



# Public Facilities Committee Agenda

## City of Newton In City Council

Wednesday, May 5, 2021

The Public Facilities Committee will hold this meeting as a virtual meeting on Wednesday, May 5, 2021 at 7:00 pm. To view this meeting using Zoom use this link: <https://us02web.zoom.us/j/85695430448> or call 1-646-558-8656 and use the following Meeting ID: 856 9543 0448

### Item Scheduled for Discussion:

#### Referred to Public Facilities & Finance Committees

- #167-21**      **Appropriate \$2.5 million for the Transportation Network Improvement Plan**  
HER HONOR THE MAYOR requesting the authorization to appropriate and expend two million five hundred thousand dollars (\$2,500,000) to supplement funding for the Transportation Network Improvement Plan.
- #113-21**      **Resolution in support of EPR and an expanded Bottle Bill**  
COUNCILORS LEARY, NORTON, KALIS, KRINTZMAN, NOEL, LUCAS, HUMPHREY, GROSSMAN, LIPOF, KELLEY, BOWMAN, DOWNS AND CROSSLEY requesting a resolution of the City of Newton supporting Extended Producer Responsibility and expanded Bottle Bill.
- #294-20**      **Discussion to require or encourage the use of efficient electric technology**  
COUNCILORS CROSSLEY, KELLEY, LEARY, NORTON, ALBRIGHT, GREENBERG, AUCHINCLOSS, MARKIEWICZ, NOEL, DANBERG, KALIS, DOWNS, LAREDO & HUMPHREY requesting a discussion with the Sustainability Team to consider creating an ordinance that may require and/or encourage the use of efficient electric technology for heating, cooling, hot water, cooking and other appliances in new and substantially renovated buildings.

Respectfully submitted,

Alison M. Leary, Chair

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The location of this meeting is accessible and reasonable accommodations will be provided to persons with disabilities who require assistance. If you need a reasonable accommodation, please contact the city of Newton's ADA Coordinator, Jini Fairley, at least two business days in advance of the meeting: [jfairley@newtonma.gov](mailto:jfairley@newtonma.gov) or (617) 796-1253. The city's TTY/TDD direct line is: 617-796-1089. For the Telecommunications Relay Service (TRS), please dial 711.



167-21

City of Newton, Massachusetts  
Office of the Mayor

Ruthanne Fuller  
Mayor

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Honorable City Council  
Newton City Hall  
1000 Commonwealth Avenue  
Newton, MA 02459

2021 APR 26 PM 5:00  
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CITY CLERK  
NEWTON, MA 02459

Honorable City Councilors:

I respectfully submit this docket item to this Honorable Council requesting the authorization to appropriate and expend \$2,500,000 to supplement funding for the Transportation Network Improvement Plan. Funding will come from the City's first tranche of American Rescue Plan Act funds set to arrive in City accounts shortly. In the last few years, this supplemental funding has come from Free Cash, Overlay Surplus or the Capitalization Fund. The pandemic-related revenue shortfalls left the City with much less Free Cash this fiscal year.

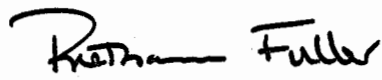
Below is a table showing the Transportation Network Improvement Plan's sources of funding since FY2018. The FY2021 budget for the program, revised when the pandemic hit, was \$5.5 million. This additional \$2.5 million increases it to \$8.0 million.

Newton Transportation Network Improvement Program Funding FY18-FY21				
Source	FY18	FY19	FY20	FY21
Chapter 90	\$ 2,445,000	\$ 2,309,000	\$ 1,850,000	\$ 2,750,000
2013 Override and Operating Budget	\$ 2,154,873	\$ 1,640,117	\$ 1,710,000	\$ 1,350,000
Reclassified Revenues/Savings	\$ 982,903	\$ 669,235		\$ 400,000
Free Cash	\$ 3,929,011	\$ -	\$ 3,000,000	\$ 1,000,000
Overlay Surplus	\$ -	\$ 5,000,000	\$ 1,750,000	
Capital Stabilization			\$ 1,250,000	
ARPA	\$ -	\$ -	\$ -	\$ 2,500,000
<b>TOTAL</b>	<b>\$ 9,511,787</b>	<b>\$ 9,618,352</b>	<b>\$ 9,560,000</b>	<b>\$ 8,000,000</b>

As noted in Commissioner McGonagle's attached memo and road listings, the additional funds will allow the city to address high priority road and sidewalk improvements in village center areas. The American Rescue Plan Act is designed in part to allow municipalities to move forward with economic recovery projects and to fund projects hurt by lost revenues. The City is anticipating approximately \$65 million in total ARPA funding, as well as grant program funds that are expected at the state level.

Thank you for your consideration of this matter.

Sincerely,

A handwritten signature in black ink that reads "Ruthanne Fuller". The signature is written in a cursive style with a large, looping initial 'R'.

Mayor Ruthanne Fuller

City of Newton

DEPARTMENT OF PUBLIC WORKS

Ruthanne Fuller  
Mayor

OFFICE OF THE COMMISSIONER  
1000 Commonwealth Avenue  
Newton Centre, MA 02459-1449

To: Maureen Lemieux, Chief Financial Officer  
Jonathan Yeo, Chief Operating Officer

From: James McGonagle, Commissioner of Public Works

Subject: Request to Appropriate \$2,500,000 for the Transportation Network  
Improvement Plan

Date: April 26, 2021

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I respectfully request that the Mayor docket the following request to appropriate and expend two million five hundred thousand dollars (\$2,500,000) to supplement funding for the Transportation Network Improvement Plan.

The Department of Public Works will use the funds to increase the number of streets being paved. In addition, these funds will allow for additional bicycle accommodations, sidewalk safety improvements and curb ramp adjustments to increase ADA compliance.

Given the American Rescue Plan Act's focus on economic recovery, DPW has highlighted sections of the city near village centers that need substantial road and sidewalk improvements based on the latest road condition assessment. Please see the attached list of streets.

Thank you for your consideration of this matter.

James McGonagle  
Commissioner

Telephone: (617) 796-1009 • Fax: (617) 796-1050 • [jmcgonagle@newtonma.gov](mailto:jmcgonagle@newtonma.gov)

## 2021 ARPA-Funding: Roadways in Economic Development Areas

- Albemarle Road (between Watertown Street and Crafts Street) – This portion of Albemarle Road is the access and parking for a major recreation area used by residents and visitors to the City. The recreation area includes soccer, football, baseball, and softball fields, tennis courts, a playground, and a public pool. In addition, this portion of Albemarle Road is the bus and parent drop-off for a public preschool and middle school. This road project will include paving, sidewalk and ramp improvements, new pavement markings including ADA symbols, potentially a new bike path, and a refreshed parking area that will better serve the residents and visitors.
- The following pavement management projects are roadways that serve as gateways to village centers and serve several small businesses. Roadway improvements and new pavement markings including ADA symbols to these streets will provide better access for pedestrians, cyclists, and motor vehicle users to retail shops, restaurants, community centers, and houses of worship in these centers.
  - Parker Street and Cypress Street – Newton Centre
  - Centre Street (from the Route 9 ramps to Walnut Street) - Highlands
  - Washington Street from Commonwealth Avenue to Perkins Street – West Newton
  - Curve Street from Prospect Street to Auburn Street – West Newton
- Auburndale: Grove Street from Woodland Road to just before Hotel Indigo – This portion of road serves a large commuter rail/bus station, several large office buildings, a college, and an assisted living center. Roadway and pavement marking improvements to this area will benefit employees of the businesses, public transportation users, and residents and visitors to both the college and assisted living center.
- Nonantum: Watertown Street (between Pearl Street to Walnut Street) – This portion of roadway runs through a village center with a variety of retail shops, small businesses, restaurants, and a small but well-utilized park. The pavement project and new pavement markings will compliment recent ADA improvements along this portion of Washington Street and will encourage shopping and dining.
- Newton Corner: Belmont Street, Arlington Street, Ricker Road, Marlboro Street, and Ricker Terrace (cluster of streets in Newton Corner) are major walking routes to a nearby village Center with small businesses, restaurants, and a transportation node. In addition, these roadways are in proximity to Bigelow Middle School and are walking routes for the students. Improvements to roadways, sidewalks, and pavement markings will encourage visits to the village center and use of public transportation.

