NEW ECOLOGY NEWSLETTER

Spring 2021

BuildingWell

A NOTE FROM THE PRESIDENT

Massachusetts' March 2021 climate law has created new mechanisms to address the climate crisis. It requires a 50% reduction in greenhouse gas emissions (from 1990 levels) by 2030, 75% by 2040, and "net zero" emissions by 2050, specific reduction targets for the residential building sector, makes it harder to further burden environmental justice communities with additional pollution, and authorizes a net-zero stretch code.

Meeting these goals in housing will require electrification of hot water and heating systems, and a clean electric grid supplied by renewable energy. To electrify existing buildings, we will need efficient, effective ways to achieve deep energy retrofits, and sensible means of financing these improvements. Utility rebate programs will shift to rewarding GHG reductions, not just reducing costs, and owners will have to tackle these changes over time.

New Ecology has already started down this pathway. We are assisting in the development of 30 multifamily low-energy passive homes, helping policy-makers evaluate approaches for existing buildings, and helping owners with planning.

We expect other state and local governments to enact similar regulations. We will be sharing our experiences and doing whatever we can to succeed in this difficult and urgent work.

— Edward F. Connelly
NEI President

Electrification and Affordable Housing in Massachusetts: What You Need to Know

BY LAUREN BAUMANN, VICE PRESIDENT, REBECCA ANSOLABEHERE, ENERGY ENGINEER, AND MICHELLE MORAN, SENIOR ASSOCIATE

On May 7, 2021, Lauren Baumann partnered with Emily Jones from LISC to present "Electrification and Affordable Housing: What You Need to Know" at the 2021 NESEA Conference in Boston. They explained why electrification in affordable housing is so important, key drivers on the horizon, and shared case studies.

Why Electrification is Important

Massachusetts recently set a goal of reaching net zero emissions by 2050. The building sector is a major source of emissions, and we will need to enact major changes in our existing and new buildings to get there. We can do this by employing the ***4 E's:***

- ***Efficiency:*** A high-performance building envelope is important for energy savings because with high-quality continuous insulation and air sealing, we can drive heating energy loads down by reducing pathways for heat loss.
- ***Electrification:*** Unlike natural gas and other fossil fuels used to heat and cool buildings today, electricity has the potential to be generated with clean energy. Once we have decreased our overall energy load through efficiency measures, we will need to convert heating and domestic hot water to efficient electric equipment.
- ***(Clean) Energy:*** The energy grid operates on increasingly greater renewable and clean energy, especially in New England, and we must amplify our efforts to decarbonize it. Buildings can also fully utilize their potential for on-site renewable generation, such as rooftop solar.
- ***Equity:*** Strategies to decarbonize must address historic stresses placed on communities of color and produce equitable outcomes. Cost savings and other benefits from energy efficiency must be distributed equitably. Efficiency and electrification projects must not place additional environmental or financial stresses on underserved communities.

Drivers

Public policy and financial incentives are driving affordable housing decarbonization. MA state level regulatory drivers include emissions goals (Massachusetts Clean Energy and Climate Plan for 2030 and the MA 2050 Decarbonization Roadmap) and plans for a net zero stretch code. The Massachusetts Clean Energy Center's (MassCEC) Clean

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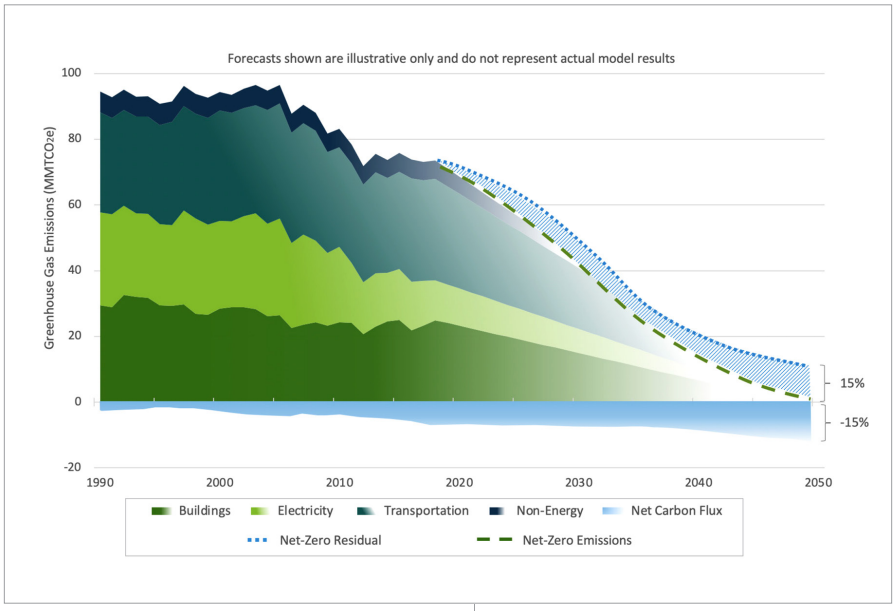


