing extensive pedestrian systems throughout neighborhoods to minimize walking distance for residents. The approach makes provision for buffering cyclists from automobile activity with few conflict points.

A significant example of this is the proposed Charlotte Gateway Station[30] that will provide a multi-modal transportation facility that will merge public transit with intercity modes, increasing transportation options. Moreover, the project team also developed a Multi-modal Station Area Plan (MSAP) that identifies current priorities and transportation needs, like locating high density mixed-use development around the station.

Workforce Development

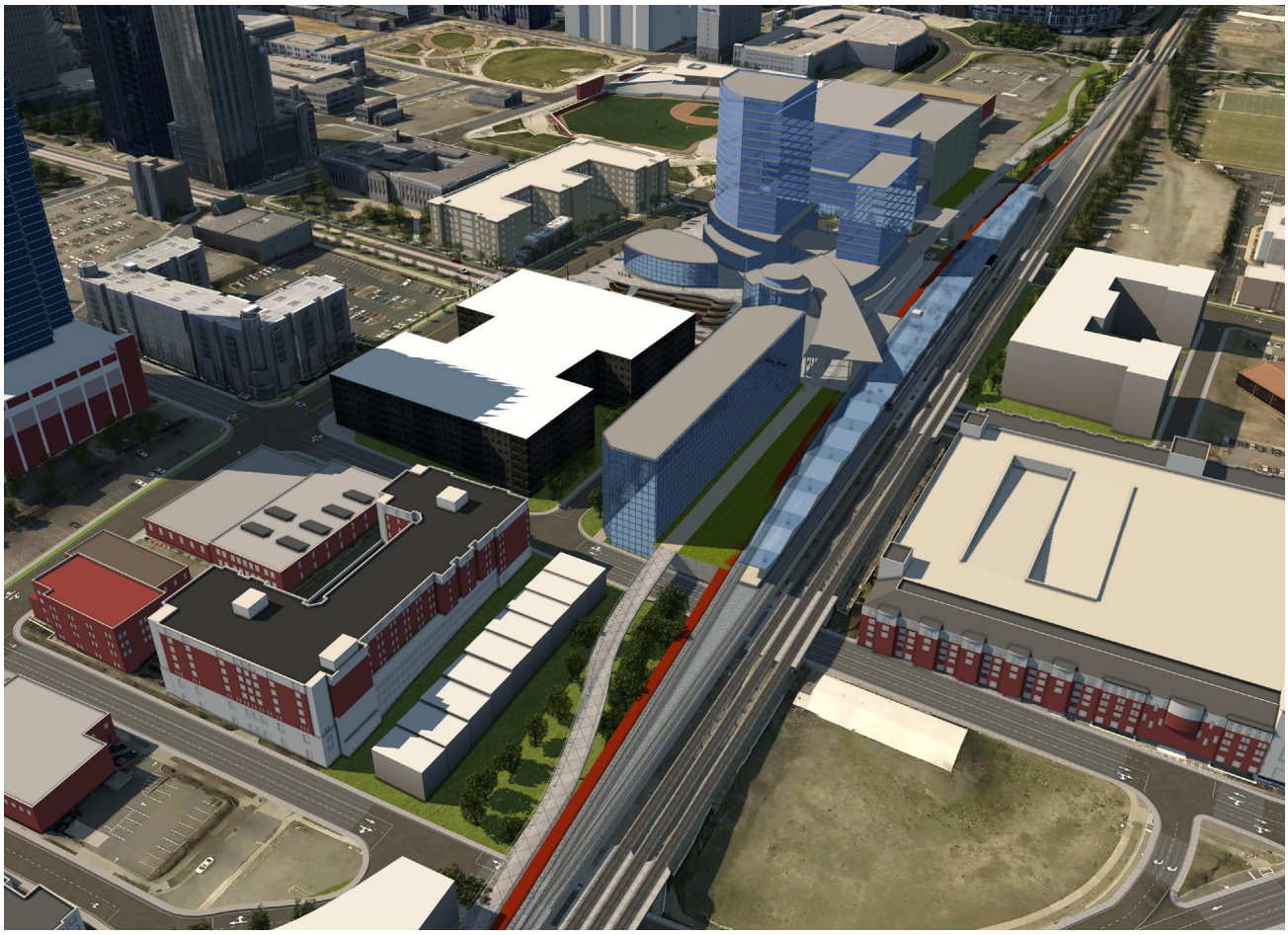
Over the past five years, the City of Charlotte has amplified their role in equitable economic development through workforce development initiatives to remove the seemingly insurmountable barriers facing Charlotte residents in poverty. As part of this effort, the City's Economic Development department partnered with Goodwill Industries of the Southern Piedmont and the Urban League of Central Carolinas to sponsor the Partnership for Inclusive Employment and Career Excellence (P.I.E.C.E.), a workforce development program that provides skills and training as well as supportive services to help people obtain and keep jobs. This innovative program connects individuals with multiple barriers to employment to meaningful career paths while fulfilling labor market shortages in key industries, and makes a lasting impact on its participants and the Charlotte community.

27 A highly important issue to consider when looking to transition the fleet to a low carbon one is to see that these cultural implications are not challenged too much.

28 Procurement varies between departments based partly on whether they are an enterprise or general fund. Enterprise funds get their rates and fees in a manner to recover the full cost of their operation and necessary capital investments. The following City departments' budgets are part of the enterprise funds: Aviation, Storm Water Services, CATS, and Charlotte Water.

29 General fund service departments' budgets and performance achievements are funded by the City's property and sales taxes.

30 http://charlottenc.gov/cats/transit-planning/charlotte-gateway-station/Pages/gateway-station.aspx



The proposed Charlotte Gateway Station Transportation Facility

WHY DOES THE CITY NEED A SEAP?

The overarching purpose of a SEAP is to provide a strategy for a city or region to follow as it strives toward 'a low carbon, resilient future'. A successful SEAP will focus on 'how do we get there?' rather than answering the question 'can we actually get there?' The key focus of a SEAP is GHG emissions reduction, but also explores the opportunity to align economic development policy, such as the creation of green jobs with the actions necessary to transition to a low carbon energy future.

Like many strategies, a SEAP can be thought of as being comprised of three core components: (1) a baseline assessment; (2) a vision; and (3) a roadmap for how to achieve the targets. The SEAP is a living document. This means that every two years, progress will be benchmarked by City staff that are tracking key data points. If necessary, the SEAP will undergo a formal update process that will realign it to ensure the City is continuing to move towards its 2030 and 2050 GHG reduction targets as stated in the Resolution. Formal reviews and updates are required due to policy change, technology innovation, and shifting of resources.

A SEAP has targets and structures that set out the pathway for a city's future energy consumption that spans decades. It requires a mindset that embraces change and looks for opportunities to: reduce energy consumption (everyone being energy conscious); change the energy that we use (using bioenergy rather than oil); and, change the way that we generate it (using renewables rather than fossil fuel).

The SEAP requires high level buy-in from City government leadership to be successful because it requires resources, including program-focused funding and staff who are dedicated to implementing the recommendations. Because of a need for integration into daily living, it also requires widespread engagement of stakeholders, which are comprised of City staff, private sector corporations and businesses, NGOs, utilities, advocacy groups, and community members.

Charlotte's SEAP makes recommendations that address the necessary structural and behavioral changes, as well as physical projects that can help the City achieve a low carbon future. These recommendations, in the form of Action Areas, will result in fundamental changes to how decisions are made in relation to investment within the City, most notably how the City approaches cost. It also requires a change in the way in which energy is thought about, particularly in understanding consumption patterns. As energy is fundamental to our business and working lives, a SEAP provides many opportunities for job creation, increased resilience, enhanced health, and improved energy security among other issues. While there are various factors to navigate in the implementation of the Plan, there is an exciting opportunity for Charlotte to shape and implement change with significant positive outcomes in the form of job creation and keeping revenues within the city.

Addressing Climate Change and Associated Challenges

Cities are hubs of innovation, commerce, and culture, and by 2050 nearly 70% of global the population is projected to live in urban areas. As cities grapple with the effects of climate change and global warming, the need to understand the embedded challenges within these complex systems becomes critical.

Charlotte's development of the SEAP shows the City's leadership in their desire to address the fact that the impacts of climate change significantly affect all communities, and the need for solutions that are effective, fair, and equitable. Like many cities throughout the world, Charlotte is experiencing the challenges of energy poverty[31], resilience[32], demand for job opportunities and training, equitable economic development, and many other urban issues.

Energy Poverty

While Charlotte's energy costs are approximately 10% lower compared to the national average[33], energy poverty is still an issue for many low-income families in Charlotte. The average price of electricity has grown by 30% in NC over the last ten years and 28% nationally[34]. The Action Areas recommended in the SEAP will work to address these challenges by providing more affordable

31 Energy poverty occurs when households spend more than 10% of their incomes on energy expenses each year. In North Carolina, many low-income families often spend 20% of their income on energy. (www.retiset.org)

32 Resiliency is defined as "the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow, no matter what kinds of chronic stresses and acute shocks they experience." (www.100resilientcities.org)

33 https://www.eia.gov/electricity/data/state/

34 https://www.energy.gov/energy-economy/prices-trends

options and access for households experiencing energy burdens.

Resiliency

Having a stable energy grid with reliable and diverse energy generated locally is key to a resilient strategy for Charlotte. The alternative, depending on finite resources like oil, gas, and coal, is not a resilient approach. The SEAP focuses on ways to decentralize the energy supplies within a regulated state. This will drive an increase in the use of renewable energy, localized energy generation, and procurement of zero carbon energy. This will help the City develop a resilient future for generations to come while minimizing environmental impacts from using fossil fuels.

City Bond Ratings

Climate change is quickly becoming a credit issue for city and state governments as they become more vulnerable to extreme weather events and natural disasters. Credit rating agencies like Moody's[35] have started factoring in the impact of these climatic events on infrastructure, economy and revenue base, and environment. This means that if cities do not have strategies in place to mitigate and adapt to climate risks, the costs of borrowing money will start to become more expensive. By developing the SEAP, Charlotte is taking a proactive approach to ensuring its bond ratings remain at the very top of the municipal credit market as that market evolves.

Equitable Economic Development and Jobs

Through the expansion of a low carbon energy sector, employment opportunities expand. Part of the focus of implementing the SEAP is on how the workforce pipeline will be filled to ensure well-paying jobs and sustained employment.

Economic development and job creation opportunities range from energy efficiency measures like retrofitting residences and buildings, to installation of solar PVs, to retrofitting internal combustion engine (ICE) cars with electric motors. There is approximately the same number of people employed in the green energy sector in the USA as there are in telecommunications[36]. North Carolina has established itself as a clean energy leader by ranking third in the US for gigawatt-hours of solar power produced annually[37].

LYNX Gold Line Trolley in Uptown Charlotte

35 https://www.moodys.com/research/Moodys-Climate-change-is-forecast-to-heighten-US-exposure-to--PR_376056 35 https://www.edf.org/energy/clean-energy-jobs

36 https://www.bizjournals.com/charlotte/news/2018/07/18/how-north-carolina-is-pushing-beyond-solar-to.html

37 While agriculture is currently at 0% of Charlotte's emissions inventory, it is anticipated to grow as the Circular Charlotte strategy is implemented. A key part of developing a circular economy paradigm within a city is redesigning food systems and recognizing that growing locally is a key part to this. So, while it's anticipated that agriculture emissions might increase minimally, but growing locally other emissions, like transportation, will subside.

CHALLENGES + OPPORTUNITIES

Charlotte will face many challenges as it works to implement the SEAP and transition to a low carbon energy future. However, with these challenges come opportunities to implement equitable and inclusive low carbon solutions that improve the quality of life for all citizens of Charlotte, grow our local green economy, and create new job opportunities.

Growing Population

Charlotte was ranked as the second fastest growing large City in the U.S. in 2017[38]. Current statistics state that 43 people were moving to Charlotte per day in 2017[39]. The City's current population sits at around 860,000[40] with the population projected to hit 1.1 million by 2030 and 1.4 million by 2050[41]. Charlotte is attracting proportionally more millennials to it than any other city in the USA; this cohort represents a key demographic in awareness of climate change issues.

Rapid population growth can be a challenge because with rapid growth comes the demand for quality housing (existing and new) and the associated upgraded infrastructure. However, there are many opportunities that arise as a result. With high rates of rental housing, Charlotte could work with landlords to transition all lighting to LED, or incentivize on-site generation of zero carbon energy that is then sold to tenants. While this increase in population can increase GHG emissions, it also presents the opportunity to pilot projects, scale up existing successes, and drive zero carbon developments.

The City of Charlotte currently has a mandate to deliver 5,000 affordable housing units within the next three years (2017-2020)[42]. In addition, the City is putting together a $150 million fund for delivering the housing. An opportunity exists to work closely with the organizations helping to deliver the affordable housing units and ensure that they are Energy Star certified, powered only by zero carbon energy sources, and built by a local workforce that have been trained specifically in the field of green buildings.

Non-residential Buildings

One of the biggest areas that Charlotte can address to reduce GHG emissions is through its buildings. Every building that is constructed without a focus on energy is a missed opportunity with an impact that may last over 100 years. Construction that occurs without thought to multi-modal transportation is a barrier to future change. These are both examples of 'lock-in,' which must be avoided to facilitate an innovation-minded approach.

Charlotte is already in a prime position to make their commercial buildings throughout Charlotte more energy efficient. Envision Charlotte has successfully piloted Smart Energy Now, in partnership with Duke Energy and the University of North Carolina – Charlotte's Sustainably Integrated Building Systems program (UNCC-SIBS), which worked with 61 commercial buildings in Uptown Charlotte and achieved energy savings of 19% over five years. The pilot was expanded by a grant from the U.S. Department of Energy for an additional three years and successfully reduced energy by 13.1% in an additional 81 buildings. This program has already developed a framework, now it just needs to be aggressively scaled throughout the City of Charlotte.

Energy Transition in a Regulated State

One of the larger challenges Charlotte faces is transitioning to a low carbon energy future in a regulated state. North Carolina is a regulated energy market with clear controls over how, who, and when energy may be bought and sold. Regulated markets feature vertically-integrated utilities that own or control the entire flow of electricity from generation to meter.

Duke Energy Carolinas (DEC) is currently in control of this. However, it has recently been announced that Duke Energy Progress (DEP) and DEC are to merge[43]. This presents greater opportunities for the integration of a variety of energy sources. With intermittent

38 *https://wallethub.com/edu/fastest-growing-cities/7010/#overall*

39 *This represents an annual growth rate of 1.8%. (https://www.bizjournals.com/charlotte/news/2018/05/31/with-charlottes-population-growth-among-the-top-in.html)*

40 *US Census Bureau estimated Charlotte's 2017 population to be 859,035 people. (https://www.census.gov/quickfacts/fact/table/ charlottecitynorthcarolina/AFN120212)*

41 *Extrapolated from Personal Communication, Lowry, Evan, 14th Feb 2018. Sphere of Influence.*

42 *http://charlottenc.gov/HNS/Housing/HAB/Pages/default.aspx*

43 *Page 15. Duke Energy Integrated Resource Plan 2018.*

SMART ENERGY NOW

Envision Charlotte, in partnership with Duke Energy, Cisco, and Verizon, worked with uptown buildings on energy reduction, installing shadow meters and lobby kiosks. 61 commercial facilities (>10,000 sq ft) pledged to reduce energy by 20%. At the same time, Duke launched Smart Energy in Offices, focused on behavior and energy efficiency. As of 2017, the program showed a 19% reduction in energy consumption, saving $26 M.

Envision Charlotte was awarded a grant from the U.S. DOE to build upon the success of the original energy reduction initiative. The 2015-2018 grant funded development and implementation of Energy Roundtables and Building Performance Training, and to develop an Eco-Network. This is expanding the program enrollment to include an additional 200 buildings outside of CLT's Uptown area. The grant expanded targeted building sectors to include: real estate, hospitality, higher education, healthcare, and retail. The grant has three goals: 1) Realize a 20% aggregate energy savings across more than 200 buildings in the Greater Charlotte region; 2) Develop and implement a comprehensive behavioral change component; and, 3) Utilize smart city initiatives to create a scalable, replicable model for market transformation.

renewables being distributed over a larger area, the opportunity for an ultra-low carbon grid expands.

Recognizing that Charlotte exists in a regulated energy market, the SEAP utilizes the '5 Steps to Zero Carbon Energy' as an organizing framework for the recommendations, so that when energy is procured, it is being done at a non-peak time and for a minimal amount. This is to help reduce demand on the grid and drive up demand for zero carbon energy sources.

Local Resources in Charlotte's Backyard

One of the biggest opportunities Charlotte has is with the amazing resources in their own backyard. Besides having the headquarters of the largest U.S. utility located in Uptown, they also have the third largest banking center with Wells Fargo and Bank of America having headquarters within the City. In addition, Charlotte has 148,000 students enrolled at 175 Charlotte-Mecklenburg Schools, several universities, a leading community college, and two world-class healthcare systems.

These organizations are key to successfully implementing the SEAP and achieving the targets. The private sector, like the banks, will need to engage to add additional skills, knowledge, and investment. Charlotte's universities and school system are key assets to the plan with their role being focused on research and development. The CMS school system is a targeted audience where efforts focused around education and behavioral changes can be addressed and scaled.

Sustainable Transportation

With the recent expansion of CATS Lynx Light Rail Blue Line extending up to UNCC's main campus and the ongoing construction for the Light Rail Gold Line, sustainable transportation options are increasing. Charlotte WALKS and Charlotte BIKES are two comprehensive plans that the Charlotte Department of Transportation is currently implementing. Both guide the development of communities that offer zero carbon modes of transit and are connected, and in turn help reduce greenhouse gas emissions within the transportation sector. The 2030 Transportation Action Plan is another recently developed comprehensive plan that works to enhance the quality of life in neighborhoods through providing a safe, balanced, and efficient multi-modal transportation system.

Republican National Convention

The Republican Party recently chose Charlotte to be the host for the 2020 Republican National Convention (RNC) which provides a great opportunity to shine a light on Charlotte's transition to a sustainable and resilient future. Having already successfully hosted the Democratic National Convention (DNC) in 2012, Charlotte is aware of the opportunity the RNC provides to develop legacy projects that will live on beyond the Convention.

The RNC provides opportunities to showcase Charlotte's various ambitions and will include its desire for a 'resilient and sustainable' future. People from around the world will be coming to Charlotte or watching the Convention from afar and by identifying and piloting ambitious projects, such as providing only electric vehicle transportation for Convention participants, Charlotte can showcase their leadership in sustainability.

THE APPROACH TAKEN

A key part of the development of the SEAP was understanding what the objectives and goals of the project were. Charlotte is not starting from scratch in this transition to a low carbon, resilient future. This section will set out the approach to developing the SEAP and the ensuing rationale for the development of Action Areas and recommendations.

Building on Existing Work

In preparation for developing the SEAP, a thorough review of relevant City strategies and plans occurred, as well as in-person interviews and meetings. One point of constant feedback provided in meetings with various stakeholders was that there needs to be a stronger cohesion between efforts. The goal of the SEAP is to be a connector that links and leverages various relevant City strategies and policies.

Key plans and policies that influence the SEAP include the Policy for Sustainable Facilities (PSF), the 2030 Transportation Action Plan, and the Urban Forest Master Plan. To build and accelerate these efforts, it is important that the City put in place structural changes that align efforts, resources and staffing.

