CLIMATE CHANGE BUSINESS JOURNAL®

Innovation in the Climate Change Industry

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Innovation in the Climate Change Industry

Climate change may be more universally regarded as the steadily mounting existential challenge of our lifetimes with each passing season, but many would regard the progress of humanity to slow or reverse anthropogenic climate change — and minimize its impacts on civilization and the natural environment — as being only one of fits and starts.

The climate change industry as defined and quantified by CCBJ continues to grow there is no doubt, but behind revenues measured in the commercial market across nine segments and over 60 subsegments, lies a foundation of research and development. This R&D is expected to sustain growth throughout the energy transition and climate change mitigation eras, and what looks to be the never-ending climate change adaptation & resilience challenge — a challenge that one could argue our species has already endured for 100,000 years.

So just where are we in continuing to build on this foundation and just how does it manifest itself in innovation in climate change industry segments? Measuring the pace of innovation across the climate change industry is challenging because of a number of factors.

First is the difference in innovation in science and technology that can create transformative breakthroughs versus innovation in engineering and implementation that lead to incremental improvements and commercialization milestones.

Second is the variation across climate change industry segments from renewable energy to energy storage to carbon capture to transportation to greening the built environment and infrastructure.

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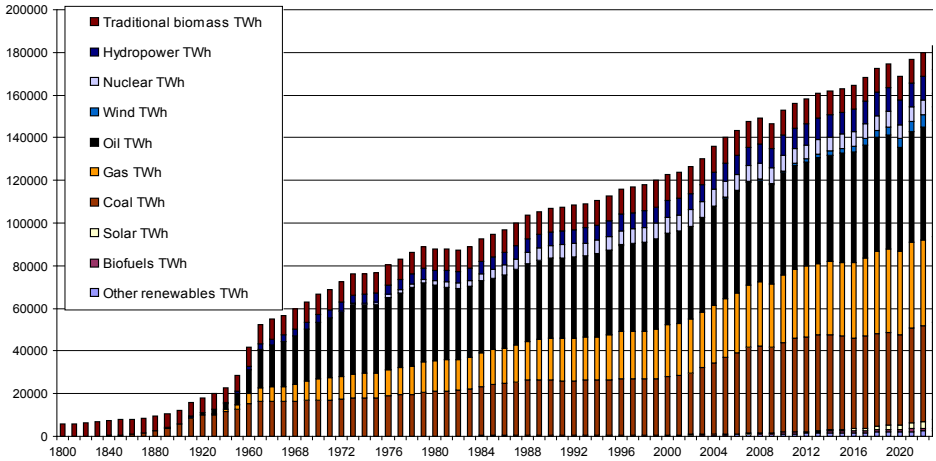
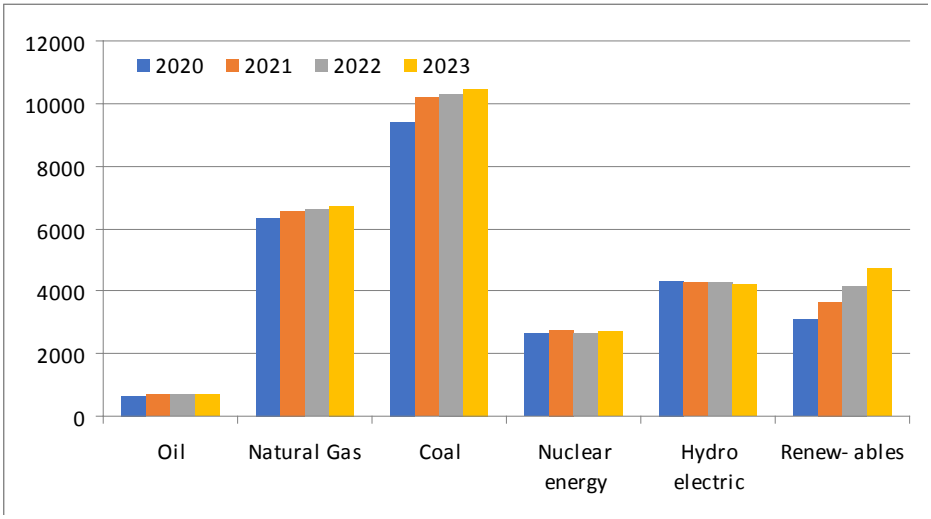
Global Energy Consumption by Fuel 1800-2023 in Terrawatt-hours