Above: Net Zero requires deeper emissions reductions than Massachusetts' previous "80% by 2050" target, as well as a new requirement to balance any remaining emissions with the same amount of carbon removal from the atmosphere. Image Credit: Massachusetts 2050 Decarbonization Roadmap (December 2020, p.8).

Below: Image Credit: Carbon Free Boston Summary Report 2019 (February 2019, p.42).

Heating and Cooling program helped financially incentivize implementation of electric heating and cooling systems in multifamily housing and increase market penetration and knowledge of these systems. The competitive advantage that high performance, electrified affordable housing projects get when they submit applications for Low Income Housing Tax Credits (LIHTC) has been another driver in this transition.

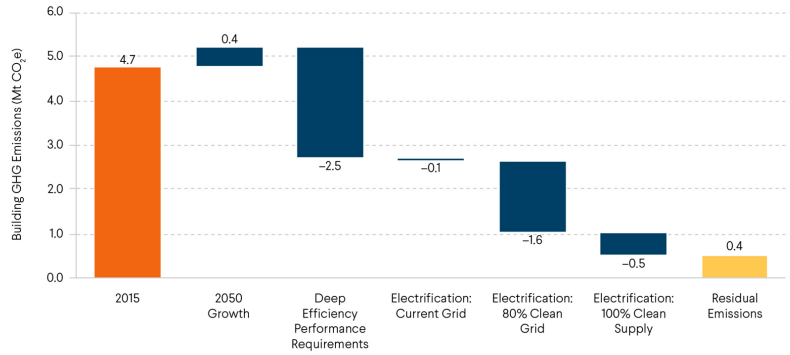
Many cities in MA are leading the way in this movement towards carbon neutrality in the building stock. For example, the Cities of Boston and Cambridge are developing and implementing new versions of their building energy use disclosure and reporting ordinances, which will include specific carbon emissions reduction requirements over time for the existing building stock to enable these cities to meet their 2050 carbon neutrality goals. These cities are also aggressively rethinking their zoning ordinances and funding programs related to new construction projects, with a goal of developing high performance Passive House-type projects that could easily achieve zero emissions. Other cities and municipalities are following the precedent that Boston and Cambridge have de-veloped, and are creating mechanisms to improve the performance of their buildings as well. In addition to local regulatory process, pressure to improve the performance and emissions of the building stock is also happening from the grassroots level. Local advocacy groups like the Green Newton and the effort in Brookline to create a local natural gas ban put pressure on builders and owners to increase the performance of their projects and electrify.

Technical Context

The NEI team provided the audience with a summary of important approaches to pursue electrification of buildings. This includes improving the performance of the building as much as possible to reduce heating and domestic hot water energy (DHW) load so that it does not become significantly more expensive to operate the building. The relative utility cost of heating energy produced with electricity is much higher than gas. NEI also gave the audience a short summary of the different types of electrified heating and DHW systems that could be employed on different sizes and scales of projects.

Figure 18. The Steps to Carbon Neutrality in Boston's Buildings

The steps reflect the GHG reduction potential of specific consecutive actions starting from today's conditions. Source: Institute for Sustainable Energy model calculations.



