



# A CALL TO ACTION

A report by  
**The Cape Cod Climate Change Collaborative**

February 2019



# ABOUT THE CAPE COD CLIMATE CHANGE COLLABORATIVE

Established in 2015, the [Cape Cod Climate Change Collaborative](#) (5Cs) is a consortium of Cape and Islands-based organizations and individuals whose mission is to unite available resources, organizations and intelligence to mitigate climate change impacts on Cape Cod, reduce greenhouse gas emissions, and work toward achieving “net zero”-based goals for the region. Board members include community leaders from across the region representing organizations such as the Association to Preserve Cape Cod, Cape Air, Cape Light Compact, Center for Coastal Studies, Friends of Pleasant Bay, Outer Cape Energize, Woods Hole Research Center, and numerous faith, educational, non-profit and business entities.

This report was developed and written by Mon Cochran, Executive Director of the 5Cs, with editorial assistance from Fran Schofield and Janet Williams, and technical assistance from Stephen Gates, members of the 5Cs Board of Directors. The 5Cs is appreciative of all who helped in the preparation of this Report.

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# 1 EXECUTIVE SUMMARY

This Report has been prepared by the Cape Cod Climate Change Collaborative (“5Cs”), an organization established to address the regional causes and impacts of climate change. Focusing efforts on Cape Cod and the nearby islands of Martha’s Vineyard and Nantucket (“Cape & Islands”), the 5Cs has been working to spur local and regional actions to mitigate the impacts of climate change by linking existing regional knowledge, talent and tools.

The 5Cs developed a set of “Cape & Islands Net Zero<sup>1</sup> Goals” and launched those goals at a “Round Table” event held in September 2018. This Report puts the adopted Goals in the context of climate change mitigation efforts that have been underway on the Cape & Islands since the 1990’s, and which are now providing the solid foundation for the urgent transition to “net zero” as quickly as possible. This Report aims to paint a brief yet complete picture, linking concrete actions to the Net Zero in anticipation of the upcoming development of a comprehensive Climate Action Plan for the Cape & Islands.

## **The Net Zero Goals:**

**GOAL 1:** *Reduce fossil fuel usage by 50% from 1990<sup>2</sup> levels on the Cape & Islands by 2030.*

**GOAL 2:** *Achieve 100% use of renewable electricity by 2050.*

**GOAL 3:** *Determine how the natural carbon balance is changing over time and recommend ways that Cape & Islands residents can enhance and increase carbon storage by natural processes.*

**GOAL 4:** *Educate residents about causes and impacts of climate change, the Cape & Island Net Zero Goals, and priority action steps for achieving the Goals.*

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<sup>1</sup> “Net Zero” carbon (a/k/a carbon neutrality) means achieving on balance zero carbon emissions by avoiding all carbon dioxide emissions, or, for unavoidable emissions, by offsetting or storing (sequestering) them to achieve a balance between carbon emitted and carbon removed from the atmosphere.

<sup>2</sup> The 1990 level is the baseline used by the Commonwealth of Massachusetts as required by the Global Warming Solutions Act of 2008. Massachusetts has set a statewide goal of 80% below 1990 GHG emissions levels by 2050.

## 2 INTRODUCTION

The Cape & Islands today sit in the crosshairs of accelerating climate change impacts. Surrounded by water, the region is already experiencing some of the devastating impacts of a changing climate: increasingly frequent severe storms, flooding, large-scale coastal erosion and changes to the region’s fisheries and ecosystems. The Cape & Islands face severe risks if action is not taken – and soon – to slow and then reverse the temperature increases resulting from increasing greenhouse gas (primarily carbon dioxide) emissions.

The nature and scope of the global climate change risks are becoming increasingly clear. The recent [IPCC report](#) and the [National Climate Assessment](#) underscore the need for urgent action to avoid climate disaster. Aggressive cuts to carbon emissions are needed to safeguard our health, our economy, and our children's future. The federal government’s failure to act has made it incumbent on all of us to take action to avoid irreparable damage.

The 5Cs has taken initial steps toward rallying action. In September 2018, the 5Cs convened organizations, institutions and businesses from across the Cape & Islands to coalesce around a set of “Net Zero Goals.” In a day-long “Round Table” event it organized these groups to evaluate proposed Net Zero Goals and start developing action steps designed to move the Cape & Islands region to net zero energy as quickly as possible. Held in Hyannis, Massachusetts, the Round Table included 100 community leaders from throughout the Cape & Islands, representing the following eight economic and institutional sectors:

- Advocacy/outreach
- Built environment
- Education
- Energy
- Environmental protection
- Faith communities
- Municipalities
- Transportation

Participants came in search of solutions: to reduce and eliminate dependence on fossil fuels as quickly as possible, and to increase reliance on renewable energy to achieve the Net Zero Goals. And they came to hear local success stories that others have had in moving toward net zero energy. At the end of the day, participants gathered in their sector groups to brainstorm a starting list of priority action steps to be implemented in 2019 and beyond to advance the Net Zero Goals.

Since the Round Table, the 5Cs has been synthesizing, developing, and refining priority action steps to create a *Cape & Islands Climate Action Plan*. That *Action Plan* will form a recommended roadmap for Cape & Islands organizations, institutions and businesses to follow moving forward into 2019 and beyond.

# 3 ADDRESSING CLIMATE CHANGE: CAPE & ISLANDS

## The Cape & Islands Context

The process of transitioning from fossil fuels to renewable energy sources is generally location-specific. Natural and man-made resources potentially available for energy production in a particular location play important roles in this shift. For the Cape & Islands—famous for sun, wind and water—solar gain is most favorable and plentiful in the summer. Although the latitudinal location of the region is less favorable for solar power than regions further south, many roof-tops and industrial lots across the Cape & Islands are already supporting residential and commercial photovoltaic arrays. Data presented later in this report indicate that Cape Cod residents have, in fact, installed solar arrays at a greater rate per household than have residents in other regions of the Commonwealth.

Balancing the potential for solar energy in winter are the wind resources available to the Cape & Islands region: Boston is the 4th windiest city in the U.S. and the Cape & Islands are even windier than Boston. The vast continental shelf that surrounds the Cape & Islands extending approximately 80 miles to the east creates relatively shallow coastal waters. The accessibility of the ocean bottom, combined with the advent of turbine floating technologies, means that the potential for offshore wind power is great. In contrast, land suitable for land-based industrial scale wind turbines is limited.

Another geographic resource particular to the Cape & Islands is tidal energy. Tidal energy is currently being tested in the waters of the Cape Cod Canal.

Looking at transportation, the geographic limits of the Cape peninsula and both islands suggest that the transition to battery powered vehicles should be an easy one.

These local geographic features along with technological advancements in energy storage provide both the potential for and the limitations to how the Cape & Islands will create its roadmap through the process of moving away from a dependence on fossil-fuel to a renewable energy future.

## Early Renewable Energy Efforts

Addressing and mitigating climate change impacts have been a focus of activity on the Cape & Islands since at least the 1990's. A brief history of these efforts follows.