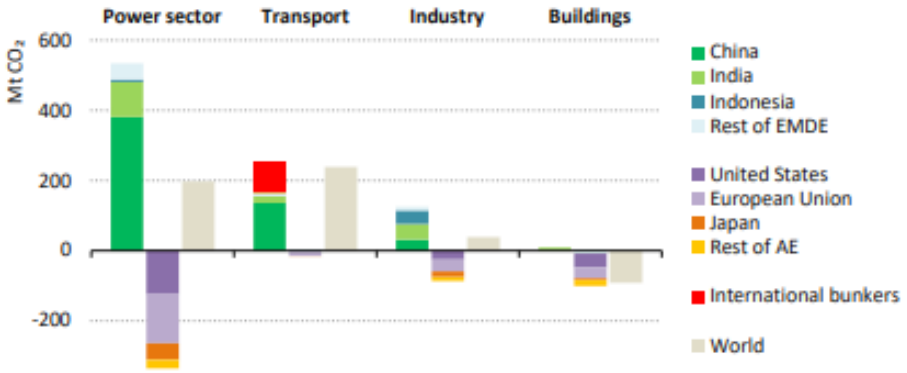


Global Electricity Generation by Fuel in Terawatt-hours, 2020-2023



Change in CO2 emissions by Sector and Region, 2022-2023

Figure 15: Change in CO_2 emissions from combustion by sector and region, 2022-2023



Source: International Energy Agency, IEA's report CO2 Emissions in 2023 issued in April 2024

At the sector level, IEA's CO2 Emissions in 2023 reports that transport experienced the most pronounced growth in emissions, surging by 240 Mt globally. The power sector contributed the second largest increase with the highest level of regional disparity, as emissions in advanced economies collapsed while those in emerging developing economies soared. Industrial emissions saw a slight uptick, as the combination of moderately weaker industrial output, efficiency gains, and fuel switching in advanced economies was insufficient to counterbalance the emissions increase from industrial development in emerging economies. Buildings was the only sector to see emissions fall at the global level, largely attributable to milder temperatures experienced in 2023.

GZA Environmental and the Town of Groton Collaborate on Downtown Mystic CT Resiliency & Sustainability Plan

Wayne Cobleigh is Vice President at GZA Environmental. Wayne specializes in community engagement and financing and funding resilience and climate adaptation projects. He's been with GZA for 23 years, providing community planning for climate vulnerability assessments, coastal resilience and nature-based solutions.

Megan Granato is Sustainability and Resilience Manager for the Town of Groton, Conn. She integrates climate change planning and action into Town operations and the community at large.

CCBJ: Do you know what percentage of small businesses carry FEMA flood insurance?

Wayne Cobleigh: According to the Federal Emergency Management Agency (FEMA), as of April, only a fraction of the country's small businesses – about 120,000 – carried insurance through FEMA's National Flood Insurance Program (NFIP), the country's largest insurance provider for small businesses. Experts, advocates and business owners say local governments can help small businesses by investing in infrastructure upgrades for things like sewage, drainage and water catchment systems; funding flood prevention and resilience programs; and requiring greater transparency on flood history. According to the U.S. Chamber of Commerce, one in four (27%) of small businesses say they are one disaster away from shutting down.

CCBJ: How did GZA become a consultant for the Downtown Mystic Resiliency & Sustainability Plan?

Cobleigh: Mystic, Connecticut is like a small town version of Boston. It was founded in 1705 as a colonial maritime town on the Mystic River. The west side of the river is in Groton, and the east bank is in Stonington. It's a picturesque New England village with a drawbridge that takes you into a downtown with a thriving mix of shops, restaurants and housing. This area of Connecticut represents about 30% of tourism spending in the state, and it's an economic engine for the Town of Groton. The Town decided to focus on this downtown study area rather than complete a climate resiliency plan for the entire town. They were awarded a grant and put out a request for proposal to find a consultant.