Case Studies

To help the audience understand the context and considerations associated with electrifying affordable housing, the team at New Ecology presented three different case studies. The first represents a new construction project that is the early stages of design and is studying the implications of electrification of the HVAC systems. The second project is an existing, low-performance affordable housing project

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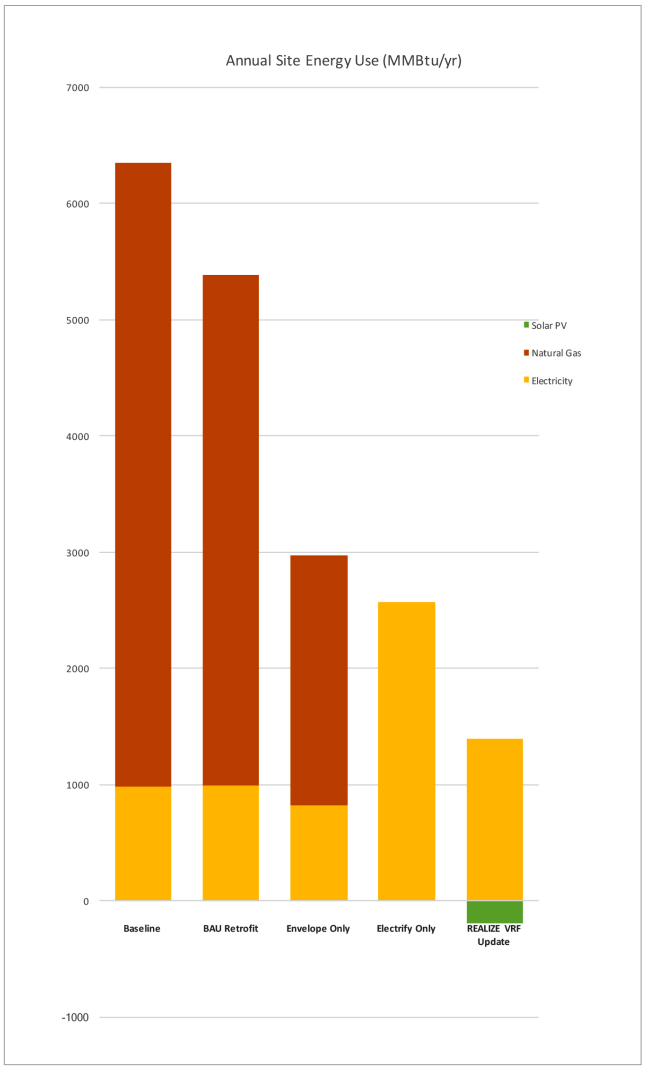

Graphical representation of the annual energy use for different retrofit options for an existing building.

that is in the process of designing and pricing a Deep Energy Retrofit that includes electrification of the mechanical systems. The third is a hypothetical study of the implications of electrifying the mechanical systems on a high-performance affordable housing townhome project that was built approximately 10 years ago.

FIRST CASE STUDY: NEW CONSTRUCTION

In early-stage design, the project team for this roughly 100-unit multifamily new construction project has designed a nearly electrified high-performance project. While the baseline design is not quite to the Passive House standard of performance, it is very close. It includes an electric heating/cooling system and a gas-fired DHW system. The project team studied the capital and operating cost implications of converting that DHW system to electricity. Early stage modeling indicates that this DHW conversion would result in a 7.8% reduction in energy use, and reduces the building's carbon emissions by 4.34 metric tons. This change also results in an approximately 1.5% increase in annual operating cost. From an operations perspective, the team is concerned about the emerging nature of the technology. In order to achieve its efficiency and operational potential, the system must be properly designed and installed. The team also has reservations around the ability of their operations team to maintain this type of new technology, or to find third-party vendors who could do this for them. These operating costs are somewhat unknown at this point, and are not included in the operating cost metrics, but could increase the operating cost burden of adoption of this type of system.

SECOND CASE STUDY: EXISTING BUILDING DEEP ENERGY RETROFIT

Eva White is a 102-unit multifamily public housing rehabilitation project that is currently pursuing a Deep Energy Retrofit (DER) design approach, supported in part through the Rocky Mountain Institute's (RMI) REALIZE

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WE ARE HIRING!