### ***Cape Light Compact***

The [Cape Light Compact](#) (“CLC”) was formed in 1997 to advance the interests of consumers in the newly restructured electric industry. State legislation enabled municipal aggregators like the CLC to: 1) purchase power on behalf of all customers in the municipality on an opt-out basis; and 2) implement energy efficiency programs instead of the local electric utility. This ensured that funds collected from residents and businesses were spent to reduce their energy costs.

During its first decade the CLC concentrated on developing an award-winning energy efficiency program, piloting a power aggregation purchasing program, assisting the Cape & Islands’ 21 towns to purchase more efficient street lights.

### ***Cape & Islands Renewable Energy Collaborative***

In 2000, the [Cape & Islands Renewable Energy Collaborative](#) (CIRenew) was established with funding from the Massachusetts Technology Cooperative to “provide a collaborative forum for individuals and organizations with a common interest in achieving a sustainable energy future.” CIRenew engaged local communities and the public in efforts to increase energy conservation and efficiency, adopt green energy practices and encourage applications of clean energy technologies and practice.

In 2008 CIRenew issued [A Call to Action and Report to the Community](#), which established reasons for urgent action, described obstacles to progress, and pointed to a confluence of interests and opportunities for positive change. The report contained two ambitious goals: 1) generate sufficient renewable energy in the Cape & Islands to meet 100% of net annual electricity needs by 2020; and 2) reduce direct use of fossil fuel for heating and transport applications in the Cape & Islands by 50% by 2020. Despite efforts of CIRenew to promote action toward meeting these goals, intervening economic and political forces created unsurmountable obstacles, and the Cape & Islands are not currently on track to reach them. The 5Cs believes that the time is now to revisit this important effort, update the goals and develop an action plan to reach them as quickly as possible.

### ***The Cape Wind Project***

The Cape Wind Project was proposed in the late 1990’s as an offshore wind farm on Horseshoe Shoal in Nantucket Sound off Cape Cod. It won initial approval but ran into significant opposition from some Cape and Island residents. Prolonged legislative battles resulted in the loss of a key utility contract, and the company terminated the lease rights for the site in late 2017. While the Cape Wind Project ultimately did not succeed, other significant land-based wind projects have come on line during the past decade.

### ***Utility-Scale Wind Turbines***

In 2006, the Massachusetts Maritime Academy completed installation of the first utility-scale wind turbine on Cape Cod. The turbine today provides about one third of the Academy's energy needs. To read more about this project, [click here](#).

In 2008 the Air Force Civil Engineer Center installed a large wind turbine at the Massachusetts Military Reservation to compensate for high electricity costs associated with the water treatment plant performing chemical clean up in the Upper Cape water supply (the Sagamore lens).

The success of that initial clean energy project led to construction of two more wind turbines in 2010 (also offsetting use of electricity for remediation of groundwater contamination). Since then two additional turbines have been built to offset the electrical demands of the Reservation's PAWS radar facility. The Air Force now touts the effort at MA Military Reservation as a "net zero clean-up" project and has been working with Raytheon to develop a state-of-the-art micro-grid with battery back-up on the base. To read more about the projects at the Massachusetts Military Reservation, [click here](#).



## **Renewable Energy Today on the Cape & Islands**

### ***Cape and Vineyard Electric Cooperative***

Energy conservation and efficiency, green energy practices, and use of clean energy technologies have continued to advance on the Cape & Islands. Many of these advances can be traced to the CLC and its investment in local renewable energy supplies. In September 2007, the CLC invested \$3 Million in the [Cape and Vineyard Electric Cooperative](#) (CVEC), a non-profit energy cooperative charged with building local renewable energy supplies to help stabilize and reduce power prices. Since its inception, nearly every town on Cape Cod and Martha's Vineyard has joined CVEC, with municipal representatives comprising its board of directors.

With the advent of the Massachusetts Green Communities Act of 2008 and introduction of virtual net metering, CVEC began moving in a new direction: in 2011 it managed a procurement process for construction of 16 megawatts of solar photovoltaic (PV) capacity in its member towns, mostly on landfill sites. In 2012, CVEC managed a second round of procurement for an additional 12 megawatts of PV capacity. The CVEC PV efforts gained broad support, despite mounting opposition to the then-proposed Cape Wind Project on Nantucket Sound. To date, CVEC's efforts have provided over \$12 million in avoided electric costs and a 60 million pound reduction in greenhouse gases.



In all, the CLC has supported CVEC's start-up with \$3.7 million in funding over a seven-year period, with a 20-year return on investment projected at \$60 million. The largest amount of solar energy developed by a small regional group of municipalities in the United States, this endeavor is being used by Massachusetts officials as a model for communities in the rest of the state.

### ***Private Residential Properties***

Significant progress has also been made regarding solar PV at private residences. Figure 1 shows the number of residential PV arrays installed on the Cape and Vineyard between 2002-2018.



On the Cape & Islands, 92% of all PV solar installations have occurred in residential settings. Production capacity, meanwhile, is more broadly distributed across these sectors:

- 37% residential
- 25% municipal/government
- 11% commercial/office
- 27% distributed among 8-10 sectors

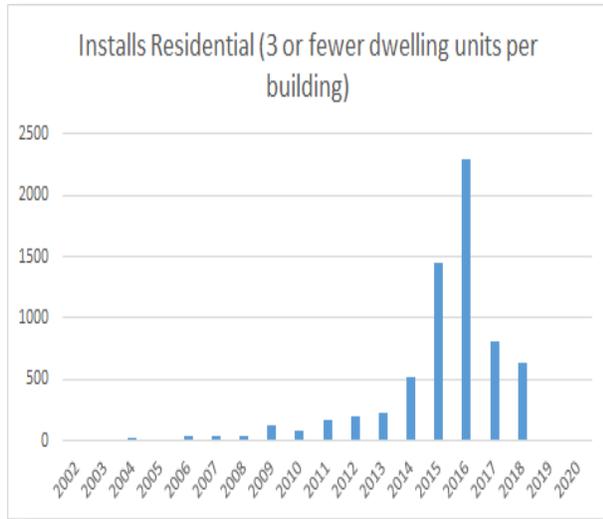


Figure 1

The data show that residential installations were negligible until 2011 but gradually increased through 2014 when they reached 500. In 2015, the number almost tripled, and then more than quadrupled in 2016 compared with 2014. More recently, these numbers have dropped back closer to the 2014 total<sup>3</sup> due primarily to changes in state incentives for photovoltaic installation.

Within Massachusetts, the Cape & Islands have been particularly receptive to the production of solar-powered electricity. With a population representing just 3.5% of Massachusetts, the

region accounts for 8.3% of its overall solar panel installations and 5.4% of the statewide installed capacity. While that percentage is impressive, to date only about 6.5% of Cape & Islands households have completed solar installations.<sup>4</sup> There is clearly ample opportunity for growth going forward.

See **Appendix B** for more information on the rate of residential solar installations and future capacity on the Cape & Islands.

