

# Town of Marblehead Climate Action Plan Framework



**A Strategy for a Carbon-Free Marblehead by 2040**

December 2019

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# Foreword

**Marblehead is our home. With almost 400 years of rich and storied history, our town is now at great risk from the climate crisis. In order to preserve our past as well as maintain our current quality of life, we must work immediately and passionately to protect our future. In the 1770s, Marblehead was a leader in the fight for freedom from the tyranny of the British crown. Now we must come together again to fight for freedom from the tyranny of the climate crisis – and its catastrophic effects.**

**The vision of a climate-smart Marblehead forms the basis for this Framework for a Carbon-Free Marblehead 2040, which describes how the town and its residents can and must work to meet and manage the challenge of the climate emergency, the greatest challenge humanity has ever faced.**

**The accelerating pace of climate change is ravaging our world and jeopardizing our lives and our children’s future. The relentless accumulation of greenhouse gases in the atmosphere must be stopped and rising global temperatures halted. Marblehead can and must be a leader in efforts to reduce human impact on the global climate by making a successful transition from a town run on fossil fuels to one based on carbon-free and renewable energy. This is really a manifesto for our town’s survival.**

**Marblehead and all who live and work here must take responsibility for our climate. We implore town officials and leaders to understand the urgency of our situation and make bold decisions that break free from our longtime paradigm that the future will be largely the same as the past. Residents need to make informed choices in their daily lives. This framework lays down a minimum level for these efforts, and puts Marblehead on a path to be the first carbon-free community in Massachusetts.**

**To those who may say that such change is not possible, we say that the dire consequences of not making the needed changes are unthinkable. In fact, both science and economics are telling us unequivocally that we must make these needed changes. Leadership is changing what’s possible, and more than ever, we need strong and courageous leadership to help guide us forward to a future that will sustain us.**

**This framework lays out the tools and methods we need to adopt to become a carbon-free town – a town that can meet its needs now without compromising the ability of future generations to meet their own needs. It is the foundation upon which a sustainable Marblehead will be built. We’re all in this together, and we must begin now!**

**Sustainable Marblehead**

**December 2019**

# Executive Summary: A Carbon-Free Marblehead by 2040

*“The problems of the world cannot possibly be solved by skeptics or cynics whose horizons are limited by the obvious realities. We need men (and women) who can dream of things that never were.” – John F. Kennedy*

*Some of the countries, corporations, and communities that have committed to becoming 100% carbon-free: Sweden, Denmark, Scotland, New Zealand, Apple, GM, Walmart, Amazon, Bank of America, Goldman Sachs, Miami, Salt Lake City, Cincinnati, Cambridge, Concord, Hingham, Northampton, Salem, MA.*

*Stanford engineers have developed a state-by-state plan to convert the U.S. to 100% clean, renewable energy: [www.thesolutionsproject.org](http://www.thesolutionsproject.org)*

# Executive Summary: A Carbon-Free Marblehead by 2040

A crisis is defined as a time of intense difficulty, trouble, or danger when critical decisions must be made. The global climate is in crisis and requires urgent attention. In October of 2018, the Intergovernmental Panel on Climate Change (IPCC), which advises world leaders, issued a clear warning that humanity can only burn fossil fuels (coal, oil, gas) at current emission rates for 10 more years before the carbon accumulating in the atmosphere pushes the earth past a climate tipping point beyond which it can no longer be reversed.

What does this mean? It means that we have a limited carbon budget, a known amount of carbon which we can still safely emit and which will need to be strictly monitored. **It means that we can use roughly three quarters of our carbon budget in the next decade (2020-2030) and the remaining quarter in the following decade (2030-2040) on our path to carbon freedom by 2040.** This is not a matter of choice or debate, it is a matter of scientific necessity and fact – a reality that we all must come to accept and successfully address.

Nowhere are the impacts of the climate crisis felt more acutely than at the local level. Communities around the country and the world are experiencing shifting weather patterns, extreme rainfall, increased flooding, higher temperatures, more frequent heat waves, wildfires, and drought. These changes are affecting our quality of life, natural resources, infrastructure, and budgets.

While towns are on the frontlines, they can also be beacons of hope, charting the course forward to climate action and developing effective, robust, and equitable solutions. Enhancing the resilience of towns is important for the health, safety, and vitality of our communities. Involving a diverse cross-section of town residents and groups in developing climate solutions is critical to creating a plan that speaks for the entire community.

In 2018, Sustainable Marblehead completed the [Town of Marblehead's first Greenhouse Gas \(GHG\) Inventory](#), which categorized and quantified town-wide energy use and carbon emissions, and provided a baseline from which to measure future emission reductions. The report was presented to the Board of Selectmen in January of 2018, with the primary recommendation being the development of a Climate Action and Sustainability Plan with specific targets and actions for carbon emission reductions.

# Executive Summary: A Carbon-Free Marblehead by 2040

Some months later, at the May 2018 Town Meeting, Marblehead voters overwhelmingly passed Article 45 – sponsored by Sustainable Marblehead – which put the town on record as supporting a goal of “using 100% carbon-free energy in Marblehead, including in electricity production, building energy use, and transportation, and moving with fiscal responsibility and all deliberate speed to achieve this goal.” As such, the citizens of Marblehead endorsed the decarbonization of our town’s energy use.

Eliminating carbon (decarbonizing) requires smart technical solutions and reduced demands for energy. It is possible to do this using today’s technology; however, if this goal is to be met, numerous strategic decisions must be made in the coming 1-2 years.

A climate-smart Marblehead means incorporating our climate goal into all municipal operations and assigning clear responsibility to designated municipal employees and the boards of municipal departments to coordinate and promote action. This document provides a framework for what the Town of Marblehead can do to make its own operations carbon-free. Carbon freedom also requires close collaboration with local residents and businesses and regional and state public sector entities.

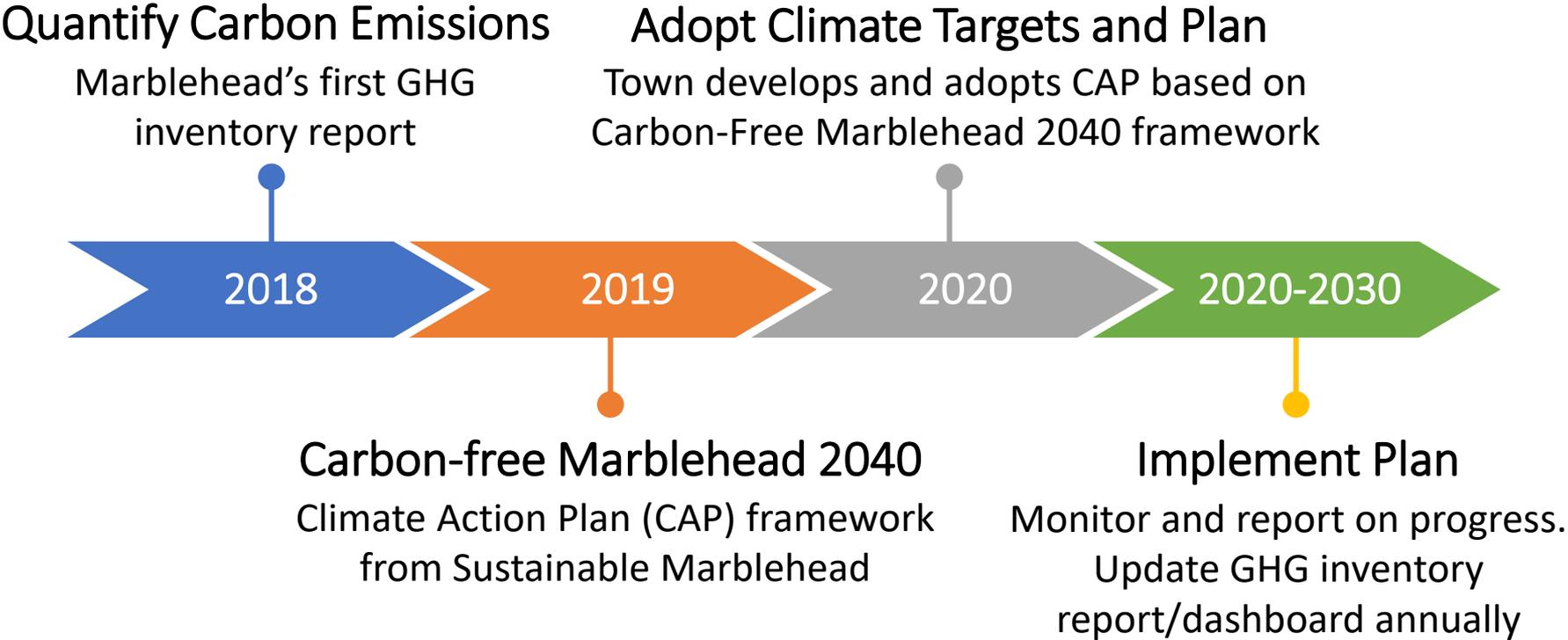
Some of the steps that need to be taken by 2040 are outside the purview of the town. For this reason, the long-term strategy detailed in his document includes a discussion of approaches to influence Massachusetts state and federal action and legislation.

Sustainable Marblehead looks forward to working closely with and supporting town leaders, residents, businesses, and the newly formed Green Marblehead Committee to “create a vision and action plan to guide the town in its carbon emission reduction, clean energy, and sustainability efforts.” We recommend that this document be used to provide the targets and strategic framework for Marblehead to become carbon-free by 2040.

We can and must do this. The well-being of our families and our community, indeed our very survival, depends on it!

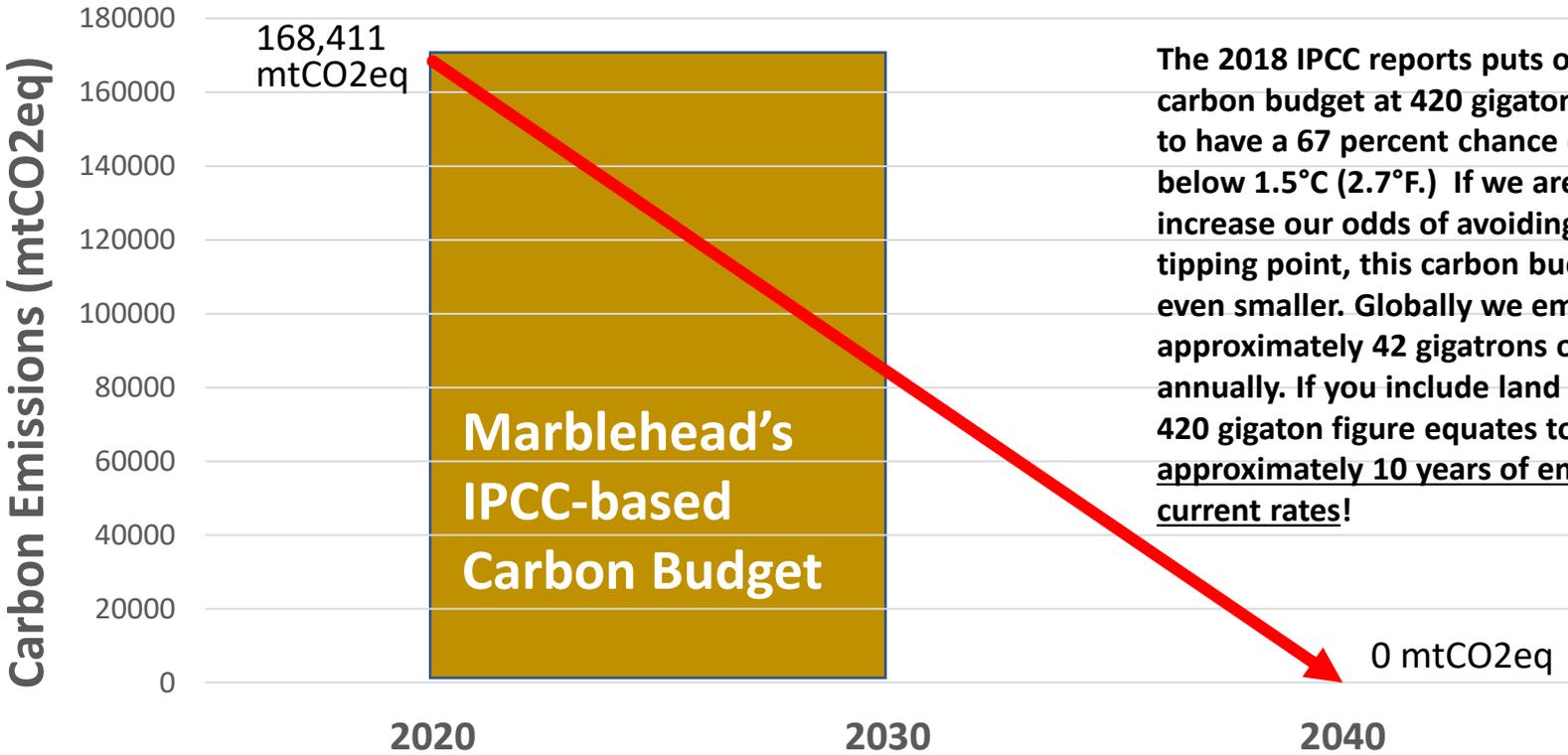
# Executive Summary: A Carbon-Free Marblehead by 2040

## Proposed Climate Action Timeline



# Executive Summary: A Carbon-Free Marblehead by 2040

## Carbon Emission Reduction Pathway to 2040 Goal



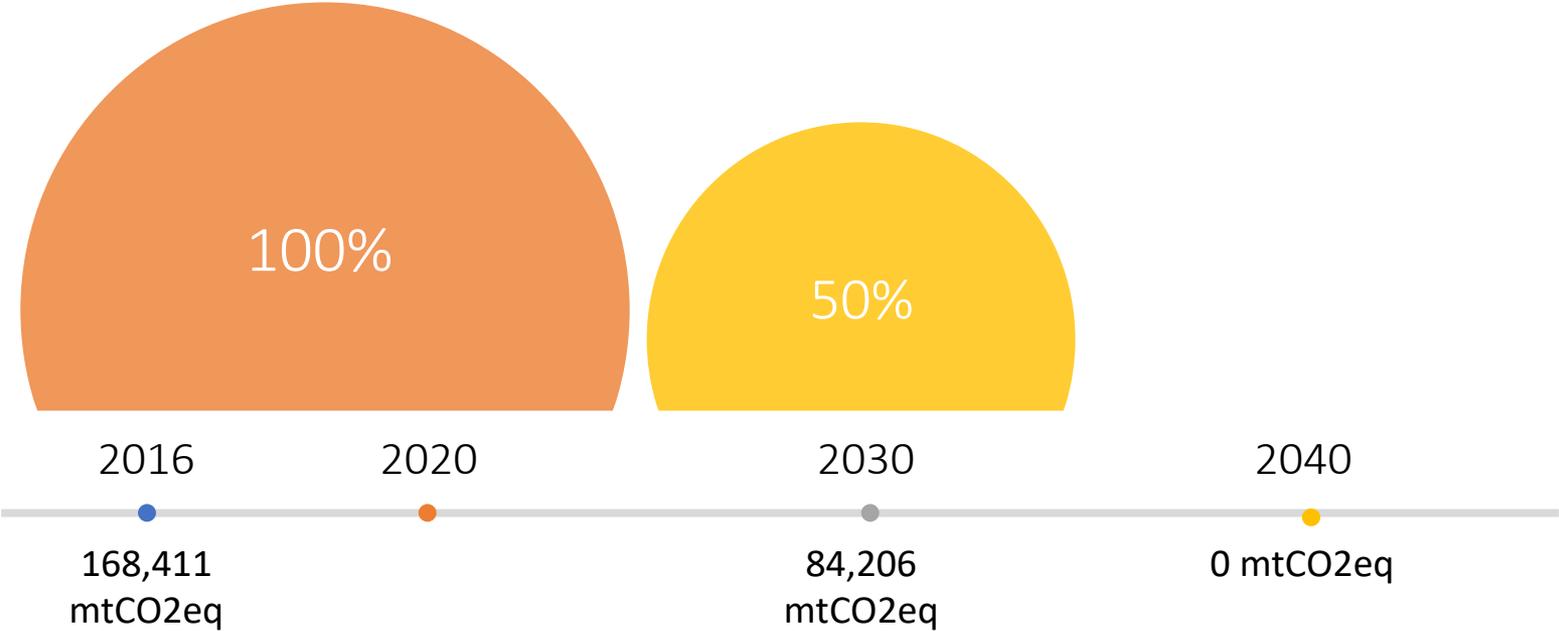
The 2018 IPCC reports puts our global carbon budget at 420 gigatons of CO<sub>2</sub> to have a 67 percent chance of staying below 1.5°C (2.7°F.) If we are to increase our odds of avoiding a climate tipping point, this carbon budget is even smaller. Globally we emit approximately 42 gigatons of CO<sub>2</sub> annually. If you include land use, the 420 gigaton figure equates to approximately 10 years of emissions at current rates!