New Ecology is looking to expand our team!
We have several open positions, and we are successfully working to on-board and train new hires remotely. We are currently hiring for:

- Senior Energy Engineer (Boston)
- Project Manager (Boston)
- Assistant Project Manager (Boston)
- HERS Rater Trainee (Boston)
- Assistant Project Manager/HERS Rater (Baltimore)
- HERS Rater Trainee (Baltimore)

Visit **newecology.org/category/jobs** for our complete list of job postings and instructions on how to apply. Feel free to pass this along to your professional networks!

Older, high-performing building stock have the potential to achieve further savings by replacing gas-fired heating and DHW equipment with electric systems, but oftentimes the total utility costs will increase in such cases.

pilot program. In partnership with RMI, Winn Development has modeled and studied the different approaches to significantly reducing the carbon emissions of this property through building envelope retrofit and high-performance electrified system implementation, while working to minimize disruption to tenants and systematize approaches. The team evaluated the following scenarios and their energy and carbon metric impacts:

Scenario Description	EUI (kBTU/SF)	Greenhouse Gas Emissions (MTCO2e)
Existing Building	166	370
The "Business as Usual" (BAU) upgrades - a typical rehab project	140	319
Only the building envelope improved – no other upgrades	78	186
Only electrification – no other upgrades	67	224
DER- includes envelope, electrification, solar and Energy Recovery Ventilators (ERV)	41	138

A "BAU" retrofit would still improve performance over the baseline, but a DER would realize far greater energy, carbon and operational cost savings. One challenge is that the DER has a much higher upfront cost–approximately $58k per unit more than the "BAU" approach. Ultimately, the team was able to make the budget work because of incentives from the utilities for performance improvements and additional tax credit equity generated by the newly enacted 4% tax credit "floor," the ability to keep previously assumed resources in the project. Every project has a unique financing mix and not all projects will be able to "close the capital gap." Funding and financing approaches that support deeper performance intervention and electrification for affordable housing rehabilitation projects are needed to make sure this level of performance can be pursued at scale.

THIRD CASE STUDY: ELECTRIFICATION OF A MODERN HIGH-PERFORMANCE BUILDING

There are electrification opportunities for more recently-constructed buildings that were designed with gas-fired systems. The Old Colony townhome buildings that were constructed to high performance standards roughly 10 years ago are a good example of this type of electrification opportunity. Designed and built to Energy Star and LEED Platinum standards, these properties do not have many cost-effective opportunities to easily improve the building envelope further, but will require conversion of their systems to help them reduce their carbon footprint. New Ecology did a hypothetical analysis of what it

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would mean to replace the gas-fired heating and DHW systems with electrified systems currently available on the market. Without changing the envelope, there is still great energy and carbon savings potential; however, the total operating cost for these buildings would increase approximately 2-3%. Especially for affordable housing, it is important to consider on a case-by-case basis the capital costs of changing these systems, and whether the project's operating proforma could absorb this type of annual increase or realize other opportunities to mitigate that impact.

Operating Costs to Electrify

	Gas-Fired Systems ($/yr)		Electrified Systems ($/yr)		Total Utility Cost Difference ($/yr)
	Heating	DHW	Heating	DHW	
Building 1	2,457	5,575	4,292	6,364	2,625
Building 2	3,190	3,496	5,573	3,991	2,979

	Total Utility Cost Difference ($/yr)	Total Ops Cost Estimate* ($/yr)	Delta
Building 1	2,625	121,000	2%
Building 2	2,979	110,000	2.6%

Looking Forward

Electrification of buildings' systems will be an important component of meeting our state and local carbon neutrality goals. Electrified heating and cooling systems have had a high level of market penetration and are often good candidates from a capital and operating cost perspective on high-performance new construction affordable housing projects. Retrofitting these types of systems into the existing affordable housing building stock will need to be done carefully with consideration of capital and operating cost implications. More research is still necessary to ensure that these electrified heating systems are being properly designed and installed, and are reaching their efficiency potential.

Domestic hot water system technology has not advanced as quickly, and there are fewer off-the-shelf options with demonstrated success in our climate, especially for large scale central DHW systems. Demonstration projects with the newly emerging technology will provide valuable information and data for more confident integration into affordable housing system design.

From a financing perspective, additional innovation and funding resources are needed to compensate for the capital and operating cost implications of electrification to ensure that affordable housing is not adversely impacted in this movement. Resources that accompany policies that encourage/require achievement of low carbon design and rehabilitation will help equitably implement this approach. Federal, state, and municipal opportunities for encouraging this transition must all be considered and leveraged.