## The Cape Cod Climate Change Collaborative

### ***Establishment and Mission***

Inspired by the Paris Climate Change Accord of 2015, thirteen Cape & Islands environmental and business organizations joined forces in 2016 to create the Cape Cod Climate Change Collaborative. The organization’s mission is to mitigate climate change impacts, including warmer ocean waters, sea level rise and increased storm intensity in the region. By linking available knowledge, talent and tools of Cape & Islands individuals and organizations, the 5Cs seeks to create conditions to foster innovative, feasible solutions to the climate crisis.

<sup>3</sup> Data and graph courtesy of Stephen Gates analysis.

<sup>4</sup> Id.

### ***Getting to Net Zero: The Four Goals***

In 2017, the 5Cs developed a set of specific goals to realize net zero carbon on the Cape & Islands. A subcommittee<sup>5</sup> of regional sustainable energy leaders met to define specific Net Zero Goals for the ongoing work of the 5Cs and its regional member organizations. This group initially established three preliminary Net Zero Goals (currently, Goals 1 – 3).

**GOAL 1:** *Reduce fossil fuel usage by 50% from 1990 levels on the Cape & Islands by 2030.*

**GOAL 2:** *Achieve 100% use of renewable electricity by 2050.*

**GOAL 3:** *Determine how the natural carbon balance is changing over time and recommend ways that Cape & Islands residents can enhance and increase carbon storage by natural processes.*

Discussion and feedback at the Round Table (see below) led to some refinement of the Goals and the addition of a fourth Goal focused on education.

**GOAL 4:** *Educate region residents about human-produced causes and impacts of climate change, Cape & Island Net Zero Goals, and priority action steps for achieving goals.*

More detailed information on the Goals can be found in **Appendix D** and **Appendix E**.

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<sup>5</sup> The three original goals were developed by a working group consisting of Austin Brandt (Cape Light Compact); Mon Cochran (Cape Cod Climate Change Collaborative); Max Holmes (Woods Hole Research Center); Chris Powicki (Sierra Club of Cape Cod); Lauren Sinatra (Energy Coordinator, Town of Nantucket); Dan Wolf (Cape Air) and Jim Wolf (Cape Air).

# 4 THE NET ZERO CAPE & ISLANDS ROUND TABLE

## Objectives

In early 2018, the 5Cs began planning a Cape & Islands-wide event to convene leaders in the climate change and renewable energy arenas. The objective was to set goals, share success stories, pool resources, and expand a collective sense of the possible in achieving a region powered by renewable energy. Dubbed “Net Zero Cape & Islands,” the Round Table event aimed to change the energy future of the Cape & Islands through collaboration, innovation and cross-sector fertilization. The all-day/invitation-only event was held on September 27, 2018 in Hyannis, Massachusetts.



## Speakers

**Keynote Speaker** - Max Holmes, Ph.D., Deputy Director, Woods Hole Research Center, opened the Round Table by laying out the facts about carbon in our atmosphere, its sources, the reductions needed to prevent catastrophe, and the current uptake of energy alternatives, including solar and wind energy. Max drew on his own personal experience, tracing changes made by his own family as they insulated the walls of their home and transitioned from fuel oil to gas to an electric mini-split heating system backed by solar panels. To see a video of Max’s presentation [click here](#).

**Lunchtime Speaker** - Emily Norton, new Executive Director of the Charles River Watershed Association (and former Sierra Club Massachusetts Chapter Director).

**Special Guest Speaker** - Bernd Garbers, Technical Consultant, Samsø Energy Academy, Samsø Island, Denmark. Samsø Island has transitioned from full dependence on fossil fuels to become the [first island](#) in the world completely powered by [renewable energy](#).

**Facilitator** - Former state senator and Cape Air CEO Dan Wolf challenged participants to think critically, constructively and creatively throughout the event.

## The Moral Component

In planning the Net Zero Round Table, the 5Cs Board took pains not to lose sight—in the rush to find technical solutions—of the moral and ethical dimensions of climate change impacts and responses. As a result, the Board endorsed a paper entitled *Toward a New Moral Vision (Appendix C)*, which addresses the need to build “a new moral vision, along with the behavioral norms and expectations that together constitute a moral infrastructure fit for an emerging ecological civilization.” Central to this vision is reverence and respect for our Earth-home, and a rich recognition of our interdependence with all of the human family and of the entire Earth community. For further discussion of such a vision see Moore, K.D., *Great Tide Rising: Towards Clarity and Moral Courage in a Time of Planetary Change*. (Berkeley, CA: Counterpoint, 2016).

## Net Zero Success Stories

The first portion of the Round Table event featured fifteen stories of success at reducing carbon emissions and converting from fossil fuel to electrical use on the Cape & Islands. These stories celebrated success and inspired new thinking about strategies that could be taken to scale in the future. Success story project summaries, grouped by Net Zero Goals, are set forth in **Appendix D**.

## The Samsø Story

The most dramatic – and biggest - success story about converting from fossil fuels to clean energy was told by guest speaker Bernd Garbers. At 5Cs’ invitation, he traveled from Denmark to Cape Cod to share his homeland’s—Samsø Island’s—journey from total dependence on fossil fuels in 1997 to total powering by renewable energy (even exporting excess clean energy) a decade later. This stunning achievement was reached by using land- and sea-based wind machines, solar installations, and locally produced bio-fuels (straw). Garbers emphasized that political transparency and resultant buy-in by island residents was critical to this rapid transition. To view inspirational videos about Samsø Island’s transformation, [click here](#).

## Developing Net Zero Action Steps

The success stories were designed in part to stimulate ideas and strategies for future larger scale carbon reduction actions. Following lunch and the Samsø story, Round Table participants divided into eight ‘sector’ groupings to brainstorm possible future actions.

Included as arenas for action were transportation, energy, the built environment, municipal government, education, advocacy/outreach, the faith communities and environmental protection. **Appendix E** contains the full range of proposed actions generated in those eight brainstorming sessions.

To view a video of highlights from throughout the day-long Round Table event, [click here](#).

To view the full collection of videos from the event, [click here](#).

# 5 A CLIMATE ACTION PLAN FOR THE CAPE & ISLANDS

A primary objective of the Cape & Islands Net Zero Round Table was to generate ideas to help guide the 5Cs in setting priorities for 2019 and beyond. The universe of actions that might be implemented to reach the Goals appears theoretically limitless. Given the urgency of the need to reduce emissions as quickly as possible, selected actions must be carefully prioritized to maximize effectiveness.

To do this, the 5Cs surveyed the participants to elicit views as to the top four priority Action Steps for each Net Zero goal. (The survey respondents were presented with the lists shown in **Appendix F.**) The survey responses were then analyzed and synthesized, and the proposed action steps ranked.

The list of actions below is the result of this process, organized by focus area. (Note: these priorities anticipate an abundance of access to clean electricity on Cape Cod beginning in the early 2020s, when Vineyard Wind and subsequent wind farms come on line.).

## Science & Measurement

- Develop a baseline inventory of Cape & Islands greenhouse gas emissions.
- Analyze the past fifteen years of natural above-ground carbon storage trends on the Cape & Islands and compare those to carbon emissions during that same timeframe.
- Determine the overall potential for carbon storage on Cape Cod.