What's unique about Mystic is you have the Town of Stonington on one side of the river and the Town of Groton on the other.

Stonington had completed a resilience plan before this study, but Groton had been looking at climate change and planning for sea level rise impacts for almost 10 years. Various small studies had been done throughout Groton, but resiliency planning hadn't focused on downtown Mystic.

When we saw the RFP we assumed every consultant would want to study downtown Mystic because it's such a great place. I grew up nearby in Westerly, Rhode Island, so I knew the downtown area well. I volunteered to scout, take photos, and see what types of flood vulnerability exist. We presented our proposal and were interviewed for the project even before the Town's sustainability and resilience manager was hired. This was in April 2022, so the pandemic was not quite over.

Fortunately, we were interviewed in person, which helped us because while I was waiting in the town hall annex for my interview, I saw this interesting flyer about a web-based survey tool called Bang the Table. The Town uses it to poll the public on ideas for how to use its recent ARPA funding. Although that particular survey tool wasn't part of our proposal, in our interview we commented on how Bang the Table could be an asset for outreach to residents and businesses. We emphasized how robust community input improves the chances of winning grants. Bang the Table was integrated into the project and worked quite well.

CCBJ: How did the Downtown Mystic Resiliency & Sustainability Plan get funded?

Cobleigh: The funding source made this project different to Climate Ready Boston. Groton applied to the Long Island Sound Futures Fund, which is managed by the National Fish and Wildlife Foundation (NFWF). Grant requirements changed our typical scope of work for a resilience plan. GZA had completed several townwide resiliency plans in coastal Connecticut municipalities with HUD CDBG Disaster Recovery grants due to Superstorm Sandy and Tropical Storm Irene. We noticed in Groton's request for proposal that they required a federal Quality Assurance Project Plan (QAPP), which is more typical for environmental sampling projects on a Superfund site or an EPA brownfield site. This QAPP was a requirement of National Fish and Wildlife Foundation and EPA.

A question municipalities need to consider when applying for grants is, will your scope of work or schedule be increased by the grant requirements? You need to factor a QAPP review and approval into the front-end schedule of the project. We thought the quality assurance project plan wouldn't take long, but we had never completed one for a community resilience plan only for site investigation projects. What we didn't plan on was 2022 being a big year for Bipartisan Infrastructure Law grants. Many grants were awarded at the same time. NFWF was processing all these grants through their national grant program at the same time. The project start was delayed for six months waiting for the review by NFWF's contractor, NFWF approval and obtaining several signatures required on the QAPP.

I'll just put that out as a lesson learned that if you do apply for these grants and you see that requirement, understand that

it will prevent you from starting work until that plan is approved, although you can do some of the planning work at risk. We did prepare the first community outreach meeting before the QAPP was signed because the meeting was outside of the purview of the QAPP, but you really want to know that the QAPP is approved so there's no rework later.

CCBJ: How did the Town of Groton manage the Plan?

Cobleigh: Many people were involved in this resiliency plan representing the Town: The Office of Planning & Development Services hired Megan Granato as the Sustainability and Resilience Manager, and two other planners worked with Megan. A nine-member steering committee of Town staff and volunteers also met with us at key points in the project and attended community outreach meetings.

CCBJ: What were the goals and scope of the Plan?

Cobleigh: The goals were to protect natural and man-made resources, sustain the local economy, and provide a list of priority climate-mitigation strategies using 2050 sea-level rise predictions that the Town could pursue. Those strategies needed to be vetted through the community engagement process.

We completed property evaluations of buildings in the special hazard flood zone. The town really liked that idea, and I think this task really helped inform the plan. The plan documents the results of these building evaluations. Public outreach was mostly conducted in person; with one virtual event for local business owners. Public outreach was a combination of workshops led by GZA and presentations to community groups by Megan Granato.