➔ Annual Carbon Emissions, Town of Marblehead

**Metric tons of carbon dioxide equivalent (mtCO<sub>2</sub>eq)** A measurement used to compare the emissions of different greenhouse gases based upon their global warming potential (GWP). The carbon dioxide equivalent for a gas (e.g. methane and nitrous oxide) is derived by multiplying the tons of the gas by its associated GWP.

# Executive Summary: A Carbon-Free Marblehead by 2040

## Carbon Emission Reduction Pathway to 2040 Goal



*“If you don’t know where you’re going,  
you might wind up some place else.”  
– Yogi Berra*

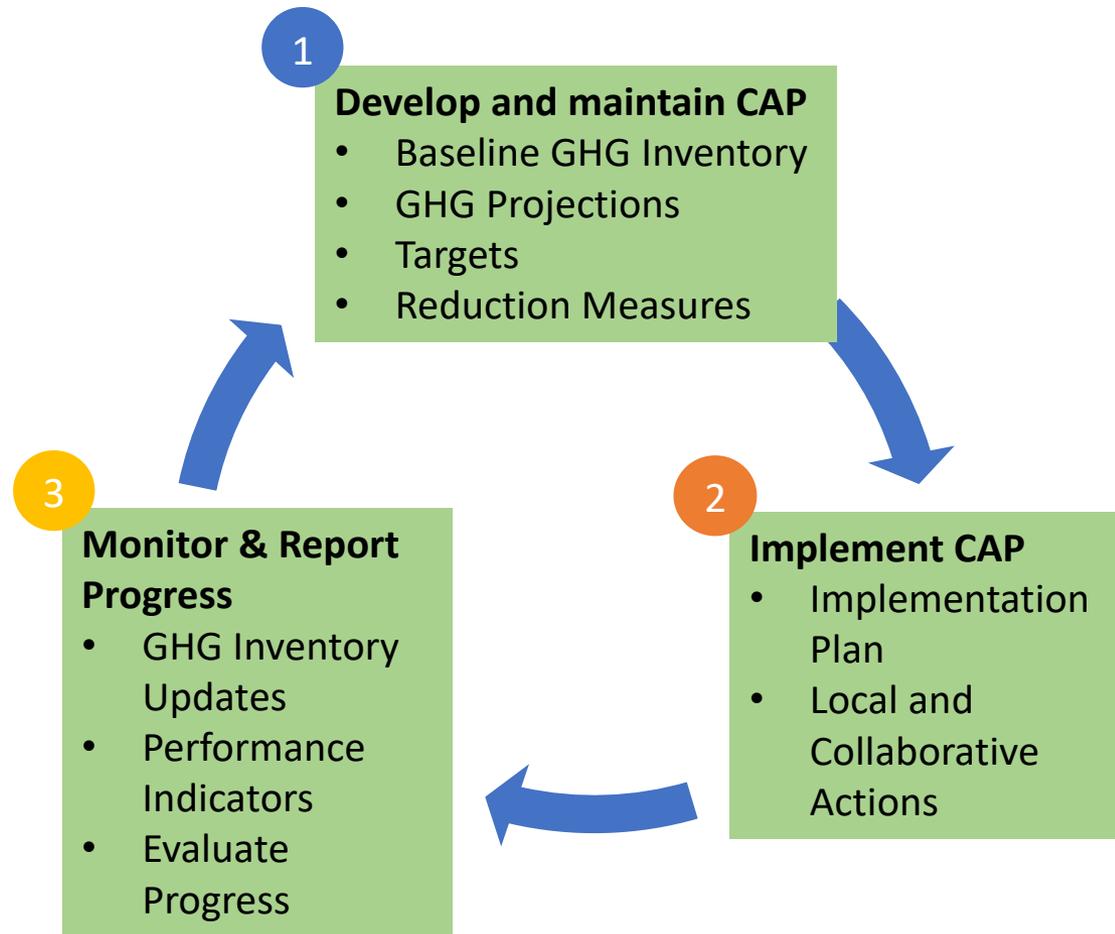
# What is a Climate Action Plan?

A Climate Action Plan (CAP) is a comprehensive policy document that outlines the actions a jurisdiction will take to reduce carbon emissions. CAPs are commonly prepared by communities to show how local goals and policies align with or exceed statewide targets for carbon reductions.

The main elements of a CAP are:

- ✓ GHG inventory report
- ✓ GHG reduction targets
- ✓ GHG reduction measures
- ✓ Implementation and monitoring

Adopting a CAP marks the beginning of an iterative process of implementing, monitoring, and updating the plan as the community progresses towards its climate goals. Considered throughout are stakeholder engagement and costs and benefits of mitigation actions.



Climate Action Planning

# Guiding Principles for Climate Action Planning

## Guiding Principles for City Climate Action Planning

City climate action planning should be:



### **Ambitious**

Setting goals and implementing actions that evolve iteratively towards an ambitious vision



### **Inclusive**

Involving multiple city government departments, stakeholders and communities (with particular attention to marginalized groups), in all phases of planning and implementation



### **Fair**

Seeking solutions that equitably address the risks of climate change and share the costs and benefits of action across the city



### **Comprehensive and integrated**

Coherently undertaking adaptation and mitigation actions across a range of sectors within the city, as well as supporting broader regional initiatives and the realization of priorities of higher levels of government when possible and appropriate



### **Relevant**

Delivering local benefits and supporting local development priorities



### **Actionable**

Proposing cost-effective actions that can realistically be implemented by the actors involved, given local mandates, finances, and capacities



### **Evidence-based**

Reflecting scientific knowledge and local understanding, and using assessments of vulnerability and emissions and other empirical inputs to inform decision-making



### **Transparent and verifiable**

Following an open decision-making process, and setting goals that can be measured, reported, independently verified, and evaluated

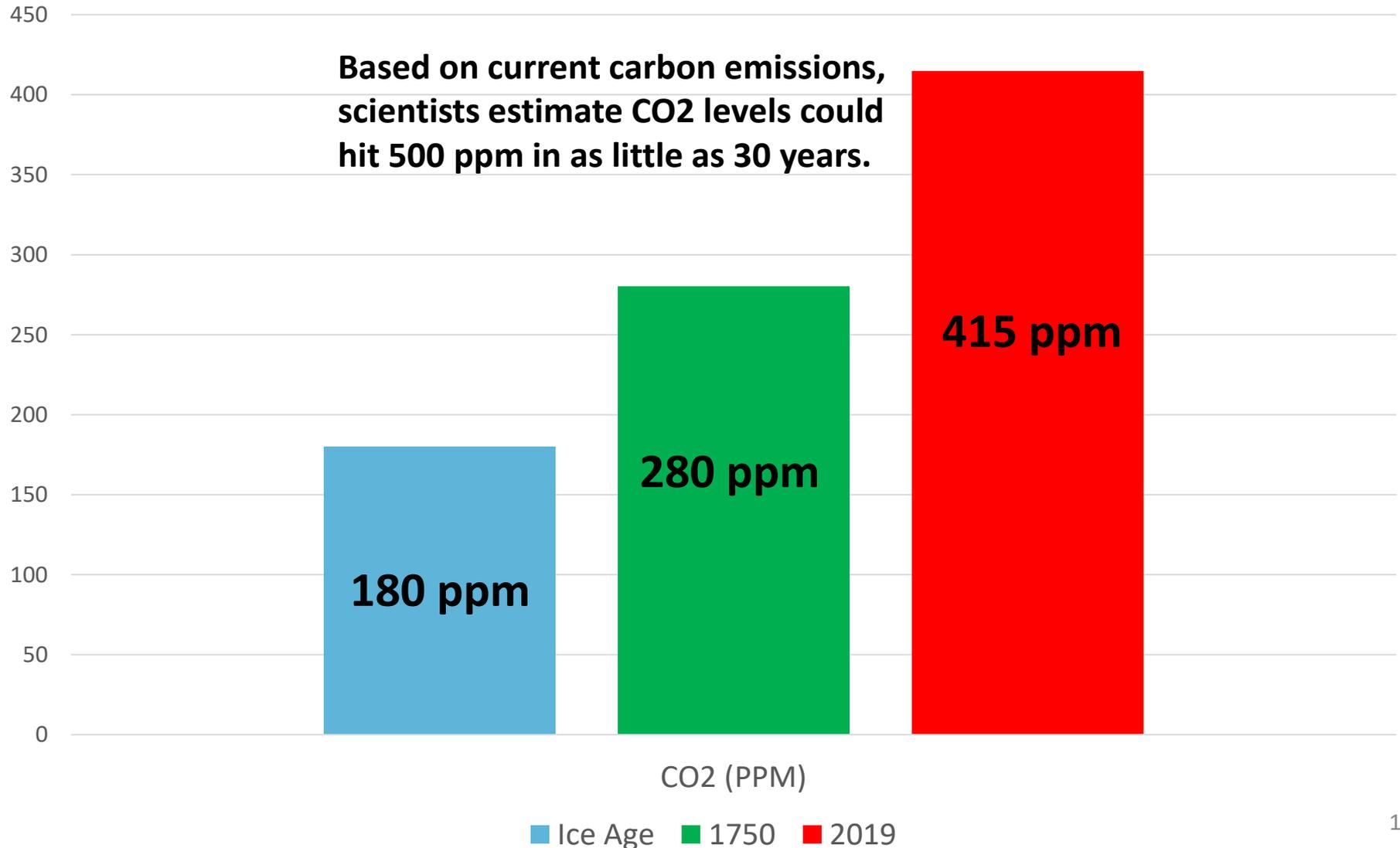
# Introduction: The Climate Crisis

“Only in the last few years did the science crystallize, revealing the urgency – our planet really is in peril. If we do not change course soon, we will hand our children a situation that is out of their control. We have at most ten years – not ten years to decide upon action, but ten years to alter fundamentally the trajectory of global greenhouse emissions... We are near a tipping point, a point of no return, beyond which the built-in momentum and feedbacks will carry us to levels of climate change with staggering consequences for humanity and all of the residents of this planet.”

– *Dr. James Hansen, Former Director, NASA  
Goddard Institute for Space Studies*

# Dangerous Increase in CO2 in Earth's Atmosphere

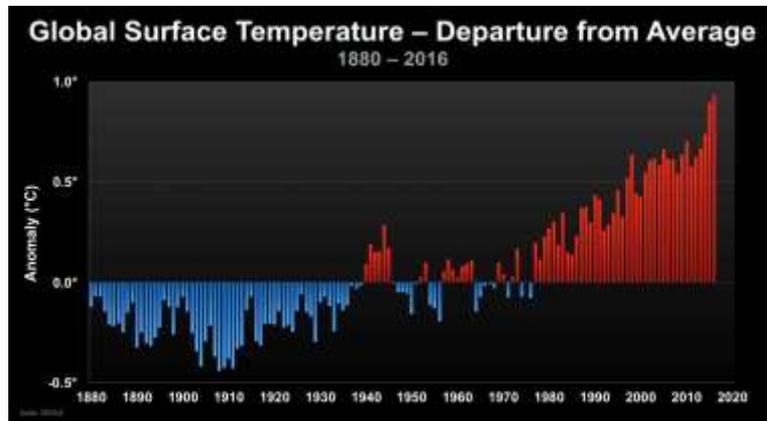
The current carbon level of 415 ppm has not occurred on earth for over 3 million years - before humans existed - when the earth was several degrees warmer, and sea levels were 50 feet higher than today.



# The Science: 10 Years to Act

Respected scientific organizations around the world have documented that human-generated greenhouse gas (carbon) emissions are dramatically altering the earth's climate systems and threatening human health and survival. The implication of this reality is staggering and almost unimaginable. The October 2018 [Intergovernmental Panel on Climate Change's \(IPCC\) Special Report on Global Warming](#) found that limiting global warming to 1.5°C (2.7°F) will require “rapid and far-reaching” transitions in energy, land, industry, buildings, and transportation. Global net human-caused emissions of carbon dioxide (CO<sub>2</sub>) need to fall by about 45 percent from 2010 levels by 2030, reaching ‘net zero’ around 2050. According to the report, “These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options, and a significant upscaling of investments in those options.”

“We have pointed out the enormous benefits of keeping to 1.5°C, and also the unprecedented shift in energy systems and transport that would be needed to achieve that,” said Jim Skea, co-chair of the IPCC Working Group on Mitigation. “We show it can be done within laws of physics and chemistry. Then the final tick box is political will.” “Every extra bit of warming matters, especially since warming of 1.5°C or higher increases the risk associated with long-lasting or irreversible changes, such as the loss of some ecosystems,” said Hans-Otto Pörtner, IPCC Working Group Co-Chair.



**The main take-away from the IPCC report is that humanity, and each of us individually and our communities, have 10 years (until 2030) to be halfway complete with this unprecedented shift to zero carbon emissions!**



Our earth has already heated up 1.0°C (1.8°F) since 1750.

# The Science: 10 Years to Act

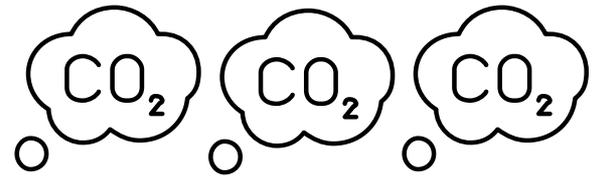
Global carbon emissions are still rising! We need to peak emissions in 2020 in order to begin the rapid ramp-down ([7.6% per year](#) according to the Nov 2019 UN Environmental Program Annual Assessment) and phase-out of fossil fuel use. Basically, we need to stop burning things to generate our electricity, to power our homes and buildings, and to transport ourselves. We need to rapidly transition to meeting our needs with renewable energy – primarily wind and solar with battery storage – and dramatically reduce the amount of energy needed to power our society.