## Clean Energy Production/Conversion

- Support conversion to carbon neutral propulsion systems by the RTA, ferries, school buses, private vehicles, delivery vehicles, boats, planes, etc., through renewable energy production, battery storage and charging.
- Encourage solar car ports and community solar installations in both public and private settings.
- Protect existing subsidies and lobby for additional legislation to support conversion to electric vehicles/battery storage/charging/ for citizens and businesses.
- Educate political office candidates on legislative priorities relevant to key action items.

## Financing

- Work with financing entities to create loan products with favorable rates and other community-based finance mechanisms for purchase of electric vehicles, battery storage, and on-site renewable energy production.
- Work with financing entities to allow community residents to invest in local large-scale renewable energy projects.

## Municipal Mobilization

- Support all Cape & Island towns becoming Green Communities by October, 2020.
- Develop and promote a universal Cape & Islands building code that is more ambitious and stringent than current “stretch code” for Green communities.
- Advocate for community empowerment legislation to allow communities to finance renewable energy projects.

## Natural Carbon Storage

- Coordinate a regional effort among land conservation organizations in relation to climate change goals and partner with towns in those goals.

## Cross-Cutting Theme: Protection of Marginalized Groups

- Seek to ensure that traditionally marginalized groups are included as participants in and beneficiaries of any shifts toward a green future.

Moving forward, the 5Cs—working closely with each sector represented at the Round Table—will use these proposed steps to develop a comprehensive Climate Action Plan for the Cape & Islands. Work on the plan is expected to progress through the winter and a draft Plan is scheduled to be completed by Spring 2019.

The second annual Net Zero Cape & Islands Round Table—scheduled for Fall 2019—will provide an opportunity to discuss this Climate Action Plan and share progress made during 2019 on the shift to clean energy.

# 6 APPENDICES

- A. Carbon Emissions: The Challenges Depicted in Nine Graphs
- B. Photovoltaic Installations and Capacity on the Cape & Islands
- C. The Moral Component: Toward a New Moral Vision
- D. The Net Zero Success Stories
- E. Net Zero Action Steps
- F. Round Table Participants

# APPENDIX A

## Carbon Emissions: The Challenges Depicted in Nine Graphs

Mon Cochran, Executive Director, Cape Cod Climate Change Collaborative

The planet is in trouble. Global warming is on the increase, fueled primarily by human activity and the burning of fossil fuels. Dr. Max Holmes, Deputy Director and Senior Scientist at the Woods Hole Research Center, opened the Round Table by laying out the facts related to the carbon in our atmosphere, its sources, the reductions needed to prevent catastrophe, and the current uptake of energy alternatives to fossil fuels.

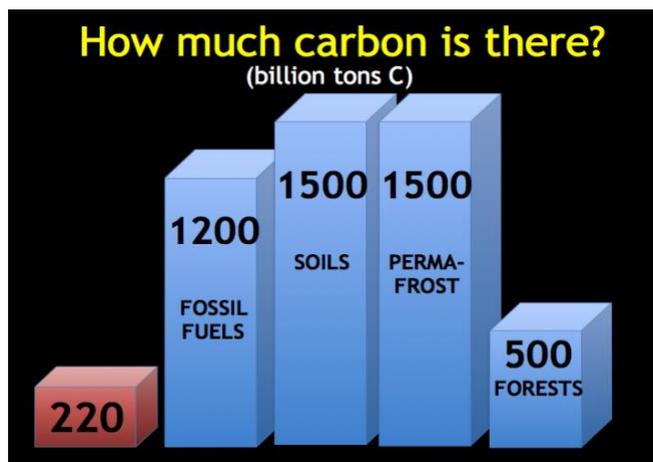


Figure A-1

Scientists estimate that in order to keep the global warming increase below 2C<sup>6</sup> (3.6F) no more than 790 billion tons of carbon can be emitted from the earth in the period since the beginning of the Industrial Revolution. **Figure A-1** shows the 790B limit; 570 billion tons have already been emitted. The 220 billion ton ‘buffer’ against overrunning the total 790B ton carbon limit will diminish very quickly, given the rate at which humans and natural cycles are omitting carbon.

Figure A-1 shows the major sources of carbon on Earth, and how much each source could contribute to the atmosphere. These are compared with the relatively small ‘buffer’ in red that could keep us below the 2C threshold. These fossil fuels are still in the ground, as is the carbon in soils, permafrost and forests. Will they remain there, or be released into the already dense atmosphere?

<sup>6</sup> This analysis was performed before the IPCC’s 2018 Special Report on 1.5C was released. That Report warns it is no longer sufficient to work toward keeping global average temperatures below 2C. Rather, the IPCC’s conclusion is that a maximum warming of 1.5C is the safer goal. The 5Cs will review this conclusion and may adjust its own Goals and Action Steps accordingly.

How much carbon is currently being emitted from each of these carbon 'pools' each year? **Figure A-2** shows that 9 billion tons of carbon is released through the burning of fossil fuels each year. Soils release about half a billion tons each year and forests about 1.5 billion tons due to deforestation. Permafrost is currently neutral, but with warming is likely to become a net emitter. If the total emissions are about 10 billion tons annually, then the 220B ton 'buffer' shown above will be expended in less than 25 years.

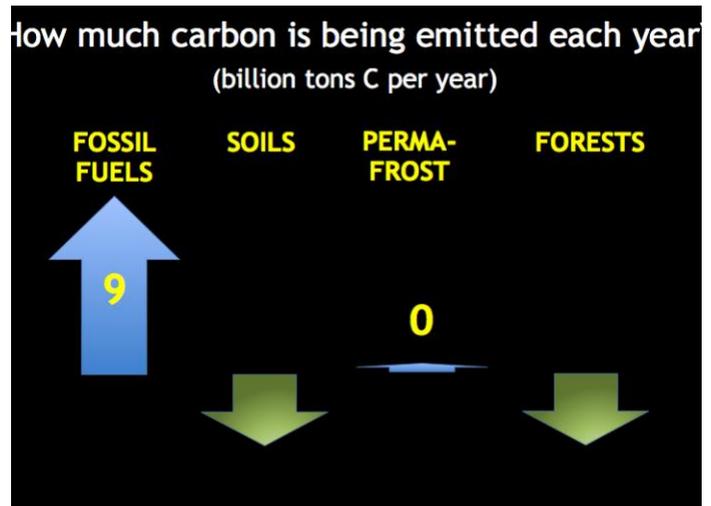


Figure A-2

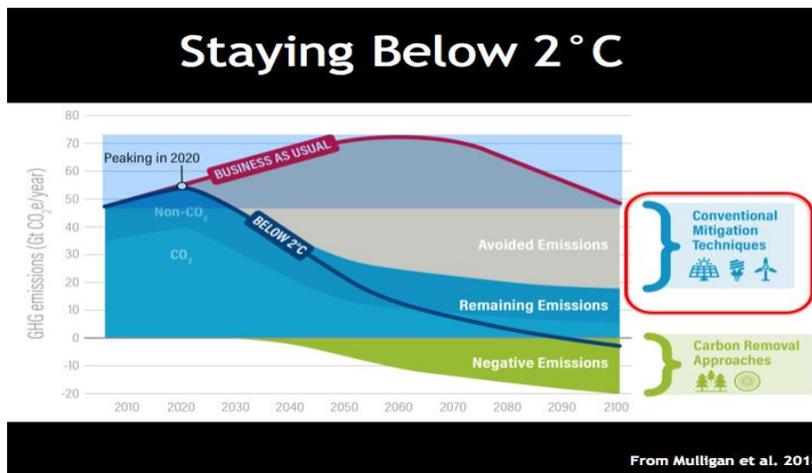


Figure A-3

What needs to happen in order to keep the global temperature increase below 3.6 degrees F (2 degrees C)? **Figure A-3** shows impacts resulting from 'business as usual' and a dramatic, worldwide effort to reduce emissions and remove atmospheric carbon.