Most recently, Charlotte City Council voted unanimously to approve the 'Sustainable and Resilient Charlotte by 2050' resolution. By committing to reduce GHG emissions, the City provided a foundation upon which all the implementation items of the relevant plans and policies can be grounded.

Data Collection

The project launched with the start of data collection. A list of key data points was provided by CDP cities as part of their resources available in support of their GHG reporting platform. Additional information was added to the list to help refine and or fill in gaps where data was not available.

Additionally, the project team worked closely with Duke to gather more granular data than prior GHG baseline efforts. The process was iterative, as Duke was gathering and compiling new data points. The project team worked closely with Duke to define the correct data sets and ensure alignment with broader GHG data.

Through this intense data collection period that lasted several months, it was determined that 2015 was the year where the most comprehensive and reliable data was available, making it ideal to set as the baseline per guidance from the GCoM and CDP Cities.

Understanding the Current Energy Situation

North Carolina is a regulated state; therefore customers within it have a specific utility from whom they must buy their electricity and natural gas. In the case of Charlotte, more than 99% of this energy is supplied by Duke Energy Carolinas (DEC) with the small remainder supplied by Energy United. As there is no competition between suppliers for active customers, the regulator (North Carolina Utilities Commission) manages and approves rates with the utility, meaning there is little opportunity for competition.

Energy Research, Development and Innovation

Charlotte is a thriving hub of energy-related research and development and has multiple opportunities for development. This is guided in part by policies such as House Bill 589[44] which sets out maximum requirements for utilities to incorporate intermittent renewables into their systems. HB 589 also contains a moratorium on new wind farms being constructed (in North Carolina) due to military reasons. North Carolina has already laid a strong foundation for deploying low carbon innovations as the state is ranked third in the US for the largest deployment of solar PV.

Lock-in a Barrier to a Low Carbon Future

The lifespan of power stations, often at least 40 years, is important when making climate-oriented energy policy decisions. The current intention of DEC is to construct a set of new natural gas power stations by 2033, suggesting their existence in 2070. While natural gas emits approximately half as much as coal, it remains a high carbon source.

This will hinder the main target of getting to less than 2tCO_2e per capita, unless the power stations run on a different fuel e.g. biogas/hydrogen – or if carbon capture storage (CCS) is fitted. This is the level required for Charlotte to play its appropriate part in delivering the international climate agenda

Current Emissions and Projections

The future energy mix, and resulting carbon intensity, is provided in the projections provided by DEC in

44 https://www.ncleg.net/Sessions/2013/Bills/House/PDF/H589v8.pdf

Charlotte B-Cycle station. Photo Credit: James Willamor

its Integrated Resource Plan (IRP)45and shows a substantial increase in natural gas capacity. The IRP argues that this is necessary to ensure grid stability when incorporating intermittent renewables.

The projections assume increases in electricity consumption and demand changes, and low levels of electric vehicles and electric heating. These changes would help the City deliver on its 40% reduction goal by 2030, but would 'lock it in' to a high carbon future in the period beyond - stopping the kind of reductions in CO_2e intensity necessary to meet Charlotte's $2tCO_2e$ per capita goal.

The DEC system links to nine transmission operators including Duke Energy Progress (DEP). These provide a larger area that renewable generation can be sourced between, thereby reducing the CO_2 intensity and increasing greater opportunities for demand-side responses, storage mechanisms, and distribution of renewable technology46.

The IRP recognizes the limitations of its projections and particularly identifies the limitations attached to data, as customers 'change from passive consumers of energy'. This means technical opportunities are overlooked and become an issue of risk management. The projections are based upon past experience, rather than current and near-term technological opportunities. This has significant implications for medium- to long-term cost consideration and as a result, decisions move away from low carbon options. The electricity mix available to Charlotteans is that supplied by DEC. The chart in Appendix 3 shows the production of electricity, by technology, which dictates emissions from Duke Energy. In this case, coal is the largest polluter, followed by natural gas. This mix largely defines the emissions from electricity usage47.

There is potential for the cities of North Carolina to come together with Duke and others to provide signals to the North Carolina Utilities Commission of their combined desire to lower the carbon intensity of electricity production. This is needed in a world where other countries are reducing their GHG emissions, which means their goods and services in the future will have a lower carbon intensity associated with them and is likely to become an important component of international trade.

The limitations attached to the projections, and therefore how low carbon the grid could become, offer opportunities for collaboration and job development. This could propel Charlotte to the forefront of low carbon energy systems. Such opportunities are discussed in the Action Areas.

45 *http://www.energy.sc.gov/files/2018%20DEC%20Annual%20Plan_SC__Final.pdf*

46 *Overcoming issues such as cloud coverage.*

47 *Unless zero carbon electricity is procured via a separate contract.*

Stakeholder Engagement

Stakeholder engagement has taken place throughout the duration of the project starting at the end of January 2018 and running through to delivery of the SEAP to City Council. There have been formal engagements in the form of public meetings, external advisory group meetings, GRIP scenario sessions, internal stakeholder meetings, and informal meetings where project team members have had one-on-one sessions with community stakeholders, advocates, and City staff and leadership.

Throughout the project, the project team sought to utilize these meetings to educate the stakeholders on the overall process objectives of the work, and proposed focus pillars where recommendations would have the greatest impact on reducing GHG emissions. In addition to the process, constructive feedback from the stakeholders was sought on a variety of topics, including: challenges the City is currently encountering, opportunities for improvement, ongoing and upcoming projects that reduce GHG emissions, and other stakeholders that should be engaged.

Some of the consistent feedback from the stakeholders was that this strategy needed to be an implementable plan that did not just sit on a shelf, that there was effective and clearly designated leadership to guide implementation of the SEAP, and that the City government ensure stakeholders remain actively engaged through implementation.

Figure 5 was shared with stakeholders to help address the challenges around effectively and authentically engaging stakeholders within processes, especially the SEAP. The key takeaway of the figure is to map out in advance of a project which stakeholders fit in which role, how they will be engaged, and when they will be engaged.

The City of Charlotte is in the midst of massive stakeholder engagement efforts around a variety of plans and policies, like the Unified Development Ordinance and Comprehensive Plan updates. However, it is important to note that while the City has conducted stakeholder engagement for the development of the SEAP, the stakeholder process that is currently underway is different from other stakeholder engagement processes. A key motive behind this is that a large portion of this Plan is extremely technical – it is for these reasons that an external expert was brought on as a consultant to develop the SEAP and ensure the recommendations will help the City achieve the targets. Whereas most stakeholder engagement processes have relied more heavily on the community and advocacy groups on the front end of the project, the City sees the opportunity for heavier stakeholder engagement existing after the SEAP has been approved by Council and the behemoth task of implementation lies ahead. It was determined that many organizations and groups would like to be involved, and the SEAP implementation will build on that.

To ensure success of this plan, collaboration with organizations, community members, and advocacy groups already engaged in zero carbon efforts and programs will need to increase. The local knowledge and enthusiasm of the wide range of community and advocacy groups in Charlotte needs to be leveraged through catalytic partnerships and collaboration.

GRIP Scenario Sessions

The Greenhouse Gas Regional Inventory Protocol (GRIP) is a three-stage process for forming energy action plans at the local or regional level[48]. The first stage is to compile a GHG emissions inventory and energy baseline, the second stage is to, as a group, form future scenarios that reduce overall emissions with the goal of achieving or going beyond set targets, and the third stage is to use the results and experience to inform the development of the SEAP. The project team hosted five scenario workshops, forming four scenarios, in addition to an initial introductory scenario session with a total of 8-10 participants each time, excluding the first workshop.

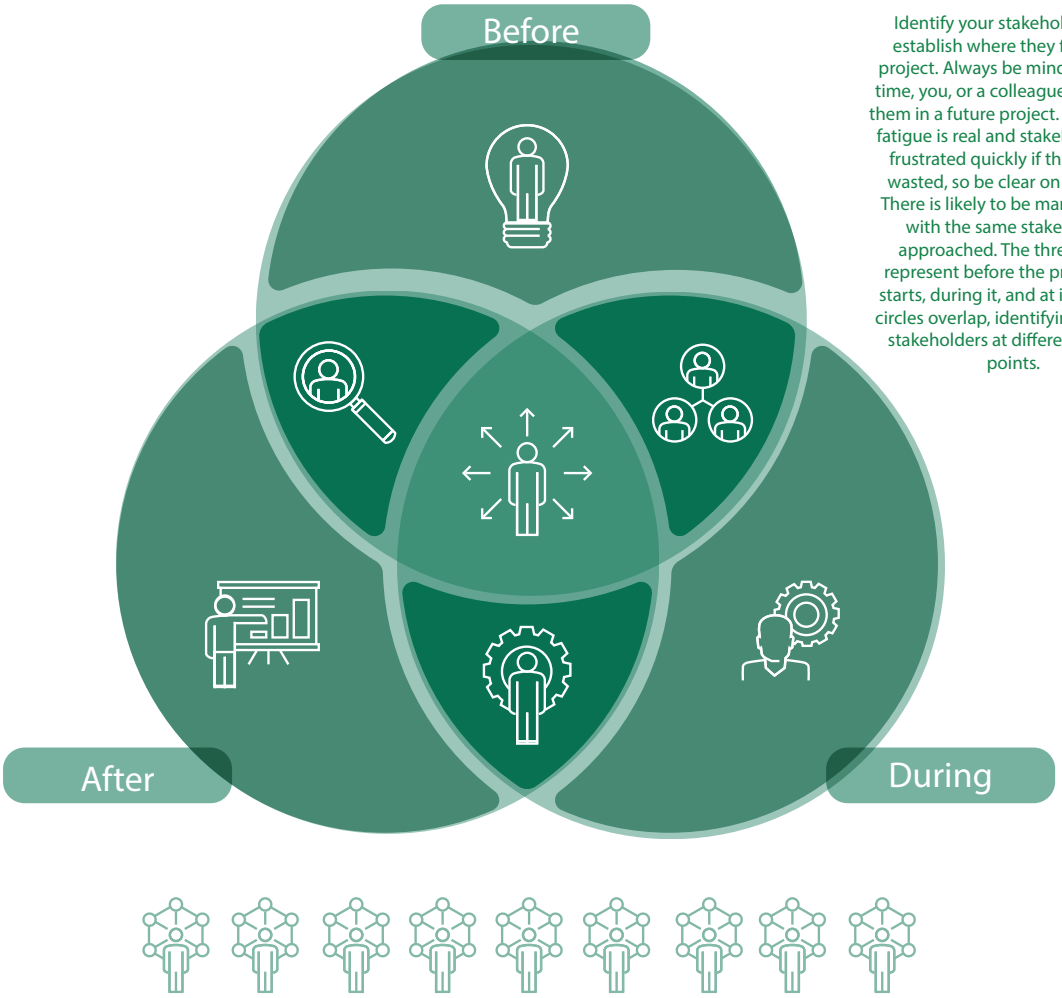
The first workshop engaged 30 City employees along with four representatives from Duke Energy and set the scene for the project and ensuing discussions. This workshop began the journey of identifying opportunities for a cohesive SEAP and showed that stakeholder engagement in this manner was possible. The primary objective of this session was to raise awareness and understanding of the GRIP process and how it connected overall with the development of the SEAP and to educate participants as to the complexity of reducing GHG emissions.

The objective of each of the four scenarios was to produce an energy future that achieved the 2050 target of below 2tCO2e per capita and the 2030 target of under 7tCO2e. The scenarios all adopted the population

48 The Greenhouse Gas Regional Inventory Protocol (GRIP™) is an award-winning approach that has been applied in fifteen countries. It was developed by Dr. Carney as part of his research. This dialogue focused approach was crucial to the engagement that was achieved in the project. Carbon Captured created a customized version of the tool for Charlotte to help increase the engagement (www.carboncaptured.com)

GUIDE

Identify your stakeholders and establish where they fit in your project. Always be mindful of their time, you, or a colleague, may need them in a future project. Stakeholder fatigue is real and stakeholders get frustrated quickly if their time is wasted, so be clear on their role. There is likely to be many projects with the same stakeholders approached. The three circles represent before the project fully starts, during it, and at its end. The circles overlap, identifying different stakeholders at different project points.



Key

Initiators

These Stakeholders have the idea and get the project running. They may also be funders of the project.

Shapers

These Stakeholders are usually gatekeepers to resources, the project may need to be shaped to gain their buy-in.

Reviewers

These Stakeholders review the interim and final results of the project. This is done at key points and certainly before publication.

Recipients

This is the most common category of Stakeholders because they receive the results. If this is the main focus of the project it will likely fail.

Advisory

These Stakeholders are involved at every stage of the project and provide guidance. They are often members of an advisory group.

Informants

These Stakeholders provide inputs to the project. This may be in the form of data, knowledge, or time. This may be via email, phone, workshops or bilateral meetings.

Foundational

These Stakeholders are possibly the most important. They are the people that are represented by those above.

Reflectors

These Stakeholders provide feedback on the project. This can then be taken into the next project. This reflection is important to leadership.

Adapted from Carney et al

carbon captured

Figure 5: Charlotte Stakeholder Engagement tool, adapted from Carney et al.

projections of 1.1 million by 2030 and 1.4 million by 2050, but each scenario session opted for different levels of economic growth varying between an average of 1.5% and 2.5% annually over the period.

All of the scenario sessions achieved the emissions reduction by 2050 with two of the three meeting the targeted reduction for 2030. There were broad similarities between the different scenarios with each delivering similar levels of emissions reductions overall.

In each session, the largest emissions reductions came from residential and commercial buildings, followed by transportation, which was largely driven by a low carbon electricity supply. The groups had remarkably similar grid mixes that were dominated by nuclear power, due to extending the life of existing plants, which also aligns with Duke Energy's most recent Integrated Resource Plan (IRP)[49].

A significant factor in each of the scenarios was a drive for efficiency in both the building stock and appliances. The changes represent the overall change in energy consumption in each sector. For the residential sector, this is per household. Due to electrification, the transportation sector had the largest efficiency gains. The improvements to the building stock were generated through new construction with further efficiency improvements occurring due to behavioral change.

Delivering the Plan

The SEAP is a long-term action plan with a 32 year implementation timeline. The Action Areas, recommendations, targets, and projects that come out of this plan will span the duration of that period. However, to ensure that energy is sustained beyond the planning process, recommendations and projects will include 'immediate' implementation items that showcase both ambitious projects and the City government's leadership in transitioning to a zero carbon energy future.

In the call-out box titled 'The Approach to Delivering the SEAP Targets,' the approach to delivery of the SEAP is shown. For the first two years, the key focus will be on implementing structural changes and internal projects within City government to facilitate delivery of the plan, as well as implementing 'Legacy Projects' that can be showcased at the RNC as a demonstration of Charlotte's leadership within this space. The following three years will be focused on delivering larger scale infrastructure projects that have been preceded by the structural changes. Medium term will see the implementation and completion of projects that will deliver on the 2030 GHG reduction target and City target for sourcing 100% zero carbon energy for municipal buildings and transportation. The longer term will see a multi-prong approach that includes working to scale up pilot projects and accelerate impact, and implementing larger scale infrastructure projects. The focus of implementing the plan should be

49 *Page 10, 43, 44 & DUKE Integrated Resource Plan http://www.energy.sc.gov/files/2018%20DEC%20Annual%20Plan_SC__Final.pdf*

50 *http://ww.charmeck.org/Planning/Commission/2017/2017_09_Sep_Presentation_01.pdf*

STRATEGIC OUTCOMES

There are a number of strategic outcomes of the SEAP which will be delivered by the Action Areas. These are:

- Engaging community to help implementation
- Reducing energy costs that help address issues of energy poverty
- Improving quality of life
- Improving air quality
- Creating equitable access to new jobs and workforce training opportunities
- Creating a resilient city
- Attracting and retaining talent
- Becoming a Winning City of Tomorrow[51]

THE APPROACH TO DELIVERING THE SEAP TARGETS

Immediate (1-2 years):

Laying the foundation for success by implementing structural changes and 'Legacy Projects' that show leadership and early wins.

Short (2-5 years):

Pivoting to a strong focus on identifying and implementing larger projects that have a big impact on GHG reduction, as well as scaling up 'Legacy Projects.'

Medium (5-12 years):

Focus shifts to achieving the 2030 municipal targets and assessing status on 2030 GHG targets, while continuing to identify and implement large scale projects that have biggest GHG savings.

Long Term (12-32 years):

Maintaining the momentum of earlier projects and continuing to grow them, while identifying new technologies and innovation that can be implemented throughout Charlotte to achieve the 2050 target.

achieving the targets set out in the resolution and overall improvement in quality of life for citizens of Charlotte. However, as the projects are being implemented, they should continuously be viewed through the lenses of environmental, social, and economic impact, ensuring an equitable approach to all projects.

FORMING AN ACTION PLAN

This section sets out the Action Areas and subsequent recommendations and projects. Factored in to these are an understanding of the current state of energy in Charlotte, state level regulations, existing and proposed projects, and City and County priorities. Some of the projects are implementation ready, while others will require collaboration, planning, and identification of funding opportunities.

Leading by Example

The City acknowledges that the 2030 and 2050 targets are aspirational, but achievable. To maintain energy and support around the SEAP, it is important that the City take a role of leadership through demonstration. There is an additional component of the City being host to the 2020 RNC from August 24-27, 2020. This provides an ideal deadline for executing 'Legacy Projects' that show both the citizens of Charlotte and the world, that Charlotte is a leader in the zero carbon energy space.

Pillars and Working Groups

The SEAP has an overarching focus on energy; the following three pillars have been determined to be the areas where the biggest GHG savings can occur and highlight significant areas of opportunity for the City to transform policies and procedures:

- Buildings
- Energy generation
- Transportation

Underpinning these three pillars is a foundation of innovation. Innovation in this case is defined as putting in place the structures and policies that allow for people and businesses to try something for the first time.

Buildings

Buildings are crucial to a low carbon future because they represent much of the energy consumption, and therefore emissions, in Charlotte. They therefore provide a significant component of the strategy, which covers both existing and new buildings. When looking at existing buildings, thought needs to be given to how much energy consumption can be reduced, how much energy can be produced on-site through renewable means, and how much energy can be provided from low carbon sources. Additional considerations for new buildings must include the longevity of the building and their energy consumption together with the potential for low carbon energy sources. It must also be considered how they will interact with current and future infrastructure, as well as the people that exist within them.

Energy Generation

Generation of energy includes the production of electricity, heat, and cooling. Decarbonized electricity is crucial to delivering a low carbon future. This means embracing new technologies onto the grid and learning how to match them to consumption. Most low carbon generation technologies are not susceptible to primary energy costs (as wind, solar, and hydro are free), enabling significant opportunities for providing low carbon cost effective energy whose costs are not linked to international energy trade. There are also opportunities for distributed heating and cooling which could be in individual buildings or small districts. This would mean customers purchasing heating or cooling, rather than electricity or gas and would allow for sales from landlords rather than utilities[51].

Transportation

Transportation in the case of Charlotte is comprised of three categories (as there are no boats). These include road vehicles (passenger cars, busses/coaches, freight, and various utility vehicles); rail (including light rail, freight, and intercity) and aviation (including national and international covering both freight and passenger transportation). This sector is a significant consumer of fossil fuels in the form of gasoline. It has the potential to deliver rapid change and deep cuts in emissions. Policy in the case of this sector can support change through infrastructure development and planning policies. There are significant opportunities associated with electrification, hydrogen, and bioenergy.