The plan recommended next steps and identified what funding is available to help pay for them. We came up with a list of 19 actions, one of which was 'no action', the lowest-ranked priority. The first step was to complete a thorough analysis of the natural hazards using primary and secondary data sources as approved in the Quality Assurance Project Plan. We had to go through each of these approved data sources and identify current and future predictions of coastal flooding hazards, stormwater-related flooding hazards, and extreme heat hazards. The number of extreme heat days in the future in the Mystic area was based on a temperature gauge in nearby Norwich, Connecticut.

CCBJ: What is the time horizon for the Plan?

Cobleigh: Early in the planning process we decided to set the year 2050 as our time horizon. In 2050 the level of uncertainty for temperatures and sea level rise is acceptable; beyond 2070 and 2100 the level of uncertainty is too great. Sea level rise predictions published by the State of Connecticut for 2050 indicate a fairly well defined range for planning for flooding hazards notwithstanding the level of greenhouse gas emissions levels. We analyzed sea level rise impacts on the 10-year or 10% annual chance flood event using data from the Connecticut Institute for Resilience and Climate Adaptation (CIRCA) at the University of Connecticut's campus in Groton. Director of CIRCA James O' Donnell was on the Advisory Committee.

Sea level rise of 20 inches is predicted for 2050, which would cause flooding in a large area of downtown Mystic, so mitigation strategies are needed along the water's edge. The other challenge is grade: There's a steep hill when you look at the west border of this site and to the river. Residents living on the hill stay pretty dry, but if they want to drive into downtown Mystic they will run into some flooding. That's the challenge: extreme stormwater drainage down to the river's edge and flooding from the coast. When you look at intense precipitation flooding and project that out to 2050, we can predict the increases in rainfall per various storm scenarios.

Mystic's stormwater system was designed many years ago and does not address the current 25-year flood event, because the roads very close to the Mystic River just don't have enough grade change to enable large enough piping to convey the volumes of water produced by such an event. So we had to plan using GIS maps of the entire stormwater system. We mapped it out and projected where the runoff was going to be, using published models available from the State of Connecticut.

Regarding extreme heat, in 2050 we found that the number of 95-degree days or higher would increase by at least five days a year, and the number of days in the winter lower than 32 degrees were likely to decrease by about 14 days. We will have a longer period, potentially from winter to spring, where we could be getting more rain events. Health impacts will be exacerbated in the summer when you have more extreme heat events. Based on various greenhouse gas emission scenarios, the trend is that the number of extreme-heat days is going to increase: Mystic will get hotter and wetter.

CCBJ: Does the Plan address critical infrastructure?

Cobleigh: During the property evaluations we noted that the Town's pump station on the bank of the Mystic River is for a sanitary sewer system; wastewater has to climb the hill to get to that treatment system. The pump station needs to be located in this flood-vulnerable location, but the challenge is by being right next to the Mystic River the structure is not watertight. So for critical infrastructure in that flood zone, we made recommendations to make it more watertight. Flood-proofing the pump station is now in the Town's capital budget.

We also looked at visitor and tenant parking areas adjacent to the river that service downtown businesses and found that these properties also face challenges. We evaluated 56 of the 105 properties in the flood zone. We obtained permission from

owners to access their basements to see if they were doing any kind of mitigation and, if not, where and what their flood vulnerabilities were. A small business on the street will have to elevate stock or supplies stored in the basement; and if they have a sump pump, it may need power to operate during a storm. There are myriad flood mitigation challenges.

CCBJ: How did community outreach and engagement inform the Plan?

Cobleigh: The first outreach meeting was in November 2022. About 35 people attended and were very engaged. We polled them for how they live, work or visit downtown using digital smartphone polling software. The final workshop in January 2024 was held in a church basement on Pearl Street that had literally flooded the week before. The room was packed with over 110 attendees to hear our recommendations and help us prioritize them. They were allowed two additional weeks from this final meeting to submit feedback.

Megan Granato held several presentations, in addition to the workshops. Interestingly, we had heavy flooding in December 2023 and the final workshop was January 4, 2024—not an ideal time to get the public to turn out. But they did, thanks to great publicity through social media, the town and various television news channels. The recent flooding also spurred the public to come out in full force.