NEWSLETTER CONTRIBUTORS:
MICHELLE MORAN, REBECCA ANSOLABEHERE, JUSTIN IOVENITTI, FRANK STONE, BARBARA MARTINS, LAUREN BEACH, PAT COLEMAN, LAUREN BAUMANN, ASHLEY WISSE, SANKHANIL GOSWAMI, ED CONNELLY.

NEW ECOLOGY AWARDS

- **Colonial II Apartments** in Rome, NY was recently selected as a winner in Round Two of New York State's Buildings of Excellence Competition for the design and construction of a zero-carbon and near net zero energy emitting multifamily building. This competition supports the Climate Leadership and Community Protection Act (CLCPA), which places New York state on a path to economy-wide carbon neutrality and mandates an 85 percent reduction in greenhouse gas emissions by 2050.

https://www.beaconcommunitiesllc.com/news-post/colonial-ii-apartments-awarded-in-second-round-of-buildings-of-excellence-competition

- **Carter School Apartments** in Leominster, MA was selected to receive the 2021 Paul & Niki Tsongas Award from Preservation Massachusetts. The award is Preservation Massachusetts' highest honor, honoring people and projects that have displayed the highest level of commitment to historic preservation in the Commonwealth.

https://www.preservationmass.org/tsongas-award

Massachusetts' New Climate Bill

BY REBECCA ANSOLABEHERE, ENERGY ENGINEER

In March of 2021, Massachusetts Governor Charlie Baker signed an exciting new energy bill into law. The bill requires the state to achieve net zero emissions by 2050, sets emission reduction targets for six energy sectors, and begins to address changes needed to reach these goals. The bill allows for much more aggressive climate strategies than those currently in place. For example, there is a requirement for Mass Save to address carbon emissions in addition to energy efficiency.

These changes will encourage building owners and managers to act more aggressively and adopt new technology in order to achieve these ambitious goals. To be successful, MA building owners will need to think beyond energy efficiency, and prepare our infrastructure to accommodate emerging technologies that will reduce our carbon impact. Project teams will need to think holistically and invest in measures with less immediate payback, such as improved building envelope and other load reducing upgrades.

The bill also includes social justice measures both in expanding public say in new development projects that could increase the environmental or financial burdens on locals, and in the expanded access to jobs training in clean energy. Ensuring that local communities participate in the development in their neighborhoods is key in reducing negative impacts to underserved communities. The bill brings hope that opportunities will be available to all as the clean energy industry expands.

A summary of the bill can be found here: https://www.wbur.org/earthwhile/2021/03/26/new-mass-climate-law-faq

The original text of the bill can be found here: https://malegislature.gov/Bills/192/S9

PRESENTATIONS

*NEI Vice President Lauren Baumann recently presented on the webinar discussion as a part of the KLA Climate Solutions Series, on how local governments can take steps toward implementing Net Zero buildings in their communities. Check out the **blog post** outlining the discussion, as well as a **recording of the presentation** to learn more.*

*NEI Vice President Lauren Baumann also recently presented at NESEA's Build Energy Boston 2021, along with Emily Jones from LISC, on Electrification + Affordable Housing: What You Need to Know. A brief summary of the presentation can be found **here**, or check out the article on this topic in this newsletter.*

Housing Hurdles

BY JUSTIN IOVENITTI, ENERGY ENGINEER

While we focus on the built environment at New Ecology, our society at large must tackle multiple environmental emergencies. The potential benefits of carbon neutral buildings, energy efficiency, electrification, and other strategies are significant, but these strategies alone will not allow us to meet climate goals. One way to illustrate this is by examining the end uses of energy in the United States. Per Lawrence Livermore National Laboratory, 26% of energy consumed in 2020 went to transportation, whereas 12% went to residential uses. This figure was 28% in the pre-Covid world of 2019.