The City government will lead the development of six working groups that will align with the three main pillars of buildings, energy generation, and transportation. Within the building and transportation sector there are two working groups per topic, with one working group focused on municipal assets and a second working group focusing on citywide implementation. These working groups will be developed and engaged once the plan has received Council approval and will be further explained in the implementation section of this document.

51 https://www.ncuc.net/ncrules/Chapter22.pdf

The Epicenter, located in Uptown Charlotte

ACTION AREAS + TASKS: OVERVIEW

INTERNAL ACTION AREAS

ACTION AREA 1: STRUCTURAL CHANGE

Task 1: Set Up Internal City Resilience Delivery Team (CREDIT)

Task 2: Setting the CREDIT Programmatic Agenda in FY20

Task 3: Set Up Internal Revolving Fund Mechanism

Task 4: Develop strategy for stakeholder group engagement in FY20

Task 5: Hold a Meeting of Content Expert Advisory Group (CEAG) and Internal Working Group

ACTION AREA 2: INITIATE A CITYWIDE COMMUNICATION CAMPAIGN TOWARDS A LOW CARBON FUTURE

Task 1: Form a Branding Team in FY20

Task 2: Create a Striking Visual for Zero Carbon Buildings and Vehicles in FY20

Task 3: Finalize Full Website Development in FY20

ACTION AREA 3: DEVELOP SMART DATA APPROACHES

Task 1: Through CREDIT, Develop a Smart Data Implementation Plan in FY22

Task 2: Internalize Long Term Vision for Energy in FY20

Task 3: Standardize Data-based Decision Making into Practice in 2021

Task 4: Annually Monitor and Submit Emissions Inventory and Questionnaire to CDP

Task 5: Timeline and Measuring Progress

ACTION AREA 4: DEVELOP AND IMPLEMENT RESILIENT INNOVATION DISTRICTS (RIDS)

Task 1: Formalize the Concept of a Resilient Innovation District Through Dialogue with all Relevant Stakeholders and in Line with The Comprehensive Plan Process in FY21

Task 2: Implement a Set of Criteria that will Guide the Selection and Development of Resilient Innovation Districts in FY22

ACTION AREA 5*: STRIVE TOWARD 100% ZERO CARBON MUNICIPAL BUILDINGS BY 2030

Task 1: Revise the Policy for Sustainable Facilities to align with the Sustainable and Resilient Charlotte Resolution in FY20

Task 2: Identify Specific Building Targets for Action in FY20

Task 3: Focus on specific projects in FY21

ACTION AREA 6*: STRIVE TOWARD 100% ZERO CARBON CITY FLEET BY 2030

Task 1: Update the Fleet and Motorized Equipment Asset Management Policy in FY20

Task 2: Begin installation of a telematics system across the City's entire vehicle fleet in FY21

Task 3: Establish the Staggered Introduction of Electric and Other Alternative Fuel Vehicles

Task 4: Consider Opportunities for Retrofitting of Vehicles to Electric Drivetrain in FY21

** Achieving zero carbon facilities and fleet by 2030 is an aspirational and ambitious goal for the City organization. Achievement of the 2030 goals will be dependent on many factors, including technological advancements, operational compatibility and risk management, and the availability of appropriate resources and funding. The City will look for all opportunities to move toward the goals.*

COMMUNITY ACTION AREAS

ACTION AREA 7: NEAR ZERO CARBON NON-MUNICIPAL BUILDINGS BY 2050

Task 1: Form a Building Working Group in FY21

Task 2: Make Existing Residential Buildings Low Carbon by 2050

Task 3: Influence the Energy Requirements of New Residential Buildings to be Near-Zero Carbon by 2050

Task 4: Make existing non-residential buildings low carbon by 2050

Task 5: Make New Non-Residential Buildings Low Carbon by 2050

ACTION AREA 8: FACILITATE RAPID UPTAKE OF SUSTAINABLE MODES OF TRANSPORTATION

Task 1: Form a Transportation Working Group in FY19

Task 2: Develop a Promotion and Awareness Campaign Around Electric Vehicles (EVs)

Task 3: Deploy a Citywide EV Charging System for Charlotte by 2030

Task 4: Increase Access to Zero Carbon Mobility Options

Task 5: Continue to Integrate Transportation Orientated Development (TOD) Policies into Land Use Policy Frameworks, Namely the Comprehensive Plan and UDO Update

ACTION AREA 9: DEVELOP AND IMPLEMENT STRATEGY FOR DEPLOYING LOW CARBON INFRASTRUCTURE GENERATION

Task 1: Form an Energy Generation Working Group Focused on Near-Zero Carbon For Buildings in FY19

Task 2: Develop a Suite of Educational Tools that can be Utilized Throughout the City in FY22

Task 3: Demonstrate New and Integrated Approaches to Meeting Energy Demand in 2022

Task 4: Reduce the Carbon Intensity of Grid Supplied Electricity by at Least 90% by 2045

Task 5: Target a carbon intensity on the grid of at least 90% per kWh by 2045

Task 6: Identify Opportunities for a Bioenergy with Carbon Capture and Storage (BECCS) Combined Heat and Power (CHP) Unit by 2030

Task 7: Negotiate to Develop Tariffs for Low Carbon Electricity in 2022 and Identify a Period for their Rollout by 2030

ACTION AREA 10: DEVELOP GREEN WORKFORCE PIPELINE IN SUPPORT OF ENERGY TRANSITION

Task 1: Form a Working Group for Workforce Development and Equity in FY19

Task 2: Establish and Produce the Training Pipeline for Skilled Labor Jobs and Entrepreneurship Opportunities in FY22

ACTION AREA 11: ESTABLISH PUBLIC-PRIVATE-PLUS PARTNERSHIPS TO ACCELERATE TRANSITION TO A LOW CARBON FUTURE

Task 1: Identify, Build, and Formalize Relevant Partnerships in FY20 and FY21

ACTION AREAS

INTERNAL ACTION AREAS

ACTION AREA 1: STRUCTURAL CHANGE

The transition to a low carbon economy is a substantial undertaking and cannot rest solely within the city government. It requires active buy-in from a range of groups, businesses, NGOs, advocacy, regulatory bodies, and individuals. Ultimately it requires partnerships, within and beyond Charlotte. Stakeholders such as those in the working groups, help build the community's knowledge base and awareness that are critical to bringing about change. The Content Expert Advisory Group (CEAG) helps provide a wider business, construction, and academic perspective that can help to guide the implementation of the SEAP.

Structural Change is therefore required for the following reasons:

1. To build a core capacity within the City for low carbon, resilient Charlotte delivery;

2. To ensure buy-in from leadership down;

3. To ensure alignment and integration with other City initiatives and projects;

4. To provide a basis from which additional projects may be formed and funding secured;

5. To ensure common understanding in project management approach – to reduce project costs and overrun;

6. To engage with external stakeholders and partners to ensure ongoing momentum and support change;

7. To enable a strategic approach to cost that considers packages of approaches rather than individual costs of actions.

Task 1: Set Up Internal City Resilience Delivery Team (CREDIT)

To realize the goals and recommendations set forth in the Resolution and the SEAP requires internalization of knowledge and a structured approach to sustainability and resilience within the City. A dedicated team is recommended to help guide Charlotte towards the low carbon, resilient future determined by the resolution.

Step 1: Appoint a team leader in FY19

A team leader is needed that has a personal interest in sustainability and resilience and will oversee all of the work of the CREDIT team. This person will demonstrate leadership and need to work closely with the team, especially the Energy Ambassador. This person will engage with a wide variety of people, will have international awareness and a proven ability to win funds, and coordinate projects and programs. This role requires a unique blend of technical awareness combined with strong communication abilities.

Step 2: Identify citywide Energy Ambassador in FY19

Working closely with CREDIT's team leader will be an entrepreneurial, solution driven Energy Ambassador. This person will be responsible for focusing largely on projects and have a strong knowledge base within the energy sector. They will be championed by the team leader. This working relationship will be key to the successful implementation of the SEAP. The Ambassador will work with external experts and will be the designer of the Resilient Innovation Districts, as outlined in Action Area 4.

Step 3: Assemble team in FY19

It is recommended that CREDIT is formed of representatives from existing teams: including the sustainability team, SFOT, and individuals within departments. CREDIT will need to operate across City Government Departments. CREDIT's team members should be recruited based on their skills, knowledge, and personalities. While assembling the team, it is important to specify roles, responsibilities, and reporting requirements for each team member.

Step 4: Arrange for project management training for all team members as appropriate in FY20

CREDIT's members will require training in project management to maintain consistency and oversight.

Task 2: Setting the CREDIT Programmatic Agenda in FY20

This is an evolving process but requires an understanding of common goals within the team. This will need to follow project management structures to define them and set the tone that will

feed into all projects.

Step 1: Review the SEAP and progress requirements

This requires developing a strategy for stakeholder engagement, identifying any data gaps, and addressing those gaps.

Step 2: Identify reporting requirements and timeline

Internal team reporting is required, and will be determined based on individual staff types.

Task 3: Set Up Internal Revolving Fund[52] Mechanism

By utilizing an Internal Revolving Fund mechanism for driving energy efficiency efforts within municipal buildings and fleet, the City can take savings and reinvest in additional energy efficiency efforts. This requires new modes of working, embracing uncertainty, and entrepreneurial ways of dealing with cost and difficulty.

Step 1: Establish preferred financing model

It is recommended that a structure similar to a Revolving Fund or an Energy Service Company (ESCO) is implemented to enable cost to be spread between projects within a program. There is currently such a model called Internal Service Providers that could be adapted. In this regard, deep energy retrofits to reduce energy consumption and shift energy demand need to be considered in tandem with savings. In short, cost savings need to be considered at a program, rather than project level, ensuring buildings and fleet projects are considered in tandem.

Step 2: Establish reporting requirements

Clear reporting requirements need to be developed and standardized so that targets can be established and finances tracked. This should encompass how often and when reporting should be performed.

Step 3: Internal team to identify weaknesses and gaps in knowledge base

CREDIT should determine the frequency of meetings with the Internal Leader and the Energy Ambassador to ensure alignment of efforts. The stakeholder group should work with the CREDIT team to nominate two representatives (solution orientated, subject matter experts) that can provide feedback of the views of the group to CREDIT.

Task 4: Develop strategy for stakeholder group engagement in FY20

This is an important link and needs to be based on mutual trust. Both groups have a desire to transition to a low carbon energy future as fast as possible. The importance here will be developing clear connections that leverage the knowledge and expertise of the stakeholder group.

Step 1: Internal team to identify weaknesses and gaps in knowledge base

See Action Area 1, Task 3, Step 3.

Task 5: Hold a Meeting of Content Expert Advisory Group (CEAG) and Internal Working Group

Charlotte is a rapidly growing city benefiting from a business community open to engagement with local policymakers. The CEAG members were selected due to their knowledge, experience, and the organizations they are associated with. The members are well placed to provide a sounding board for solutions and helping the City guide implementation. Energy transitions are complex, so engaging people across the spectrum of the community is crucial.

Step 1: Agree on reporting structures and set out meeting dates for the following year

To avoid misunderstandings and ensure ongoing comfort, the personalities involved need to agree to structures that best suit their mutual ways of working.

Step 2: Identify any options for extending the group (max size of 12)

For reasons of group dynamics, a size of between 8-12 people is needed to maximize dialogue between participants. The individuals may change due to various personal and organizational reasons.

Step 3: Consider a figurehead for promotion of the integrative work

A figurehead is useful for promoting the work of the SEAP. The person best suited to this role may emerge following the SEAP. This could be a celebrity, business person, or similar person with a status within the community.

52 *This is comparable to the use of an Energy Service Company (ESCO) model.*

ACTION AREA 2: INITIATE A CITYWIDE COMMUNICATION CAMPAIGN TOWARDS A LOW CARBON FUTURE

The success of the SEAP is dependent upon clear promotion and communication of the SEAP and its central focus for resilience work across the City. The website will serve as a point for sharing and finding information relevant to sustainability and resiliency efforts in Charlotte. There are different stages required to form and maintain this campaign. The main effort will need to be developed by the City with the anticipation that ultimately, the campaign will be taken up and added to by the community.

Task 1: Form a Branding Team in FY20

To encourage the wider community to reduce their CO_2e emissions, it is critical to actively engage them. Moreover, it is important that Charlotte can communicate to the world that it is a sustainable and resilient city with an eye on the future. This requires a branding campaign that can grow with it.

Step 1: Identify team

The team needs to be representative of the larger community, non-profit, and business interests. This team will comprise a chair from CREDIT and include cross-sector representatives that represent the City, community, arts and science, and hospitality and tourism industries.

Step 2: Set up organizational mechanisms for branding team and formalize purpose

It is recommended that the branding team is structured and assigned clear roles and responsibilities. There will be many organizations and individuals involved so having a clear, common understanding is important to the smooth running of the campaign. This will help to manage expectations.

Step 3: Establish list of initiatives and engagement

Create an interactive and informative SEAP website. Together with video releases and updates, promote the '5 Steps to Zero Carbon' diagram and the 'Charlotte Stakeholder Engagement' tool, to show how organizations and individuals can get involved. In order to encourage ongoing sign-up to the SEAP, it is recommended that the SEAP website be a source for training materials, guides to best practices, guidance on how to reduce personal emissions, and companies that specialize in low carbon technologies, and be incorporated into Charlotte travel guides. The SEAP also highlights specific opportunities for engagement and explains issues of concern and priority actions. The City will host a dashboard for emissions data that will highlight the progress being made in achieving the emissions targets.

Step 4: Agree on communication performance metrics

There are different performance metrics in this space. These include Charlotte, the State, the wider US, and international audiences. The intended audience should be considered when using topic specific language to promote Charlotte as an aspiring world leader in this space.

Task 2: Create a Striking Visual for Zero Carbon Buildings and Vehicles in FY20

Charlotte is known as the Queen City, and this branding campaign needs to sit under that. To maximize visibility and impact, the campaign will need to be deployed by 2020 and focus on vehicles and buildings.

Step 1: Utilize the various groups (internal, stakeholder, and external advisory) to provide feedback

The role of the various stakeholders is significant within this Action Area. The criteria may include a mascot, a logo, and/or a color scheme for building entrances. The idea is to give an identity that residents and visitors can link to the low carbon, resilient future.

Step 2: Launch a citywide competition for schools and colleges to design the branding package

The purpose of this is to bring wider attention and focus to the work of the SEAP and CREDIT. By utilizing local talent, it is a great way to educate and engage a new group of stakeholders.

Task 3: Finalize Full Website Development in FY20

The website and other forms of electronic outreach require an individual within the CREDIT team to take a leadership role in driving the development and completion of website content. The CREDIT team member should work with the community to provide feedback and ways to better incorporate into community efforts.

Step 1: Encourage local resources, like university students, to collaboratively develop promotional films and campaigns

Developing content and keeping it updated is the biggest challenge. Ensuring the website is active will add value to the SEAP implementation and will guarantee it is used as a resource.

Step 2: Encourage core content

It is recommended that certain aspects are included, such as Charlotte's sustainability and resilience history. This could sit alongside performance metrics such as the number of buildings and vehicles that are zero carbon.

Step 3: Include carbon calculators and educational resources

One of the best forms of communication is storytelling, and therefore, stories of successful low carbon approaches in Charlotte could be promoted on the website. Carbon calculators for individuals and Small and Medium Enterprises (SMEs) could be incorporated onto the site, utilizing existing widgets.

ACTION AREA 3: **DEVELOP SMART DATA APPROACHES**

Charlotte has two great data resources. The 'Quality of Life Explorer'[53] , formerly the Quality of Life Study, has been around for more than 20 years. In 2012, it was transformed into an interactive dashboard that included all of Mecklenburg County. In 2013, Charlotte expanded their 'open data' platforms and created 'Open Charlotte'[54]. This is an online, largely static, repository of data. It is an excellent building block upon which a data driven approach can be based.

To achieve a low carbon future, there has to be a considerable change in the energy system. Today's energy system has largely evolved, without guidance, largely due to market forces. To create a new energy system requires foresight, which is greatly aided by data. The data that is required to inform a low carbon future is similar to the data that is required for other areas such as local air quality, equity, transportation flows, workforce development, and economic development.

One of the challenges of transitioning to a low carbon future is the demand on the electricity system, due to a growing population, and increase in EVs, and electrification of heating and cooling. Under the existing regulatory structure, Duke Energy Carolinas (DEC) has a significant role to play in this.

In its Integrated Resource Plan (IRP), Duke recognizes that the traditional approaches to utility resource planning need to be improved to keep pace with the changes that are happening and will continue to happen as the energy system becomes more decentralized. This provides significant opportunities for Charlotte to truly build and shape an energy system capable of supporting the low carbon future that is built on the collection of smart data. That can then be used as a model and exported elsewhere. Charlotte's rapid growth provides significant opportunities in this regard.

Task 1: Through CREDIT, Develop a Smart Data Implementation Plan in FY22

With the increasing number of players entering into the energy market, the complexities of monitoring and tracking will continue to increase. This is not a problem specific to Charlotte, as other cities are grappling with the same challenge and have developed data programs in response. The issue has been incorporated into planning in cities around the world. Further strengthening the City's relationship with UNCC's Data Science Initiative (DSI) will be a key component to delivering this.

Step 1: Establish the data collection as part of the RIDs

The RIDs will provide a significant source of data and provide learning outcomes that can be utilized as part of developing jobs within the 'green economy'. This will serve, in part, as a mechanism through which progress can be measured. The data here will also capture neighborhood related information, so that these areas can be better understood and resilience efforts supported.

Step 2: Identify areas for dynamic data

The RIDs will provide opportunities for a wide-ranging amount of live data. Encompassing traffic flows, street lighting, residential and commercial energy use, energy generation, and similar data can help to inform decision making centrally on such issues as refuse collection, street repair, and lighting repair.

53 *http://charlottenc.gov/HNS/CE/CommunityInfo/Pages/QOL.aspx*

54 *https://clt-charlotte.opendata.arcgis.com/*

Step 3: Identify specific areas where data is required

Key non-dynamic data sets include workforce performance on projects. This may include time to completion, number of staff, delays due to absence, and similar. The precise data to be collected should be determined between CREDIT and the work packages.

Step 4: Establish requirement for consistent data collection as a step towards resilience.

The CREDIT team will conduct a baseline study of best practices from cities around data collection. A part of this study will look at consistent points of data collected and the frequency in which data is collected. These will be provided as recommendations to City Government Leadership to ultimately become standardized practice.

Step 5: Utilize data visualization techniques for enhanced communication and education opportunities

A member of CREDIT should engage with the IT Department and UNCC students and staff to develop visually pleasing interfaces. This data visualization is something that could be incorporated into online resources.

Task 2: Internalize Long Term Vision for Energy in FY20

It is recognized that there are considerable risks and associated learning curves with respect to transitioning to a low carbon future. Data collection approaches will need to help promote and inform the internalization of the long-term vision and will need to be promoted through Action Area 2. This will then need to be promoted with links to transportation, weather impacts, and onsite generation opportunities.

Task 3: Standardize Data-based Decision Making into Practice in 2021

Duke identifies that many customers have come to recognize the benefits that technology can bring and are no longer passive consumers of cheap energy. These changing practices may be seen elsewhere as Charlotteans increase the amount of data they have available.

Step 1: Provide training on data opportunities and integration

The amount and type of data can appear overwhelming so staff training should be offered, with data visualization techniques employed - potentially using dashboards.