**RESOLUTION NO. [REDACTED]  
RESOLUTION OF THE CITY OF NEWTON  
SUPPORTING EXTENDED PRODUCER  
RESPONSIBILITY AND AN EXPANDED BOTTLE BILL**

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NEWTON, MA 02459

**WHEREAS**, in FY20, 18,175 tons of discarded materials and products were sent to disposal from our community, and the cost per ton is currently \$68.97, but is expected to significantly increase by 2028; and

**WHEREAS**, in FY20, 9,400 tons of discarded packaging and printed paper were collected at the curb through single stream recycling from our community, and the processing cost per ton has increased from \$30 to approximately \$75 since 2020; and

**WHEREAS**, our community has paid over \$92,000 in contamination fees for our recycling from late 2017 to early 2019; and

**WHEREAS**, local governments must arrange and pay for the management of waste and recycling, and state policies currently make local governments responsible for achieving waste diversion goals; and

**WHEREAS**, municipal recycling programs have expanded, diverting more waste materials from landfills and incinerators; and

**WHEREAS**, the U.S. faces a solid waste crisis stemming from overconsumption of material goods, excess packaging and reliance on single-use plastics; and

**WHEREAS**, Massachusetts faces a finite and dwindling amount of landfill space and capacity at waste-to-energy disposal facilities; and

**WHEREAS**, municipalities must find alternative ways of managing products banned from disposal or incineration through the MassDEP Waste Disposal Bans using taxpayer funding; and

**WHEREAS**, China's National Sword policy and the policies of other international purchasers of recyclables from the U.S., limiting the types and amount of recyclable materials exported from the U.S., has made recycling more expensive throughout the country, and in Massachusetts specifically; and

**WHEREAS**, excess packaging, single-use products, products designed for disposal, and hazardous products contaminate recycling streams, increasing costs to municipalities; and

**WHEREAS**, local governments do not have the resources to adequately address the contamination rates of recycling streams, nor hard-to-manage and hazardous products; and

**WHEREAS**, costs paid by local governments to manage products are, in effect, subsidies to the producers of products designed for disposal or recycling, and hard-to-manage or hazardous products; and

**WHEREAS**, there are significant environmental and human health impacts associated with improper and inefficient management of all categories of waste, and the costs of such impacts are externalized with the burden placed on taxpayers; and

**WHEREAS**, Extended Producer Responsibility (EPR) is a policy approach in which producers are obligated to pay for and manage the end-of-life collection and disposal/recycling of their products and/or product packaging, reducing costs to municipalities, and which has been shown to be effective at increasing recovery of materials and reducing costs of recycling systems overall; and

**WHEREAS**, when the higher costs of responsible management for products are placed on the producer, there is an incentive to design products that are more durable, easier to repair and recycle, and less toxic; and

**WHEREAS**, there has been national support for EPR legislation in the form of resolutions and policies (National Association of Counties, July 2008; National League of Cities, November 2009; US Conference of Mayors, June 2010); and

**WHEREAS**, in January 2019, the Massachusetts Municipal Association passed a resolution which supports statewide product stewardship legislation; and

**WHEREAS**, the Massachusetts Bottle Bill, a type of EPR program enacted in 1982, has incentivized the collection and recycling of up to 70% of deposit containers, reducing litter and lowering the cost of recycling or disposal for deposit containers from municipal government and taxpayers,

**NOW, THEREFORE BE IT RESOLVED BY THE NEWTON CITY COUNCIL**, that by adoption of this Resolution, the City of Newton urges MassDEP and the Massachusetts Legislature to continue taking timely action to promote a circular economy in Massachusetts to manage excess packaging, single-use products, products designed for disposal, and hazardous products; and

**BE IT FURTHER RESOLVED**, that the Newton City Council instructs the Massachusetts Legislature to enact product specific and framework legislation to have producers share in the responsibility for product waste management costs by passing extended producer responsibility laws, including bills currently under consideration, which will shift costs from municipalities and give producers the incentive to design products to make them easier to reuse and recycle and less toxic; and

**BE IT FURTHER RESOLVED**, that the Newton City Council instructs the Massachusetts Legislature and the Governor to support and vote in favor of updating the Massachusetts Beverage Container Law by adding to the definition of beverage containers

bottled water, sports drinks, tea, wine, spirits, 'nips' and others, and an increase in the deposit fee to 10 cents to further reduce litter and waste management costs for municipal governments; and

**BE IT FURTHER RESOLVED**, that the Director of Sustainable Materials Management of the City of Newton Department of Public Works be authorized to send letters to the Massachusetts Municipal Association, MassDEP, the State legislature, and any other local government and to use other advocacy methods to urge support for EPR Framework or product legislation and related regulations when deemed appropriate; and

**BE IT FURTHER RESOLVED**, that the City of Newton encourages all manufacturers to share in the responsibility for eliminating waste through minimizing excess packaging, designing products for durability, reusability, repairability and the ability to be recycled; using recycled materials in the manufacture of new products; and providing financial support for collection, processing, recycling, or disposal of used materials; and communicating with waste haulers and local governments about end-of-life management of their products and product packaging.

PASSED AND ADOPTED by the Newton City Council, Commonwealth of Massachusetts on \_\_\_\_\_ by the following vote:

AYES:  
NOES:  
ABSENT:  
ABSTAIN:

Signed: \_\_\_\_\_  
(Name), Chair

Date: (mo/day/year)

ATTEST: \_\_\_\_\_  
(Jurisdiction name)

(Name), Clerk



## ARTICLE 21

### SELECT BOARD'S SUPPLEMENTAL RECOMMENDATION

Article 21 is a petitioned article asking the Town to create a new by-law that would prohibit the installation of fossil fuel infrastructure in new buildings and gut/significant rehabilitation projects in Brookline. For these types of construction projects, installing gas or oil piping would be prohibited. This will have the effect of preventing the installation of new major appliances (e.g., boilers, furnaces, clothes dryers) or other systems that require on-site combustion of fossil fuels (e.g., natural gas or oil) for these types of projects. Specific exemptions are outlined in the By-Law, and construction project can also seek a waiver from a to-be-created Sustainability Review Board.

Specific exemptions in the By-Law include exemptions for piping required to fuel backup electrical generators, cooking and related appliances, centralized hot water systems in buildings with floor areas of at least 10,000 square feet (provided that the Engineer of Record certifies that no commercially available electric hot water heater exists), any building being constructed subject to a Waldo-Durgin Overlay District Special Permit, research laboratories for scientific or medical research or to medical offices regulated by the Massachusetts Department of Public Health as a health care facility, among other exemptions.

The Sustainability Review Board will be a three or more member Town Board established and appointed by the Select Board with expertise in affordable housing; commercial development; high-performance sustainable design; architecture; mechanical, electrical, and plumbing engineering; or other technical areas as determined by the Select Board.