**The 2018 IPCC reports puts our global carbon budget at 420 gigatons of CO<sub>2</sub> to have a 67 percent chance of staying below 1.5°C. If we are to increase our odds of avoiding a climate tipping point, our carbon budget is even smaller. Globally we emit approximately 42 gigatons of CO<sub>2</sub> annually. If you include land use, the 420 gigaton figure equates to approximately 10 years of emissions at current rates!** And since near-term emissions reductions matter more than those farther in the future, it is prudent to also set ambitious near-term emission reduction goals for the Town of Marblehead.

The most important concept to understand is the **climate “tipping point”**, the point at which the amount of carbon in our earth’s atmosphere reaches a level that causes further rapid heating (release of methane from melting arctic permafrost) and runaway climate disruption that no amount of human action can reverse.

***It is imperative that we immediately limit our carbon emissions so we do not cross the climate tipping point!***

The clock is ticking, and we need to act now!



# The Moral Imperative: What's at Stake

*“On climate change, there is a clear, definitive and ineluctable ethical imperative to act...There is an urgent need to develop policies so that, in the next few years, the emission of carbon dioxide and other highly polluting gases can be drastically reduced, for example, by substituting for fossil fuels and developing sources of renewable energy.” – Pope Francis, Encyclical ‘Praised Be: On the Care of our Common Home’*

Everything we love is at risk: our town, our families, our livelihood, our very survival. And everything we do – *Everything* – is predicated on having a habitable climate. This is not about ‘saving the planet’ – the earth will go on – this is about preserving the ability of humans and all other life forms to continuing living here. Every year we delay climate action, the speed of action needed becomes more rapid, and the more we place the burden of the climate emergency on our children. Ten years from now, if the earth has passed a climate tipping point, a response of “Wow, I didn’t know” or “It was too big of a challenge” will be completely unacceptable. It will be seen as morally negligent, perhaps even criminal.

The next 10 years will be the most important and consequential decade in the entire history of humanity. It is imperative that we rise to the enormous existential challenge facing us. Failure is not an option. We must find the courage to come out from our comfort zones to do the things that are urgently necessary now to ensure our survival.



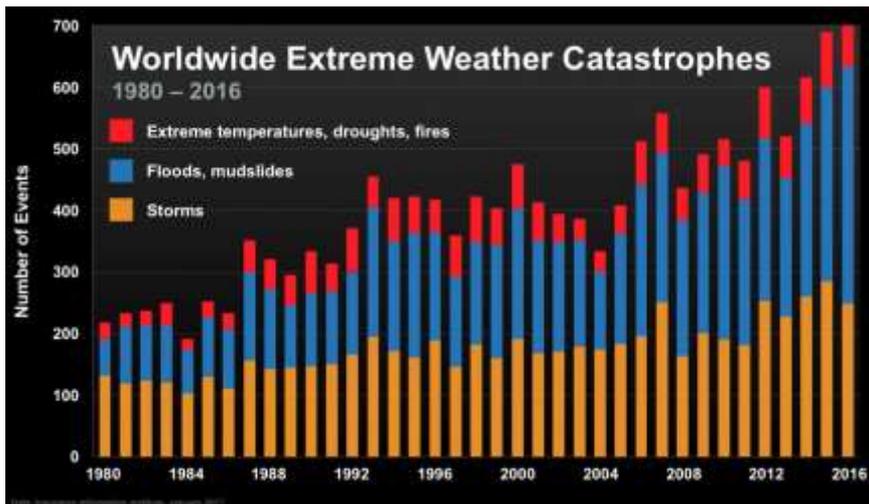
# The Moral Imperative: What's at Stake

*We do not inherit the earth from our ancestors, we borrow it from our children.*  
– Native American Proverb

Even while we work urgently to ramp down our carbon emissions (mitigation), we must also protect our town from the disruptive effects already built into the climate system from historical emissions (adaptation). Together, mitigation and adaptation form a cohesive strategy to prepare our town for a future that will be different from what we have known. In 2018, Marblehead received state funding to develop a Municipal Vulnerability Preparedness (MVP) Plan that looks at climate risks to the town and suggests possible adaptation strategies. Marblehead just received a [\\$93,000 Coastal Resiliency Grant](#) from the state for community engagement, data gathering, modeling of sea level rise for 2030, 2050 and 2070 and an engineering study on the town's public seawalls.

In Marblehead, we have 14.2 miles of coastline. Statistics from the Massachusetts Climate Change Clearinghouse and the Northeast Climate Science Center show that sea levels are projected to rise by 2.7 feet by 2050, accompanied by an increased frequency of storms such as [nor'easters](#), blizzards, and hurricanes. Annual precipitation could also increase by 53 inches by mid-century.

Dramatic carbon emission reductions reduce the likelihood of increased climate disruption and damage to our town.



# The Moral Imperative: What's at Stake

**“Climate Change  
is a  
Medical Emergency.”**

Professor Hugh Montgomery, Co-Chair,  
The 2015 Lancet Commission on  
Health and Climate Change

June 2015

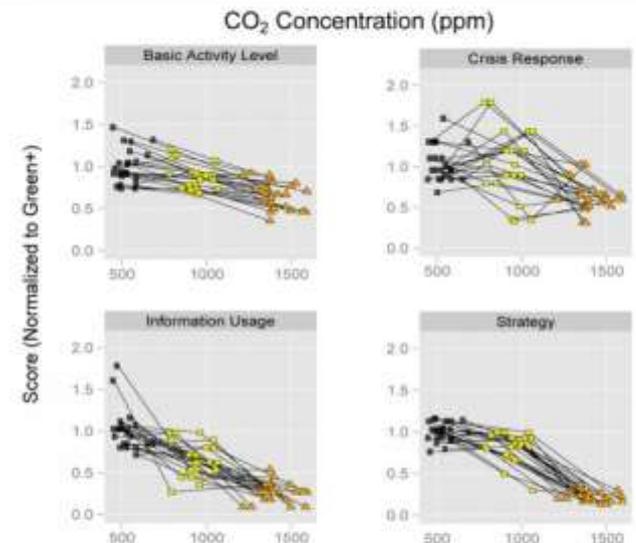
U.S. Department of Defense  
2014 Climate Change Adaptation Roadmap

Climate change  
“will likely lead to  
food and water shortages,  
pandemic disease,  
disputes over refugees and... natural  
disasters in regions across the globe.”

We now risk  
losing up to  
**50% of all  
land-based  
species**  
in this century



## How CO2 Levels Affect Human Cognition



Normalized cognitive function scores by participant and corresponding CO<sub>2</sub> levels in their cubicle. The Green+ case had CO<sub>2</sub> in the 500 ppm range due to high levels of outside air. It was compared to office settings in the 930 ppm range (yellow squares) and in the 1400 ppm range (orange triangles).

■ Green+ ■ Medium CO<sub>2</sub> ▲ High CO<sub>2</sub>

# The Moral Imperative: What's at Stake



We are now faced with the fact that tomorrow is today. We are confronted with the fierce urgency of now. In this unfolding conundrum of life and history, there "is" such a thing as being too late. This is no time for apathy or complacency. This is a time for vigorous and positive action.

Martin Luther King Jr.

We, the leaders and citizens of the Town of Marblehead have a moral imperative to do everything in our power to make the bold changes necessary to ensure a healthy and sustainable world for ourselves and future generations!



There is no task that is more urgent, more compelling or more sacred than that of protecting the climate of our planet for our children and grandchildren.

Christiana Figueres  
*Executive Secretary of the UNFCCC*  
July 2010 - July 2016

# Human Psychology: Why we delay

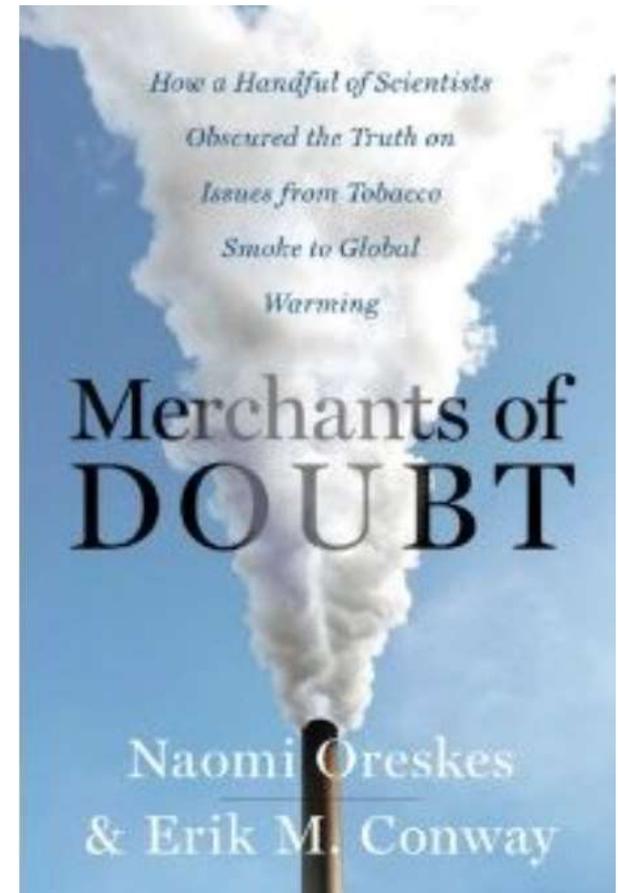
*“Many people don’t understand how severe this crisis actually is because they have not been informed.” - Greta Thunberg*

*“It is difficult to get a man (woman) to understanding something, when his (her) salary depends on his (her) not understanding it.” – Upton Sinclair*

There is still a general lack of understanding of the urgent need to address the climate crisis. While it is becoming increasingly difficult for anyone to escape the news of climate-related disasters and impacts, there has long been an active effort by the fossil fuel industry to obscure the facts.

Well documented in multiple studies, including in the documentary film, [Merchants of Doubt](#), oil, gas, and coal companies have for years internally acknowledged and understood how their product is putting humanity’s survival in jeopardy, while publicly sowing doubt as to whether there is really a crisis at all. The enormous profits of the fossil fuel industry, and their actions to preserve them – including exerting undue influence on politicians – have put at risk our civilization and humanity’s survival.

It is understandable that many have been confused by the mixed messages about the climate crisis that appear in the media. Now, however, due to the urgency of the situation, it is incumbent on each of us to fully educate ourselves on the science that documents the severity of climate change, and then to take action. Knowledge is power, and sows the seeds of responsibility that we must plant and nurture together.



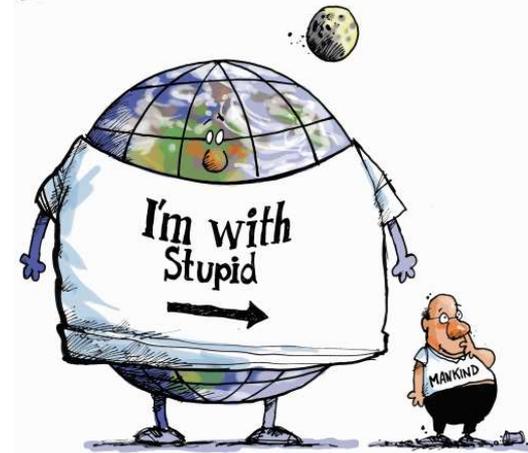
# Human Psychology: Why we delay

*“Facts do not cease to exist because they are ignored.”*

– Aldous Huxley

*“All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident.” - Arthur Schopenhauer*

tsidona@telus.net  
DAILY SOCIAL MEDIA



Thinking about the climate crisis is challenging and can feel overwhelming. Some call it eco-anxiety. It is human nature to avoid issues we fear or feel we have little control over. [Per Espen Stoknes](#) has illuminated the five main human psychological barriers to addressing the climate crisis:

**Distance:** The climate crisis can seem remote from our everyday lives. We can't see carbon emissions, melting glaciers and Antarctic ice sheets are far away, and the most severe impacts are still in the future.

**Doom:** When climate change is framed as an encroaching disaster that involves loss, cost, and sacrifice, it creates a desire to avoid the topic. With a perceived lack of solutions, helplessness grows and the fear message backfires.

**Dissonance:** If what we know conflicts with what we do, we experience cognitive dissonance. We can reduce this dissonance by doubting or downplaying what we know, or by bringing our actions in accord with what we know.

**Denial:** When we deny, ignore, or otherwise avoid the facts about the climate crisis, we find refuge from fear and guilt. When we participate in denialism, we provide ourselves an emotional buffer against what we know to be true.

**Identity:** We filter news through our professional and cultural identity. We tend to look for information that confirms our existing values and ideas, and filter out that which challenges them.

# Human Psychology: Why we delay



*“Live so that when your children think of fairness, caring, and integrity they think of you.” - H. Jackson Brown, author, Life’s Little Instruction Book*

*“What is the fate of great nations but a summation of the psychic changes in individuals?” – Carl Jung*



While acknowledging the human psychological obstacles to facing the reality of climate change, the fact remains that we have a global and local crisis that urgently needs our focused attention to successfully address. Having a plan, a climate action plan, gives us control and a path to help protect our future, reducing feelings of powerlessness and strengthening feelings of control. When we align our actions with our values, our feelings of being overwhelmed can flip into a feeling of strength and empowerment.

Humans are social animals, and we look around at others to help form our sense of normal behavior – the social norm. While we may not always think our actions matter, they do. Others are watching us as we actively create the social norms that guide our collective behavior. And our collective behavior determines the course of history.

True leadership, redefining what’s possible politically and in our broader society, is essential to successfully addressing our climate emergency. The citizens and leaders of the Town of Marblehead have an opportunity to take a leadership role and metaphorically guide our ship safely into the harbor.



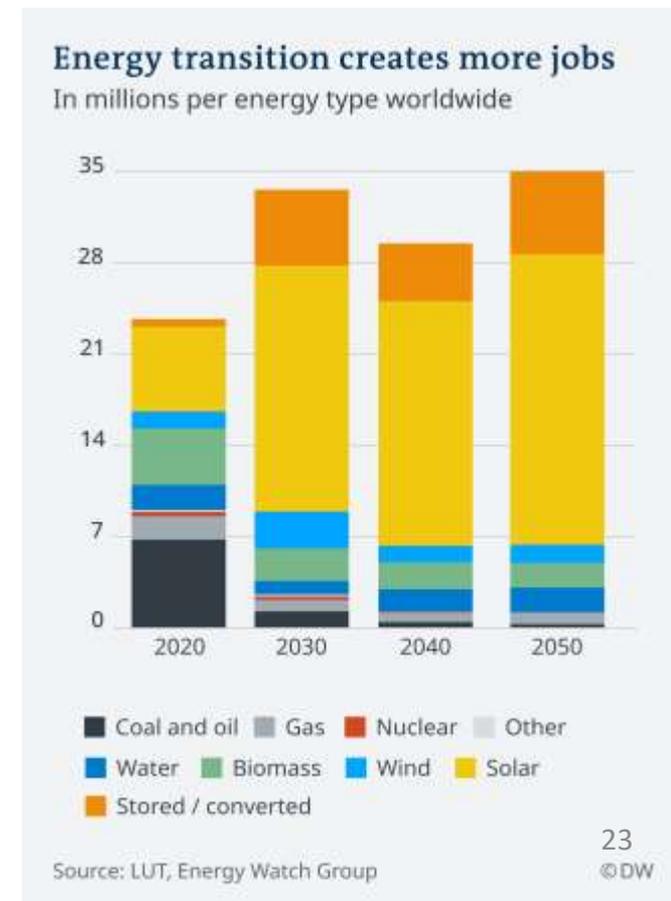
# The Economic Opportunity and Risk

“We are quite convinced that if he were alive today, as an astute businessman looking out to the future, he would be moving out of fossil fuels and investing in clean, renewable energy.” - *Rockefeller Brothers Fund Director Heintz on oil tycoon John D. Rockefeller*

“If this trend continues, the damage (from climate change) could exceed global gross domestic product by 2065.” – *Andrew Dlugolecki, General Insurance Development*

We stand at an economic crossroads. Do we continue on our current fossil fuel/pollution path and suffer the enormous and crippling costs of destruction of property, human life, and the natural world? Or do we pursue a new and necessary path toward clean energy and zero carbon, with its tremendous financial opportunities and a multitude of benefits to humanity and the natural world? Never before have we as a society been faced with such a life-changing and consequential choice – with impacts that will be felt far into the future.