Step 2: Demonstrate value through success stories to staff

Successful utilization of data should be promoted. Providing real life stories as to how data has been used to help Charlotteans is particularly helpful, especially where individual stories can be highlighted.

Task 4: Annually Monitor and Submit Emissions Inventory and Questionnaire to CDP

CDP (formerly the Carbon Disclosure Project) requires annual submissions relating to climate change. This includes an assessment of energy and emissions within the City. This inventory is based upon the Global Protocol for Cities (GPC) methodology. This is the methodology underpinning the targets within the Resolution. Additionally, there is an assessment of resilience and adaptation as part of the questionnaire. The report will need to be completed by July each year.

Step 1: Appoint a member of CREDIT to compile the energy and waste datasets

The energy and waste datasets represent the largest sources of emissions within Charlotte. These are broken into three main parts. The first part takes the waste and energy consumption data from City-owned buildings and fleet. The second part is the electricity and gas data provided by Duke. The third part is non-government owned transportation. The reporting is usually two years in arrears, meaning that in 2017, 2015 data would be reported.

Step 2: Compile internal energy and waste data

This data comprises the amount of natural gas and electricity consumed by buildings, the amount of fuels consumed by vehicles, the amount of renewable energy generated onsite, and the data pertaining to waste deposited to landfill sites.

Step 3: Collect energy data from Duke Energy

Duke holds the data on the total amount of electricity and gas consumed by customer type. This data will include the data from Step 2, so it will need to be subtracted. They also hold the data relating to the generation mix and its carbon intensity. In addition, Duke can provide the data on renewable energy facilities registered in Charlotte.

Step 4: Collect data from North Carolina Department of Transport (NCDOT)

NCDOT provides data on vehicle odometers by vehicle type. These datasets are provided on request, however ample time is suggested to collect the data and it is recommended that data is requested at least three months ahead of when it is required.

Step 5: Appoint a member of CREDIT to compile the resilience assessment as part of the CDP questionnaire

The resilience/adaptation assessment needs to be performed annually. This can be performed through the running of a workshop with the correct members of departments required to answer the questionnaire present. The questionnaire varies each year so the CREDIT member will need to check the questionnaire and establish the right people to bring together to provide the answers.

Task 5: Timeline and Measuring Progress

The SEAP will need to be updated and reviewed after the first two years, and then at five-year intervals in the period beyond. The reporting of progress will be to the CREDIT board in the first instance and then in the form of an annual report to Council. The precise structure for this will need to be established when CREDIT is formed. The timeline spreadsheet in the appendix should be used to identify progress on specific tasks. Wider measures of success linked to the projects external facing should also be included.

ACTION AREA 4: DEVELOP AND IMPLEMENT RESILIENT INNOVATION DISTRICTS (RIDS)

A resilient city is one that can deal with shocks and stresses. Shocks may include climatic events such as floods, or it could be the disappearance of an industry upon which the city is highly dependent. Stresses are issues that weaken a city, and may be associated with income inequality, high unemployment, a lack of affordable housing, poor education, and high rates of crime. Ensuring resilience at various scales (city, neighborhood, district) requires the ability of cities to engage with their stakeholders to form a greater understanding of vulnerabilities that span communities, government agencies, city departments, businesses, and utilities.

The SEAP is based upon the three pillars of buildings, transportation, and generation, with these being set on a foundation of innovation. To maximize economic advantage and speed up the innovation process, structures need to be put into place to prove and realize the transition to a low carbon future. The suggested approach is to establish a set of Resilient Innovation Districts[55] (RIDs) as the City seeks to 'rid' itself of CO_2e emissions while ensuring resilience and maximizing job opportunities. These RIDs should be in different areas of Charlotte and will integrate the three pillars - this will allow the City to address economic mobility. The proven low carbon, resilient business models can then be applied elsewhere with revenue opportunities returning to Charlotte, and at the same time deliver greater resilience.

The suggested concept of a Resilient Innovation District (RID) builds upon the existing Smart City District Model (SCDM). The SCDM promotes energy efficient projects and renovations for neighborhoods and communities that lead to a scaling up of proven energy efficiency solutions.

Through the RIDs, barriers to action due to policies and regulations can be overcome through piloting projects and data collection. This will enable emissions to be reduced alongside costs, while at the same time creating jobs and exports from the City that can be deployed around the United States and beyond, bringing finance with them.

Task 1: Formalize the Concept of a Resilient Innovation District Through Dialogue with all Relevant Stakeholders and in Line with The Comprehensive Plan Process in FY21

To be successful, the RID concept cannot be deployed in isolation. Rather, it needs to link to other activities, including the Comprehensive Plan process and the UDO Update. The RID concept requires a partnership approach along with a clear idea of how learning from them can be incorporated into a wider planning.

The technologies and processes exist for living in a low carbon future, however the business models required to realize them have not yet been established. The RID concept allows for collaboration and realization. The regulatory structure of North Carolina could be used positively to address this. The business models needed to exploit low carbon, resilient technologies require development to facilitate a more rapid transition to the target of $2tCO_2e$ per capita.

55 The proposed Resilient Innovation Districts are a combination of Energy Innovation Zones (EIZs), Resilient Innovation Neighborhoods, and the Smart Cities Concept. They are there to deliver low carbon, resilient approaches in order to establish the business models that can see their deployment elsewhere.

Task 2: Implement a Set of Criteria that will Guide the Selection and Development of Resilient Innovation Districts in FY22

The precise structure of each individual RID is still to be determined. It is recommended that the RIDs include at least some or all of the following:

1. Located near to research centers whether they be university-based or private;
2. Linked to City government-owned sites, businesses, residences, and/or transportation infrastructure;
3. May contain micro-grids and other forms of distributed generation.

Step 1: Utilize CREDIT to identify policies that would be a barrier to the creation of RIDs

Ideally, a RID would be located in an area that already has policies and structures in place to support it, for example, areas such as University City, South End, and Uptown. High levels of engagement will be required to achieve and deliver such a model if these areas are to form part of a RID. To establish the RIDs, engagement with regulatory bodies will be necessary, although part of their purpose is to overcome such barriers. This is part of the learning process.

Step 2: Update and/or create policies to support the creation of five RIDs in FY22

The target of five RIDs is aspirational, and should seek to cover different elements of Charlotte's demographics. The RIDs should engage with the

Figure 6: An example of what a Resilient Innovation District can consist of.

operations functions of various relevant Charlotte government service departments like Charlotte Solid Waste Services and Charlotte Water. The plans should be clearly visually set out and developed in tandem with the community through CREDIT and incorporate feedback from relevant groups.

ACTION AREA 5: STRIVE TOWARD 100% ZERO CARBON MUNICIPAL BUILDINGS BY 2030

The Sustainable and Resilient Charlotte resolution sets an expectation that the City will strive to run all City-owned buildings on zero carbon energy by 2030. The approach needs to address behavioral change as well as changes in mechanical systems and operations. Data gathered through analysis of current energy consumption and facility audits will extend staff knowledge about the opportunities for demand and consumption reductions. This Action Area will be delivered by the CREDIT team in consultation with City leadership.

Achieving zero carbon facilities by 2030 is an aspirational and ambitious goal for the City organization. Achievement of the 2030 goal will be dependent on many factors, including technological advancements, operational compatibility and risk management, and the availability of appropriate resources and funding. For some segments of City facilities, achieving the goal may not be possible because operational and other concerns will outweigh or not allow for carbon reduction benefits. However, the City is committed to and will look for all opportunities to achieve the goal.

Task 1: Revise the Policy for Sustainable Facilities to align with the Sustainable and Resilient Charlotte Resolution in FY20

The resolution expectation and the implementation of the '5 Steps to Zero Carbon' diagram pushes beyond the current policy requirements. Among other things, this will mean incorporating additional metrics into the policy, including carbon emissions calculations for the Global Protocol for Cities (GPC).

Step 1: Adjust the policy to meet the requirements of the Sustainable and Resilient Charlotte resolution

It should be a function of CREDIT to establish the weighting of the Council resolution goals against the other goals laid out in the current LEED-based policy. The policy should include a clear process for staff to follow to make the best decisions about facility construction and renovation in light of the resolution.

Step 2: Align the roles of the SFOT to CREDIT

The team structure of SFOT will have significant synergies with CREDIT. Consequently, careful thought needs to be given to how these two approaches will exist. Recognizing capacity challenges, merger of these two groups can be explored.

Task 2: Identify Specific Building Targets for Action in FY20

A complete listing of buildings by operational type and their potential for being subject to the '5 Steps to Zero Carbon' process will need to be established by CREDIT. This will require widespread engagement, particularly with departmental leadership and building managers. One or more example buildings will need to be identified earlier – in FY20.

Step 1: Make data-gathering and analytical capacities more robust

As a starting point, data needs to be carefully examined and incorporated into the decision-making process. This will entail making good use of all energy consumption data, and conducting energy audits in a strategic way. Combined approaches to the five steps then need to be identified – establishing if there are any equipment synergies.

Step 2: Build employee awareness and identify individual(s) that will carry messages about reducing energy consumption and demand in each building

CREDIT cannot deliver this work on its own. The projects to deliver zero carbon futures require that individuals with a working understanding of each building are incorporated into each stage of the project planning. The stakeholder engagement tool should be used to identify who will be involved.

Step 3: Consider compulsory training on energy efficiency and demand reduction for building operators and facility managers

This program could be an updated version of the highly successful UNCC-SIBS Building Re-tuning Training (BRT) program supported by the U.S. Department of Energy.

Building operators and facility managers will

need to go through a compulsory education and awareness program to help them to identify the difference and how their actions can support the transition to a zero carbon future. This is part of a change management activity to change behaviors and understand new procurement requirements.

Step 4: Ensure that procurement processes support cost-efficient approaches to meeting the goal

CREDIT will need to work with procurement teams and identify how to standardize decisions and minimum efficiency standards for new equipment that do not impact operational performance. Individual user requirements will need review, e.g. who requires two monitors for their work, when servers are required to update, etc. An enforcement process needs to be put in place. The total cost of ownership, including the equipment lifespan and financing opportunities, need to be incorporated into the cost projections.

Task 3: Focus on specific projects in FY21

The level of data required needs consideration; too high a level becomes unwieldy and a barrier to action, while too little provides a lack of certainty. However, certain things are known – LED lighting requires less energy, and more efficient monitors and computers can pay back on energy savings – and these types of aspects can be put into place ahead of more detailed data requirements.

Step 1: Through strategic audits, identify the buildings and/or building types with the capacity for incorporating renewables in financially viable ways today or in the future

The cost of on-site generation technologies continues to decrease. They are not always cost competitive in all areas today. This cost competition is linked to the right time frames, as well as the certainties of energy pricing that comes attached to them. With an understanding of the onsite potential for each building (part of the energy audit) the price opportunities can be known and identified with projections.

Step 2: Identify buildings with largest opportunity for savings and payback

Consider selection of a flagship building to retrofit as a demonstrator. This will require additional considerations and weightings that incorporate softer issues such as location and awareness raising. This will need to be determined by CREDIT.

Step 3: Reduce the demand for heating and cooling of internal spaces. Some suggested areas for achieving this include:

1. Reduce the area that needs to be heated / cooled through passive measures
2. Develop strategy for enforcing no new natural gas boilers in retrofits or new buildings
3. Ensure Building Automation Systems (BAS) or Energy Control Systems (ECS) are being effectively utilized and building operators are knowledgeable about operating standards (see Task 2, Step 3)
4. Modify building envelopes to ensure climate appropriateness and reduction of leaks
5. Analyze chilled, hot water, and steam solutions – particularly in areas where there are clusters of buildings
6. Utilize on-site renewable energy generation technologies to provide space and water heating

The specifics of these will be identified through the energy audits. These bullets should form part of the training afforded to staff. The considerations for linking buildings together is one that should be considered and goes beyond most energy audits.

Step 4: Reduce energy consumption and shift energy demand from appliances and lighting

These are key for day to day aspects of procurement in every building, with policies that can be established for them rapidly. This aspect of procurement policy should be in place by FY20. This could require at-desk guidance for staff, or localized smart sockets for certain devices to facilitate charging.

Considerations:

1. Change procurement requirements of lighting and appliances
2. Set parameters for the use of small appliances in the workplace
3. Maximize natural light and minimize artificial light
4. Integrate onsite electrical renewables
5. Load shift to zero carbon availability

6. Identify and replace early opportunities where payback is proven

These considerations will all be featured as part of the energy audits to be conducted, or developed. Part of this auditing is to understand how these buildings are being used. If staff are often off-site or regularly collaborate away from their desks, then consideration needs to be given to how they use the space and if it is used appropriately.

ACTION AREA 6: STRIVE TOWARD 100% ZERO CARBON CITY FLEET BY 2030

The Sustainable and Resilient Charlotte resolution sets an expectation that the City will strive to transition the City's vehicle fleet to zero carbon by 2030. The requirement to become zero carbon means that the vehicles must run on electricity, hydrogen, biogas, or biofuel by 2030. The electricity or hydrogen consumed by these vehicles in 2030 (and beyond) must be produced using zero carbon electricity sources (either on-site or through procurement contracts).

There are more than 4,000 vehicles that are owned by the City, and they have varying degrees of 'life expectancy' attached to them. This means that a staggered introduction of zero carbon vehicles will need to be introduced over the next 12 years, with EVs being prioritized in areas where they best suit operational needs.

There are additional benefits that extend beyond the zero carbon component required by the resolution. When the total cost of ownership is considered, electric vehicles often cost less to run than their internal combustion engine counterparts. This is because the energy on which they run costs less and with significantly fewer engine parts, electric vehicles have a far lower maintenance requirement. Beyond fuel and maintenance benefits, electric vehicles also mean cleaner air and less noise pollution.

Achieving a zero carbon fleet by 2030 is an aspirational and ambitious goal for the City organization. Achievement of the 2030 goal will be dependent on many factors, including technological advancements, operational compatibility and risk management, and the availability of appropriate resources and funding. For some segments of the City fleet, achieving the goal may not be possible because operational and other concerns will outweigh or not allow for carbon reduction benefits. However, the City is committed to and will look for all opportunities to achieve the goal.

Task 1: Update the Fleet and Motorized Equipment Asset Management Policy in FY20

The procurement decisions will need to incorporate the Resolution and the calculations set out by the Global Protocol for Cities upon which these figures will be determined. The policy will require standardization and seek to develop the "fix-it first" requirement of the Policy for Sustainable Facilities. The opportunities for vehicle conversions or retrofits should be an active consideration.

Step 1: Form an action team comprised of existing Fleet Maintenance Advisory Team (FMAT) and CREDIT

The fleet maintenance team will need to remain in place but work closely with CREDIT because they remain central to delivery of the aftercare of the vehicles. There will need to be training and awareness raising of vehicle opportunities that are available today along with those in the pipeline of existing manufacturers going forwards.

Step 2: Revise the Fleet and Motorized Equipment Asset Management Policy to align with the goals of the Sustainable and Resilient Charlotte resolution

The Fleet and Motorized Equipment Asset Management policy will need to be revised to reflect how decisions will be made about vehicle replacement so that at each decision point, consideration and analysis is given to purchasing a vehicle that would reduce or eliminate carbon emissions.

Step 3: Raise awareness of the resolution goals and increase acceptance among staff

Engage staff to show how resolution goals will be met. Right-sizing the fleet and choosing an alternative fuel option for departments, dependent on the vehicle application will serve as an example to the community.

Step 4: Establish requirements per vehicle type based upon their expected lifespan to align with the 2030 goal

A clear, staggered timeline attached to existing vehicles and their anticipated lifespans should be formed. This builds upon the existing data repository. The timeline for replacement should incorporate vehicle retrofitting opportunities particularly those of heavy fleet where known opportunities exist.

Task 2: Begin installation of a telematics system across the City's entire vehicle fleet in FY21

Telematics should be installed across the vehicle fleet to identify which vehicle usage lends itself best to different fuel choices and resources can be allocated accordingly. This will help identify which vehicles should be transitioned to electric, which can be retrofitted to electric, which may be biofuel-based, and so on. The telematics may also provide opportunities for reducing the fleet size, making opportunities for using vehicles for more than one purpose, identifying more efficient routes, and where to locate charging stations.

Step 1: Utilize a pilot project lasting three months using the selection of the fleet that already has telematics to identify potential fuel savings opportunities

Collect data to inform an education program that sets expectations for improvement and train drivers on eco-driving. The fuel savings achieved as a consequence can then form a benchmark for performance as well as a revenue source. The current telematics are not being used to monitor fuel use.

Step 2: Identify the type of telematics that will have the largest impact and consider telematics with filming technology to reduce insurance liabilities

The City provides its own insurance; however, telematics can still be used to reduce liabilities, as they can help to prove speed at the time as well as record incidents. This is likely to reduce insurance settlements. The savings attached would then be a revenue source.

Step 3: Utilize the combination of fuel savings, insurance payments averted, and any other savings to finance the rollout of telematics across the vehicle fleet

This is made possible through the revolving fund structure of CREDIT. This telematics data is then to be used to inform the staggered procurement exercise. This is part of the wider considerations of total cost of ownership.

Step 4: Roll Out Education Program that Provides Training on Eco-Driving to all City Staff.

Training on vehicle driving and 'eco-driving' should be rolled out to all staff, especially those that run City vehicles. Eco-driving is being aware of the vehicle to better conserve fuel and reduce emissions, including using gears correctly, keeping tires inflated, accelerating at a slower rate, and practicing mindful breaking, among others. This will then be incorporated into their day-to-day activities. Training should also be provided on the use of the existing electric vehicles.

Step 5: Identify any drivers falling short of development marks and provide additional training

The telematics information and benchmarking should be used to identify any drivers who continue to drive in an un-economical way to provide further training to help reduce energy consumption.

Task 3: Establish the Staggered Introduction of Electric and Other Alternative Fuel Vehicles

Electric vehicles (EVs) are the current preferred car to transition the fleet to and the data for the establishment of their staggered introduction will come about through the previous steps. The procurement will also need to integrate the introduction of the charging infrastructure needed to meet the requirements.

Step 1: Update the centralized procurement policy and/or process to enable the consideration of total cost in FY20

The total cost of ownership, including the vehicle lifespan and financing opportunities, need to be incorporated into the cost projections. This is because EVs have less moving parts and have the potential to replace the batteries, extending their lifespan.

Step 2: Align efforts with Action Area 5 to identify potential for producing electricity on site.

There is opportunity to provide the electricity upon which the vehicles will run through onsite means. This is particularly true of parking lots and decks. The transition could consider battery storage seasonal variations and vehicle charging opportunities to establish the opportunities for onsite generation more fully. These calculations will be the responsibility of the CREDIT team.

Step 3: Identify resilience strategies required to ensure continuity of electricity supply by 2022

As electric vehicles require a source of electricity rather than the availability of petroleum, a

resiliency strategy will need to be in place to ensure continuity for vehicles. This will need to provide a priority function. Such a resilience strategy should not be a barrier to change if restrictions are higher than those in place today.

Step 4: Work with existing retail partners to install a charging network that makes use of gas station canopies by 2025

It may be possible to work with existing gas stations and their solar opportunities to provide charging and storage opportunities to help with resilience.

Task 4: Consider Opportunities for Retrofitting of Vehicles to Electric Drivetrain in FY21

There are opportunities to retrofit vehicles with electric drivetrains, which extend the life of much of the vehicle, and potentially change how well a vehicles shell may be maintained. This has the opportunity to change the approach to procurement and the value of a vehicle currently considered to end of life. It may also mean that drivetrain conversion occurs before the end of life of the combustion engine.