The effective date will be the later of (1) January 1, 2021, (2) 5 months after written approval is received from the Attorney General's Office, or (3) the date upon which the Sustainability Review Board and its procedures have been established.

Significant consensus has been built between various boards, committees, commissions, community stakeholders and co-petitioners during the vetting of this Article. The Board appreciates the efforts of the petitioners and the Advisory Committee to craft language that can be supported by a wide range of stakeholders.

The Select Board unanimously voted FAVORABLE ACTION on the motion offered by the Advisory Committee.

ADVISORY COMMITTEE'S SUPPLEMENTAL RECOMMENDATION

SUMMARY:

Article 21 is intended to be a major step towards achieving Brookline's goal of reducing its carbon emissions to zero by 2050. It would, with limited exemptions, prohibit the installation of new fossil fuel pipe infrastructure (natural gas, propane, fuel oil) in new construction and so called "Significant Rehabilitations".

The Advisory Committee recommends FAVORABLE ACTION on Article 21 in the form presented on November 5, 2019.

*As of November 11, the petitioners were considering revisions to the article that have not been reviewed by the Advisory Committee. No recommendation should be inferred for any version submitted subsequent to the November 5, 2019 vote.*

BACKGROUND:

Article 21 is sponsored by a team of petitioners which include architects, lawyers, members of various advocacy groups including Mothers Out Front and the Greenspace Alliance plus three members of the Select Board.

The proposal is intended to support the Brookline Climate Action Plan which states the Town's intention to reducing its greenhouse emissions to zero by 2050. One strategy is to begin requiring the complete electrification of new buildings and buildings undergoing significant renovations. While the short term greenhouse emissions effects of this strategy is dependent on the fuels used to generate electricity, it is Massachusetts state policy to increase the percentage of electricity generated from renewable sources over time. Additionally, Brookline sponsors a community aggregation program in which the default choice has a higher percentage of renewable sources than the Eversource default. Plus Town electric customers can opt up to the Brookline Green Option which has 100% renewable source. Lastly, individual electricity consumers can make additional renewable investments on their own using strategies such as installation of onsite solar panels or participation in community solar.

The bylaw would prohibit installation of new fossil fuel piping in new buildings and "significant rehabilitation" of existing buildings. The original proposal had limited exemptions for (1) portable appliances for outdoor cooking and heating (ie., propane barbeque grills), (2) backup electrical generators and (3) the Waldo Durgin project (since that was the subject of a separate negotiation with the Town.) The original proposed effective date was June 1, 2020, but that has been revised to the later of:

1. January 1, 2021
2. 5 months after the Attorney General approves the bylaw

3. The date upon which the SRB is appointed by the Select Board and after a public hearing publishes its procedures and decision criteria.

The proposal does not affect existing piping, boilers, stoves or water heaters. However, in a covered project, the bylaw as originally proposed would prohibit new piping to accommodate relocating any existing appliances. For example, in a covered “gut” renovation project (called a “Significant Rehabilitation” in the bylaw) that includes a kitchen renovation, the homeowner would not be able to install pipes to relocate a gas stove to the other side of the room or to even move it a few inches.

Under the version of Article 21 adopted by the Advisory Committee and accepted by the petitioners, proposal, residential cooking appliances such as ranges, ovens and stovetops would not be covered even in a “gut” renovation, thus allowing renovated kitchens to continue to have gas appliances, no matter where in the kitchen the homeowner wishes to place them.

The petitioners, the Planning and Community Development Department plus various Town Boards and commissions have sponsored or participated in a number of “community feedback” sessions in addition to the normal vetting hearings that take place for Town Meeting warrant articles. As a result of the feedback prior to the Planning and Regulation Subcommittee’s public hearing, the petitioners added additional exemptions for (1) restaurant kitchens, (2) large central hot water systems (with an engineer’s statement) and (3) added a waiver process where it would be otherwise impractical or financially infeasible to go with all electric systems.

Additionally, with input from the Building Commissioner, they have attempted to clarify the definition of significant rehabilitation to generally correspond to a “Level 3” renovation as defined in the Building Code for commercial buildings. Exemptions proposed by others which the petitioners did not accept were (1) an exemption for all cooking, (2) a broad exemption for commercial buildings; (3) including only single family homes, and (4) including only new construction.

#### DISCUSSION:

Electrification of our infrastructure is one strategy to reduce and eventually eliminate our reliance on fossil fuels. Currently, fossil fuels (mainly natural gas in New England) are used to generate a percentage of our electricity, which percentage will decrease over time as more renewable generating sources come on line. No one on the Advisory Committee took issue with the need to reduce our carbon emissions and the electrification strategy. This report will now focus on the details of the proposed bylaw and the practical aspects of the proposal.

When the bylaw was originally submitted, the petitioners listed two exclusions; outdoor cooking and heating appliances and the Waldo-Durgin project. Waldo-Durgin was excluded because it was the subject of a Memorandum of Understanding with the Town

which specifically addressed how the approaches to energy efficiency are to be handled including involving the Town's Sustainability Program Administrator during the design phase.

Note that the bylaw only applies to new construction and so called gut renovations. No one is required to replace any existing gas appliances. Even in a gut renovation, a gas appliance can be replaced; but no new piping can be installed unless there is an exemption. But, in order for this to work, we need to have a sense of reality as to what can be replaced by electric appliances.

#### Heating and Cooling

In New England, space heating consumes the most energy in buildings. In Brookline, the predominant fuel source is natural gas and fuel oil. Many factors contribute to the amount of energy consumed including the efficiency of the heating appliance (furnace, boiler, heat pump, etc.) and how well the building envelope is insulated and sealed. This bylaw only addresses the fuel source, which is only one piece of the equation.

Typically, we think of electric heat as utilizing baseboard resistance heaters, which are cheap to install but very expensive to operate. The preferred electric heat sources now are either ground source or air source heat pumps. Heat pumps can be used for both air conditioning in summer and heating in winter. In winter, the refrigerant absorbs heat from the air outside (or the ground) and uses it to warm the space. Ground source heat pumps use heat drawn from geothermal wells to facilitate heat transfer. Generally, heat pumps are extremely efficient to operate (however as the temperature drops, heat pumps become less efficient and there is a point where they stop working though with today's heat pump they will work to as low as -25F degrees. The Planning and Regulation Subcommittee heard testimony that the industry is moving towards heat pumps as the preferred space heating and cooling technology and it works well for most applications.

Given the variety of commercial building types and their uses, blanket claims of practicality and financial feasibility of the technology for all uses are difficult to substantiate. The Planning and Regulation Subcommittee heard testimony that at least laboratories and certain types of medical offices have higher air circulation and replacement requirements, which heat pumps may not always be able to handle. We also need to balance the Town's critical financial need to be competitive with other communities with respect to promoting development of buildings devoted to medicine and science with its overall goal of reducing greenhouse emissions. The Town is in a unique position to leverage its close proximity to one of the world's great medical/science complexes.

The Advisory Committee therefore proposed, and the petitioner accepted, an exemption for such uses given the difficulty of quantifying the requirements to a degree sufficient to write into a bylaw in the timeframe of this Town Meeting. The failure to have a

lab/medical exemption could work to divert such development to other close-by communities.

#### Domestic Hot Water

For residential and smaller commercial uses, there are practical alternatives to a gas hot water heater. These include traditional resistance and the newer technology heat pump hot water heaters.

For large central hot water systems, there are currently no alternates to the traditional gas hot water heater. Many large buildings are moving away from central hot water to a distributed hot water system, (the water is heated just prior to the using fixture or for a floor or unit in a building.), For systems of this type, there are electric alternatives.