A lesson learned from the consultant's perspective is when you're expecting a full house make sure you have a good PA system. Even though people in the back had a hard time seeing the screen, they could hear us loud and clear. We had poster displays for the public to view before the presentation. Groton Municipal Television recorded all three workshops, which allowed people who couldn't attend the meetings to follow proceedings. This is why we titled our presentation Downtown Mystic Floods News at 11—because flooding does make the news, and what worked in the Town's favor was when Megan Granato was interviewed and the top trending story wasn't 'Mystic is flooding again' but Megan on the evening news, spreading the word on how the Town was planning solutions and holding a meeting on January 4.

Based on public outreach and the results of Bang the Table survey software, we learned where people wanted us to focus climate resiliency efforts and spending. We asked questions about flooding and heat adaptation strategies Public utilities were rated the most important asset for flood protection. We could clearly see that marinas, businesses and civic resources were a big concern. People want us to protect these businesses.

Looking at flood mitigation measures, elevating buildings didn't get a lot of interest, but making buildings more flood-resilient did. People also supported adding flood compliance criteria to the building code. Of course, the challenge is that Mystic has 617 historic buildings in the study area and many in the flood zone, so there's only so much they can do in terms of elevation strategies or even temporary flood barriers.

One solution that clearly generated interest at community meetings was stormwater system gate valves to stop water from entering the stormwater system during high tide and surge events and overflowing out of the storm water system further inland. Extreme heat strategies were also deemed important, especially with regard to shopping and tourism, so strategies like misting and heat relief areas, shading, and green infrastructure became part of the plan recommendations.

We developed a transparent scoring mechanism, with public support as one of the criteria; if the public wanted something, it scored extra in terms of climate adaptation actions. We ended up with 19 strategies for mitigating flooding and heat.

Dry flood proofing was one of the strategies proposed for businesses in downtown Mystic. Flooding happens on Pearl Street, and because storms occurred while the plan was being developed, we were able to integrate photos into the plan and workshops so people could see that business-as-usual isn't going to work, and we need to start investing in infrastructure.

We identified a role for folks living on the top of the hill by storing storm water instead of letting it run down through the stormwater system to the bottom of the hill. Everybody at the bottom of the hill would benefit from green infrastructure for up-gradient homeowners. There is a section of the report that describes exactly what private building owners and homeowners could do on their own properties to help the Town.

CCBJ: Megan, please comment on the Plan's heat recommendations.

Megan Granato: Strategies that we would consider include increasing shade through tree cover and canopies. On West Main Street, which is the prime downtown street, one side of the road has storefront awnings and shade canopies for the pedestrians but the other side doesn't, so there are easy opportunities to increase shade to protect people visiting stores and restaurants during the height of summer.

We're also proposing pop-up cooling measures. For example, Mystic hosts a huge outdoor arts festival in August, and we've spoken to our emergency management staff about whether or not cooling measures like a misting station is something we could implement or strongly encourage for outdoor events. We're also hoping to continue the partnership with CIRCA, where researchers have been studying extreme heat and collecting on-the-ground measurements in different municipalities throughout Connecticut.

Interestingly, some folks push back on heat, saying that as a coastal area we get a lot of ocean breezes. This project has really helped change that narrative as we've had feedback from a local store relating how in

the height of summer customers come in suffering from the heat. Yes, this is an area where heat traditionally hasn't been a concern, but unfortunately that's changing.

CCBJ: Have parts of the plan been implemented yet?

Granato: The plan has been in place for about six months and we are now working on implementation. Initiatives moving forward include getting a capital project in place thanks to our Public Works Department to do additional assessments of the stormwater drainage system on Pearl Street. This system takes 44 acres of drainage and is essentially at sea level; we don't have a lot of gradient to get that stormwater out. So we are going to be soliciting contractual services to understand options to improve it, in addition to looking at the condition of the existing infrastructure. The area was developed hundreds of years ago so it will have pipes that need replacing and upgrading to meet current design standards.

We had a backflow preventer demonstration from WAPRO, a flow regulation and flood management specialist, showing us more about their gate valve technology. And we had a couple of other municipalities join us in a lunch-and-learn session. So as we learn about these things, we share the information with others.