Step 1: Identify existing areas of expertise within the Fleet Maintenance Advisory Team (FMAT) and other City Departments

As the cost of batteries declines and the technologies and understanding of battery vehicles improves, opportunities for conversion are increasing. This brings job opportunities and revenues associated with it to Charlotte.

Step 2: Identify opportunities for workforce development

There are opportunities for increased employment and entrepreneurial opportunities, as well as additional prospects for the workforce pipeline.

Step 3: Pilot a diesel bus or heavy equipment retrofit at the City maintenance facility.

The City maintenance team has a large site and skilled staff. A pilot project could see an existing CATS bus or other heavy-duty vehicle retrofitted as an electric one.

Step 4: Align with the City's circular economy strategy

The retrofitting of vehicles to electric helps to close the waste cycle. This closed loop approach is central to the circular economy strategy. If a retrofitting strategy was adopted it could align with the activities of the City's innovation barn, and would then provide an additional revenue stream to CREDIT's revolving fund structure.

COMMUNITY ACTION AREAS

ACTION AREA 7: NEAR ZERO CARBON NON-MUNICIPAL BUILDINGS BY 2050

Buildings are crucial to a low carbon future. They are the biggest energy consumers and therefore are the biggest component of emissions in Charlotte. The City will use the '5 Stages to Zero Carbon Energy' diagram when retrofitting existing buildings and constructing new ones. It is necessary to consider the longevity and energy consumption of new and existing buildings, together with the potential for low carbon energy sources and on-site generation. It is also important to consider how buildings will interact with current and future infrastructure and the people within them.

The City is expanding rapidly. New residents require housing, workplaces, and the infrastructure to support them. This includes healthcare, schools, retail outlets, leisure facilities, and the hospitality industry. The location of these buildings and their proximity to facilities and transportation infrastructure affects how people live in the short, medium, and long term. This means that in the absence of coordinated planning efforts, energy consumption patterns can be set for decades.

This action area identifies two overarching categories where the greatest impact can be had: 1) retrofitting (deep weatherization) of existing buildings and, 2) low carbon construction of new buildings.

Task 1: Form a Building Working Group in FY21

CREDIT will not be able to deliver a near zero carbon building stock itself. It will need to work through and with partners. It is therefore recommended to set up a working group specializing in getting to near zero carbon for buildings. This group will need to comprise experts from academia, construction, planning, energy systems, and infrastructure to inform and direct it. To achieve such a future will require, per the scenarios produced, a system for buildings that is largely based on electricity.

Task 2: Make Existing Residential Buildings Low Carbon by 2050

The existing building stock is the biggest challenge to nearly every city striving towards a low carbon future. They require a considerable amount of work and effort with a diverse ownership, including homeowners, landlords, mixed use developments and multi-family occupancy.

Step 1: Develop an ongoing educational program with partners on the opportunities associated with retrofitting

Understanding how to reduce energy consumption, shift demand, and increase renewable generation onsite is limited and needs to be increased as part of this long-term transition to near zero carbon. CREDIT will need to support and develop programs through the working group with for-profit partners such as Duke, as well as through non-profit organizations like RETI.

Step 2: Develop deep retrofitting example demonstrations (or varying types – detached, multi-family, attached single family development) to net-zero energy levels

CREDIT, in partnership with the working groups, will need to utilize RIDs to pilot and show proofs of concept for varying types of buildings, including carbon negative, high carbon, and low carbon buildings. Like the North End Smart District Smart Homes program, these demonstrations could use technology to inform their inhabitants on how to reduce future utility bills.

Step 3: Consider policy to stop natural gas boiler implementation and replacement by 2025

Delivering a near zero carbon building stock by 2050 requires discontinuing the installation of gas boilers and their replacements as soon as possible. This was the policy that stemmed from each GRIP scenario session, due to the longevity of the boilers (over 20 years). Continuing to use and install natural gas distribution for hydrogen or biogas was consistently discounted as unviable.

Step 4: Develop a workforce pipeline of qualified workers trained in deep energy retrofits

Deep energy retrofits at the scale required to drive the transition will require many laborers to deliver. The development of a low carbon future is dependent on achieving such energy retrofits of differing sizes. These will all require an expansion in the labor force above that of today.

Step 5: Utilize the RIDs as further proof of concept and move forward with retrofitting roll out

The working groups will need to establish with the Energy Ambassador the criteria for the RIDs. Retrofitting will need to be a key component of each of the RIDs with the level to be established. With an estimated number of households of approximately 500,000 by 2050, homes will likely need to be retrofitted at an increasing rate from 2030 onward. The scale of this will need to be established but is likely to be around 1,000 per month in 2030, increasing to as much as 5,000 by 2045. This level of retrofitting will also need to be maintained and will require additional workforce.

Task 3: Influence the Energy Requirements of New Residential Buildings to be Near-Zero Carbon by 2050

New buildings exist on average for over 100 years, so buildings constructed today ensure a particular energy pathway going forward. Strong policies, in collaboration with the County and State, are therefore required to achieve a near zero carbon building stock.

Step 1: Exert influence to establish minimum building standards for energy efficiency with scaled introductions to net zero energy by 2030

Raising the minimum building standard is required to ensure that the future energy system is not overburdened with meeting the future energy needs of its inhabitants. This requires a scaled introduction of minimum building standards, appropriate training, and effective rollout. There are standards in place, but to achieve the target, a design that permits net-zero energy development by 2030 is required. This necessitates an appropriate skill set that places additional requirements onto workforce development.

Step 2: Incentivize alternatives to gas boilers by 2022

See Action Area 7, Task 2, Step 3.

Step 3: Incorporate cutting-edge low-carbon residences into Resilient Districts targeted with new mixed-use developments.

The RIDs should trial opportunities for low carbon developments at new mixed-use sites. CREDIT should work with the County, developers, and home owners to help identify and incentivize ways to make the residence low carbon. These developments allow for the implementation of new systems of heat, cooling, and electricity provision. An option could be to direct projects to the Hybrid Collaborative Design Team (HCDT) for a quicker permit and approval process.

Step 4: Ensure sufficient capacity at all developments for electric vehicle infrastructure.

Meeting the electricity requirements for charging vehicles requires a grid capable of supporting it. Sites should include charging points and spare capacity to connect additional ones. These systems could share the electricity supply to enable rapid charging where required, when other vehicles on the same supply do not require rapid charging.

Step 5: Exert influence to implement minimum requirements for renewable generation of 10% by 2022 sliding up to 40% by 2030.

A minimum standard specifying the percentage of energy consumption to be sourced from onsite renewable energy generation is needed to facilitate the long term installed infrastructure that is needed to deliver a near-zero carbon building stock. The gradual introduction of a minimum requirement is necessary to support the 2tCO_2e target. This will need to be done in collaboration with the County and the State.

Step 6: Identify incentives or programs that help to inc orporate installation of batteries into new residences

Storage in the form of batteries is a very helpful component of shifting energy demand throughout the day. Such storage can be topped off through solar during the day for deployment at night. It can also charge at night through smart grids in anticipation of cloudy days. These technological approaches are made possible through specifications at the point of construction and can serve as a data input to the data requirements of Action Area 11.

Task 4: Make existing non-residential buildings low carbon by 2050

The existing non-residential building stock requires retrofitting in much the same way as the existing housing stock. There are additional challenges associated with ownership, lease length, construction quality, and associated standards of energy efficiency. This makes the use of RIDs particularly valuable for testing solutions in order to identify business models that can deliver near-zero carbon buildings.

Step 1: Exert influence to establish minimum building standards for energy efficiency with scaled introductions to net-zero energy by 2030

See Action Area 7, Task 3, Step 1.

Step 2: Incentivize alternatives to gas boilers by 2022

See Action Area 7, Task 2, Step 3.

Step 3: Ensure sufficient capacity at all developments for electric vehicle infrastructure.

See Action Area 7, Task 3, Step 4.

Step 4: Establish opportunities with demand side management to link heat requirements in mixed-use developments

Through the RIDs, innovative approaches can be incorporated that have been proven in other countries. These include the ability to share waste heat between buildings, as well as utilize heat dumps[56] such as swimming pools.

Step 5: Establish Smart Energy Now 2.0 and PACE programs

CREDIT will need to establish a partnership with a local organization and UNCC to deploy a Smart Energy Now 2.0 program that works on educating building operators and facilities managers to operate buildings more efficiently. CREDIT should also work with the working group to establish how this could be incorporated into PACE funding programs to encourage active standards today.

Step 6: Incorporate best energy practice into developer outreach and communication

CREDIT will, through the working group, establish mechanisms of communication with current and potential developers within Charlotte to improve efficiency standards for new developments. The knowledge attached to these development types can also be incorporated into retrofitting projects.

Task 5: Make New Non-Residential Buildings Low Carbon by 2050

The development of new non-residential buildings brings with it opportunities for minimizing energy requirements, integrating renewable energy generation, and being creative with transportation solutions.

Step 1: Exert influence to establish minimum building standards for energy efficiency with scaled introductions to net-zero energy by 2030

See Action Area 7, Task 3, Step 1.

Step 2: Incentivize alternatives to gas boilers by 2022

See Action Area 7, Task 2, Step 3.

Step 3: Develop a shared solar model where each owner pays solar installation cost based on their peak demand

There will need to be innovative energy service style solutions to reducing energy costs into the future and ensuring that they come from low carbon sources. This means looking to solutions at sites where there is a landlord and multiple businesses within the property. A set of example buildings would need to done in the first instance to test and demonstrate the opportunity.

Step 4: Form educational packages on the benefits of consistent pricing for renewables

CREDIT, with the working group and partners should form training packages, for commercial building owners and their tenants to inform them of the opportunities attached to energy in a low carbon future. This type of outreach and engagement is a key component of building links to commercial building operators that can bring about the needed transition. This can be used to demonstrate how low carbon building design can be useful to their business both in terms of energy savings and in terms of their Corporate Social Responsibility.

Step 5: Work with new building owners to trial an Energy Service Company (ESCO) on site, where all lessees pay for heat, cooling, lighting, and local transportation rather than electricity

CREDIT, in partnership with the building working group, can work to include in a RID a commercial building or district where energy services are sold, rather than electricity, to establish working business models. These services may include lighting, refrigeration, cooling, heating, and local transportation.

56 A heat dump is a term for where heat can be placed instead of being wasted entirely. This is usually a space that requires heating, it may be one like a swimming pool that doesn't need heat but may want it.

Step 6: Incentivize ongoing reporting and minimum standard targets for sites

Identify opportunities for incentives for providing consistent reporting and setting of minimum targets in the development phase. This can help develop a greater real-time understanding of energy data and should be developed in tandem with recommendations in Action Area 11.

Step 7: Maximize potential for renewables on-site

CREDIT, in partnership with the building working group and partners, should identify opportunities to incorporate on-site renewable energy generation for heating and electricity in new development construction across Charlotte.

Step 8: Enable fast-tracking of applications that meet minimum standards

CREDIT, in partnership with the City of Charlotte and Mecklenburg County, should develop a pilot process and clear project requirements to accelerate applications through the approval process that meet high efficiency standards. These developments would then be approved faster and receive dedicated support opportunities with them. This may include buildings that utilize passive temperature.

ACTION AREA 8: FACILITATE RAPID UPTAKE OF SUSTAINABLE MODES OF TRANSPORTATION

The transportation sector is the second largest source of greenhouse gas emissions in Charlotte. This is primarily due to the structure of the economy, the efficiency of the vehicles, and the availability of alternative transportation options. This also considers the emissions from Charlotte Douglas International Airport, which is one of the busiest airports in the USA and is a hub for American Airlines.

In order to reduce emissions from the transportation sector there needs to be focused efforts:

- Change how people move about
- Improve efficiency in vehicles (whether technological or behavioral)
- Change the fuels that are being used by the vehicles
- Make the last mile of a person's journey zero carbon
- Provide the new infrastructure required to support alternative modes of transportation
- Change the existing transportation infrastructure to support a range of transportation choices

Fundamental to the transition to a zero carbon energy transportation future is the infrastructure to support it. This comes with a series of complex issues that need to be resolved. Some of these challenges include where to locate the charging points, how many charging points are required, what type of charging point is needed, how to connect electricity infrastructure to support the charging points, how charging points can be incorporated into older buildings, how to make provisions for charging points in new buildings, how to procure zero carbon electricity to support electric vehicle growth, and how to design the system so that peak demand is controlled.

There are also opportunities for external companies providing services in the form of short-term rental bikes, scooters, and similar. These latter options have become more possible with the advancement of technology and help to address last mile transportation challenges.

Air transportation is likely to remain the area that is hardest to mitigate. This means that a sizeable chunk of the 2tCO_2e target will be absorbed by aviation in the future. This also means that other sectors will likely need to reduce by more to accommodate this industry, moving forward.

Task 1: Form a Transportation Working Group in FY19

CREDIT will not be able to deliver a sustainable transportation system on its own; it will need to rely on developing key partnerships to support implementation. It is therefore recommended to set up a working group specializing in getting to a sustainable future transportation system. This group will need to comprise experts from academia, construction, planning, energy systems, and infrastructure to inform and direct it. To achieve such a future will require, according to the scenarios produced, a system built largely on electricity.

Task 2: Develop a Promotion and Awareness Campaign Around Electric Vehicles (EVs)

The challenges associated with EVs largely relate to their perceived reliability and technical abilities, i.e. the distance that they can go, where they can be charged, etc. As a result, continuous awareness

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raising and education is required to support the rapid uptake of EVs. A large part of this will be visual and collaborative. One way to accomplish this is to locate charging stations in high foot traffic areas so that people see the EVs parked and charging out in public. This will need to align with the broader communication strategy of Action Area 2.

Step 1: Create a visible monthly event to educate the community around zero carbon modes of transportation

This may include activities such as closing N. Tryon St. for one day during the week to internal combustion engine (ICE) vehicles, with opportunities to test EVs.

Task 3: Deploy a Citywide EV Charging System for Charlotte by 2030

Facilitating the uptake of EVs requires a visible charging network. These chargers need to be located where people remember them, such as in retail outlets, in government buildings, and at work places. The EV network initially needs to be ahead of the vehicle fleet, but this will change in time. As an electric fleet has not been present before, it is difficult to know what the optimum number of chargers and locations precisely is. The charging system will need to grow with the number of vehicles that require it.

Step 1: CREDIT and transportation working group will produce an EV transportation deployment strategy and business case

This strategy may include a requirement to provide priority parking and/or free parking to electric vehicles in areas of high density, like Uptown or South End, and at transit sites with charging opportunities. The strategy can also explore the possibility of limiting access to certain roads to electric only vehicles at particular times and providing access to carpool lanes. The strategy may also make provisions for charging at particular locations such as restaurants and at places of work.

Step 2: Ensure sufficient capacity at all developments for electric vehicle infrastructure.

See Action Area 7, Task 3, Step 4.

Task 4: Increase Access to Zero Carbon Mobility Options

Getting people out of automobiles requires providing them with alternative transportation options, making areas more walkable, or providing an alternative that removes the transportation requirement.

Step 1: Create a taskforce to review and update policies that support rapid uptake of last mile modes of transit

The purpose of this taskforce is to target the 'last mile,' a specific but crucial element of transportation. The taskforce will need to include internal team members from CATS and CDOT, as well as community stakeholders to identify how this may be better addressed. Last mile modes of transit can include scooters and dock-less bikes.

Step 2: Actively support and further the work of CATS and transportation stakeholders to develop a series of campaigns to overcome negative perceptions of public transportation

This step should work with the communication aspects in Action Area 2 and specifically work with the Content Expert Advisory Group to identify how best to address this. Wider groups for engagement may include the hospitality industry, CMS, and CRVA, among others.

Step 3: Increase last mile opportunities at transit development sites

The development of new sites enables construction that encourages low carbon transportation options such as cycling and mass transportation. The existing planning needs to involve the existing corridors and see the implementation of the additional light rail lines.

Step 4: Develop app or platform that provides for one-stop purchase of tickets for all modes of transit available in Charlotte

The idea behind this is to extend the ticket to include rental of the scooters/bikes as part of the ticket purchase. A further extension could see pre-booking of electric vehicle parking in areas linked to light rail stops.

Task 5: Continue to Integrate Transportation Orientated Development (TOD) Policies into Land Use Policy Frameworks, Namely the Comprehensive Plan and UDO Update

TOD encourages the development of systems that decrease reliance on the automobile. Integrating such policies has long term implications for a downward pressure on transportation. The Comprehensive Plan will have far reaching implications for direct and indirect energy requirements and this should be part of it.

Step 1: Assign a person from CREDIT responsible for ensuring effective communication and alignment between the SEAP and the Comprehensive Plan update

The role of energy must be reinforced within the Comprehensive Plan to ensure that it is firmly integrated into it.

ACTION AREA 9: DEVELOP AND IMPLEMENT STRATEGY FOR DEPLOYING LOW CARBON INFRASTRUCTURE GENERATION

The adoption of zero carbon electricity sources needs careful planning today to ensure that it is in place for the long-term. Power stations, such as coal and gas, are often promoted by power companies as a means to support renewable technologies. Implementation is likely to result in long-term difficulties. This demands careful thought to be given to how electricity requirements will be met in the future. This is complicated by federal policy that has reduced the requirements for CO_2 reductions. This has the trickle-down effect of CO_2 reduction not becoming a requirement in setting energy policy in North Carolina.

The resolution's 2050 target necessitates minimal CO_2 in the electricity system (a reduction of more than 90% against today's carbon intensity[57]) in order to meet the less than 2tCO_2e per capita target. In order to reach the target, we must focus on innovative solutions, such as Bioenergy Carbon Capture and Storage (BECCS).

With no clear solution as to how to achieve such deep carbon cuts, the strategy will require detailed consideration, and should include the implementation of on-site electricity generation that addresses heating and cooling needs, rather than solely electricity. Given these requirements, there are strong connections to the Buildings and Transportation pillars in this strategy, as well as being heavily reliant on the underpinning innovation pipeline of trained individuals.

This Action Area is complementary to Action Area 3, as many of these recommendations require key public-private-plus partnerships to drive rapid implementation.

Task 1: Form an Energy Generation Working Group Focused on Near-Zero Carbon For Buildings in FY19

Because Charlotte is in a regulated state, CREDIT will not be able to deliver a 90% reduction in the carbon intensity of electricity provided by the grid on its own. It will therefore need a targeted working group specializing in getting to this point. This group will need to comprise experts from academia, construction, planning, energy systems, and infrastructure to inform and direct it. To achieve such a near-zero carbon future will require, according to the scenarios produced, a system that takes advantage of the widespread opportunities for renewable integration across Charlotte and wider North Carolina.

Task 2: Develop a Suite of Educational Tools that can be Utilized Throughout the City in FY22

Education and training are key to leveraging change. These educational tools can come in a variety of forms and will need to recognize the equity elements relating to access to this information.

Step 1: Incorporate CO_2e values onto energy bills

The CO_2e emissions associated with a customer's energy use can be added to both electricity and gas statements. This can be displayed alongside percentages of generation by technology for electricity and by type of gas used (natural gas, fracked gas and biogas). This can help to inform customers of the level of CO_2e emissions that are associated with their energy consumption. This information can be linked to efficiency and demand guides to drive behavior change in customers and help them reduce their impact.