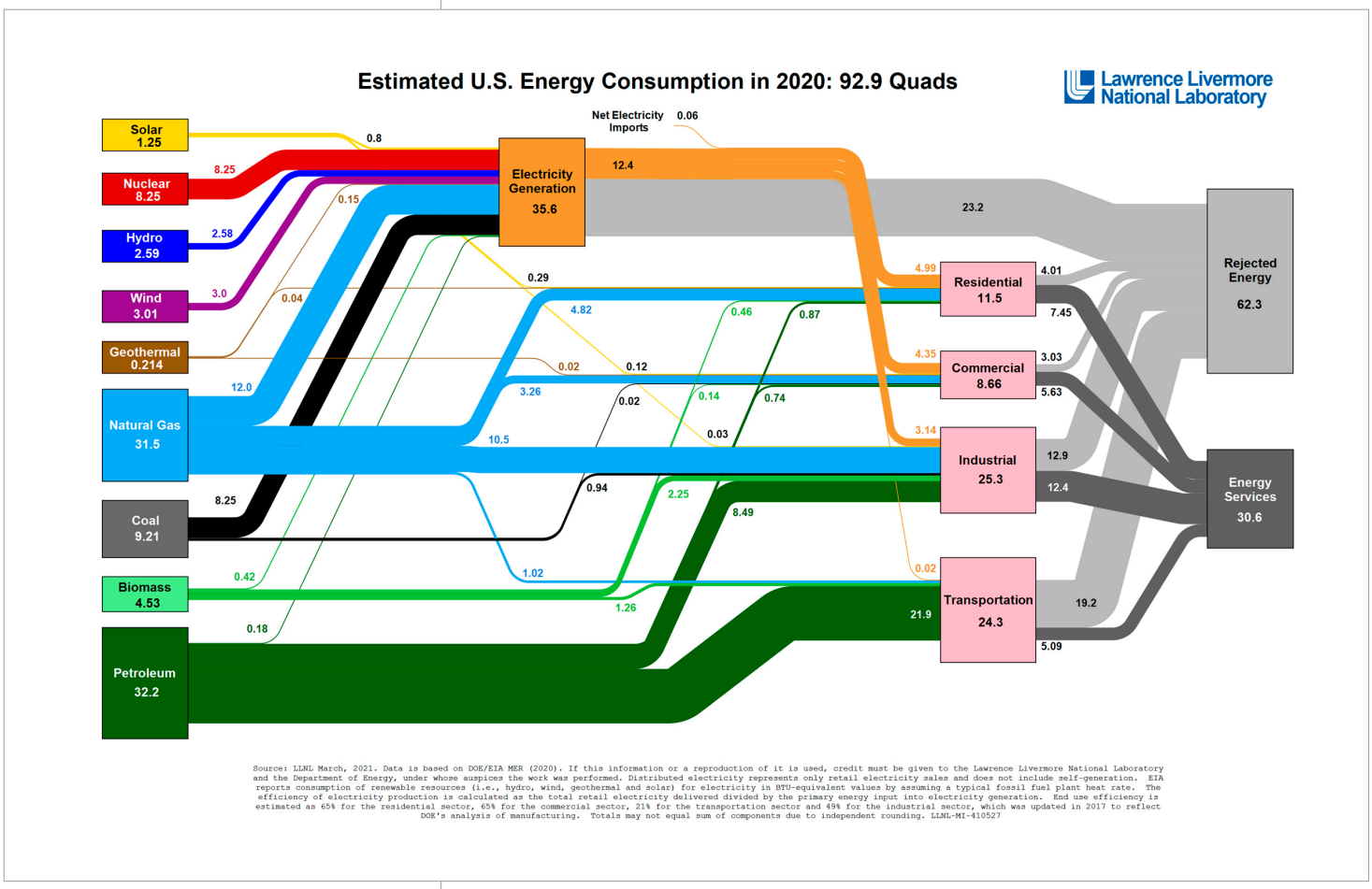

Image Credit: Lawrence Livermore National Laboratory and the Department of Energy

How do these two large energy "buckets" overlap? By increasing the density of housing in urban areas, we can put more residents in close proximity to jobs, schools, and services. Urban infill also provides individuals with less carbon-intensive transportation options than areas that rely almost exclusively on car trips. While perhaps counterintuitive, city dwellers typically have smaller carbon footprints than suburban, exurban, and rural counterparts. Sadly, such infill projects are faced with numerous hurdles. For one such example, see the following Slate article which describes how design review boards have helped restrict our home building to the slowest rate since World War II.

https://slate.com/business/2021/04/good-design-bad-cities-zoning-commissions-preservation-boards.html

Sankhanil Goswami

LET'S TALK

New Ecology is eager to work with partners who are interested in learning more about our work and how we can help you to achieve your project's goals. We have worked on hundreds of projects for owners in market sectors including housing, office, retail, education, healthcare, government, arts, and nonprofit.