The vertical axis is total greenhouse gas emissions and the horizontal axis shows the years in this century. The red line is business as usual while the blue line illustrates what could be possible with a huge reduction in emissions over the century and development of new techniques for removal of atmospheric carbon.

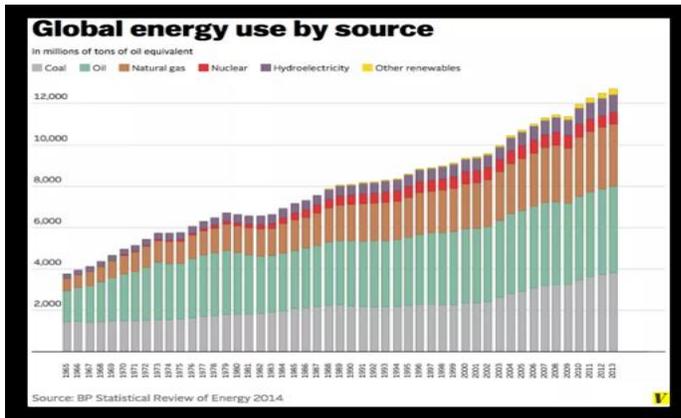


Figure A-4

Figure A-4 shows the development of global renewable energy sources since 1965. Clearly much has been accomplished in an absolute sense over that period, particularly in the 21st century.

However, Figure A-5 shows how alternative energy sources compare with coal, oil, and natural gas during the same period (1965-present). The data in Figure A-5 indicate that solar and wind are dwarfed by the fossil fuels as energy sources, even when combined with hydroelectric and nuclear fuel sources.

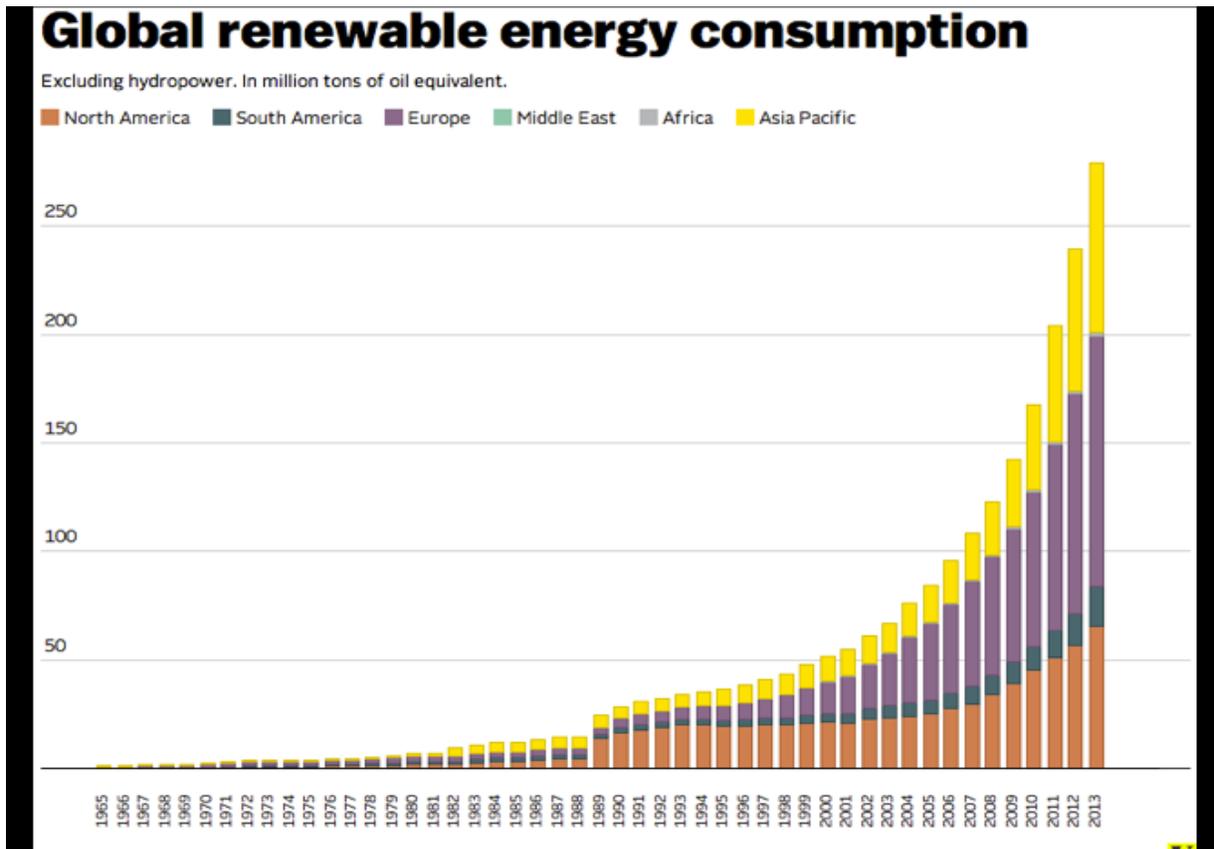


Figure A-5

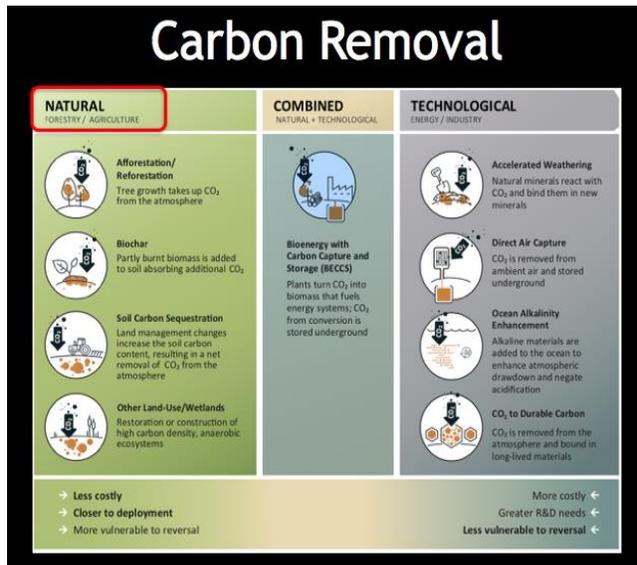


Figure A-6

Staying below 2 degrees C will require more than weaning the world off fossil fuels; we need to engage actively in removing carbon from the atmosphere. **Figure A-6** illustrates techniques for atmospheric carbon removal. Some of the strategies shown on the left in Figure A-6 are familiar; reforestation, and soil carbon sequestration through improved tilling methods, for instance. Others are highly experimental and still in the development stages.