Step 2: Create a mechanism that links emissions to smart meters to help educate customers on when CO_2e is at its highest or lowest

To provide real-time updates, smart meters can be used to guide customers to when the CO_2e associated with their electricity demand is at its lowest (e.g. during the night when energy is generated largely by nuclear) and highest (at times of winter peak demand when solar generation is at its lowest and fossil generation at its highest). This can then be linked to live CO_2e monitoring and conveyed in their bills.

57 *Carbon intensity is defined as the amount of carbon (in terms of weight) emitted per unit of energy consumed.*

Step 3: Encourage training on demand side management

Further developing the information under Steps 1 & 2 enables the development of demand side responses[58]. This can be automated through the use of smart appliances such as washing machines and electric vehicles. It can also be manual, making the change a conscious behavioral choice. This demand side management may be linked to utilizing onsite generation for appliance use when energy generation is at its peak, rather than relying on grid availability.

Step 4: Utilize RIDs to understand and overcome demographic variance in technology and process uptake

The RIDs may be used to better understand the business models needed to see the uptake in low carbon technology and processes. This is likely to vary by income group and awareness levels, as customers become more aware of their energy usage as access to more granular data improves.

Step 5: Provide training and events on alternative technologies

A key component of the uptake of renewable energy generation is to provide demonstration of the technologies to show that it is possible to incorporate their utilization into buildings. This may include solar thermal, geo-thermal, and solar photo-voltaic (PV).

Step 6: Create an 'outward bound' and other demonstration site(s)

As well as events, demonstration sites can serve as a year-round opportunity to demonstrate the ability of renewables to provide the energy required for a building. Such sites could include schools. Additionally, a site (similar to a campsite) could be formed for team building activities where participants would be required to 'keep the lights and heating on'. This could be located within a proposed RID.

Task 3: Demonstrate New and Integrated Approaches to Meeting Energy Demand in 2022

The Resilient Innovation Districts (RIDs) will provide opportunities to establish how proven technologies can be integrated into the energy system that provides us with our energy needs (heating, cooling, or electricity). This may mean combining technologies (e.g. solar thermal, geo-thermal, and bio-energy CHP system) to produce heating and cooling for a site (the solar thermal and geo-thermal providing a lower grade heat). The RIDs offer an opportunity to test as well as diffuse technologies and processes.

Step 1: Identify new technologies, processes, and opportunities for demonstration in the RIDs

The identification of new technologies can come from multiple sources and these may be subject to procurement requirements. Ultimately, part of the reason for the RIDs is to demonstrate technologies and processes produced in Charlotte that can then be diffused throughout the U.S.

Step 2: Utilize the RIDs to demonstrate district heating and cooling opportunities

The RIDs offer the opportunity to incorporate approaches that are not well known in the U.S., which includes district heating and cooling systems. One of the RIDs could be used to extract methane (bio-gas) from waste sites and compress it for carbon-free CNG (it is not actually natural gas – but has the same chemical composition). The same bio-gas could also be distributed in the gas network.

Task 4: Reduce the Carbon Intensity of Grid Supplied Electricity by at Least 90% by 2045

The requirement to get to 2tCO_2e per capita by 2050 requires that the majority of energy consumption is low carbon. This is because, of the 2tCO_2e target, approximately 1.2tCO_2e will be from energy. The remainder will be largely associated with waste and agriculture. The likeliest carbon intensive category will be aviation – a return trip in economy represents 0.51tCO_2e. This greatly limits emissions from other sectors. The development of this future needs to be developed through the working group in strong alignment with Duke Energy, the commission, further partners, and other cities.

Task 5: Target a Carbon Intensity on the Grid of at Least 90% per kWh by 2045

This target is comparable to a figure of approximately 0.4 CO_2 per kWh today. It is necessary to set targets

58 Demand [side] response provides an opportunity for consumers to play a significant role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based rates or other forms of financial incentives. (https://www.energy.gov/oe/activities/technology-development/grid-modernization-and-smart-grid/demandresponse)

in terms of kWh as this is what will determine the emissions. A 90% reduction in the kWh does not mean a 90% reduction in electricity emissions, as this number could vary. This compares to figures of 0.18CO_2 per kWh for natural gas and 0.24CO_2 per kWh for gasoline. The electricity equivalent would need to be around 0.035CO_2 per kWh. As electrification of transportation and heating increases, the carbon intensity of electricity production becomes even more important. This carbon intensity is a function of the electricity that is supplied on average over a given year.

Task 6: Identify Opportunities for a Bioenergy with Carbon Capture and Storage (BECCS) Combined Heat and Power (CHP) Unit by 2030

This is currently an unproven technology. However, it is the 'cornerstone' of each Intergovernmental Panel on Climate Change (IPCC) scenario produced immediately prior to the Paris summit to identify a future that is well below a global temperature rise of 3.6°F. This technology, deployed globally, is therefore required to keep warming below 2.7°F – which is the ultimate goal of the Paris Accord.

Task 7: Negotiate to Develop Tariffs for Low Carbon Electricity in 2022 and Identify a Period for their Rollout by 2030

The City will need to negotiate new electricity contracts that incorporate zero carbon generation to be implemented now until 2030. This negotiation will require an understanding of how rates could link to capacities, onsite generation, demand side management and other points. These models for tariffs could then be implemented elsewhere.

HB 589 provides low carbon electricity tariffs for high energy consumers. The Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories (GPC) allows for such tariffs to be reflected in emissions inventories. This requires changes to how such tariffs are formed and applied. The rollout of these should be identified through Action Area 3.

Step 1: Smart sub-meters that link to CO_2 to encourage behavioral change at work

Individual organizations and the departments within them may use sub-metering systems to encourage the uptake of zero carbon energy use. This can be used to track and reward individual department activities.

Step 2: Tariffs for different customer types and level of renewable integration

Structures and agreements to introduce new tariffs could be negotiated between Duke, other cities, and the North Carolina Utilities Commission (NCUC). These have a direct impact on emissions calculations, but should not be used to bypass local energy reduction and production opportunities.

Step 3: Tariff for 100% zero carbon energy for Charlotte government in place before 2030

The final component of the '5 Steps to Zero Carbon Energy' diagram is the procurement of zero carbon electricity, which is a last resort option. This definition includes nuclear power and can therefore, with the correct contract, reflect both demand and consumption of electricity (which a renewable only tariff may fail to do).

ACTION AREA 10: DEVELOP GREEN WORKFORCE PIPELINE IN SUPPORT OF ENERGY TRANSITION

Workforce development is a national issue referring to the development of skilled labor jobs. Currently, the average age of those in these roles is 47[59]. This means there will soon be a considerable employment gap. As Charlotte works to develop a green economy through transitioning to a zero carbon energy future, there is a wealth of job creation opportunities for various skill levels.

Charlotte currently has high unemployment rates in specific communities[60]. There are many groups in Charlotte, including the City of Charlotte government, that are actively working to address this issue of inequity and include organizations like: Goodwill Industries of the Southern Piedmont, the Urban League of Central Carolinas, and Charlotte Works.

It is necessary to ensure that the job creation opportunities are equitably distributed across all communities. It is also important to consider the opportunities of entrepreneurship in this space together with the mechanisms and models that realize it.

As with many transitions that we have seen in history, there is a process of 'creative destruction,' where new

59 https://tinyurl.com/y9bmwadq

60 https://mcmap.org/qol/#38/

technologies and ways of doing things lead to the destruction of certain jobs and the creation of new ones. There is a need to formalize and predict what these jobs of the future are in order to ensure an adequate workforce labor pipeline. It is through these initiatives that guidance can be provided by the City in collaboration with its various current and future partners.

There is likely to be conflict in the investment priorities and resource allocation between the public and private space. This Action Area is fundamental to the innovation pathway that is foundational to each of the pillars of buildings, transportation, and generation.

Task 1: Form a Working Group for Workforce Development and Equity in FY19

CREDIT will not be able to ensure the workforce required to deliver the low carbon future on its own and will require inputs and guidance from multiple groups to ensure equity in job creation and deployment of low carbon technologies. A working group is needed in partnership with CREDIT and other partners. This group will need to comprise experts from nonprofits, government, academia, construction, and energy systems to inform and direct it.

Task 2: Establish and Produce the Training Pipeline for Skilled Labor Jobs and Entrepreneurship Opportunities in FY22

Additional knowledge will be gathered through efficiency activities under Action Area 5.

Step 1: Develop mechanisms and partnerships to support and encourage energy efficiency job opportunities and pipeline creation

There are a series of job opportunities attached to energy efficiency, which can include, for example, energy auditors that identify a building's energy performance before and after the implementation of energy efficiency measures, and project management associated with deployment of large-scale energy retrofits – such as intense weatherization. In addition, there are training opportunities for the public, businesses, and educational establishments.

Step 2: Develop mechanisms and partnerships to support and encourage shifting energy demand response job opportunities and pipeline creation

There are job opportunities associated with building management systems, their integration into existing structures, and their ongoing proper use, as well as property performance management to ensure the integration of efficiency approaches in combination with onsite generation. Educational programs relating to the use of smart metering, smart products, and similar should be implemented so that all consumers can benefit.

Step 3: Develop mechanisms and partnerships to support and encourage onsite generation, job opportunities, and pipeline development

There are multiple job opportunities attached to the installation and maintenance of onsite and distributed generation, which includes solar PV, wind generation, heating and cooling networks (together with combined and tri-generation), and solar and ground source heat pumps. Finally, there are integrated opportunities that combine one or more of these technologies. We can learn from the existing solar portfolio being offered by Duke Energy and the zero carbon building target the City government set.

Step 4: Develop mechanisms and partnerships to support and encourage third party intermediary jobs and opportunities

Jobs and entrepreneurial opportunities exist for these organizations which should be encouraged through various established communities, like faith-based communities. The entrepreneurial opportunities attached to new businesses in this field provide opportunities for building equity. New approaches may see energy services being sold rather than the energy itself. This option may be considered in terms of the circular economy and job opportunities attached to approaches such as the retrofitting of vehicles to make them zero carbon. There are already opportunities that are being explored by companies in this space. With the targeted scheme relating to municipal buildings, there are additional opportunities for entrepreneurship with a program being put into place.

ACTION AREA 11:
ESTABLISH PUBLIC-PRIVATE-PLUS PARTNERSHIPS TO ACCELERATE TRANSITION TO A LOW CARBON FUTURE

The City government cannot deliver the resolution or large aspects of the strategy on its own. It needs to form strong links, with various partners to achieve it.

This requires identifying the key individuals in various companies, organizations, and universities that can help realize this future. Charlotte presents a unique blend of stakeholders and this includes the nation's largest utility, as well as headquarters for the second and third largest banks in the United States. In addition, there is a bustling energy sector and strong research base grounded at UNCC's EPIC. This provides excellent opportunities for developing and implementing the SEAP. There is also potential for the cities of North Carolina to come together to help achieve a regional or state level low carbon energy system.

Task 1: Identify, Build, and Formalize Relevant Partnerships in FY20 and FY21

There are various working relationships that are already in place between the City and the organizations within Charlotte, including Duke Energy, Bank of America, Wells Fargo, UNCC, and various non-profit groups. The City will also look to develop relationships beyond Charlotte. Once all relevant relationships are identified, steps should be taken to formalize the relationship with a recognition that the overall goal of the relationship is to accelerate Charlotte's transition to a low carbon future.

Step 1: Identify, in partnership with selected organizations, key areas of alignment focused on a low carbon future in FY20

These partnerships will require a strategic focus on areas that organizations can work on. The strategic focus area(s) that will be tackled and addressed, along with the timelines for their assessment and viability, need to be established. This will require building on the links to formal research units as well as training facilities, and will include universities and businesses. They can expand into the financial service space, as well. Each partner should appoint a lead person to ensure effective communication throughout the duration of the partnership.

Step 2: Utilize project management tools to map out the overall trajectory of the partnership to ensure SEAP wins for both partners in FY21

The lead person from each partner should work closely together with CREDIT team members to identify areas within the SEAP that align with each partnerships' key areas of focus - they will need to be defining the necessary strategic focus. As part of the solution-oriented approach, understanding the ever-changing positions of organizations is vital. As an example, Duke Energy's latest Integrated Resource Plan identifies areas as challenging that align with what this SEAP structure is proposing.

IMPLEMENTING THE SEAP

Implementing the SEAP

To effectively deliver and implement the SEAP, actions and change need to be monitored. An important requirement will be providing adequate resources - staff, knowledge, finances, etc. – for the SEAP. The purpose of this section is to emphasize the key mechanisms that need to be in place to support its successful implementation.

City Leadership

The City will take ownership of the plan once approved by City Council, and will work to rapidly begin implementation of immediate-term and short-term tasks. The tasks chosen will accelerate the City towards achieving the 2030 goal of driving zero carbon energy within their own buildings and fleet. However, as noted earlier in the document, the City will also need to display leadership in creating and driving public-private-plus partnerships to accelerate the transition to a zero carbon energy economy – this is a citywide strategy that will require citywide collaboration to be successful.

The City's role as a leader in this process will require the recognition of the resources that exist within the City's boundaries. This means creating unique consortiums of partners to drive the transition by connecting people and knowledge, and harnessing disruptive technologies and innovation.

Structural Change

To ensure the success of the SEAP, a key role of the City will be to ensure that critical structures and decision-making processes are in place that support

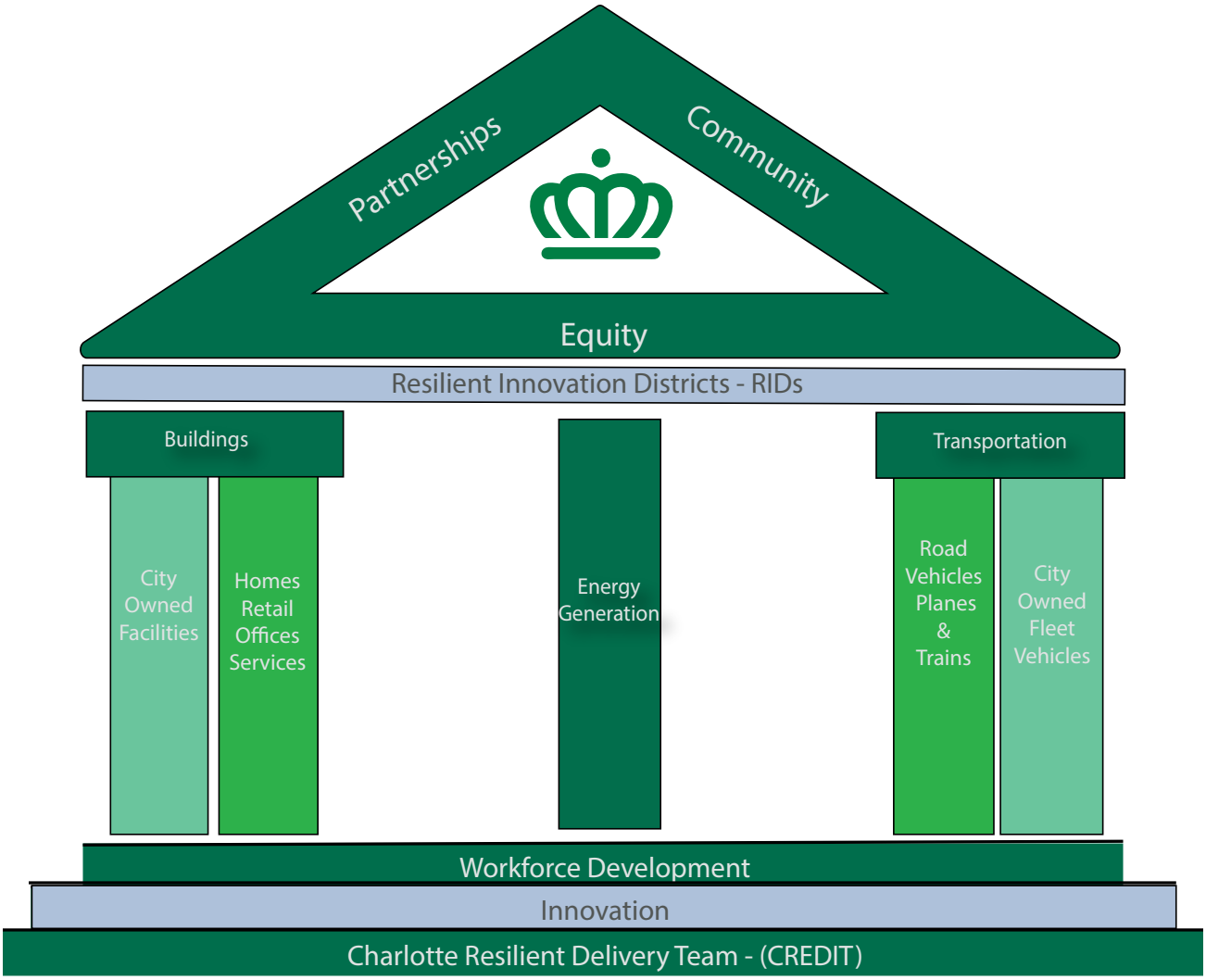

Figure 7: A graphic representation of the Charlotte SEAP Delivery Structure

and encourage internal and external implementation – this includes setting up clear roles, providing sufficient resources (including staff and skills), and reporting and tracking mechanisms. Regardless of the scale of a project, it will be necessary to have clear project plans and budgets aligned with roles, responsibilities, and reporting structures.

The SEAP has been designated a living document due to its long-term target of 2050. To account for technology advances, research findings, and inevitable changes in government policies, resources, and practices, a biennial review will be necessary. The City will lead these review efforts to realign, if necessary, as well as identify any known risks or issues that affect implementation of the plan. As part of this review, tracking all data points necessary to measure the progress towards the 2030 and 2050 targets and how effectively projects are reducing emissions, will be a key focus.

Monitoring and Reporting Structure

One of the largest challenges in developing the SEAP was the collection of data. The City of Charlotte has two great repositories of data – 'Open Charlotte' - the City of Charlotte Open Data Portal, and the Charlotte-Mecklenburg 'Quality of Life Explorer'.

Creating a dashboard to have all City data in one easily accessible location is paramount to the success of the SEAP and is an immediate task under Action Area 11. Cities are large entities and one of the biggest difficulties is prioritization. However, by developing this SEAP, the City has already expressed the outcome they desire – a low carbon city with a zero carbon energy future. By developing a dashboard that collects the broader spectrum of data needed to prioritize, the City can increase transparency, create a strong culture of data-driven decision making, and begin to create a narrative that drives collaboration among residents, businesses, and the City.

Innovative Funding

While the overall cost to deliver the SEAP is undetermined, it will be necessary to explore the wide selection of additional funding opportunities. This includes government grants and international grants with a specific focus on EU funding opportunities, leveraging local relationships with corporations for private-sector investment, as well as understanding ways to navigate City funding.

One of the key tools that could be deployed to help the City achieve the 2030 municipal goals is to explore how the model of an Energy Service Company (ESCO) could be applied. The concept of an ESCO is that it essentially acts as project developer for a comprehensive range of energy efficiency actions and assumes the technical and performance risks associated with such a project. ESCOs utilize a performance-based contracting methodology so that when an ESCO implements a project, the company's compensation is directly linked to the actual energy cost savings. The City could deploy this model and funnel the savings directly back into a fund for energy efficiency projects.

As energy efficiency and reduction of GHG emissions becomes more and more a part of everyday vernacular among different industries, it will also create additional opportunities for funding that should be explored. With the green economy as a new buzzword, a quick search will find multiple foundations offering grants for the creation of green job training programs – which could be great ways to develop a low-cost workforce to implement projects within the City.