Clearly the clean energy, zero carbon path is the only sane choice if, as NASA’s James Hansen has said, we wish “to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted.” And the beautiful thing is that we can simultaneously reduce our financial risk and create economic opportunity by doing one thing: investing in carbon reduction strategies. As Bill McKibben of 350.org reminds us, “Smart investors looking ahead can see where the future lies. Think about the scale of economic activity that comes from having to make the transition for the entire energy system off of fossil fuel and on to something else. The upside potential is enormous.”



# The Economic Opportunity and Risk

*“Climate change is a threat multiplier... because it has the potential to exacerbate many of the challenges we already confront today, from infectious diseases to armed insurgencies... and to aggravate problems such as poverty, social tensions, environmental degradation, and political instability in a number of countries.” – Chuck Hegel, Former U.S. Secretary of Defense*

According to Marblehead’s Municipal Vulnerability Preparedness (MVP) plan report, high wind events over the period from 2004-2013 caused up to \$1.1 million in damage to Marblehead. Significant climate changes are predicted to have a major impact on coastal communities like Marblehead over the next 50 years.

## The Cost of Carbon

- \$ **Political Instability**
- \$ **Floods & Mudslides**
- \$ **Wildfires**
- \$ **Drought**
- \$ **Storm Damage**
- \$ **Ocean Acidification**
- \$ **Infrastructure Loss**
- \$ **Climate Refugees**



- \$ **Species Extinction**
- \$ **Melting Glaciers**
- \$ **Famine**
- \$ **Water Scarcity**
- \$ **Ecosystem Loss**
- \$ **Our Way of Life**
- \$ **Infectious Diseases**
- \$ **Sea Level Rise**

**\$ “The #1 Threat to the Global Economy”**

Photo: © iStockphoto.com via iStock



“It’s very important that coastal communities understand the potential impacts of climate change on the town’s infrastructure, societal and environmental assets, and how its residents and businesses may be impacted,” said Barbara Warren, author of Marblehead’s Municipal Vulnerability Preparedness (MVP) Plan. “With a prioritized plan of actions, [the town] can identify immediate and long-term opportunities to advance the community’s resilience.”

# The Economic Opportunity and Risk

*“There are substantial economic and development benefits from bold climate action. And even more importantly, limiting global warming to 1.5° is imperative. Falling short would lock in climate impacts so catastrophic our world would be unrecognizable. Governments, businesses, and others have the clarity they need. Now it’s time for them to step up to the challenge.”*

– Kelly Levin, World Resource Institute

A [2018 report](#) by the New Climate Economy found that bold climate action can deliver **\$26 trillion** in economic benefits through 2030 (compared with business-as-usual) while generating more than **65 million jobs** and avoiding more than 700,000 premature deaths from air pollution in 2030. The report lays out a compelling case:

- Leading companies and investors are already getting behind this new approach, as are ambitious policy-makers.
- This is our ‘use it or lose it’ moment: the decisions we make over the next 2-3 years will determine our growth and future.
- Investing \$90 trillion in infrastructure over the next 10 years will help drive innovation, deliver public health benefits, create a host of new jobs, and go a long way toward tackling the risks of runaway climate change.

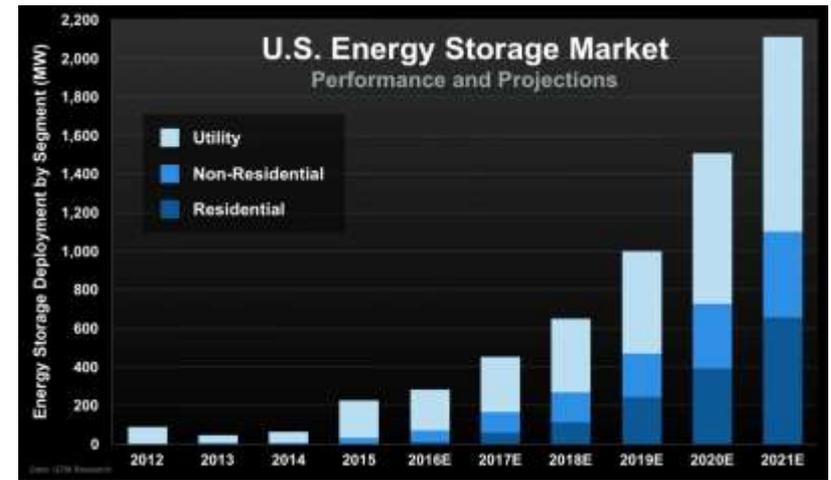
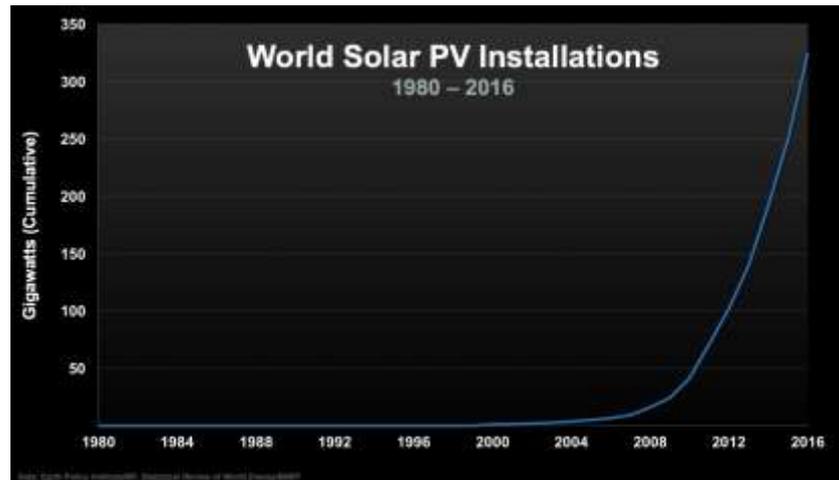
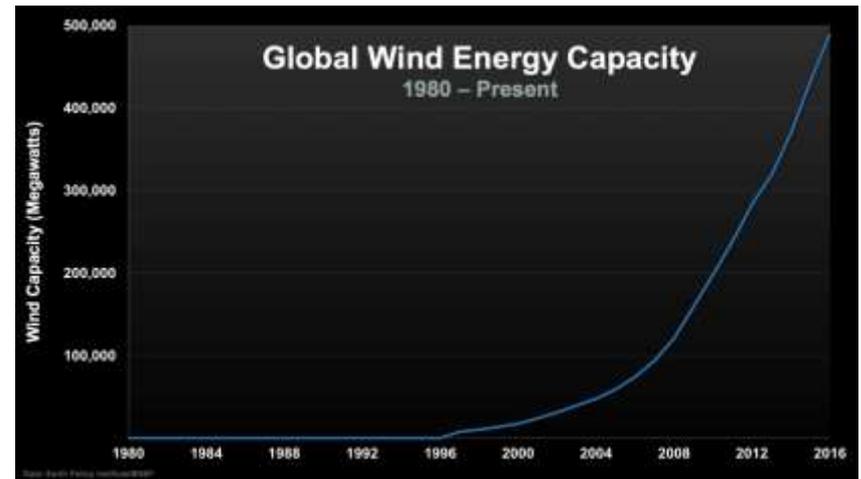
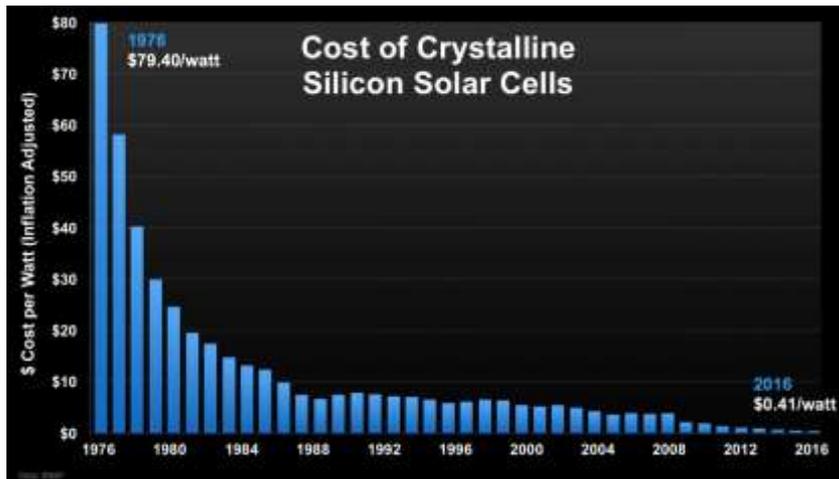
“The growth story of the 21st century will unlock unprecedented opportunities and deliver a strong, sustainable, inclusive global economy. The benefits of climate action are greater than ever before, while the costs of inaction continue to mount. It is time for a decisive shift to a new climate economy.”

–The Global Commission on the Economy and Climate

Currently \$20 billion in energy dollars are leaving Massachusetts each year!  
*What could we do with that money to support our towns and communities?*

# The Economic Opportunity and Risk

These four charts show the rapidly accelerating opportunities in clean energy – specifically solar PV, wind, and battery storage. Increasingly, the renewable energy option is more cost-effective than using polluting fossil fuel technology. In fact, renewable electricity is now cheaper than fossil generation in more than 60 countries, and will be [the cheapest source of power everywhere by 2020](#).



# The Economic Opportunity and Risk

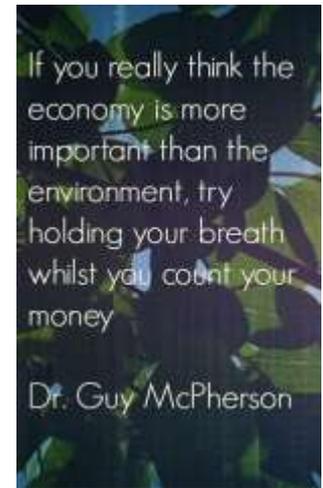
*“We cannot solve our problems with the same thinking we used when we created them.” – Albert Einstein*

The Town of Marblehead is known for its fiscal responsibility and balanced budgets. This has served us well over the years. Now we need to think differently about how we deploy our financial resources.

For instance, our Town investments and retirement accounts will mean very little in 15 to 20 years if we and others don't invest now to address the climate emergency and avert crossing an environmental tipping point that puts our residents, property, and community at great risk.

Another example of the need to think differently is the question of financial “payback”, which has been our prime consideration in our investments to save energy and reduce emissions. “What’s the payback of having a stable climate that supports life on earth?” is clearly a crazy question, but it’s exactly the question we need to ask ourselves to help us shift to a new way of thinking. The reality is that we can no longer afford to conduct business as usual.

**Numerous [studies](#) have concluded that the financial costs associated with climate-induced damage will dwarf the scale of the investments needed now to avert such damages.** To those who may say that taking the needed action is too expensive, we ask whether the Town is prepared to pay the enormous costs of trying to survive in a climate disrupted world. **True fiscal responsibility involves minimizing future risks and costs by making wise decisions today.** To pinch pennies now at the expense of our children’s future survival would be not only be fiscally irresponsible, but an intergenerational injustice. **We must redefine what is fiscally responsible, factoring in the enormous new economic opportunities and the very real and significant costs of inaction.**



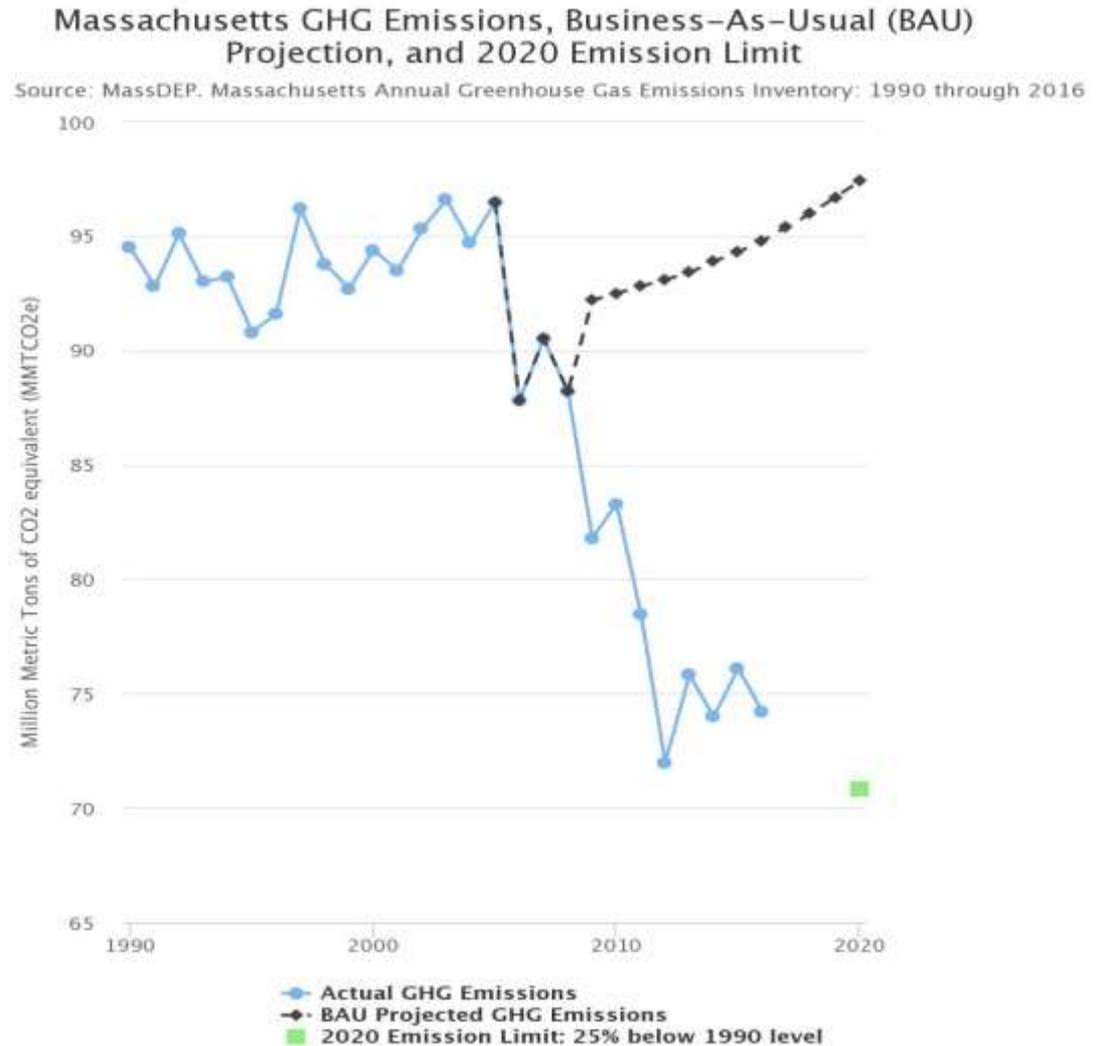
# Marblehead's Fossil Fuel Use and Climate Impact

*“What gets measured, gets managed.”  
- Peter Drucker, The Practice of Management*

# Massachusetts' Carbon Emissions

With forward-thinking state policy efforts, Massachusetts' carbon emissions have been reduced by 21% over the past 26 years. While this progress is significant, and demonstrates the viability of emission reduction programs, Marblehead will need to significantly accelerate the pace of our carbon emission reductions to achieve the goal of a carbon-free Marblehead by 2040.