The proposed bylaw does not mandate moving away from a central hot water system, and it implicitly recognizes the lack of alternatives. However, if an alternative becomes available, there is an exemption in the proposal if the alternative is more than 150% of the capital or operating cost of a conventional gas water heater as certified by an engineer. While at first glance a 150% cost differential seems high, remember that the requirement is only in effect for new construction or a “significant rehabilitation,” where hot water will be a very small fraction of the total project cost.

#### Cooking

Cooking is where residents have the most interaction with natural gas. The bylaw, as originally submitted would have prohibited new fossil fuel infrastructure for cooking appliances.

There are two electric alternatives to the traditional gas range and stove top; the standard resistance electric range and the induction electric stove top. While resistance stoves work, they deliver a different, less controllable cooking experience. Induction stoves deliver a controlled cooking experience similar to natural gas but require cookware to be made of a magnetic based material such as cast iron or magnetic stainless steel. Aluminum or copper cookware does not work.

The subcommittee received an email and heard testimony from Dr. Jeffrey Macklis, Professor of Stem Cell and Regenerative Biology, Harvard University, and Professor of Neurology [Neuroscience], Harvard Medical School. Dr. Macklis researched induction stoves when he was considering purchasing one.

“In brief, I found that the EU regulations and analyses show that a single burner on is reasonably safe for an adult user if the pan is of “appropriate”-correct size (completely covering the burner) and is perfectly centered with precision, but that this safety disappears for a pregnant abdomen with fetal head (developing brain) closer than 1 foot away, or a small child whose head (developing brain) would get closer than 1 foot away from the front of a burner. The EU agencies all point out that pregnancy and small children position developing brains directly at the least safe position– adjacent to the cooktop and at its level. That is because the main



risk is within a foot or so (30 cm) of a burner, and electromagnetic field strength from the induction cooktop is limited by EU/Swiss/now US recommendation to approximately 6 uT (microTesla). While essentially all modern residential cooktops meet this standard for a single burner on with an optimally sized pot/pan that is perfectly centered, they fail under “real world” scenarios. Unfortunately exposure with a differently sized pot/pan or one that is not optimally centered is often found to be ~5X higher (>30 uT!) than the regulatory agencies use as their acceptable limit! This even exceeds adult “occupational limits” set by the agencies. If more than one burner is on (e.g. for a normal meal or worst at a Thanksgiving dinner), the leakage around centered or uncentered pans is additive, though some will be further away than others.”

Dr. Jesse Gray, disagreed with Dr. Macklis’s assertions as follows:

“The concern raised here is a hypothetical one, since induction cooktops have been in widespread global use for decades without any demonstrated adverse health effects. No health or consumer protection authorities have banned induction cooktops for health or any other reasons, and there isn’t a single peer-reviewed epidemiological study implicating induction cooking in any negative health impact. The petitioners brought this proposed by-law forward for climate reasons, not health reasons. However, in considering health, the competing technologies must be weighed against each other, since all technology has risks, and people are going to cook with one technology or another. As it stands, there is more substantial evidence about the dangers of gas cooking than there is about induction cooking. Gas cooking kills about 8,000 people every year in the United States due to fire. There are also well-documented health impacts from combustion byproducts of gas cooking, including asthma, that should be weighed against any hypothetical health impacts of induction cooking. These impacts of gas cooking are supported by numerous peer-reviewed epidemiological studies, unlike the speculative induction concerns.”

Given (1) the competing health arguments, (2) the strong feelings by some about gas as a cooking energy source and (3) the unintended effect of prohibiting even small relocations of gas appliances in some kitchen renovations, the Advisory Committee was not prepared to support a complete ban of gas cooking appliances in projects subject to the bylaw at this time, and the petitioner accepted a cooking appliance exemption that includes residential properties.

### Unsafe or Dangerous Condition Exemption

As originally submitted, the bylaw would not have permitted the repair of unsafe or dangerous existing gas infrastructure. An exemption has been added and agreed to by the petitioners.

### Waivers and Appeals

This is a new area with developing technology and an all-electric infrastructure may not be practical or financially feasible in all situations not explicitly exempted by the bylaw. The Advisory Committee proposal creates a waiver and appeal process for these situations.

The Planning and Regulation Subcommittee heard concerns from the Economic Development Advisory Board, with respect to commercial development, the Housing Advisory Board with respect to affordable housing and the Brookline Housing Authority with respect to their properties. For affordable housing in particular, capital funds may be limited to make investing in systems with lower operating costs in the long run difficult.

For all these Boards, a robust and effective waiver and appeal process is an essential component in coming to support the bylaw. The proposal establishes a “Sustainability Review Board” (SRB) to hear and decide waivers and appeals. The bylaw specifies that members shall possess areas of expertise with regards to affordable housing, commercial development, high-performance sustainable design, architecture, and mechanical, electrical, and plumbing engineering plus other technical areas as determined by the Select Board. The bylaw sets a general standard of review but requires the SRB to adopt procedural requirements with regard to filing waivers and appeals and criteria to evaluate projects. And one of the prongs for the effective date of the bylaw is the establishment of SRB and adopting procedures and criteria of review.

### Other Municipal Ordinances

The movement surrounding mandating fossil fuel free infrastructures by municipal ordinance is a new one with the first such ordinance being passed in Berkley, CA on July 16, 2019. To the best of our knowledge, in the United States, only three other municipalities, all located in California, have passed similar ordinances since then. Other municipalities are considering this kind of legislation. All enacted ordinances, to date, cover only new construction and have various exemptions. They are summarized in the chart below:

City	Ord. Name	Summary	Exemptions	Commercial Buildings?
Brookline, MA (Proposed)	Article 21	Bans new fossil fuel infrastructure in all new construction and “Significant Rehabilitation(s).”	<ol style="list-style-type: none"> <li>1. All cooking appliances</li> <li>2. Backup generators</li> <li>3. Outdoor cooking and heating</li> <li>4. Large central hot water heaters</li> <li>5. Waldo Durgin</li> <li>6. Labs and certain medical offices</li> <li>7. Repair unsafe conditions</li> <li>8. Waivers if “financially infeasible or impractical”</li> </ol>	Yes
Berkley CA	Ordinance No. 7.672–N.S.	The Berkley ordinance prohibits natural gas in <b>new</b> buildings. The ordinance is being rolled out gradually as the California Energy Commission (CEC) models different types of all-electric buildings. Currently, the ordinance bans installation of natural gas lines in low-rise residential buildings. As the CEC completes its modeling, the ordinance will expand to include additional building types.	Exemptions possible when a developer can demonstrate that all-electric isn't "physically feasible". There is also a general "public interest exemption" for cases where gas might be in the public interest to install vs. electric.	Eventually



City	Ord. Name	Summary	Exemptions	Commercial Buildings?
San Luis Obispo, CA	Clean Energy Choice Program	The Clean Energy Choice Program "encourages" all-electric <b>new</b> buildings. "Unlike some cities that are banning natural gas entirely, the Clean Energy Choice Program will provide options to people who want to develop new buildings with natural gas. New projects wishing to use natural gas will be required to build more efficient and higher performing buildings and offset gas use by performing retrofits on existing buildings or by paying an in-lieu fee that will be used for the same purpose.	Commercial kitchens are exempt. Various exemptions for "public health and safety" (e.g. hospitals) and an exemption for manufacturing that requires gas (see page 39 of ordinance for full list). The Clean Energy Choice Program also includes a "Public Interest Exemption", which allows the permitting authority to exempt projects should unexpected or unintended effects of the program arise.	Yes
Windsor, CA	Ordinance Adopting All-Electric Reach Code	All-electric requirement for <b>new</b> single-family homes, detached accessory dwelling units, and multi-family buildings up to three stories (also referred to as "low-rise residential")		No
San Jose, CA	Building Reach Code for New Construction	The passed ordinance will ban natural gas in the construction of <b>new</b> accessory dwelling units, new single family homes and new low rise and multifamily buildings.		Yes