In addition to raising funds, looking at overall project costs need to be viewed through a creative lens. Oftentimes, project costs are broken out into capital expenditures and operational expenditures, and thus the long-term savings are not fully understood. A new perspective can be gained by looking at the lifecycle costs. By requiring the development of a project plan and lifecycle budget, total cost and a better understanding of a project's overall impact can be determined.

Communication

Urban sustainability and resiliency are complex topics that are often difficult to communicate. The project team has started to develop a communication strategy for the delivery of the SEAP, and will continue after the SEAP has been approved by Council. The communication strategy will focus on addressing how information and updates will be disseminated to the various stakeholder and City leadership groups. It will be vital to provide regular and consistent updates to the stakeholders and community groups that have been participating in this process.

Map of Charlotte roadways.

CONTACTS + FURTHER INFORMATION

Getting Involved

While the City has taken the lead in developing the SEAP, it is a citywide strategy that requires all people that work, live and play within City boundaries to play a part in reducing emissions for a greener future. As a living document, the SEAP will constantly be adapting and adjusting based on the engagement of ALL stakeholders.

Ongoing opportunities to engage community groups, advocates, business and citizens at all levels of implementation will be developed.

You can also access additional information on the Environment Committee website:

http://charlottenc.gov/CityCouncil/focus-areas/Pages/EnvironmentFocusArea.aspx

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This report is a synopsis of the work conducted and does not necessarily reflect the views of any individual consulted.

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CHARLOTTE

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APPENDICES

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State of North Carolina

ROY COOPER
GOVERNOR

October 29, 2018

EXECUTIVE ORDER NO. 80

NORTH CAROLINA'S COMMITMENT TO ADDRESS CLIMATE CHANGE AND TRANSITION TO A CLEAN ENERGY ECONOMY

WHEREAS, North Carolina residents deserve to be better educated, healthier, and more financially secure so that they may live purposeful and abundant lives; and

WHEREAS, N.C. Const. art. XIV, § 5 requires the conservation, protection, and preservation of state lands and waters in public trust; and

WHEREAS, North Carolina is well positioned to take advantage of its technology and research and development sectors, along with its skilled workforce, to promote clean energy technology solutions and a modernized electric grid; and

WHEREAS, public-private partnerships in North Carolina foster market innovations and develop clean energy technology solutions that grow the state's economy; and

WHEREAS, the effects of more frequent and intense hurricanes, flooding, extreme temperatures, droughts, saltwater intrusion, and beach erosion have already impacted and will continue to impact North Carolina's economy; and

WHEREAS, climate-related environmental disruptions pose significant health risks to North Carolinians, including waterborne disease outbreaks, compromised drinking water, increases in disease-spreading organisms, and exposure to air pollution, among other issues; and

WHEREAS, to maintain economic growth and development and to provide responsible environmental stewardship, we must build resilient communities and develop strategies to mitigate and prepare for climate-related impacts in North Carolina.

NOW, THEREFORE, by the authority vested in me as Governor by the Constitution and the laws of the State of North Carolina, **IT IS ORDERED**:

1. The State of North Carolina will support the 2015 Paris Agreement goals and honor the state's commitments to the United States Climate Alliance.

   The State of North Carolina will strive to accomplish the following by 2025:

   a. Reduce statewide greenhouse gas emissions to 40% below 2005 levels;
   b. Increase the number of registered, zero-emission vehicles ("ZEVs"; individually, "ZEV") to at least 80,000;
   c. Reduce energy consumption per square foot in state-owned buildings by at least 40% from fiscal year 2002-2003 levels.

2. Cabinet agencies shall evaluate the impacts of climate change on their programs and operations and integrate climate change mitigation and adaptation practices into their programs and operations. Council of State members, higher education institutions, local governments, private businesses, and other North Carolina entities are encouraged to address climate change and provide input on climate change mitigation and adaptation measures developed through the implementation of this Executive Order. Consistent with applicable law, cabinet agencies shall actively support such actions.

3. The Secretary or designee of each cabinet agency and a representative from the Governor's Office shall serve on the North Carolina Climate Change Interagency Council ("Council"), which is hereby established. The Secretary of the North Carolina Department of Environmental Quality, or the Secretary's designee, shall serve as the Council Chair. The North Carolina Department of Environmental Quality shall lead the Council by providing strategic direction, scheduling and planning Council meetings, determining the prioritization of activities, facilitating stakeholder engagement, and assisting in the implementation of pathways to achieve the goals provided in Section 1 of this Executive Order.

   The duties of the Council shall include the following:

   a. Recommend new and updated goals and actions to meaningfully address climate change;
   b. Develop, implement, and evaluate programs and activities that support statewide climate mitigation and adaptation practices;
   c. Establish workgroups, as appropriate, to assist the Council in its duties;
   d. Consider stakeholder input when developing recommendations, programs, and other actions and activities;
   e. Schedule, monitor, and provide input on the preparation and development of the plans and assessments required by this Executive Order;
   f. Review and submit to the Governor the plans and assessments required by this Executive Order.

4. The North Carolina Department of Environmental Quality ("DEQ") shall develop a North Carolina Clean Energy Plan ("Clean Energy Plan") that fosters and encourages the utilization of clean energy resources, including energy efficiency, solar, wind, energy storage, and other innovative technologies in the public and private sectors, and the integration of those resources to facilitate the development of a modern and resilient electric grid. DEQ shall collaborate with businesses, industries, power providers, technology developers, North Carolina residents, local governments, and other interested stakeholders to increase the utilization of clean energy technologies, energy efficiency measures, and clean transportation solutions. DEQ shall complete the Clean Energy Plan for the Council to submit to the Governor by October 1, 2019.

5. The North Carolina Department of Transportation ("DOT"), in coordination with DEQ, shall develop a North Carolina ZEV Plan ("ZEV Plan") designed to increase the number of registered ZEVs in the state to at least 80,000 by 2025. The ZEV Plan shall help establish interstate and intrastate ZEV corridors, coordinate and increase the installation of ZEV infrastructure, and incorporate, where appropriate, additional best practices for increasing ZEV adoption. DOT shall complete the ZEV Plan for the Council to submit to the Governor by October 1, 2019.

6. The North Carolina Department of Commerce ("DOC") and other cabinet agencies shall take actions supporting the expansion of clean energy businesses and service providers, clean technology investment, and companies with a commitment to procuring renewable energy. In addition, DOC shall develop clean energy and clean transportation workforce assessments for the Council to submit to the Governor by October 1, 2019. These assessments shall evaluate the current and projected workforce demands in North Carolina's clean energy and clean transportation sectors, assess the skills and education required for employment in those sectors, and recommend actions to help North Carolinians develop such skills and education.

7. Cabinet agencies shall prioritize ZEVs in the purchase or lease of new vehicles and shall use ZEVs for agency business travel when feasible. When ZEV use is not feasible, cabinet agencies shall prioritize cost-effective, low-emission alternatives. To support implementation of this directive, the North Carolina Department of Administration ("DOA") shall develop a North

Carolina Motor Fleet ZEV Plan ("Motor Fleet ZEV Plan") that identifies the types of trips for which a ZEV is feasible, recommends infrastructure necessary to support ZEV use, develops procurement options and strategies to increase the purchase and utilization of ZEVs, and addresses other key topics. DOA shall complete the Motor Fleet ZEV Plan and provide an accounting of each agency's ZEVs and miles driven by vehicle type for the Council to submit to the Governor by October 1, 2019, and annually thereafter.

8. Building on the energy, water, and utility use conservation measures taken pursuant to N.C. Gen. Stat. § 143-64.12(a), DEQ shall update and amend, where applicable, a Comprehensive Energy, Water, and Utility Use Conservation Program ("Comprehensive Program") by February 1, 2019, and biennially beginning December 1, 2019, to further reduce energy consumption per gross square foot in state buildings consistent with Section 1 of this Executive Order. The Comprehensive Program shall include best practices for state government building energy efficiency, training for agency staff, cost estimation methodologies, financing options, and reporting requirements for cabinet agencies. DEQ and cabinet agencies shall encourage and assist, as requested, higher education institutions, K-12 schools, and local governments in reducing energy consumption. To achieve the required energy consumption reductions:

    a. By January 15, 2019, each cabinet agency shall designate an Agency Energy Manager, who shall serve as the agency point of contact.
    b. Each cabinet agency shall develop and submit an Agency Utility Management Plan to DEQ by March 1, 2019, and biennially thereafter, and implement strategies to support the energy consumption reduction goal set forth in Section 1 of this Executive Order. DEQ shall assess the adequacy of these plans and their compliance with this Executive Order.
    c. By September 1, 2019, and annually thereafter, each cabinet agency shall submit to DEQ an Agency Utility Report detailing its utility consumption, utility costs, and progress in reducing energy consumption.
    d. DEQ shall develop an annual report that describes the Comprehensive Program and summarizes each cabinet agency's utility consumption, utility costs, and achieved reductions in energy consumption. DEQ shall complete this report for publication on its website and for the Council to submit to the Governor by February 1, 2019, and annually thereafter beginning December 1, 2019.

9. Cabinet agencies shall integrate climate adaptation and resiliency planning into their policies, programs, and operations (i) to support communities and sectors of the economy that are vulnerable to the effects of climate change and (ii) to enhance the agencies' ability to protect human life and health, property, natural and built infrastructure, cultural resources, and other public and private assets of value to North Carolinians.

    a. DEQ, with the support of cabinet agencies and informed by stakeholder engagement, shall prepare a North Carolina Climate Risk Assessment and Resiliency Plan for the Council to submit to the Governor by March 1, 2020.
    b. The Council shall support communities that are interested in assessing risks and vulnerabilities to natural and built infrastructure and in developing community-level adaptation and resiliency plans.

10. DEQ shall prepare and manage a publicly accessible Web-based portal detailing the Council's actions and the steps taken to address climate-related impacts in North Carolina. Cabinet agencies shall submit data, information, and status reports as specified by the Council to be published on the portal. In addition, DEQ shall develop, publish on the portal, and periodically update an inventory of the state's greenhouse gas emissions that, among other things, tracks emissions trends statewide by sector and identifies opportunities for additional emissions reductions.

11. By October 15, 2019, and annually thereafter, the Council shall provide to the Governor a status report on the implementation of this Executive Order.

12. This Executive Order is consistent with and does not otherwise abrogate existing state law.

13. This Order is effective October 29, 2018 and shall remain in effect until rescinded or superseded by another applicable Executive Order.

IN WITNESS WHEREOF, I have hereunto signed my name and affixed the Great Seal of the State of North Carolina at the Capitol in the City of Raleigh, this the 29th day of October, in the year of our Lord two thousand eighteen.

Roy Cooper
Governor

ATTEST:

Rodney S. Maddox
Chief Deputy Secretary of State

Energy and Carbon Fact Sheet

Renewable Energy

- Wind, solar PV, hydro/wave, geo-thermal, bio-energy, and storage.
- 100% is usually associated with high capacity requirements if based upon intermittent renewables (alongside storage) to meet peak demand.
- Costs in strategies often ignore demand and focus on consumption. The Resolution wants to be mindful of both in the time horizons.

Clean Energy

- Usually renewables and nuclear.
- Can be renewables with natural gas and 'clean coal.'

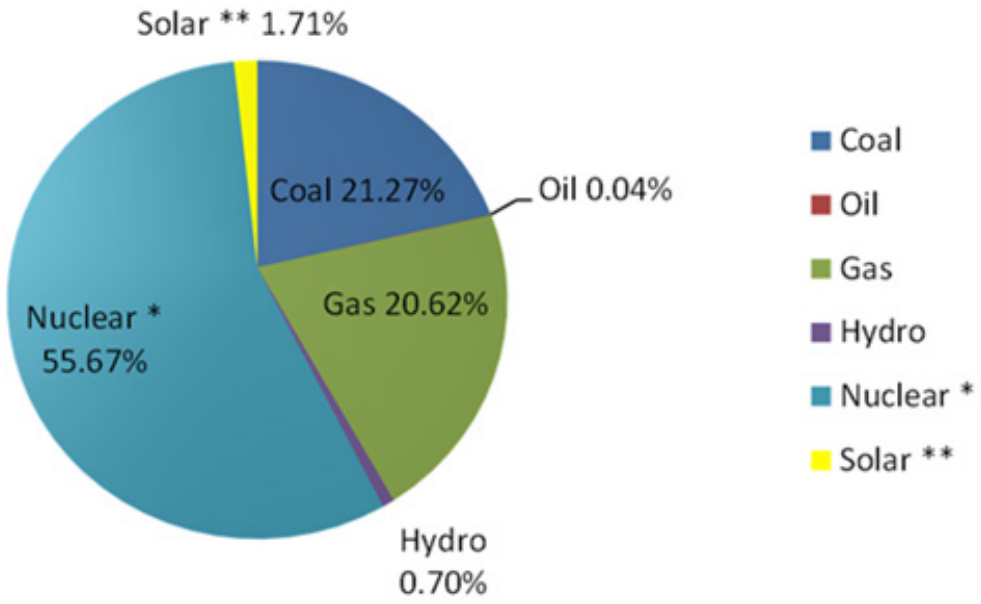
Zero Carbon/Fossil Free Energy

- Renewables and nuclear (if necessary).
- It refers to no GHG emissions other than those released when combusting/distributing/producing bioenergy.
- It does not mean nuclear will be in mix, but it does keep the door open.

Low Carbon

- Spans all GHGs across all sectors: energy; waste; industrial processes; and agriculture.
- Does not mean that zero carbon dioxide is ruled out in any or all sectors.
- It recognizes that all emissions must be included.

Chart of Duke Energy Mix



It is important to note that these figures are constantly changing.

CHARLOTTE.

City of Charlotte Facilities & Fleet Carbon Reduction Plan Timeline

November 16, 2018

DRAFT

This summarized timeline and set of goals comes from the City of Charlotte's Facilities and Fleet Carbon Reduction Plan. To see the plan in its entirety, please visit charlottenc.gov. This plan specifically addresses the goals and strategies set by the internal CREDIT team to meet the third intent of the 'Sustainable and Resilient Charlotte by 2050' resolution regarding sourcing 100% of energy use in municipal facilities and fleet from zero carbon sources by 2030. Achievement of the 2030 goals will be dependent on many factors, including technological advancements, operational compatibility and risk management, and the availability of appropriate resources and funding. For some segments of City facilities and fleet, achieving the goals may not be possible because operational and other concerns will outweigh or not allow for carbon reduction benefits. However, the City is committed to and will look for all opportunities to achieve the goals.

Short Term Goals and Objectives

Short term goals are anticipated to occur within one to three years (2019-2022). They are organized into five categories based on their mode of impact as taken from the Community SEAP. The five categories are illustrated in 5 Stages to Zero Carbon Energy Diagram and are further described below:

Future Building Project Short Term Goals

<u>Shift Energy Demand</u>

- Evaluate lighting control technology at least three facilities which will adjust lighting based on scheduling and occupancy
- Investigate ice storage opportunities across City-owned facilities & Optimize Animal Control Facility Ice Storage System.

<u>Reduce Energy Consumed</u>

- Conduct an energy treasure hunt per Energy Star guidelines, calling upon employees to pinpoint prospects for energy-saving improvements
- Implement deep energy retrofits based on audit findings
- The city would like to partner with a local community college such as CPCC in training students and providing hands-on experience to perform energy audits and potentially weatherize fire station targeted based on benchmarking
- Change work practices and renovate facilities to reduce workspace needs in CMGC (ie. increase daylighting)

<u>Change Energy Consumed</u>

- Investigate electrification of heating needs for City-owned facilities; removal of gas sources heating systems.

<u>Generate Energy OnSite</u>

- The city proposes to achieve one zero-carbon facility within the short term range. Fire Station 43 is currently being designed to zero-carbon standards. This design would henceforth be replicated for additional stations.
- Investigate solar installation on all new facilities under design.

<u>Purchase the Remainder</u>

- Assess entering into power purchase agreement (PPA) with Duke to purchase solar or wind

Future Fleet Short Term Goals

Shift Energy Demand

- PV Battery Storage (facility requirement) on EV and on parking deck at CMGC

Reduce Energy Consumed

- Implement Staff Training and behavior change
  - Increase efficiency and Reduce Fossil Fuel Usage, Reduce Mileage (Modes of Op, Routing)
  - Increase confidence and usage in alternative fuels (EV Rodeo)
- Begin "right-sizing" fleet vehicles
  - Centralize fleet procurement, operations, and maintenance
  - Decentralize locations for staff motor pool
  - Pilot Internal Light duty driver / Uber/Lyft motor pool
  - Develop internal rental fleet pool for heavy equipment
- Shift from travel between facilities for meetings to teleconferencing/videoconferencing

Change Energy Consumed

- Expand EV charging stations to 10 city facilities, using solar where practical
- Increase number of alternate fuel vehicles (CNG, biogas, biodiesel)

Generate Energy OnSite

- Evaluate WWTP Biogas

Purchase the Remainder

No short-term goals identified at this time.

Mid-Term Goals and Objectives

Mid-term goals are anticipated to occur within four to seven years (2023-2026). They are organized into five categories based on their mode of impact as taken from the Community SEAP. The five categories are illustrated in 5 Stages to Zero Carbon Energy Diagram and are further described below:

Future Building Project Mid-Term Goals

Shift Energy Demand

- Implement lighting control technologies from previous 3 facility pilot across City-owned facilities.
- Reduce Energy Consumed
- Continue effort to close gaps for implementation of onsite PV at any sites with available space based on results of PV Assessment, or other emerging technologies

Reduce Energy Consumed

- Change work practices and renovate facilities to reduce workspace needs in CMGC (ie. increase daylighting)
- Implement deep energy retrofits based on audit findings

Change Energy Consumed

- Install Solar Array at the Statesville Landfill property and/or other large city-owned properties

Generate Energy OnSite

- Investigate battery storage needs based on recommended installation of solar systems.
- Modify designs and implement construction standards to be net-zero ready for all City-owned buildings under construction (heavy emphasis on PV installations)

Purchase the Remainder

- Determine percentage of energy used to apply to power purchasing agreement based on 8 yrs. Of

Future Fleet Mid-Term Goals

Shift Energy Demand

- PV Battery Storage on EV and on parking deck city buildings (bi-directional charging, solar storage, battery storage, meter cycling)

Reduce Energy Consumed

- Expand use of an EV-based motor/van pool
- Implement heavy-duty/equipment pool
- Fleet maintenance centralization, management and consolidation

Change Energy Consumed

- Expand EV charging stations to 10 city facilities, using solar where practical
- Increase number of alternate fuel vehicles (CNG, biogas, biodiesel)

Generate Energy OnSite

- Implement WWTP Biogas

Purchase the Remainder

No mid-term goals identified at this time.

Long Term Goals and Objectives

Long term goals are anticipated to occur within eight to eleven years (2027-2030). They are organized into five categories based on their mode of impact as taken from the Community SEAP. The five categories are illustrated in 5 Stages to Zero Carbon Energy Diagram and are further described below:

Future Building Project Long Term Goals

Shift Energy Demand

- Implement battery storage and Innovative Technologies

Reduce Energy Consumed

- Change work practices and renovate facilities to reduce workspace needs in CMGC (ie. increase daylighting)
- Implement deep energy retrofits based on audit findings

Change Energy Consumed

- Net Zero Buildings and Resilient City Services

Generate Energy OnSite

No long term goals identified at this time.