Much of the Massachusetts carbon reductions were the result of the Regional Greenhouse Gas Initiative (RGGI) which placed a limit on the amount of carbon that could be emitted from electricity generating plants. Called "Cap and Trade", this approach led to the closure of high carbon-emitting coal plants around the state, including the Salem Power Station.



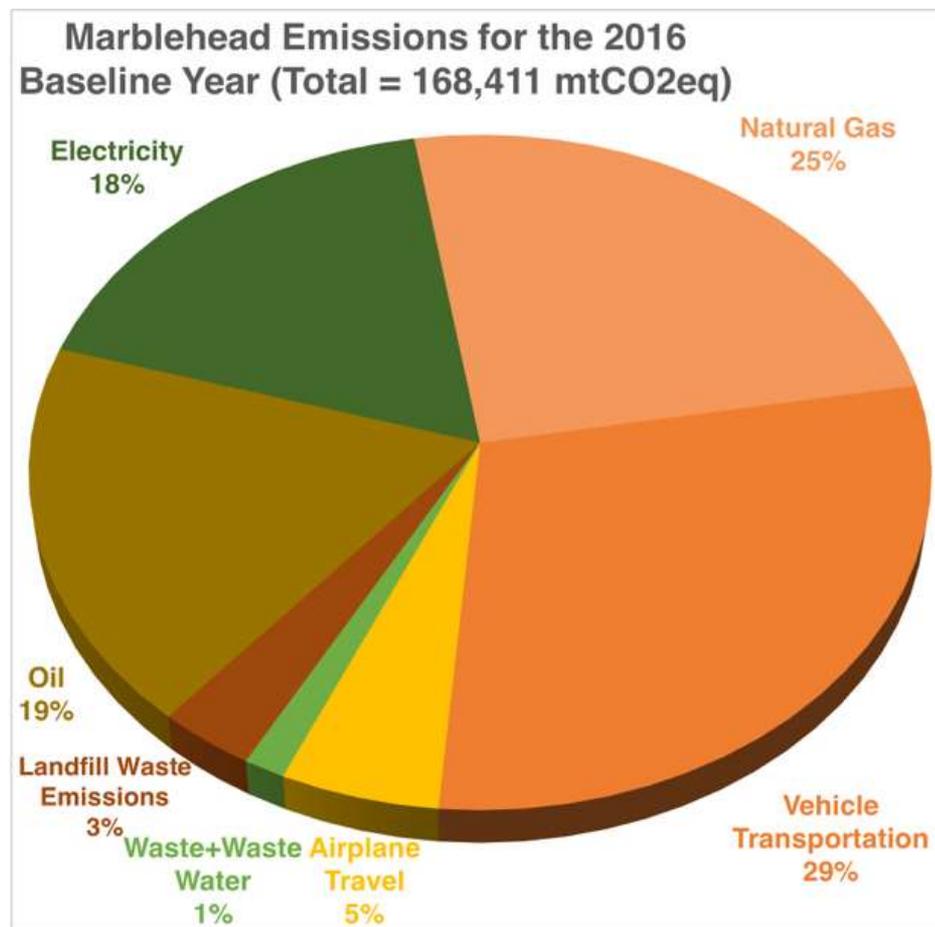
# Marblehead's Carbon Emissions

In 2018, to measure the town's carbon footprint, [Sustainable Marblehead](#) completed [Marblehead's first Greenhouse Gas \(GHG\) Inventory](#). Using the most current data available, the inventory categorizes and quantifies town-wide energy use and carbon emissions in the three primary town sectors, Residential, Commercial, and Municipal, and provides a baseline from which to measure our progress in future emission reductions.

## Key Findings

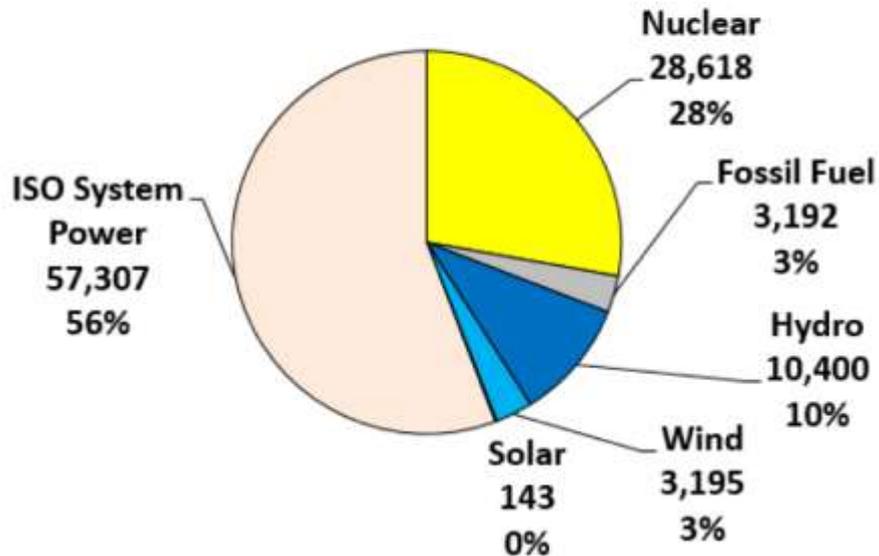
1. Vehicle transportation is the largest contributor to total emissions at 29%. Residential passenger vehicle emissions represent 27% of the 29%.
2. Natural gas use, predominantly for heating, accounts for 25% of total emissions.
3. Heating oil use represents 19% of emissions, with approximately 4 in 10 Marblehead households still heating with oil.
4. Emissions associated with purchased electricity through the Marblehead Municipal Light Department (MMLD) represent 18%.\*
5. Airplane travel emissions are approximately 5%.

\*Note: Subsequent to the release of the report it was determined that Renewable Energy Credits (RECs) had been sold for the wind generation portion of the electricity mix, making it ineligible to be counted as "renewable." As such, the emissions associated with purchased electricity are somewhat higher than stated here and need to be recalculated in the Town's climate action plan and in the next update of the inventory.



# Marblehead's Electricity Mix by Source

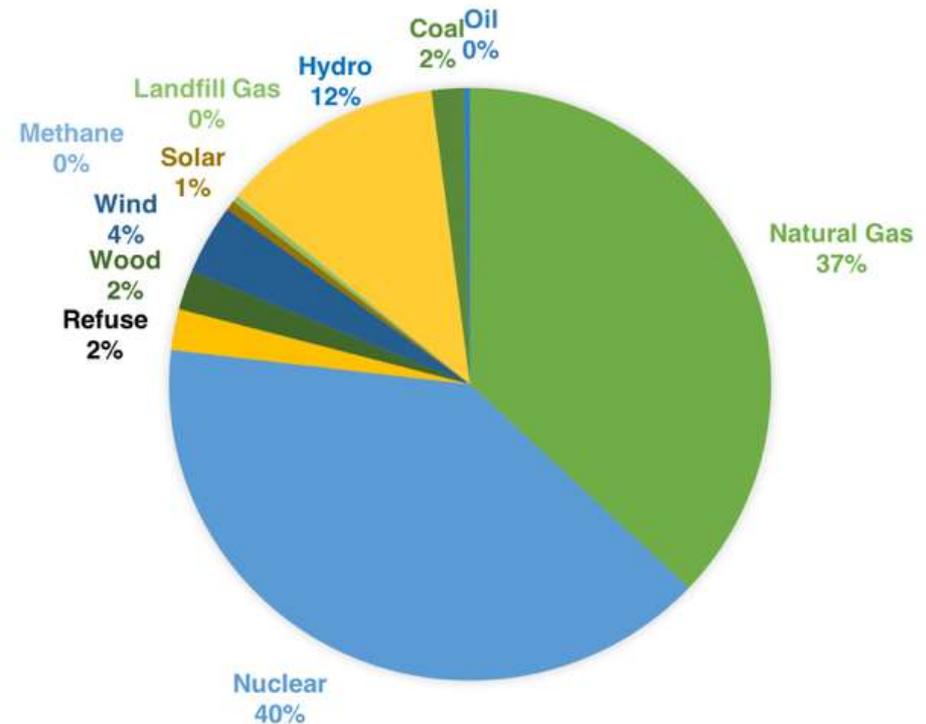
## Marblehead 2016 Load by Type MWh



Marblehead's electricity mix is a combination of the Independent System Operator (ISO) power mix (56%) and independent contracts with electricity generators (44%), based on 2016 data.

## Further Breakdown of Marblehead's ISO System Power Mix (the 56%)

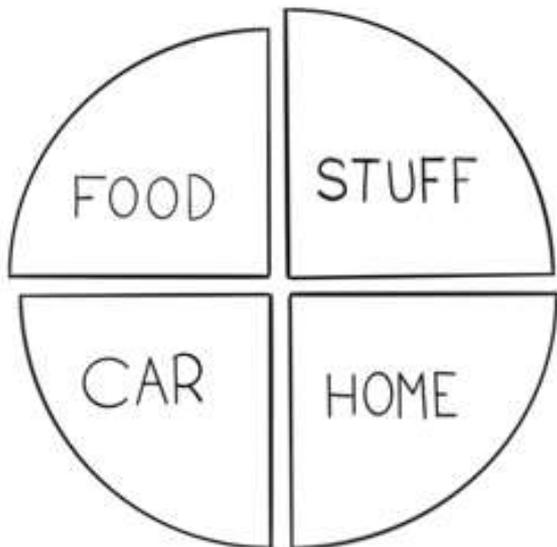
### Marblehead CY 2016 Energy Mix - With ISO System Power Mix Expanded (MWh)



# Moving to Carbon Freedom

The Town of Marblehead's Greenhouse Gas (GHG) Inventory was a cooperative effort involving many of the Town's department heads. It was intended to help us understand our impact on the health of people and our environment, and to inform our carbon reduction strategy. The report produced several key recommendations.

Total town-wide carbon emissions (168,411 mtCO<sub>2</sub>eq), when divided by the 19,808 residents of Marblehead, equates to emissions of 8.5 tons of CO<sub>2</sub> per person (2016).

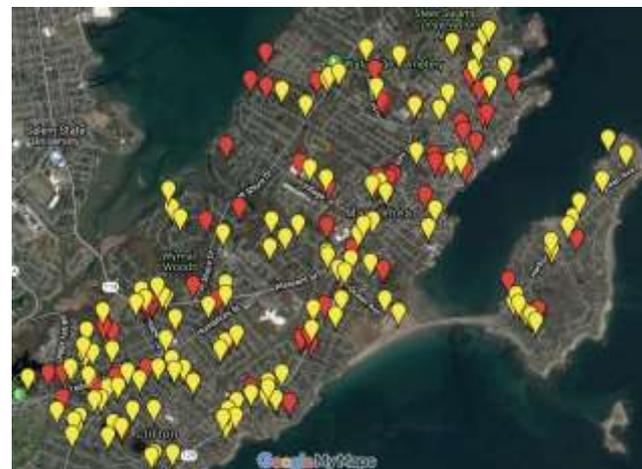


Four primary components of a typical family's carbon footprint

While the GHG inventory was based on the best available data at the time, there were two areas of emissions that were not covered: 1) gas leaks, 2) maritime activity. These should be added to the GHG Inventory 2.0 and addressed in the Town's Climate Action Plan.

## Recommendations

1. Using the emissions baseline, develop a **Climate Action & Sustainability Plan** with targets and actions for emissions reductions.
2. Push to convert transportation (29%) and oil heating (19%) to electric technologies.
3. Foster a culture of mindful vehicle transportation.
4. Expand efforts to reduce energy use: Programs, education, & incentives/financing.
5. Update the inventory report regularly.



Current gas leaks in Marblehead

# Pathways to Carbon Freedom

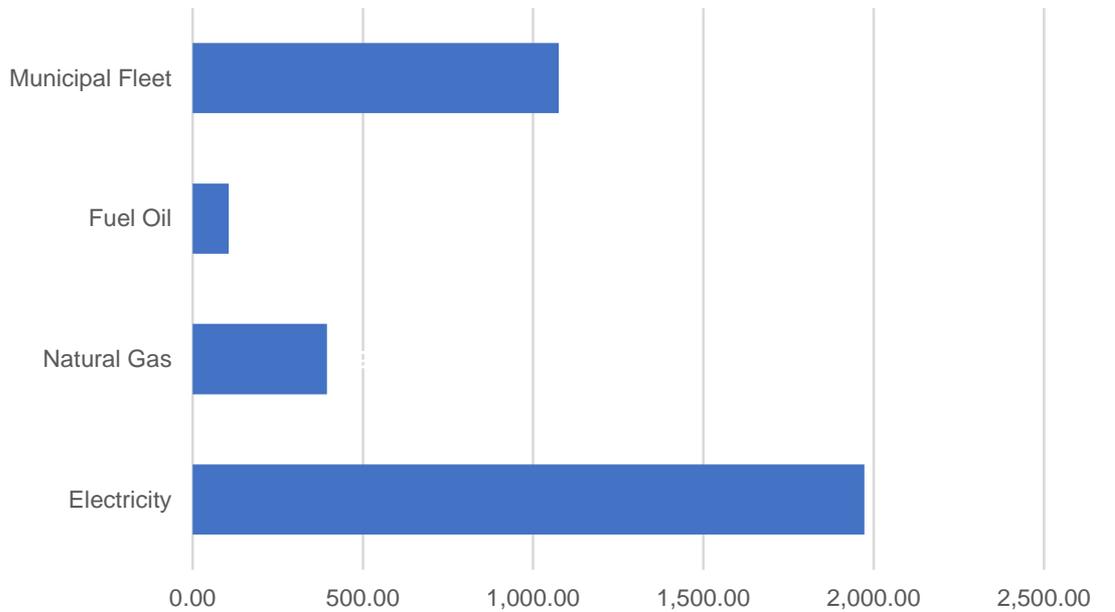
*"Preservation of our environment is not a liberal or conservative challenge, it's common sense." – Ronald Reagan, State of the Union address, January 25, 1984*

*"Sometimes we just simply have to find a way. The moment we decide to fulfill something we can do anything. And I'm sure that the moment we start behaving as if we were in an emergency, we can avoid climate and ecological catastrophe. Humans are very adaptable, we can still fix this. But the opportunity to do so will not last for long. We must start today. We have no more excuses." - Greta Thunberg, Age 16, Nobel Peace Prize Nominee*

# A Climate-Smart Marblehead by 2040 – Town Actions (Leading by Example)

*“Never doubt that a small group of thoughtful, committed citizens can change the world; indeed it’s the only thing that ever has.” – Margaret Mead, Anthropologist*

**Marblehead Municipal Emissions,  
CY 2016  
(Total = 3,549 mtCO<sub>2</sub>eq)**



Marblehead, MA municipal emissions for the 2016 baseline year

While emissions associated with the Town of Marblehead municipal functioning is a small piece of overall town-wide emissions (3,549 of 168,411 mtCO<sub>2</sub>eq, or 2% of total emissions), town officials can take the lead by showing how emissions can be dramatically reduced in buildings and transportation.