City	Ord. Name	Summary	Exemptions	Commercial Buildings?
Menlo Park, CA	Ordinance No. 1057	Heating systems in all new homes and buildings in the city must run on electricity, and all new commercial, office and industrial buildings, as well as high-rise residences, must rely entirely on electricity. Although new one- and two-story homes will be allowed to have natural gas stoves, they must be built “electric ready” with the proper wiring to enable all-electric operation in the future.	Life sciences buildings and public emergency operations centers (e.g. fire stations) need to apply for an exemption, but are eligible. For single family and three stories or less multifamily: Natural gas can still be used for stoves, fireplaces or other appliances if desired (but prewiring for electric appliances is required where natural gas appliances are used.). Nonresidential kitchens, such as for-profit restaurants and cafeterias, may appeal under certain conditions to an appointed body designated by the City Council if they want to use natural gas stoves. The advisory body’s decision can be appealed to City Council.	Yes

What renovations should be covered in addition to new construction?

Other than the Brookline bylaw, all of the bylaws referenced in the chart above cover only new construction. With new construction, the entire project can be planned and designed to maximize energy conservation and take into account the design requirements of all electric systems. Renovations present a set of complications since an all electric system will need to be retrofitted into an existing building envelope which was, in all likelihood, designed around a fossil fuel infrastructure. This only begins to make sense if all the walls are open which would be the case in a so called “gut” renovation. The Advisory Committee worked with the Building Commissioner and other staff in coming up with a legal definition that is understandable, relatively easy to enforce and, hopefully,

minimizes the unintended consequence of creating a trigger where walls are not open to the degree necessary to perform a deep energy efficiency retrofit.

For buildings subject to the commercial building code (residential buildings with 3 or more families plus commercial buildings), there is already a well-defined trigger called a Level 3 renovation when triggered, requires a high degree of code compliance. Building professionals plus the Town Building Department are familiar with this trigger and it is easily computed. For those properties, it makes sense to incorporate a Level 3 renovation into the definition of “Significant Rehabilitation.”

In the residential building code, there is no parallel concept to a Level 3 commercial renovation. Our intent is to use the existing definition of Gross Floor Ratio in the zoning bylaw as the denominator to compute the percentage to define a “Significant Rehabilitation.” Since we do not want to have an inadvertent trigger, we are opting to set the trigger percentage to a very high 75%. As we gain experience with the bylaw and gather data on how it is working, the percentage trigger can be adjusted at a future Town Meeting, if appropriate.

#### Legal issues

In Massachusetts, municipal ordinances cannot supersede the state building code which covers plumbing and other aspects of the building envelope and components. This proposed bylaw is constructed in way that attempts not to supersede the code but it is breaking new ground. As such, according to Associate Town Counsel Jonathan Simpson, there is no history or case law that directly speaks to the legal analysis of whether this bylaw is preempted. However, Mr. Simpson has cautioned that there could be several statutes that may preempt what this bylaw is attempting to do. The Office of the Attorney General (OAG), which reviews bylaws passed at Town Meeting, will not issue preliminary opinions, so the only way to know for sure whether OAG will approve a By-Law such as this, is to pass it at Town Meeting and submit it for OAG review. Even if we receive a rejection from the OAG, we will have gained some clarity as to how to approach this issue in the future. Note that even if the Attorney General approves the bylaw, it would still be subject to challenge by other parties.

#### Effective Date

As noted above, sufficient lead time for homeowners and developers has been provided to adjust their plans to comply with this bylaw.

#### RECOMMENDATION:

By a vote of 21-4 with four abstentions, the Advisory Committee recommends FAVORABLE ACTION on Article 21 as follows:

Voted: That the Town amend the General By-Laws by adopting a new article 8.39 entitled “Prohibition on New Fossil Fuel Infrastructure in Major Construction” as set forth below.

### 8.39.1 Purpose

This By-Law is adopted by the Town of Brookline, under its home rule powers and its police powers under Massachusetts General Laws, Chapter 40, Sections 21 (clauses 1, 18) and 21D, and Chapter 43B, Section 13, to protect the health and welfare of the inhabitants of the town from air pollution, including that which is causing climate change and thereby threatens the Town and its inhabitants.

### 8.39.2 Definitions

“New Building” is defined as a new building or new accessory building (a building devoted exclusively to a use accessory to the principal use of the lot) that is associated with a valid building permit application on or after the Effective Date.

“On-Site Fossil Fuel Infrastructure” is defined as fuel gas or fuel oil piping that is in a building, in connection with a building, or otherwise within the property lines of premises, extending from a supply tank or from the point of delivery behind a gas meter (customer-side of gas meter).

“Significant Rehabilitation” is defined as a renovation project associated with a valid building permit application on or after the Effective Date of this article that:

- (1) For existing structures regulated by the current edition of the Massachusetts State Building Code 780 CMR 51.00, Massachusetts Residential Code, includes the reconfiguration of space and/or building systems, in which the Work Area, not including any added space, is more than 75% of the Gross Floor Area as defined in the Brookline Zoning By-Law;
- (2) For existing structures regulated by the current edition of the Massachusetts State Building Code 780 CMR 34, the Massachusetts State Basic/Commercial Code, includes the reconfiguration of space and/or building systems, in which the Work Area, not including any added space, is more than 50% of the building floor area prior to the project, as defined by the Massachusetts Building Code.

“Sustainability Review Board” (SRB) is defined as a Town Board established and appointed by the Select Board whose members shall, to the extent possible, possess areas of expertise with regards to affordable housing, commercial development, high-performance sustainable design, architecture, and mechanical, electrical, and plumbing engineering and other technical areas as determined by the Select Board. The SRB shall have at least three members with three year staggered terms. The mission charge of the SRB shall be set by the Select Board. The mission charge shall be broad enough to perform the requirements of Sections 8.39.5 and 8.39.6.

“Work Area” is defined as the portions of a building affected by renovations for the reconfiguration of space and/or building systems, as indicated in the drawings associated with a building permit application. Areas consisting of only repairs, refinishing, and/or incidental work are excluded from the Work Area.

### 8.39.3 Applicability

The requirements of this article shall apply to all permit applications for New Buildings and Significant Rehabilitations proposed to be located in whole or in part within the Town as follows.

- A. The requirements of this article shall not apply to utility service piping connecting the grid to a meter, or to a gas meter itself.
- B. The requirements of this article shall not apply to piping required to fuel backup electrical generators.
- C. The requirements of this article shall not apply to piping required for cooking appliances and related appliances.
- D. The requirements of this article shall not apply to the use of portable propane appliances for outdoor cooking and heating.
- E. The requirements of this article shall not apply to the piping required to produce potable or domestic hot water from centralized hot water systems in buildings with floor areas of at least 10,000 square feet, provided that the Engineer of Record certifies that no commercially available electric hot water heater exists that could meet the required hot water demand for less than 150% of installation or operational costs, compared to a conventional fossil-fuel hot water system.
- F. So long as new fossil fuel piping is not installed, the requirements of this article shall not apply to the extension or modification of heating systems via HVAC system modification, or modification of radiator, steam, or hot water piping.
- G. The requirements of this article shall not apply to any building being constructed subject to a Waldo-Durgin Overlay District Special Permit, as described in Section 5.06.4.k of the Zoning By-Law.
- H. The requirements of this article shall not apply to research laboratories for scientific or medical research or to medical offices regulated by the Massachusetts Department of Public Health as a health care facility.
- I. The requirements of this Article shall not apply to repairs of any existing portions of a fuel piping system deemed unsafe or dangerous by the Plumbing and Gas Fitting Inspector.