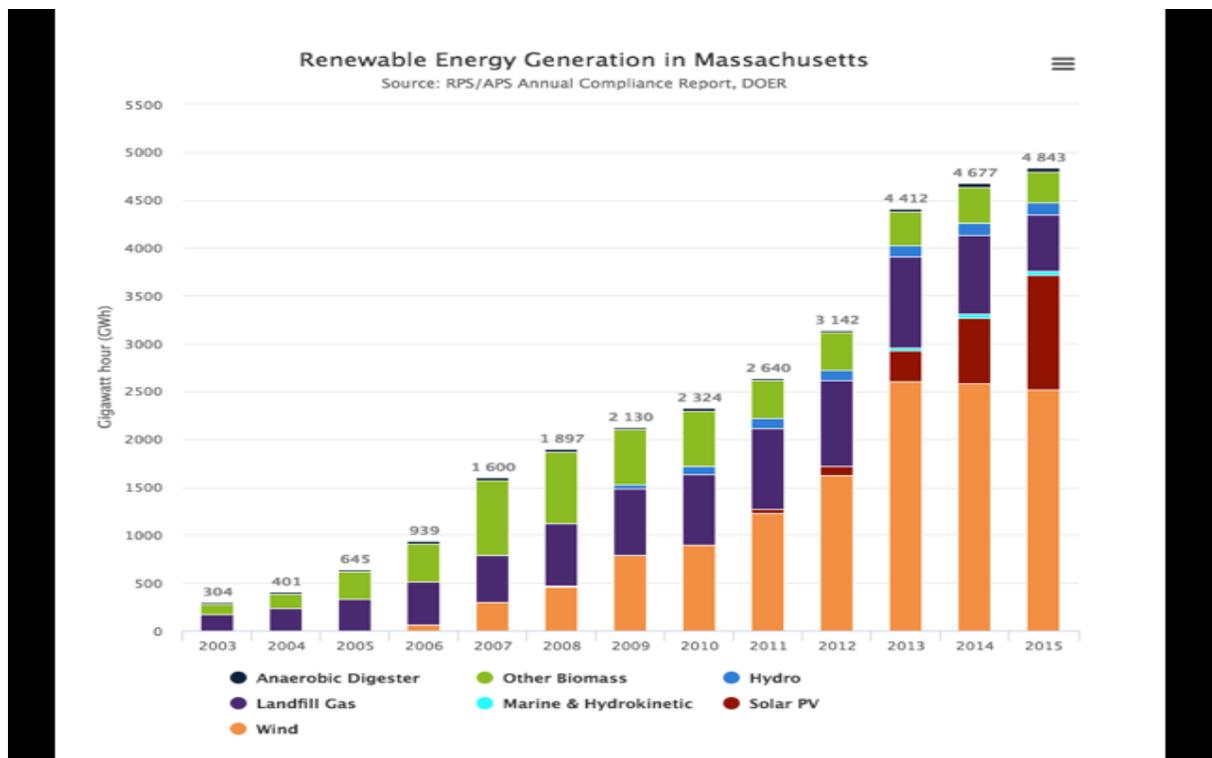


Figure A-7

Closer to home, **Figure A-7** shows the increase in renewable energy generation in the Commonwealth of Massachusetts between 2003-2015. While the trajectory is positive, renewable energy still makes up only a small portion of overall energy use statewide. It is interesting to note that increasing production of energy from wind leveled off five years ago.

That production is expected to take off when the wind farms slated for the federal waters south of Martha’s Vineyard go on line. Figure A-7 shows that solar energy production began to increase five years ago.

Finally, when targeting new projects for transition from fossil fuels to renewable energy sources it is important to know what percentage of carbon dioxide production comes from the various end use sectors. **Figure A-8** shows those percentages in 2016 for the residential, commercial, industrial and transportation sectors.

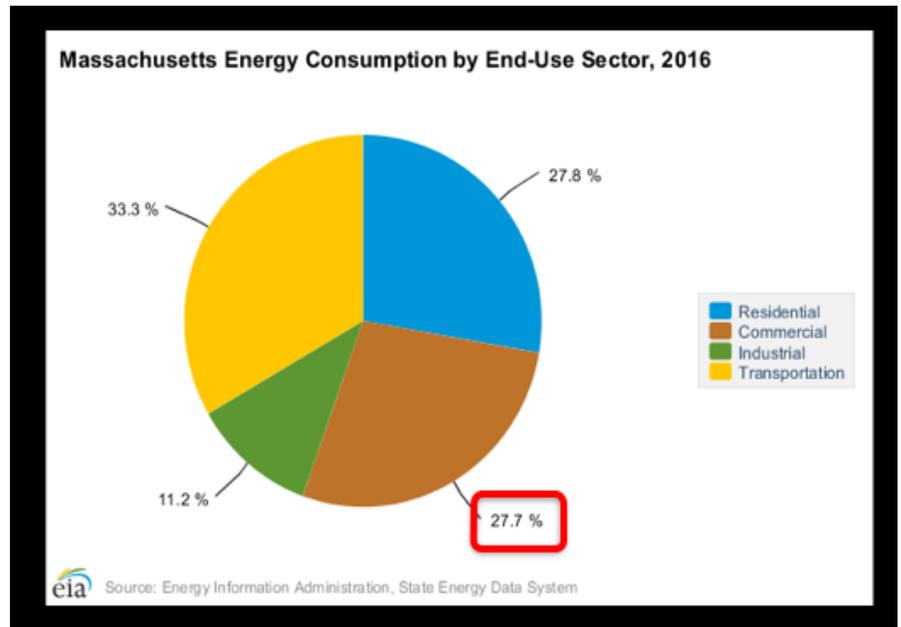


Figure A-8

Figure A-8 reveals that transportation produces about a third of overall emissions, with commercial and residential each accounting for roughly one quarter. If data were available for the Cape & Islands, we might expect transportation to assume a larger share, since most of the population in this region is dispersed. The region’s industrial sector is relatively small, and the commercial sector modest in size compared to the Commonwealth overall.