The new Bell School is a “lead by example” opportunity to show the community and our children how a building can be Zero Net Energy, producing as much or more energy than it uses.



# Marblehead Light Department (MMLD)

Our electric utility, the Marblehead Municipal Light Department, is in the unique position, along with 40 other towns in Massachusetts, of having the freedom to create its own policies and rates, separate from the constrictions of Department of Public Utility (DPU) rules for investor-owned utilities. MMLD's customers are the citizens, businesses, and town government of Marblehead. This localized structure, and control over its approval and interconnection processes, enables MMLD to make decisions more quickly and fast track clean energy projects. When there is a clear economic or strategic advantage to its ratepayers, MMLD can move swiftly to take advantage of technical innovation and cost declines.



Municipal utilities continue to break new ground, like the one in the Southern California city of Glendale, which executed a sweeping transition from fossil fuels to distributed, clean energy in the course of a single year. The locally controlled Western Farmers Electric Cooperative in Oklahoma recently contracted with NextEra for the nation's largest wind, solar, and battery plant.

Several years ago many utilities were worried about reductions in revenue from reduced electricity usage. Now, in order to meet our carbon reduction goals, we need to: **1) electrify end uses** (building heating/cooling, cars/trucks), **2) decarbonize the grid** (move quickly to 100% carbon-free energy – primarily solar and wind), **3) employ battery storage**, and **4) expand energy efficiency**. As a result, municipal utilities such as ours will see increases in electricity sales as we adopt electric vehicles and convert our oil and gas heating systems to electric-powered heat pumps.

We have an “all hands on deck” opportunity with regard to climate and, as opposed to an either-or situation, we need to pursue *all* clean energy options and solutions simultaneously. MMLD is pivotal in this one-time golden opportunity to lead Marblehead's charge toward carbon freedom. **By 2040, the entire Town of Marblehead could get 100% of its energy needs met from carbon-free electricity supplied by MMLD!**

# Marblehead Light Department (MMLD)

MMLD has long been a reliable and cost-effective municipal utility. One of MMLD's three tenets is to provide electricity at reasonable rates. As mentioned previously, it will be absolutely imperative to expand the framework of how the cost-effectiveness of climate mitigation action is calculated. Looking simply at "payback period" or standard return-on-investment calculations will be inadequate to accomplish ambitious climate goals.

In order to be fiscally responsibly in this new world of dramatic climate impacts, we must ask: What is the cost of not taking this action? We must factor into our financial calculations the substantial future costs we avoid by investing in a climate-smart Marblehead now. For it will do no good if we wake up 10 or 15 years from now, having passed a climate tipping point, and realize we should have heavily invested in clean energy to save our town. History will not look favorably on us if short-sighted thinking puts our children's world in jeopardy.

We have the opportunity to build on the town-wide U.S. DOE-funded Smart Metering system, with dynamic pricing and automated load management, to create a sustainable and even more affordable 21st century grid with integrated distributed generation.

## MMLD Proven Leadership

- Berkshire Wind Power Project
- U.S. DOE-funded Smart Meter Program
- Multiple APPA Safety Awards
- Excellent reliability for customers
- Consistently lower rates than investor-owned utilities
- NREL Study on renewables
- DOER grant to install community EV chargers



# Marblehead Light Department (MMLD)

## Recommendations

### ✓ Develop a 10-year Strategic Plan

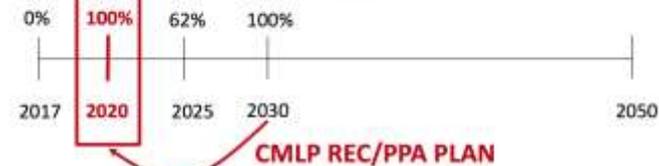
- The Town of Concord is at the forefront of strategic planning in support of their community's carbon reduction goals. The Concord Municipal Light Plant has developed a [2018-2025 Strategic Plan](#) that is guiding their actions to achieve a carbon-free power supply by 2020 and an 80% emission reduction by 2050. Their timeline lays out their key strategies and the schedule for bringing them online.

### EFTF GHG Emissions Goals

#### GHG Emissions Goal



#### Carbon Free Power Supply



### CMLP Strategic Plan Timeline

Tasks	2017				2018				2019				2020				2021				2022							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Green PPAs & RECs	Canton Mt Wind				9/1 1c REC charge				Granite Wind				First Light Hydro				Seabrook Nuclear				3/15 2019 RECs to be retired				3/15 93,371 (54% of sales) 2018 RECs retired			
Electric Vehicles	3/22 load balancing RFP				9/1 EV Level 2				11/1 EV Miles				Concord Drives Electric				MUD charging, workplace charging											
NISC					5/6 billing go live				9/23 CL go live				12/1 Engineering & Operations go live															
TOU Rates & higher fixed	1/1 \$9 → \$12				Cost of Service Study				data analysis, modeling, rate design				TOU rates															
Smart Meters (AMI)					4/15 issue RFP				6/15 award RFP				Installation															
Utility Scale Storage																												
Energy Efficiency	Pre 2007 Home Energy Assessments, Commercial Energy Audits, weatherization, LEDs												Full Res. & Comm. Program															
Smart Thermostats																												
Space & Water Heating	11/1 ASHP				2/1 GSHP				June promotional event																			
Distributed Solar	2008 Solar Rebates				11/1 SREC ends				3/1 HPWH				MA launches MLP Solar Program															
Strategic Plan Update																												

revision date 3/22/2019

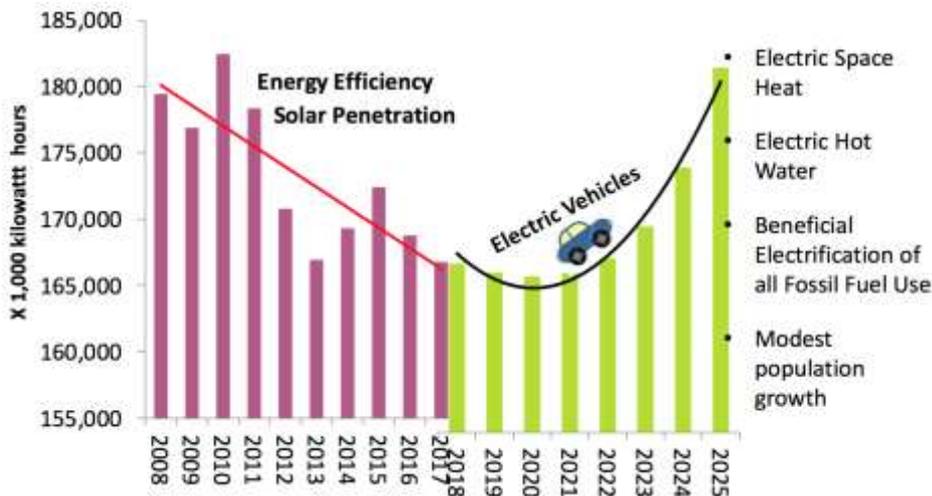
◇ Planned or Target    ◆ Done or Committed

# Marblehead Light Department (MMLD)

## Recommendations

- ✓ **Promote and incentivize electric vehicles (EVs) for all MMLD customers**
  - Electric vehicles have over 50% lower carbon emissions (the average equivalent of 102 MPG) than gasoline or diesel combustion vehicles and can cut the town's transportation emissions (currently 29%) well below 15%, and considerably lower as the town's electricity supply is decarbonized.
- ✓ **Promote and incentivize high-efficiency heat pumps for all oil and gas space-heat and hot water heating**
  - First target the third of Marblehead residents who still heat with oil, then gas-heat customers, with the goal of electrifying all building heating and hot water by 2035.

## Adjusted Load



# Marblehead Light Department (MMLD)

## Recommendations

- ✓ **Promote and incentivize solar electric systems for all MMLD customers**
  - For the benefit of MMLD and all MMLD customers, encourage all customers who can, to install solar. As the Electric Light Committee said in 1894, *“Local ownership of this indispensable new technology is a prudent investment for the future.”*
  - Solar is essential to addressing the climate crisis: As much solar, as soon as possible!
  - Distributed generation is dramatically more efficient than central power plant delivered electricity, which wastes about 67% of inputted energy.
  - Ratepayer impacts are minimal. The costs of solar constitute a very small portion of customers’ electricity rates.
  - Benefits exceed costs. Massachusetts’ solar policies are delivering benefits that far exceed the cost to customers. Benefits are 2.2x to 2.7x the costs, including customers without solar on their roofs!
  - Solar brings real money into our community: 30% federal investment tax credit, state tax credits, accelerated depreciation.
  - Installed solar is good for the Town of Marblehead. Studies show that every dollar invested in solar yields \$1.20 in local economic benefits.



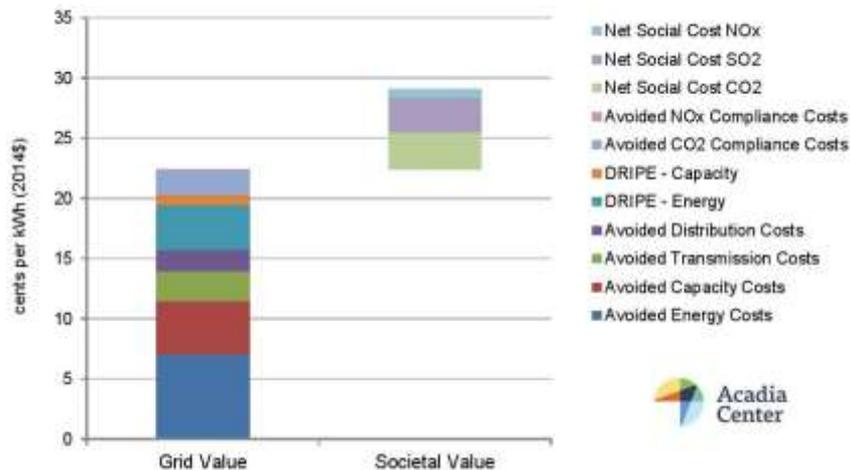
# Marblehead Light Department (MMLD)

## More Solar Benefits for all MMLD customers

- Solar benefits all MMLD customers financially by reducing energy demand, increasing grid reliability, moderating peak demand and supply costs through Demand Reduction-Induced Price Effects (DRIFE), and avoiding emissions from conventional power plants.
- With more solar energy on the market, everyone's energy prices will be lower in the long term. Renewable energy can now bid negatively into energy markets, giving solar the ability to reduce wholesale energy costs!

## Value of Distributed Solar

Figure 1: Grid and Societal Value of Solar PV in Massachusetts – 25-year Levelized Cost (2014\$)



## Acadia Center Study

### Solar PV in Massachusetts (April 2015)

- “Distributed energy resources (DERs) like solar photovoltaic (solar PV) systems provide unique value to the electric grid by reducing energy demand, providing power during peak periods, and avoiding generation and related emissions from conventional power plants.”
- “...the value of solar to the grid – and ratepayers connected to the grid – ranges from **22-28 cents/kWh**, with additional societal values of **6.7 cents/kWh**.”

**Policy Recommendation:** “Solar generation is a valuable local energy resource that provides significant benefits to all ratepayers, with a per-kWh value in excess of retail rates.”

# Marblehead Light Department (MMLD)

## Recommendations

- ✓ **Establish a community solar program**
  - Establish a “community solar” program in which customers in Marblehead’s historic district and other non solar-eligible customers are able to participate.
  
- ✓ **Promote and incentivize deep energy efficiency for all Marblehead buildings**
  - Greatly reduce energy demand for the heating and cooling of our homes and buildings to support the transition to building electrification, increase comfort and health, improve air quality, and save money and resources.
  
- ✓ **Expand and enhance energy efficiency programs and incentives/financing options**
  - Expand programs, education, incentives, and financing to actively support reduced energy use, and carbon emissions, in Marblehead buildings: Residential, Commercial, and Municipal. Consider PACE (Property Assessed Clean Energy) and on-bill financing to make it easy for homeowners and town businesses to pay for energy upgrades that save money and reduce carbon emissions.
  
- ✓ **Promote and incentivize smart thermostats for all Marblehead buildings**
  - Smart thermostats save energy, reduce carbon, and are a powerful tool in the demand response toolkit.

# Marblehead Light Department (MMLD)

## Recommendations

### ✓ Maximize the installation of utility-scale Solar

- MMLD is currently working with NREL on a study of all town buildings and town-owned sites that are appropriate for solar installations.
- This solar capacity represents less than 2% of total town electricity load.

### ✓ Maximize the installation of utility-scale Battery Storage

- Installed battery systems will help MMLD reduce the consumption peaks that drive monthly transmission costs and an annual capacity charge. By predicting peaks and discharging at the right time, the storage plants save money for utility customers.
- The Town of Sterling has saved over \$1 million in costs since their battery installation.
- Three other Massachusetts communities will soon be installing utility-scale battery storage.



# Marblehead Light Department (MMLD)

## Recommendations

- ✓ **Explore a no-cost solar financing model**
  - Investigate a no-cost financing model whereby a community financing/investment entity provides funding and captures tax credits and depreciation, to support solar installations at municipal buildings, to reduce overall municipal costs. Apply financing model to town businesses to increase number of MMLD-owned solar installations.
  
- ✓ **Explore wind power as a low-cost power option**
  - As a coastal community, Marblehead has potential access to a carbon-free power source that few other communities have. Explore collaborative regional wind options with other North Shore communities.
  
- ✓ **Explore renegotiating carbon-emitting power supply contracts**
  - A legal case could be made that such contracts violate the ability for the user (MMLD) to provide a safe environment for its customers, and infringe on the rights of Marblehead citizens to "life, liberty, and the pursuit of happiness."
  
- ✓ **Explore Time of Use (TOU) electricity rates**
  - Encourage customers to use electricity during off-peak times (e.g. at night), to help optimize load shapes, reduce peak-load charges, reduce carbon emissions, and save money.