#### 8.39.4 Effective Date and Enforcement

Upon the Effective Date, no permits shall be issued by the Town for the construction of New Buildings or Significant Rehabilitations that include the installation of new On-Site Fossil Fuel Infrastructure, except as otherwise provided in Sections 8.39.3, 8.39.5, and 8.39.6. As used herein, "Effective Date" shall be the later of (1) January 1, 2021, (2) 5 months after written approval of Article 8.39 is received from the Attorney General's

Office, or (3) the date upon which the SRB has been appointed and, after a public hearing, has adopted procedural requirements with regard to filing waivers and appeals and criteria to evaluate projects under Sections 8.39.5 and 8.39.6.

8.39.5 Waivers

A waiver from Article 8.39 may be sought from the SRB on the grounds of financial infeasibility supported by a detailed cost comparison, inclusive of available rebates and credits, or impracticality of implementation. A waiver request may be made at any time and may be based upon submission of conceptual plans. The SRB shall apply its criteria to evaluate whether particular portions of a project are financially infeasible or impractical to implement under the requirements of Section 8.39 and shall issue waivers narrowly for those portions, where appropriate, rather than for an entire project.

Particular consideration for waivers will be given to projects sponsored by the Brookline Housing Authority (BHA), given the BHA's limited sources of capital funds.

8.39.6 Appeals

An appeal may be sought from the SRB following a denial of a building permit on the grounds that Article 8.39 is not applicable to a project pursuant to Section 8.39.3. Any appeal shall be supported by detailed information documenting the basis of the appeal.

*POV*  
~~207-3-6~~  
211-3-6



Draft Warrant Article re: Fall 2019 Special Town Meeting Warrant Article 21

ARTICLE \_\_\_\_\_. To see if the Town will vote to authorize the Select Board to petition the Massachusetts General Court for special legislation, as set forth below, to (1) ratify the adoption, at the Fall 2019 Special Town Meeting under Warrant Article 21, an amendment to the Town's General By-Laws inserting Article 8.39 entitled "Prohibition on New Fossil Fuel Infrastructure in Major Construction;" (2) authorize the Town to adopt and further amend general or zoning by-laws that regulate natural gas infrastructure; and (3) authorize the Building Commissioner to administer such by-laws, including through the withholding of building permits; provided, however, that the General Court may make clerical or editorial changes of form only to the special legislation, unless the Select Board approves amendments to the bill before enactment by the General Court; and provided further that the Select Board is hereby authorized to approve such amendments that are within the scope of the objectives of this petition:

**AN ACT AUTHORIZING THE TOWN OF BROOKLINE TO ADOPT AND ENFORCE LOCAL REGULATIONS RESTRICTING NEW FOSSIL FUEL INFRASTRUCTURE IN MAJOR CONSTRUCTION.**

Be it enacted as follows:

SECTION 1. Article 8.39 of the Town of Brookline's General By-laws, entitled "Prohibition on New Fossil Fuel Infrastructure in Major Construction," is hereby ratified as adopted pursuant to Warrant Article 21 of the Town's Fall 2019 Special Town Meeting, and shall be in full force and effect as of the effective date of this act.

SECTION 2. Notwithstanding chapter 164 of the General Laws, section 13 of chapter 142 of the General Laws, the State Building Code, or any other general or special law or regulation to the contrary, the town of Brookline is hereby authorized to adopt and further amend general or zoning by-laws that restrict new construction or major renovation projects that do not qualify as fossil-fuel-free, as defined in section 4 of this act..

SECTION 3. Notwithstanding section 7 of chapter 40A of the General Laws, or any other general or special law or regulation to the contrary, the Building Commissioner of the town of Brookline, or any designee thereof, shall be authorized to enforce restrictions on new construction and major renovation projects that do not qualify as fossil-fuel-free, as defined in section 4 of this act, including through the withholding of building permits.

SECTION 4. As used in this act, the term "fossil-fuel-free" shall refer to construction or renovation that results in an entire building or an entire condominium unit that does not utilize coal, oil, natural gas or other fossil fuels in support of its operation.

SECTION 5. This act shall take effect upon its passage.

or to take any other action in relation thereto.

The following passage is from the Governor's Interim Clean Energy and Climate Plan for 2030.



## Chapter 3. Transforming our Buildings

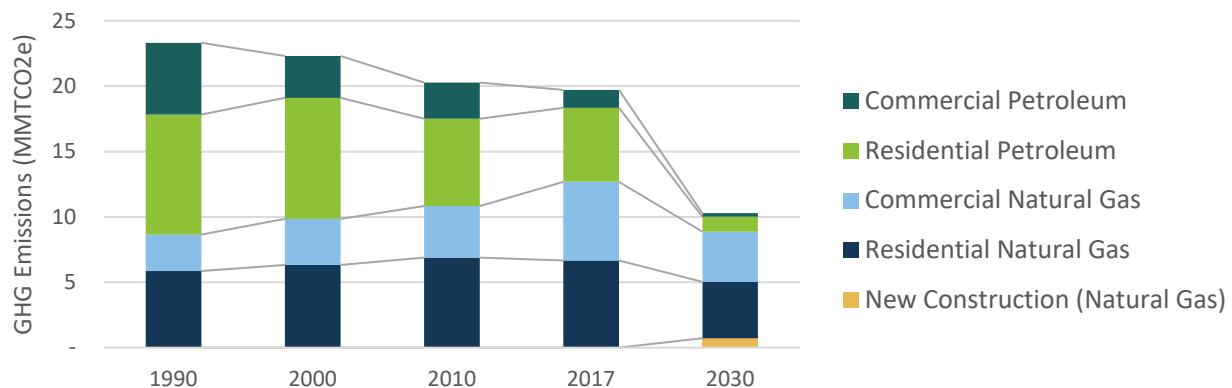
### 3.1. Sector Overview

The buildings sector in Massachusetts is large and diverse, with over two million individual buildings spanning a wide range of construction styles, occupancy needs, ownership, and equipment and with thermal requirements that vary greatly based on building configuration, size, age, and use. Currently, emissions in the building sector are driven by the combustion of fossil fuels on-site for space and water heating. Although emissions in residential and commercial buildings have generally trended downward since 1990 with the deployment of energy efficiency measures, weather variation contributes significantly to annual GHG emissions from the building sector, with longer and colder winters leading directly to more combustion of fuel oil, propane, and natural gas for space heating.

Because of Massachusetts' old building stock and cold winters, buildings currently account for almost a third (27%) of the Commonwealth's statewide GHG emissions, second only to the transportation sector. As a result, increasing building energy efficiency and electrifying end uses, especially heating, represent a significant opportunity to decrease emissions from this sector while reducing homeowner costs and increasing comfort.