# APPENDIX B

## Photovoltaic Installations and Capacity on the Cape & Islands

While the majority of the installations have been residential (Figure B-1), the total installed capacity is much more widely distributed across sectors (Figure B-2):

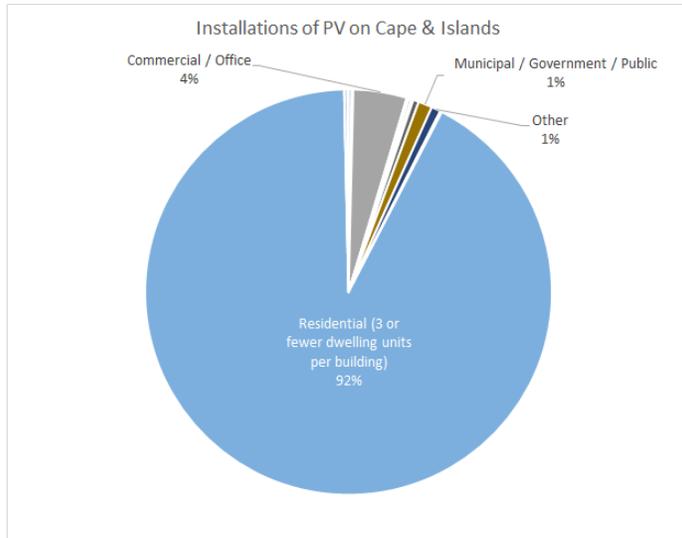


Figure B-1

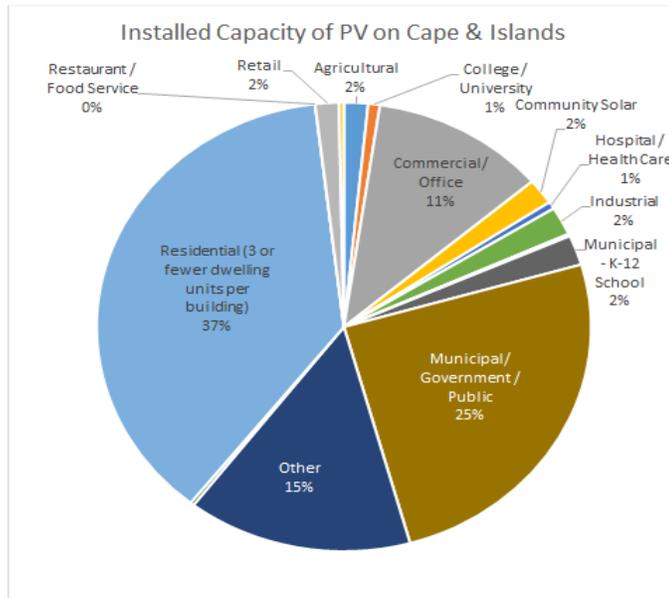


Figure B-2

## APPENDIX C

### The Moral Component: Toward a New Moral Vision

Paul M. Minus, Co-Chair, Faith Communities Environmental Network

The recent spread and intensification of destructive fires and storms are signs of the need for more robust attention to the causes and impacts of climate change. They also point to the inadequacy of many accustomed ideals and norms for both collective and individual behavior.

For generations, this nation has been increasingly gripped by a broad vision of the good life (the “American way of life”) viewing the Earth as a storehouse of natural resources available for unfettered human use. This has fueled record levels of technological-industrial development and economic expansion, along with the accumulation of enormous wealth for a few and new levels of consumption and comfort for multitudes. These shifts – now spread globally – have brought significant advances in such fields as education, healthcare and other traditional components of a higher standard of living. But we now know this vision and its accompanying behaviors are gravely flawed. Perhaps most notably, pursuing the conquest of nature has enabled a use of fossil fuels now extending the perils of global warming throughout the world, as well as to future generations – both of humankind and of other species.

If the worst possibilities of our imperiled future are to be averted, we need to give vigorous and imaginative attention to building a new moral vision, along with the behavioral norms and expectations that together constitute a moral infrastructure fit for an emerging ecological civilization. Central to this vision will be a far greater reverence and respect for our Earth-home, and much richer recognition of our interdependence with all sectors of the human family and of the entire Earth community. Some operative ingredients will include principles and values from earlier times, now reworked to address new challenges.

Included in this new moral infrastructure must be conceptual and behavioral tools for addressing a variety of important issues brought on by worsening climate change. These include such long-term tasks as assessing equitable public assistance to increasing numbers of climate victims; apportioning morally appropriate support by those most responsible for climate harm to those least responsible and most victimized; determining which potential scientific, climate-related breakthroughs are most worthy of substantial funding; and shaping new patterns of daily life with minimal negative consequences for all fellow Earth-citizens.

Movement toward this future requires contributions, cooperatively developed, from a host of sources – families, schools, faith communities, other non-profit organizations, businesses of all kinds, etc. In each of these realms, progress will come only through the dedicated and sustained attention of individuals fully committed to this great work.

## APPENDIX D

### The Net Zero Success Stories

#### **GOAL 1: Reduce fossil fuel usage by 50% from 1990 levels on the Cape and Islands by 2030.**

Several case studies illustrated how reducing fossil fuel use occurs on many levels and arenas.

#### **Public Sector**

- In his story of aggregated power purchasing, Austin Brandt of Cape Light Compact demonstrated that a Cape and Islands-wide planning process can leverage buying power, in turn leading to electrification strategies (Cape and Vineyard Electric Coop, PV on landfills and low-income housing, renewable energy purchasing).
- Lauren Sinatra and Tobias Glidden from Nantucket Island described how an effort to avoid the expense of another cable link to the mainland led that island community to implement everything from energy audits to local solar rebates and land-based wind machines.
- On the Outer Cape, the Cape Cod National Seashore has made greenhouse gas emission reduction a park priority for the multi-town region that it encompasses. Lauren McKean described the Seashore's energy reduction efforts and greening of the vehicle fleet by purchasing electric cars and installing charging stations.

#### **Private Sector**

- Jim Wolf described how Cape Air set out in 2009 to reach 'net zero' electricity at its Hyannis headquarters by installing solar panels, purchasing electric cars, and adding charging stations. This led in turn to conservation of fuel in aircraft operations, and a future goal of fully electrical aircraft.
- Matt Burke explained how the Cape Cod Five Cent Savings Bank incorporated environmental stewardship into every aspect of the Bank's new campus, including design of the new building to the LEED Gold standard, use of renewable energy, and inclusion of energy efficient systems.

## **GOAL 2: Achieve 100% use of renewable electricity by 2050.**

Goal 2 describes a major strategy for achieving the fossil fuel objective. Several electrification projects have been regional in scope:

- The federal government leases sea space in an area 15 miles south of Martha's Vineyard to companies interested in developing wind farms serving the clean energy needs of New England. Vineyard Wind, the first company to take advantage of this opportunity, is currently engaged in the permitting process to generate 800 megawatts of electrical energy with over 80 large wind turbines. This energy will be carried to the mainland in cables that will come ashore in Barnstable. Vineyard Wind was represented at the Round Table by Nate Mayo and Jennifer Cullen.
- Margaret Song reported on Cape Light Compact's success in introducing and administering energy efficiency programs across the Cape and Martha's Vineyard. Examples include the conversion of over 14,000 streetlights to LEDs and installation of solar PV on affordable housing units.
- David Mead-Fox of Outer Cape Energize described an innovative, four-town (Provincetown, Truro, Wellfleet, Eastham) program that successfully packaged energy audits of residences and small businesses with reduced cost solar panels and electric air source heat pumps.
- Angie Grant described how the Martha's Vineyard Transit Authority has begun replacing its fossil fueled buses with electric vehicles and tying everything together with a centrally controlled microgrid.
- Also from the Vineyard, Eric Peckar showcased the solar-powered canopies with EV charging stations that cover the parking lots at the two Cronig's Markets on the island.
- School buses travel long distances on the Cape, burning a lot of diesel fuel. Steve Russell from the MA Department of Energy Resources described the electric school bus project now operating in numerous off-Cape towns.
- More locally, Tom Wineman of Clean Energy Design and Julian Davis of Arey's Pond Boat Yard in Orleans described the cutting edge solar-powered floating classroom, a 37-foot long pontoon boat designed and built by Friends of Pleasant Bay and now owned and operated by Pleasant Bay Community Boating.
- Prominent in the minds of participants was how to store electricity on the Cape and Islands for use when the winds aren't blowing and the sun isn't shining. Liz Argo, Manager of the Cape and Vineyard Electric Cooperative, outlined details of a pilot battery system being installed at the Dennis Yarmouth Regional High School to support an existing CVEC photovoltaic array. The combined system will provide

electricity backup in the face of major storm events and provide demand support to the grid, reducing the need for fossil fuel build-out.