Purchase the Remainder

- Continue effort to close gaps for implementation of onsite PV at any sites with available space based on results of PV Assessment, or other emerging technologies

Future Fleet Long Term Goals

Shift Energy Demand

- Have infrastructure in place to have EV charging at night and allow public to use EV chargers during the day

Reduce Energy Consumed

- 100% EV-based and/or zero carbon motor/van pool
- Utilize private-based EV charging networks

Change Energy Consumed

- 100% renewable fuels (biogas, biodiesel)

Generate Energy OnSite

- Continuation of WWTP Biogas
- PV at EV charging stations

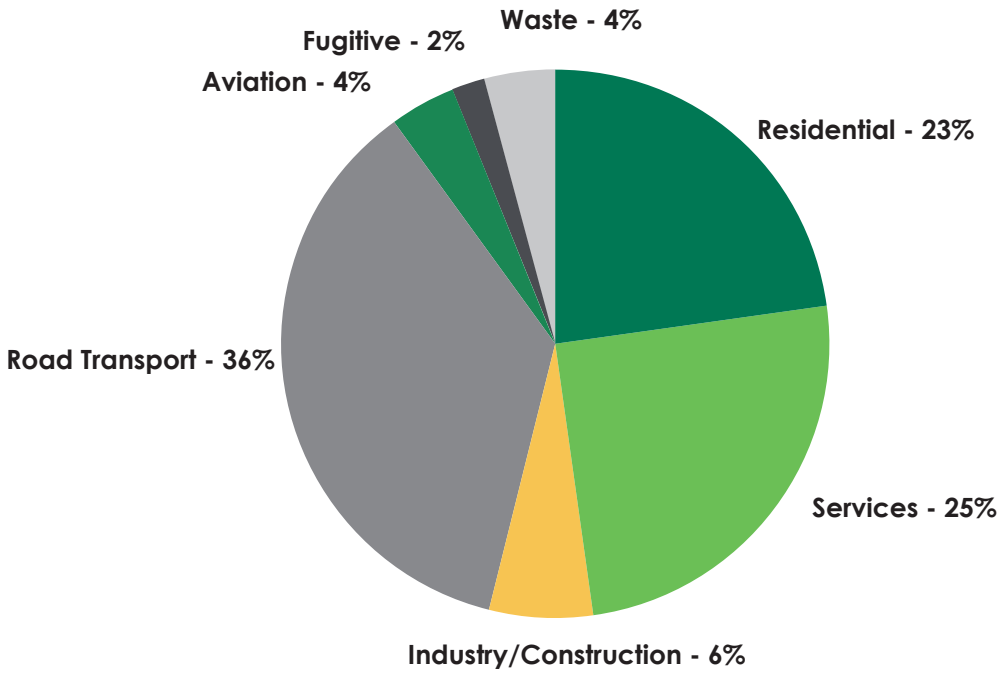
Purchase the Remainder

- No long term goals identified at this time.

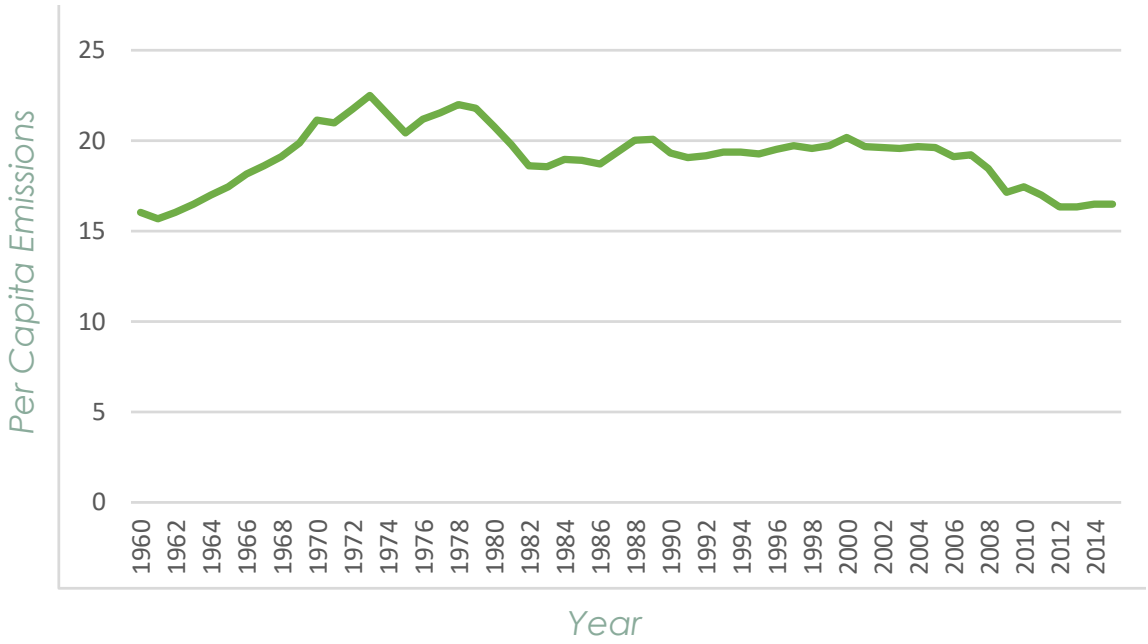
Content Expert Advisory Group (CEAG)

Name	Organization
Astrid Chirinos	YMCA
Chris Paynter	CPCC
DeAndrea Salvator	RETI
Eric Lewis	Charlotte Works
Jeff Austin	Formerly with Wells Fargo
Megan Green	Mecklenburg County Air Quality
Rob Cox	UNC Charlotte
Sara O'Mara	Choate Construction Company
Zoe Gamble	Pine Gate Renewables

"Figure 1: 2015 Baseline Greenhouse Gas Emissions for Charlotte, North Carolina" on page 13



"Figure 2: USA Emissions of CO_2 Per Capita 1960-2015" on page 14



"Figure 3: 5 Stages to Zero Carbon Energy Diagram" on page 19

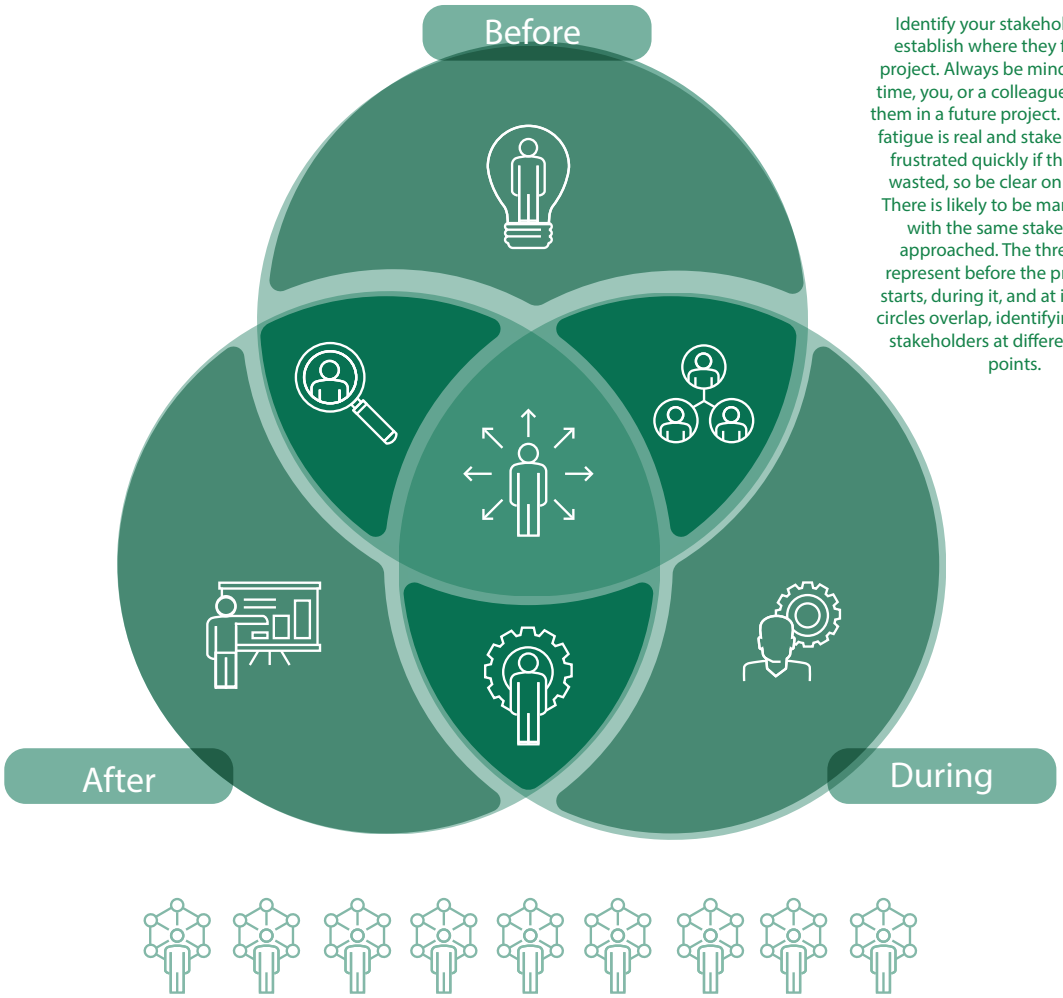
"Figure 4: Potential Annual Benefits from Charlotte's Urban Forest" on page 20

BENEFIT	QUANTITY	UNIT	ANNUAL VALUE
ENERGY: Savings from Avoided Cooling	112M	***kWhs***	$15.4M
PROPERTY: Increases in Property Values	-	***$***	$286.5M
AIR: Carbon Monoxide (CO) Removed	135,000	***lbs.***	$90,000
AIR: Nitrogen Dioxide (NO2) Removed	681,000	***lbs.***	$116,000
AIR: Ozone (O3) Removed	4.4M	***lbs.***	$3M
AIR: Sulfur Dioxide (SO2) Removed	145,000	***lbs.***	$10,000
AIR: Dust, Soot, Other Particles Removed (Particulate Matter, PM10)	5.3M	***lbs.***	$3.7M
RAIN: Rainfall Intercepted	1.2B	***gallons***	$10M
Carbon Sequestered	470,000	***tons***	$17M
	Potential Total Annual Benefits		***$335M+***

"Figure 5: Charlotte Stakeholder Engagement tool, adapted from Carney et al." on page 33

GUIDE

Identify your stakeholders and establish where they fit in your project. Always be mindful of their time, you, or a colleague, may need them in a future project. Stakeholder fatigue is real and stakeholders get frustrated quickly if their time is wasted, so be clear on their role. There is likely to be many projects with the same stakeholders approached. The three circles represent before the project fully starts, during it, and at its end. The circles overlap, identifying different stakeholders at different project points.



Key

Initiators

These Stakeholders have the idea and get the project running. They may also be funders of the project.

Shapers

These Stakeholders are usually gatekeepers to resources, the project may need to be shaped to gain their buy-in.

Reviewers

These Stakeholders review the interim and final results of the project. This is done at key points and certainly before publication.

Recipients

This is the most common category of Stakeholders because they receive the results. If this is the main focus of the project it will likely fail.

Advisory

These Stakeholders are involved at every stage of the project and provide guidance. They are often members of an advisory group.

Informants

These Stakeholders provide inputs to the project. This may be in the form of data, knowledge, or time. This may be via email, phone, workshops or bilateral meetings.

Foundational

These Stakeholders are possibly the most important. They are the people that are represented by those above.

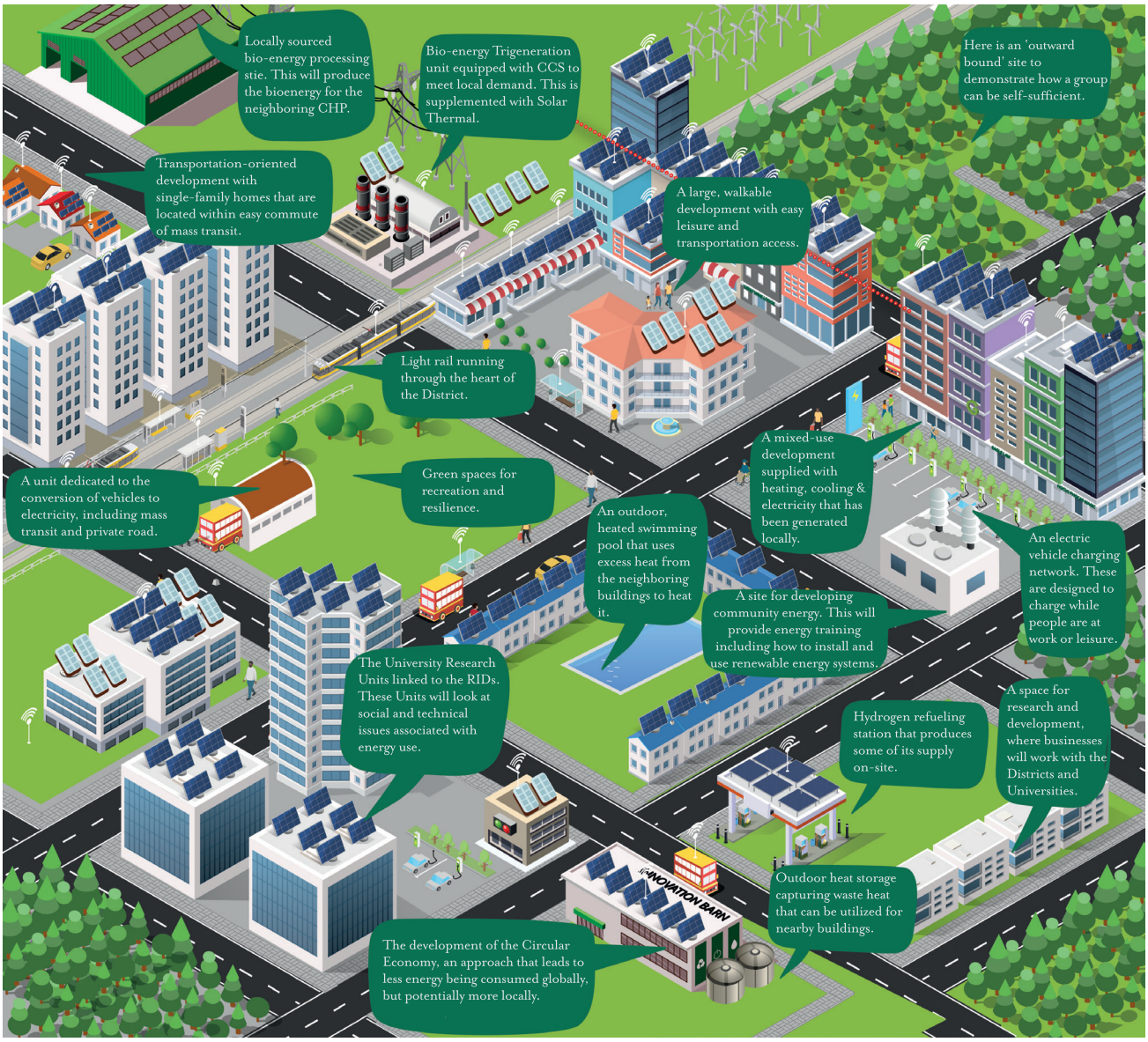
Reflectors

These Stakeholders provide feedback on the project. This can then be taken into the next project. This reflection is important to leadership.

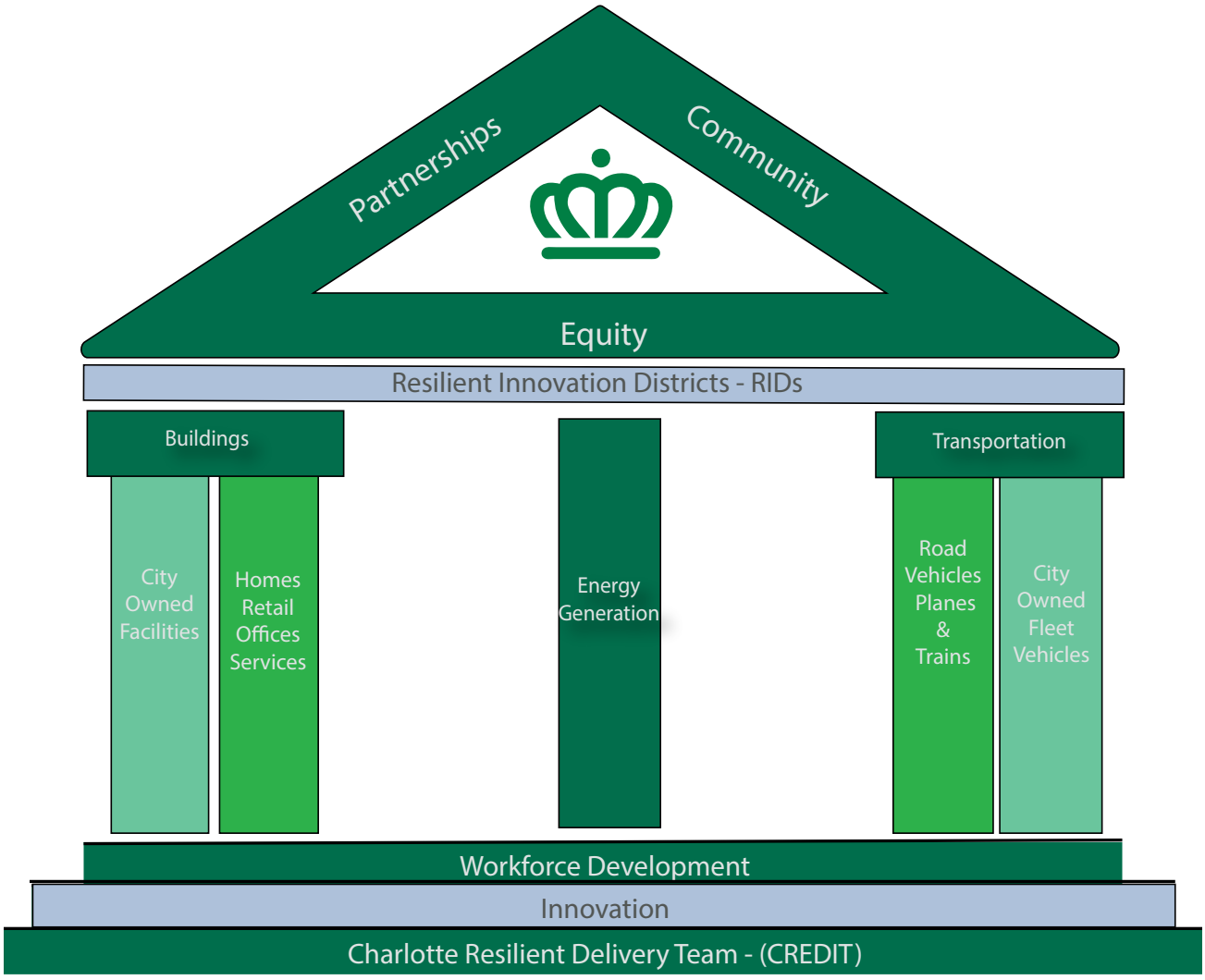
Adapted from Carney et al

carbon captured ltd

"Figure 6: An example of what a Resilient Innovation District can consist of." on page 46



"Figure 7: A graphic representation of the Charlotte SEAP Delivery Structure" on page 63



CHARLOTTE
SM
Strategic Energy
Action Plan