In exploring a Net Zero future—including one pathway designed to specifically test the continued widespread use of natural gas, hydrogen, and renewable gas combustion for building services—the 2050 Roadmap pathways converged around the deployment of electrification and envelope efficiency improvements for the vast majority (at least 60% and potentially over 95%) of all buildings in the Commonwealth by 2050. Importantly, to achieve Net Zero in 2050 via either a lower-risk, lower-cost “high electrification” scenario or a higher-risk, higher-cost “decarbonized gas” scenario,<sup>37</sup> the core required transformations in the building sector over the next 10 years are the same. The number of buildings using natural gas, fuel oil, and propane for space and water heating must begin to steadily and permanently decline, and the deployment of heat pumps and building envelope improvements retrofits must become widespread.

Figure 7: Historical and anticipated buildings sector GHG emissions.



<sup>37</sup> These risk and cost dynamics are discussed in detail in Chapter 4 of the 2050 Roadmap report and in the accompanying *Energy Pathways Report* and are subject to unanticipated future technological and market break-throughs that are unknowable today.

### 3.2. Getting to 45% in 2030: ~ 9.4 MMTCO<sub>2</sub>e Reduction

To achieve the 2030 emissions limit and position the Commonwealth to be on a viable pathway to Net Zero in 2050, emissions in the buildings sector must decrease by about 9.4 MMTCO<sub>2</sub>e over the next 10 years, dropping to about 10 MMTCO<sub>2</sub>e sector-wide by 2030 (Figure 7).<sup>38</sup> The reductions modeled above are split proportionally between residential and commercial properties, and require very significant reductions from buildings using high-emitting petroleum-based heating fuels: fuel oil and propane. New construction is projected to increase emissions between now and 2030, but low-cost policies to accelerate efficiency and electrification primarily through a high-performance stretch energy code will greatly reduce the impact from, and future retrofit costs associated with, newly constructed buildings. Electrification of space and water heating and the deployment of building envelope efficiency improvements (additional wall and ceiling insulation, air sealing, better weatherization, new windows) are the primary drivers of emissions reductions.

Transitioning the buildings sector in a strategic and least cost manner is challenging, as it relies on immediately starting to leverage stock-turnover points. The relatively long life of HVAC equipment, often 20-30 years, means that equipment installed in the 2020s may still be in service by 2050. This underscores that sales of electrified and other clean or renewable heating alternatives need to ramp up quickly to take advantage of as many of these transition points—the times during the 2020s when businesses and homeowners will be replacing heating systems—as possible.

About one million residential gas, oil, and propane furnaces and boilers will likely reach their end-of-life between 2021 and 2030. Heat pump systems, which provide both winter heating and summer cooling, are poised to provide a ready, cost-effective 2050-compliant replacement as they can provide efficient heating in cold climates even at outdoor temperatures as low as -15°F. This transition will also provide opportunities for households to install high efficiency air conditioning at no additional cost, which is increasingly important in a warming climate. However, only a limited number of HVAC installers in Massachusetts have significant experience with using heat pumps as a whole home primary heating systems.

Transitioning to a heat pump HVAC system will have varying impacts on consumer energy costs. Households heating with higher cost heating fuels (like oil and propane) will likely have similar or reduced total heating costs immediately, while those currently using natural gas for heat may see marginal cost increases in the near term that in most cases can be fully offset by future operating cost savings. This consumer cost discrepancy is of particular concern regarding low-income households, where any increase in energy cost, even if temporary, has the potential to result in financial hardship. Despite potential near-term impacts for current natural gas customers, widespread deployment of heat pump systems will translate to overall societal cost savings in the coming decades.

In commercial buildings, about 40% of HVAC equipment is also expected to retire in the next decade. The 2050 Roadmap analysis indicates that for many of these buildings, heat pump systems will be the least-cost decarbonization option, although the diversity of applications and scale in the commercial sector will require

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<sup>38</sup> The substantial emissions reductions required in the 2020s for the building sector reflect a 2050-compliant “on-pace” number of stock-rollover building conversions initially focused on higher per-conversion emissions reductions from fuel oil to heat pump transitions together with structural, non-jurisdictional limits on the pace of electrification in the transportation sector.

the use of a range of clean heating solutions. As is the case for residential buildings, these commercial replacements represent both the key opportunity for, and the key check on the pace of, cost-effective emissions reduction by 2030.

As building owners deploy heat pumps and other clean heating solutions, it will be very advantageous to simultaneously perform (or have previously performed) a deep energy efficiency upgrade to the building envelope – its windows, siding, insulation, and roofing. As with other building systems, however, the components of a building’s envelope similarly “turn over” infrequently, needing to be replaced only after decades of service or as part of a voluntary renovation. Assessing and coordinating stock-turnover and investment opportunities for any residence or business, therefore, will be essential to any specific implementation strategy. Table 4 summarizes the buildings sector transformations, policies, and associated GHG reductions, explored through the rest of this chapter. Detail on each of the numbered strategies and actions can be found in the section to follow.

*Table 4: Buildings Sector—illustration of the most likely, cost-effective, and technological feasible approaches to achieve the emissions reduction expected and required by this plan (incorporating background trends and other known or expected non-policy related changes).*

<b>Buildings</b>				
<b>Equipment or Subsector</b>	<b>Metric</b>	<b>Strategy</b>	<b>Action</b>	<b>GHG Emissions Reduction</b>
<b>Thermal Electrification</b>	Electric space heating deployed across approximately one million households and 300-400 million square feet of commercial real estate.	B2	Incentivize and Enable Heat Pump Adoption	6.8 MMTCO <sub>2</sub> e
		B3	Heating Fuel Emission Cap	
<b>Decarbonized Fuel Blending</b>	Consistent with diesel fuel in the transportation sector, fuel oil blended to achieve a ~ 20% reduction in carbon intensity by 2030. Pipeline natural gas reduced in carbon intensity by 5%.	B3	Heating Fuel Emission Cap	2.1 MMTCO <sub>2</sub> e
<b>Building Envelope</b>	20% of building stock receives a deep energy retrofit, representing about three-quarters of all replacement points for windows, roofs, etc.	B2	Realign Mass Save® incentives	1.3 MMTCO <sub>2</sub> e
		B3	Heating Fuel Emission Cap	
<b>New Construction</b>	A high-performance, passive-house level of envelope efficiency building code will contribute to the metrics above supporting heating fuel emissions caps.	B1	Building Code	(0.8) MMTCO <sub>2</sub> e*
		B3	Heating Fuel Emission Cap	
<b>Buildings Subtotal</b>				<b>9.4 MMTCO<sub>2</sub>e</b>
*Negative reduction indicates an increase – this reflects partial mitigation of emissions growth				

## Strategies & Policies

### Strategy B1: Avoid Lock-In of Building Systems That Are Not 2050-Compliant

Building stock turns over slowly, and virtually all buildings constructed in the 2020s are expected to still be operational in 2050. Limiting the number of new buildings and building energy systems that must later be retrofitted and limiting new emissions and emission sources added in the buildings sector are necessary to achieve both 45% in 2030 and Net Zero in 2050. This means avoiding new infrastructure or construction that is based on fossil-fuels for heating which would not be 2050 compliant, as well as ensuring that new equipment and products within buildings are on the path towards 2050 compliance.

**High-performance stretch energy codes**, which focus on deep efficiency and electrification, represent a key priority to ensure newly constructed buildings are built to minimize emissions. Highly efficient building envelopes can typically be obtained for little to no incremental cost when constructing a new building. Installing heat pumps or other clean heating solutions in new buildings can maximize the effectiveness of the equipment while minimizing costs. New construction in the 2020s is projected to produce approximately one billion square feet of additional building space in Massachusetts by 2030. Without improving building envelopes over the current baseline building code, where the current fossil fuels are the primary source for heating, those new buildings would likely result in annual demands of about 45 trillion additional BTUs of fossil fuels (almost all natural gas), and more than 2 MMTCO<sub>2e</sub> per year in additional GHG emissions by 2030.