**GOAL 3: Determine how the natural carbon balance is changing over time and recommend ways that Cape & Islands residents can enhance and increase carbon storage by natural processes.**

While none of the 16 success stories fell within this goal, the environmental conservation sector was well represented at the Net Zero Round Table, with attendees from nine conservation trusts, the Associate Director of the Woods Hole Research Center and numerous environmentalists in attendance. This group met as a sector and developed several action recommendations outlined later in this report.

**GOAL 4: Educate Cape & Island residents about causes and impacts of climate change, Cape & Island Net Zero Goals and priority action steps for achieving those goals.**

Numerous success stories highlighted a range of educational strategies within this goal:

- Susan Starkey described the remarkable way the Barnstable Unitarian Universalist Church educated its congregation about the human footprint behind climate change and then mobilized that community to reduce the carbon footprint of the church facility and take individual actions as congregants to reduce the use of fossil fuels. Barnstable UU leaders then reached out to other Cape and Islands faith communities and spearhead formation of a Faith Community Environmental Network comprising diverse spiritual traditions across the Cape. This 17-member network has established its own identity while working in concert with 5Cs on several projects.
- Keith Lewison of Cape Cod Academy reported on a different type of educational effort—one focused on Cape youth. In 2017 he and several colleagues gathered over 100 high school and middle school students from across the Cape for the first Youth Summit on Climate Change. Students heard from experts about the latest climate science and discussed potential local impacts. The day's work was designed to prepare students to talk directly with regional decision-makers, and students left the summit energized and equipped to mitigate the effects of climate change on Cape Cod.
- Nantucket now has a showroom dedicated exclusively to sustainability education. Tobias Glidden described how he established the Shanty, a renewable energy showroom that features solar energy technologies, provides test rides on electric bicycles, and makes solar lights available—all adjacent to the busiest ice-cream shop on the Island.

## APPENDIX E

### The Net Zero Action Steps

The action steps identified by each represented sector are listed below, clustered according to the net zero goals used to frame the Round Table. The abbreviations identify the sector or sectors suggesting the action: T=transport; EN=energy; BE=built environment; M=municipal; ED=education; AO=advocacy/outreach; FC=faith communities; EP=environmental protection.

#### **GOAL 1: Reduce fossil fuel usage by 50% from 1990 levels on the Cape & Islands by 2030.**

- Support conversion to carbon neutral propulsion systems (regional transit authorities, ferries/school buses, private vehicles, delivery vehicles, boats, planes). T
- Support pilot programs for converting from internal combustion to electric propulsion technologies in private and public fleets (air/ground vehicles/recreational and commercial boats). T
- Support on-demand carpooling/ride-sharing technologies, and societal change to go “engineless.” T E
- Enable all Cape and Islands towns to become Green Communities by October 2020. EN, BE, M
- Support home energy scorecards. EN
- Adopt a universal Cape Cod building code more stringent than MA code. BE
- Create more bike-friendly roads. EN
- Develop baseline inventory for Cape & Islands greenhouse gas emissions. M EN AO
- Develop a “marketing” approach with specific goals. AO

#### **GOAL 2: Achieve 100% use of renewable electricity by 2050.**

- Protect existing subsidies and lobby for additional legislation to support conversion to electric vehicles/battery storage/charging/ for citizens and businesses. T
- Work with financing entities to create loan products with favorable rates for vehicles/battery storage/on-site renewable energy production, energy efficient buildings. T, EN, BE, AO

- Support renewable energy production/battery storage/charging at airports/RTA/National Seashore, etc. T
- Encourage responsible use of electric bicycles. EN
- Encourage solar car ports, and community solar. EN, M
- Support advanced metering deployment. E
- Develop community-based finance mechanisms for renewable energy. EN
- Strengthen community empowerment legislation to allow communities to act as electrical aggregators. EN M
- Encourage consumer purchase of renewable energy. EN
- Expand Cape and Vineyard Electric Cooperative (CVEC) mandate to include residential and commercial properties. EN M
- Smart control of temperature in municipal buildings. M
- Conversion of all municipal buildings to non-fossil fuel based heat/AC systems.

**GOAL 3: Determine how the natural carbon balance is changing over time and recommend ways Cape & Islands residents can enhance and increase carbon storage by natural processes.**

- Analyze above-ground carbon storage trends on Cape Cod since satellite imagery became available in 2003 and compare that to carbon emissions during that same timeframe. Estimate the overall potential of natural carbon storage on Cape Cod. EP
- Coordinate regional efforts among land conservation organizations in relation to climate change goals and partner with towns in those goals. EP
- Get environmental membership organizations to encourage energy audits and other easy steps to reduce CO2 emissions. EP
- Continue to preserve lands with a focus on lowland areas to allow for salt marsh retreat and forested upland. EP
- Work to make operations and facilities within our organizations net zero and work toward lower impact land management. EP
- Divest land trust endowments of fossil fuel-related companies. EP

**GOAL 4: Educate Cape & Island residents about causes and impacts of climate change, Cape & Island Net Zero Goals, and priority action steps for achieving those goals.**

- Education regarding use of home energy audits, Cape Flyer/bikes/cars T FC
- Education for Selectmen and Town managers M
- Form chapters of a youth Net Zero club based in the communities (not schools) perhaps based in libraries, and virtual dialogue among the chapters. ED
- Convene an annual youth summit. ED
- Use social media and other virtual resources (such as the 5C's website and Instagram) to highlight resources and local activities. ED
- Explore connecting teacher and youth efforts to outside school time resources such as libraries and faith organizations. ED FC
- Seek to ensure that traditionally marginalized groups are included as beneficiaries of any changes moving to a green future. FC
- Present 'big picture' of how climate change will impact people and connect the impacts to the cause: health (ticks, etc.), sea level rise, intense storms, food sources, tourism, etc. AO
- Develop a collaboration network. AO
- Educate political office candidates on legislative priorities and key action items. A
- Request the Faith Communities Environmental Network to focus one or more of its 2019 Faith/Science collaborative public forums on the development and dissemination of a moral vision (see Appendix C) capable of adding direction and energy to diverse efforts by the 5Cs constituency to address the climate crisis. FC

## APPENDIX F

### Round Table Participants

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