# Sustainable Energy Use



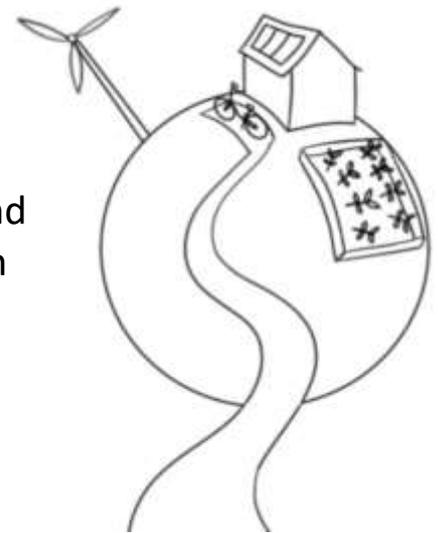
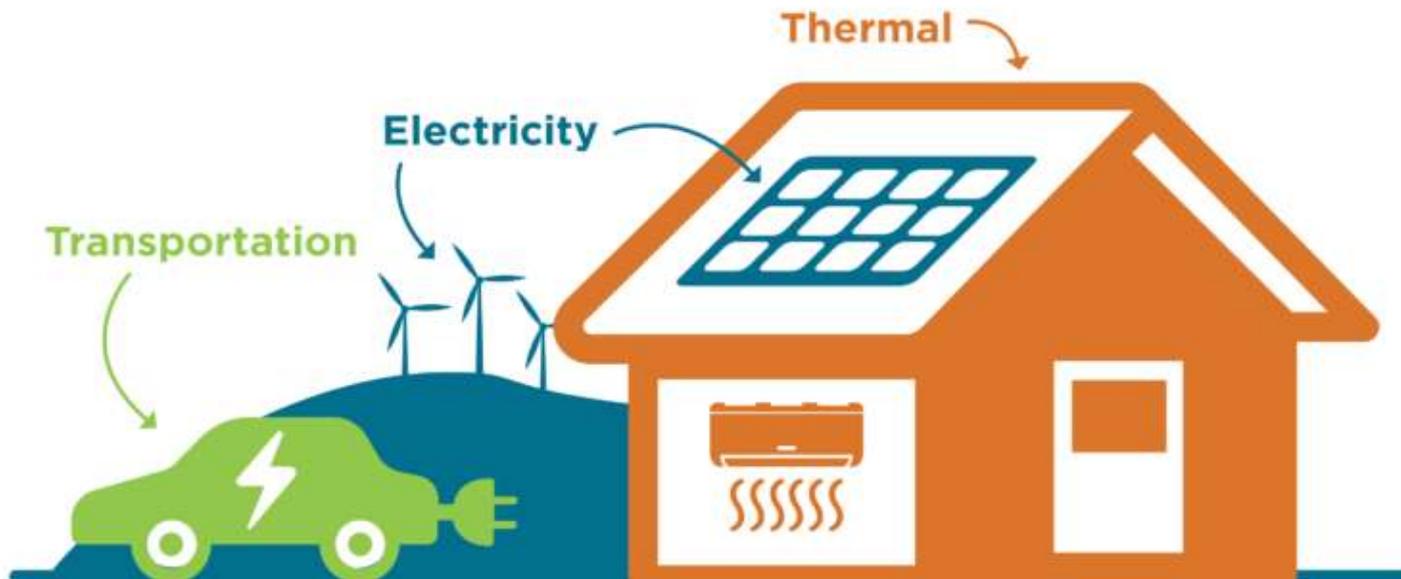
*“I’d put my money on the sun and solar energy. What a source of power!” – Thomas Edison*

*“Do your little bit of good where you are: it’s those little bits of good put together that overwhelm the world.” – Archbishop Desmond Tutu*

# Sustainable Energy Use

The three primary elements of sustainable energy use are, **1) building electrification, 2) transportation electrification, and 3) building thermal performance.** These core elements are key to achieving a carbon-free Marblehead by 2040. Actively envisioning the future we want for ourselves and our children will help us on this unprecedented transformational journey from the polluting fossil-fuel era to a clean, safe, zero carbon future.

## Total energy transformation



*Envision the future you want!*

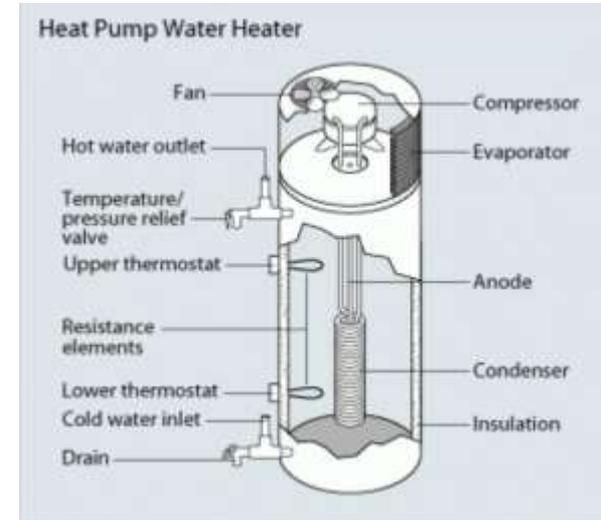
# Building Electrification

The strategy to electrify end-uses means that Marblehead homes (8,541 households) and buildings that currently heat and produce hot water with gas or oil, need to convert to electric technologies: ductless heat pumps and heat pump water heaters. Then, as the electric grid is decarbonized with more and more renewable energy generation, we can heat and cool our homes and buildings, and produce hot water, with a progressively smaller carbon intensity. In other words, with electrification and grid decarbonization, by 2040 we will be able to run all of our homes and buildings with 100% carbon-free energy, with no carbon emissions.

**This transformation of building infrastructure in Marblehead will require an unprecedented effort, led by MMLD with support from Town leaders.** It will also generate many new jobs and benefits to the local economy.

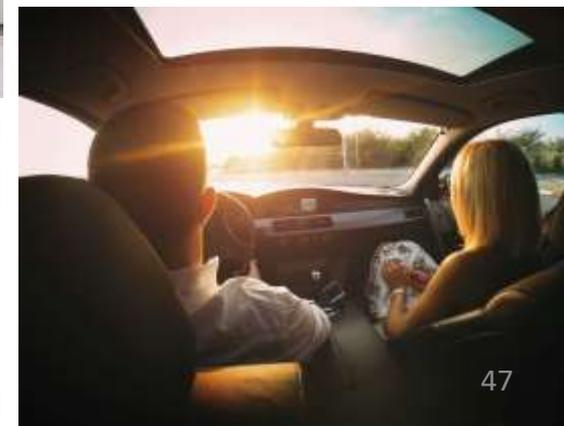
## Ductless Heat Pumps

- Heating & Cooling
- Ductless, zoned system
- Highly energy-efficient
- Low cost of operation



# Transportation Electrification

Transportation electrification means replacing our internal combustion engine (ICE) cars and trucks (gas, diesel) with electric vehicles which produce 50-75% fewer carbon emissions. The global transition to EVs has already begun, with several auto manufacturers announcing their phase-out of ICE vehicles. EVs significantly lower carbon emissions, cost less to operate, eliminate many ICE maintenance costs, and have superior driving performance. EVs also have the advantage of being able to reduce peak grid loads by discharging stored electricity when connected to a charger – called vehicle-to-grid integration (VGI). There were 14,937 vehicles registered in Marblehead in 2016, and 77 EVs rebated through the Massachusetts MOR-EV program, 2014-2018. Clearly the opportunity to increase the number of EVs in town, and to achieve the associated carbon emission reductions, is enormous – as is the savings potential of migrating the Town of Marblehead municipal vehicle fleet to all-electric.



## Going electric saves money



	GAS VEHICLE	ELECTRIC VEHICLE
<b>Fuel</b>	\$2.74/gallon <sup>2</sup>	\$1.50/gallon equivalent <sup>2</sup>
<b>Oil Changes &amp; Filter Replacement</b>	\$900	None
<b>Tire Changes</b>	\$600	\$600
<b>Engine Air Filter Replacements</b>	\$207	None
<b>Cabin Air Filter Replacements</b>	\$273	\$273
<b>Spark Plug Replacements</b>	\$439	None
<b>Coolant Flush and Replacement</b>	\$110	\$110



Source: EPA. <sup>1</sup>EV range varies by model and battery capacity. <sup>2</sup>EV range varies by model and battery capacity. <sup>3</sup>EV range varies by model and battery capacity. <sup>4</sup>EV range varies by model and battery capacity. <sup>5</sup>EV range varies by model and battery capacity.

# Building Thermal Performance

Increasing building thermal performance means upgrading our town's homes and buildings to use as little energy as possible for heating and cooling. Zero energy new homes and buildings are now commonplace in Massachusetts, and deep energy reduction techniques are readily available for existing buildings. Significantly reducing building energy use allows for smaller and less expensive heating and cooling systems, and dramatically aids in the overall transition to a renewable energy grid. The [MassSave](#) program is available to Marblehead's gas-heat customers, and provides energy assessments, free air-sealing, insulation and zero-energy incentives, 0% HEAT loan financing and other services. MMLD will need to significantly expand its existing energy performance programs and incentives, especially for oil-heat customers, in order to support customers in pursuing deep energy reductions to help achieve Marblehead's carbon emission reduction goals.



**All of the holes in an average home add up to a 4'x6' window open year round!**



**An energy-efficient home is a Healthy Home**



# Residential Case Studies

It is possible to dramatically reduce energy use and carbon emissions in homes and buildings using current energy renovation techniques. Here are the carbon emission reductions from two North Shore homes recently renovated in [Gloucester](#) and Marblehead. In addition to the major energy savings at each home, there are a number of other significant benefits including: 1) **Greater comfort** – warmer in the winter, cooler in the summer, 2) **Healthier** – easy to maintain good relative humidity and significantly fewer colds and viruses than pre-renovation, 3) **Quieter interior**, 4) **More durable** – no ice dams and less maintenance, 5) **Increased property value**, 6) **Buffer against energy price increases**, 7) **Reduced use of natural resources**, 8) **Supports the local economy** – local jobs, 9) **Reduces dependence on foreign energy supplies**, and 10) **Strengthens national energy security**.

Deep energy renovations like these are a win-win – good for our families, our economy, our town, and for the planet!



Before renovation

9.2  
Tons  
CO2



Before renovation

23.2 Tons  
CO2



After renovation

Zero  
Carbon  
Footprint



After renovation

3.7  
Tons  
CO2

# More Thoughts on Transportation

While the shift to electric vehicles is essential and will be enormously beneficial, simply trading in our existing vehicles for EVs is not the sole answer to decarbonizing our world. The resources required to produce new vehicles are significant (over 80 barrels of oil to manufacture a new car) and there are other ways to meet our transportation needs. Vehicle Miles Traveled (VMT) is a good metric for quantifying our transportation footprint. Getting ourselves around town using carbon-free modes (walking, biking) as much as possible is essential to achieving maximum carbon emission reductions. Transportation accounts for close to a third of town-wide emissions, and all ideas, along with expansion of existing approaches, need to be considered.

For instance:

- Development and expansion of bicycle infrastructure (Rail Trail, bike racks, bike share programs, safe pathways).
- Adoption of *Safe Routes to School*, a national and state program to promote safe walking and biking to school.
- Encourage use of existing mass transit (MBTA buses, subway, commuter rail).
- Free shuttle service within town.
- Carpooling and Incentives for shared mobility options.

Reimagining our transportation and envisioning a zero carbon world is a key step to getting there!



# Resource Efficiency

*“Sustainability takes forever. And that’s the point.” – William McDonough, Architect*

*“What most people see in their garbage cans is just the tip of the material iceberg; the product itself contains on average only 5% of the raw materials involved in the process of making and delivering it.” – Michael Braungart, Cradle to Cradle: Remaking the Way We Make Things*

*“What we really need is to chuck this old-school throw-away mindset. There’s a new school of thinking on this stuff and it’s based on sustainability and equity: Green Chemistry, Zero Waste, Closed Loop Production, Renewable Energy, Local Living Economies. It’s already happening. Some people say it’s unrealistic, idealistic, that it can’t happen. But I say the ones who are unrealistic are those that want to continue on the old path. That’s dreaming.” - Annie Leonard, Author ‘The Story of Stuff’*

# Resource Efficiency

Resource efficiency means using our resources as wisely as possible: rethinking how we use natural resources and products, reducing the amount of our consumption and waste, reusing and repurposing products, and recycling the rest. These were basic tenets of our frugal New England ancestors, and we need to tap into and rediscover our ancestral wisdom in order to preserve life in our town and on our planet. Another key strategy to reduce waste and carbon (methane) emissions is composting food scraps and yard waste. Often this can reduce the weight of our weekly trash by half. We can also improve the carbon intensity of our diet by growing fruits and vegetables in our own yards. The 10 calories it currently takes on average to produce 1 calorie of food in the U.S. is dramatically reduced when our food comes from our backyard or a local farm.



Reduce



Reuse



Compost



Food Gardens



Recycle

# Capturing Remaining Emissions

*“Someone is sitting in the shade today because someone planted a tree a long time ago.” – Warren Buffett*

*“He who plants trees loves others beside himself.” – Thomas Fuller*

*“The best time to plant a tree was 20 years ago. The second best time is now.” – Chinese proverb*

# Capturing Remaining Emissions

Two supplemental carbon capture strategies are recommended to augment efforts to achieve a carbon-free Marblehead by 2040.

Trees, through photosynthesis, have been a primary source of carbon sequestration on earth for millions of years. It is recommended that Marblehead dramatically expand tree plantings to naturally remove the maximum amount of carbon from the air.

All of the IPCC pathways to a stable climate include some amount of active carbon dioxide removal (CDR). While not yet deployed at scale, CDR will increasingly be a viable and important strategy in decarbonization efforts. As this technology rapidly matures, Marblehead should explore the possibility of employing CDR.