Our passion and commitment is best demonstrated by the fact that we have been at the leading edge of community-based sustainable development since 1999.

At the same time, our reach, approach and successful model have helped us attract and retain a talented staff known for its desire to make advances in a new and growing field.

Interested in learning more? Contact info@newecology.org or call 617-557-1700.

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Community-Based Sustainable Development

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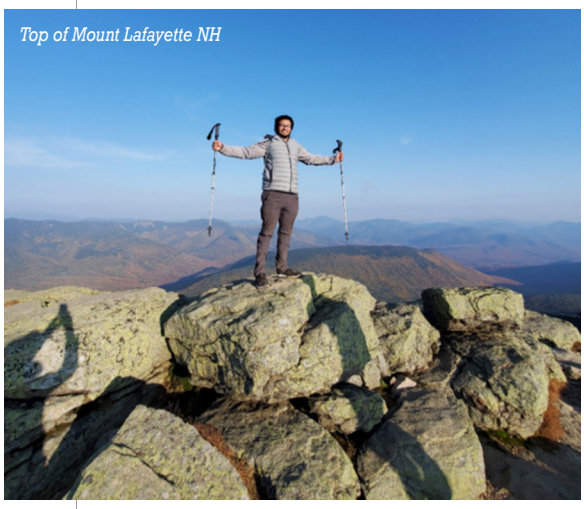
Staff Profile

Name: Sankhanil Goswami
Title: Energy IoT Developer

What does your job entail? I work on the Remote Monitoring and Optimization (ReMO) team, where I help in developing various tools and methods for real-time data collection from boilers, water meters, utility meters, etc. in various sites, and the subsequent processing, storage and analysis. This usually involves lots of coding and even more debugging.

What is the most inspiring/interesting part of your job? The most interesting part of the job is to learn and work with new technologies in a wide array of domains ranging from IoT, cloud databases, boilers, and building controller technologies. The challenging part is to integrate different kinds of technologies into a single system. Also, it is inspiring to know that my work assists the ReMO team in helping low income families reduce their utility bills and thus contributing to the overall goal of reducing energy consumption and carbon emissions.



Top of Mount Lafayette NH

What is a challenge people in this industry face that you would like to solve? Many existing buildings run very inefficiently, resulting in overconsumption and higher greenhouse gas emissions. Real-time data collection from buildings, and using that data to recommend energy conservation measures, helps to correct the inefficiencies of the system. One of the challenging parts is dealing with a wide range of equipment with different communication protocols, and also to effectively store and process a huge amount of timeseries data, so as to provide a streamlined and optimized service. With new technologies and innovation, I am hoping this challenge can be met effectively.

What do you like to do outside of work?
I enjoy playing soccer, listening to music, reading books, and watching movies. I also like hiking, star gazing, and camping in the woods.

Favorite movie/TV show/Band? It is hard to choose, but right now "The Man from Earth", "Schindler's List" and "Inception" come to mind. For TV, I will go with the unlikely pair of "Monty Python's Flying Circus" and "Black Mirror". My favorite bands are Porcupine Tree, The Beatles, Pink Floyd, Opeth, and Miles Davis.

What are you doing to keep happy and healthy? I try to put in some exercise hours every day either in the form of soccer, swimming or just brisk walking. I have found that reading a book or listening to music helps me after a long stressful day.

What advice would you give to somebody looking to start in this industry?
This is a vast industry where a wide array of skills is necessary to thrive. Therefore, an eagerness to learn new topics and technologies is very crucial. In the field of IoT, one has to stay aware of the fast-changing technologies in the cloud computing platforms. Also, this is a very dynamic field where lots of opportunities exist to contribute in a positive manner. It is as important to develop a skill-set that allows you to remain open for diversification and innovation.