Similarly, I went in front of our Historic District Commission, partnering with a company from southeastern Connecticut that does flood barrier implementation, to talk about the study results and how flood barriers can be compatible with historic district and historic building considerations. The company presented examples of flood barrier work in historic buildings in other parts of the country. Continued engagement and outreach is so important. We're trying to show people that although changes are coming, they don't have to be as startling as they might fear and can be respectful of tradition.

We partnered with the Mystic Museum of Art, which is a major landholder in the study area just south of West Main Street, on a proposal to improve their parking lot and campus for flood, resilience, water quality, and habitat stewardship. They also have one of the area's few open public green spaces, and their leadership has been tremendous in figuring out how to manage that property to protect against floods while continuing to provide an important public amenity and potentially improving habitat services.

We are also continuing discussions with the local business community. Our graduate student intern has put together a resilience building toolkit specifically for local businesses that we're introducing to owners.

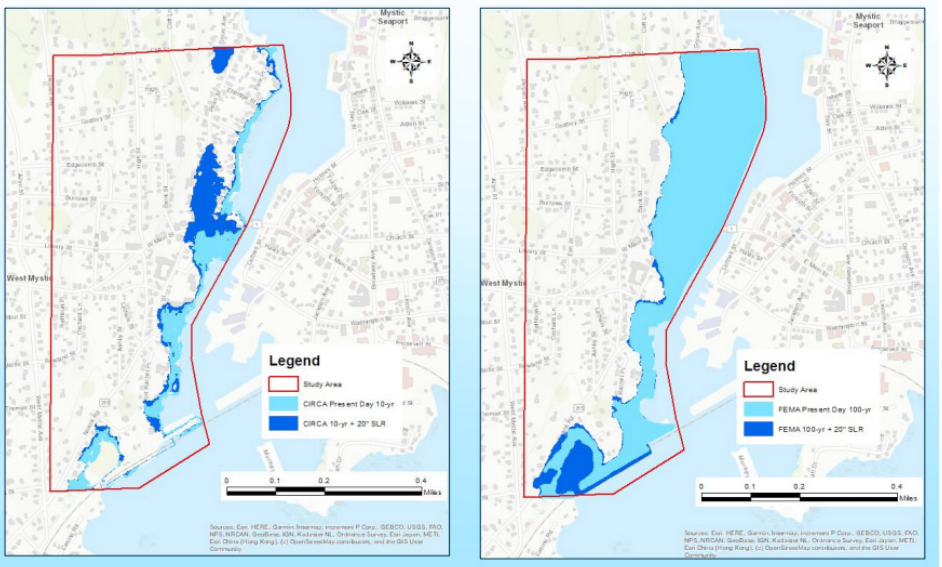
CCBJ: What role do FEMA grant programs play?

Granato: We found out recently that Groton was selected as one of the chosen communities for FEMA's BRIC Direct Technical Assistance program. We put in a joint application with the City of Groton and the Groton Long Point Association (two political subdivisions of the Town) and all three of us now have climate resiliency plans. We're so excited to be working with FEMA to understand better how we can take the recommendations in those plans and do the matchmaking with FEMA grant programs.

As Boston demonstrated, FEMA funds are so important, especially when you get into the later design and construction phases. But for us doing the benefit-cost analysis, the learning curve of managing those federal funds is significant. We're excited for this opportunity to get further along that learning curve so we can start accessing resources or at least improving our grant applications and putting together the most competitive proposals possible.

Cobleigh: The plan is about 115 pages long and has appendices listing where the Town can apply for state and federal funding. It shows the pathway through the surveys and the feedback on the highest priority projects in Downtown Mystic. It's an excellent launch pad for the Town. As we told them at the beginning, you don't just want a plan, you want a plan that gets you to action and helps you become eligible for funding. We still have two more years of Bipartisan Infrastructure Law funding, and the Town is pushing to get projects designed that to take advantage of that. ☼

Areas of the study area predicted to be flooded under present day conditions and with sea level rise in 2050 were mapped by GZA during the vulnerability assessment



Connecticut Institute for Resilience & Climate Adaptation in Groton, CT