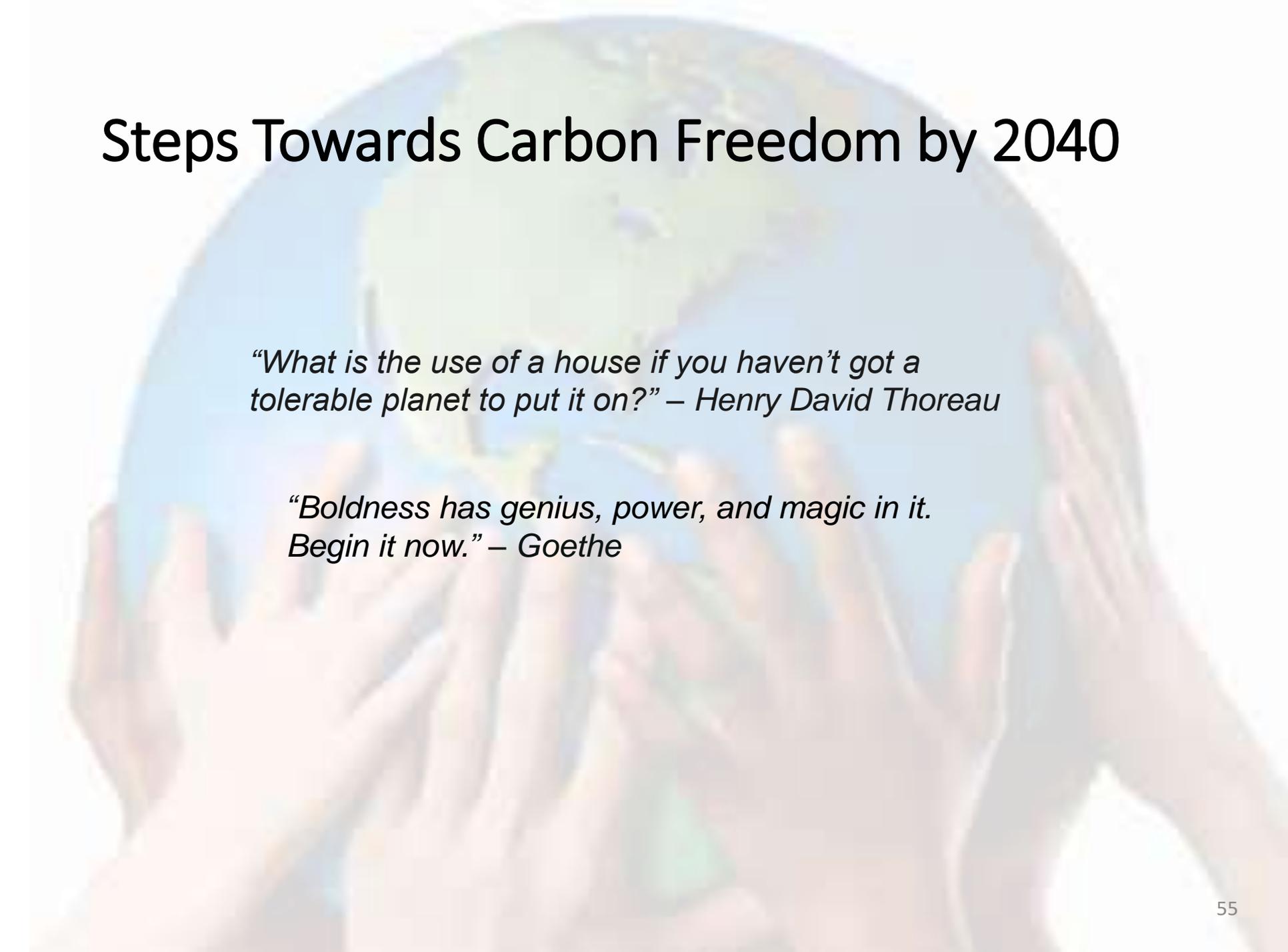


Expanded Tree Planting



Active Carbon Dioxide Removal (CDR)

# Steps Towards Carbon Freedom by 2040



*“What is the use of a house if you haven’t got a tolerable planet to put it on?” – Henry David Thoreau*

*“Boldness has genius, power, and magic in it. Begin it now.” – Goethe*

# Framework for Community Input

It will be essential to develop a strategic framework for community engagement. The Green Marblehead Committee's goal to "create a vision and action plan to guide the town in its carbon emission reduction, clean energy, and sustainability efforts" will require stakeholder buy-in and a sense of community ownership in order to be most successful. In fact, it will take everyone doing everything possible to reduce carbon emissions to the levels climate scientists say are necessary to avoid catastrophic climate disruption. We will need to start and continue conversations with those who might not even realize they need to be concerned about climate change and sustainability.

Once the Green Marblehead Committee has an agreed set of goals and strategies, we recommend engaging the Marblehead community through a proactive public education and idea-gathering process. The public engagement process should be inclusive, innovative, and grounded in science. Suggested elements of community engagement include:

- Conducting Interactive public forums, including child-focused activities
- Holding one or more key stakeholder workshops
- Conducting surveys and posting online community dashboards
- Leveraging community groups to communicate goals and strategies and gather feedback
- Engaging young people (16+) to educate and conduct interviews
- Utilizing social media content and video communication

The public engagement process will be essential to finalizing a plan that is actionable, that the community owns, and that puts Marblehead on the path to meet its climate goals.

# Interim 2030 Targets

According to IPCC data, we need to be about halfway to our 2040 carbon-free goal by 2030. Therefore, it will be essential to codify this as a plan target, and to develop interim targets for 2025 and 2035. Only by setting firm targets and measuring progress toward them will we be able to achieve carbon freedom by 2040.

The recommended town-wide carbon reduction targets are:

**2025:** 126,308 mtCO<sub>2</sub>eq

**2030:** 84,205 mtCO<sub>2</sub>eq

**2035:** 42,102 mtCO<sub>2</sub>eq

**2040:** 0 mtCO<sub>2</sub>eq



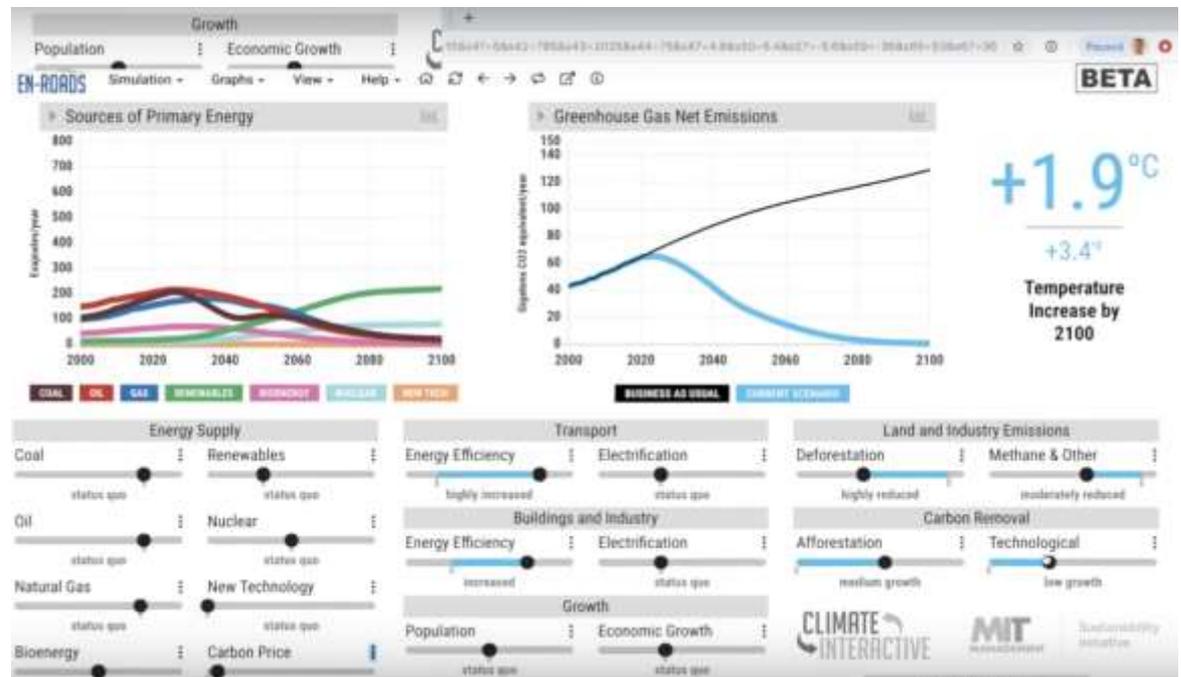
# State and Federal Policy Role

While there is currently a complete lack of climate leadership at the federal level, state policy will continue to play an important role in shaping the climate action landscape in Massachusetts. The Massachusetts Global Warming Solutions Act (GWSA) stipulates a 25% reduction in statewide carbon emissions by 2020, compared with 1990 levels, and an 80% reduction by 2050. While this legislation was passed over 10 years ago and no longer comports with the urgency of current climate science, it has provided a set of guideposts that have resulted in carbon reductions that will meet the 2020 target. More legislative action is urgently needed. Carbon pricing, when adopted, will provide a more accurate price signal to the market to accelerate the move away from carbon-based fuels. Legislated carbon budgets could be an even more powerful tool.

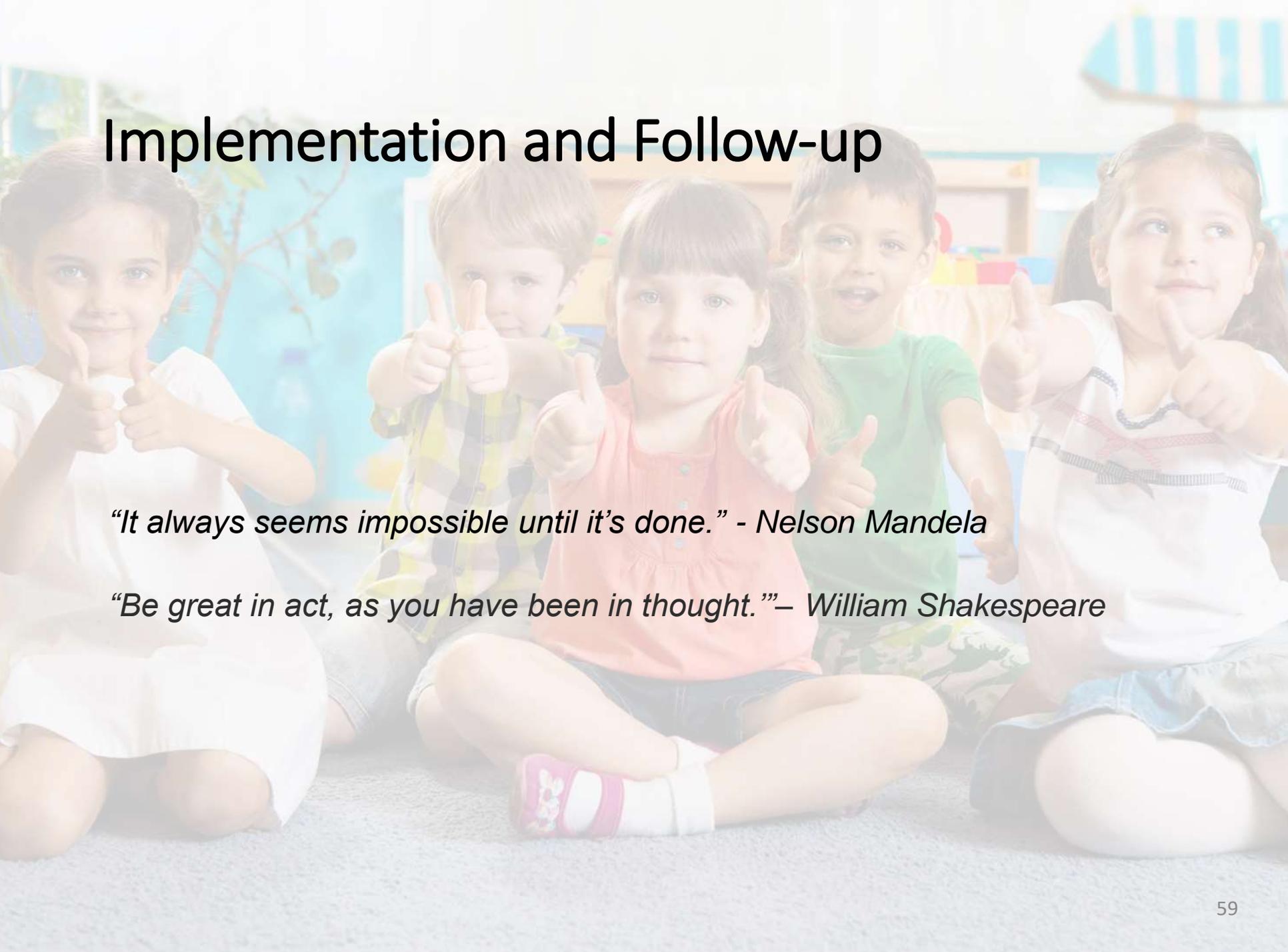
MIT has developed EN-ROADS, a powerful modeling tool that allows policy-makers to model different combinations of policy scenarios and see the resulting climate mitigation effect. It is now available [free online](#).

“If you want to teach people a new way of thinking, don't bother trying to teach them. Instead, **give them a tool, the use of which will lead to new ways of thinking.**”

- Buckminster Fuller  
Architect, visionary - 1895 - 1983



# Implementation and Follow-up



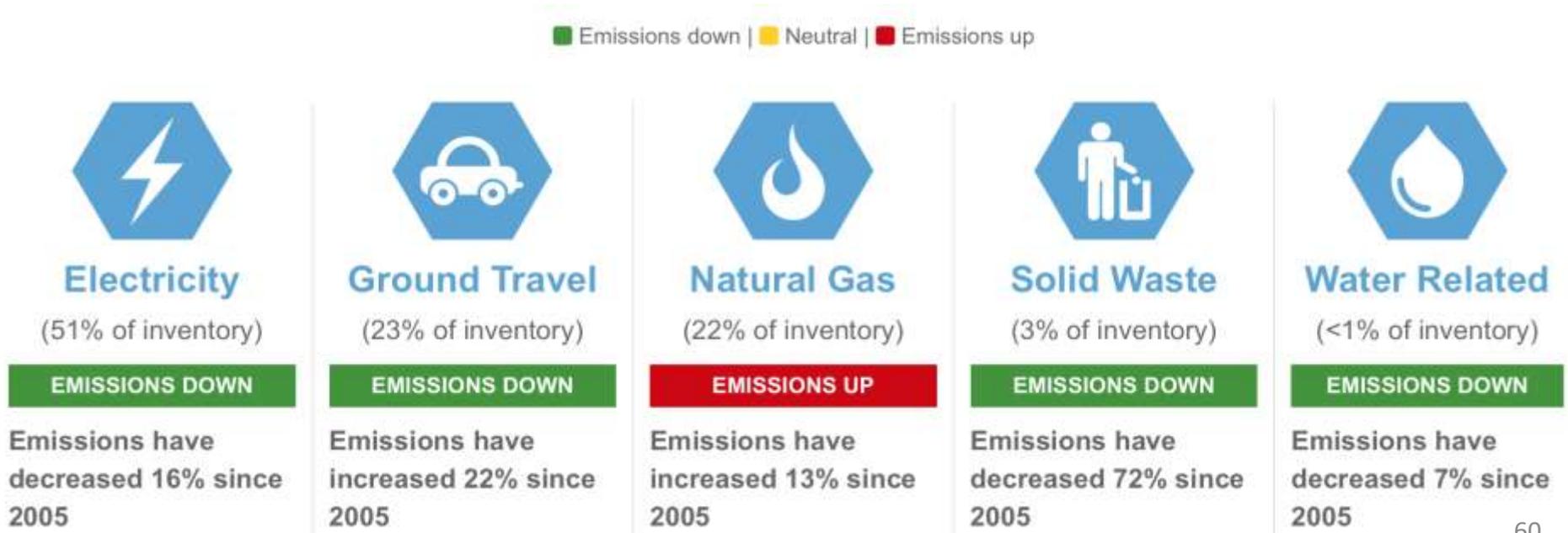
*“It always seems impossible until it’s done.” - Nelson Mandela*

*“Be great in act, as you have been in thought.” – William Shakespeare*

# Implementation and Follow-up

Any plan is only as effective as its implementation and follow-up. In order to ensure the success of Carbon-Free Marblehead 2040, we recommend the Town implement the following:

- ✓ **Management:** Hire a Sustainability Director/Manager to direct, coordinate, monitor, and drive forward the implementation of the plan.
- ✓ **Advisement:** Continue to convene the Green Marblehead Committee quarterly as an advisory group for the duration of the plan period.
- ✓ **Transparency:** Develop a climate action plan progress dashboard for the Town website so everyone is kept informed, and Marblehead residents feel engaged in the plan's action steps and ownership of the plan goals (see example dashboard template below).





[www.sustainablemarblehead.org](http://www.sustainablemarblehead.org)