#### **B1 Strategy Actions:**

- DOER will present a new high-performance stretch energy code to the Board of Building Regulation and Standards in 2021 that allows for Green Communities to opt in starting in 2022 and will become mandatory and effective statewide no later than January 1, 2028.
- DOER will work to eliminate Mass Save® incentives for fossil fuel equipment in new construction in 2022 and align incentives with a high-performance building code including incentives for Passive House construction.
- EEA will support establishing state appliance standards by statute. DOER will work to support similar action at the federal level.

Using a phased approach—one that allows Green Communities to opt-in to a new, high-performance stretch energy code requiring passive-house level building envelope efficiency starting in 2022, and that is effective as the statewide energy code no later than 2028—will allow the building design and construction industry to transition while capturing up to 50% or more of all square feet built between 2022 and 2030. Such an approach has the potential—given reasonable forecast uncertainties, particularly regarding the variety of possible commercial sector energy uses—to cut new building energy use in half, resulting in significant cost savings for building owners and occupants and in GHG emissions reductions of more than 1 MMTCO<sub>2e</sub> per year

by 2030 compared to the status quo.<sup>39</sup>

Looking directly at end-uses installed in buildings, it is increasingly important to ensure that any new equipment or products are as energy efficient as possible. For products with potentially shorter lives—such as dehumidifiers or consumer electronics—improving efficiency through **federal and state appliance standards** will help the Commonwealth meet the 2030 emissions reduction target as well as set up a product development cycle whereby product improvements and innovation push towards more efficient and lower-cost products for all.

### Strategy B2: Pivot the Market for Building Envelope Retrofits and Clean Heating Systems

To achieve emissions reductions of 45% below 1990 levels in 2030 and Net Zero in 2050, the deployment of electric and other clean HVAC systems, as well as building envelope improvement retrofits across the existing building stock, must rapidly scale. Although the strategies presented herein will allow for other actions to help achieve required emissions reductions, the lowest-cost strategies identified in the 2050 Roadmap called for the deployment of heat pumps in the vast majority of the Commonwealth's three million residential households, a combination of electrification solutions for commercial buildings, and building envelope upgrades reaching about 75% of all building shells by 2050. This represents a significant challenge to be undertaken over the next 30 years, and, because new equipment installed in the next ten years is likely to still be in service by 2050, highlights the importance of not deferring deployment of these solutions. As part of that deployment, the biggest cost-savings and emissions reduction opportunity in the next decade is the simultaneous electrification of high-cost, high-emissions fuel oil heating systems together with the deployment of building envelope efficiency upgrades in older homes.

**Mass Save®**, the statewide efficiency program, is one tool primed to help drive the near-term delivery and installation of decarbonization technology as additional programs and policies are developed. In order to better align Mass Save® with the state's GHG emissions reduction targets and requirements, DOER will work with the Commonwealth's Energy Efficiency Advisory Council (EEAC) and Mass Save® program

#### **B2 Strategy Actions:**

- DOER will work to phase out incentives for fossil fuel heating systems as soon as possible, limiting fossil fuel heating system incentives in the 2022-2024 Three Year Plan, and ending all fossil fuel heating system incentives by the end of 2024.
- DOER will work to increase electrification through Mass Save® programs through air source and ground source heat pump incentives and consumer education in 2022-2024.
- DOER will work to expand access to energy efficiency and clean heating for low- and moderate-income renters and homeowners in EJ communities through targeted community-based incentives and outreach programs, and increased funding for pre-weatherization barriers.
- EEA and DOER will seek near-term means to enhance MassCEC funding to support continued market development for building decarbonization.
- MassCEC will refine and enhance workforce development programs related to building decarbonization and will investigate the need for air-source heat pump certification and workforce training.

<sup>39</sup> The COVID-19 pandemic adds significantly to uncertainty in the new construction industry, as new development patterns may not reflect previous population forecasts nor will distribution of housing and commercial typologies necessarily reflect previous patterns.

administrators with the goal of ensuring that the cost of long-term GWSA compliance is included in all program cost-benefit calculations, incentives for fossil-fuel heating systems are limited during the program's next 3-year cycle (2022-2024), and all available program resources are directed to clean heating systems no later than the end of 2024. DOER will also work to ensure that Mass Save® develops increased air source and ground source heat pump incentives and consumer education in 2022-2024 and expands access to energy efficiency and clean heating for low- and moderate-income renters and homeowners in Environmental Justice communities through targeted community-based incentives and outreach programs, and increased funding for pre-weatherization barriers.

In addition to Mass Save® driving near-term market adoption, there are other programs through municipal utilities, non-profits, municipalities, and MassCEC that can and must continue to focus their attention on **incentivizing and enabling heat pump adoption and building envelope improvements**, especially in residential buildings, which represent the single biggest source of building emissions in Massachusetts. MassCEC will continue to expand market development initiatives to demonstrate cost-effective building decarbonization solutions; engage, educate, and facilitate consumers and communities to increase the breadth and depth of adoption; and work with industry to facilitate development of the technologies, workforce, practices, and business models needed to achieve this aggressive trajectory of building decarbonization. MassCEC will also work in conjunction with Mass Save® to establish and implement strategies to increase heat pump adoption, enhance realization of consumer benefits for households and communities that are underrepresented in building decarbonization (including those that are low- and moderate-income, renters, minorities, and limited English language proficiency) and develop innovative solutions that can be scaled.

Broader **consumer education** around the need for, and the benefits of, building electrification has the potential to help inform wise investments over the next ten years. DOER has developed a **Home Energy Scorecard** that works with both the U.S. Department of Energy Home Energy Score designed for existing homes and the Residential Energy Services Network (RESNET) Home Energy Rating System (HERS) ratings used in most newer homes and, if implemented, would help inform homeowners and renters alike of the potential improvements in efficiency and GHG reduction opportunities in their homes.

### Strategy B3: Convene the Commission and Task Force on Clean Heat & Cap Heating Fuel Emissions

Decarbonizing over two million individual buildings in Massachusetts is an immense challenge in terms of scale and logistics. While the 2050 Roadmap and other similar studies have found air-source heat pumps to be the most economical clean heating solution for almost all single-family homes and other small residential buildings, the diverse building stock in Massachusetts will require a range of options. There is not a one-size-fits-all solution, and not every building in Massachusetts can currently be cost-effectively electrified. Nevertheless, the current level of natural gas use for building heating and the continued use of petroleum heating oil is inconsistent both with achieving Net Zero in 2050 and a 45% reduction from the 1990 baseline in 2030.

Given the urgency and difficulty of meeting our goals in the buildings sector, by 2023 the Commonwealth will impose a **long-term, declining caps on heating fuel (gas, oil, propane) emissions**. In 2021, the Commonwealth will convene a special Commission on Clean Heat supported by an EEA-led, cross-secretariat, inter-agency Task Force on Clean Heat.

With consideration given to differences across the state, the Commission and Task Force will make a recommendation to EEA before the end of 2021 regarding the structure and levels for long-term emissions caps on heating fuels consistent with the findings of the 2050 Roadmap, the 2030 emissions limit, and this plan. By the end of 2022 and after considering the findings of the related, on-going DPU investigation,<sup>40</sup> the Commission and Task Force will propose the **statutory, regulatory, and financing mechanisms** needed to ensure the development of reliable and affordable clean heat solutions for the Commonwealth's buildings.

**B3 Strategy Actions:**

- The Baker-Polito Administration will convene a Commission and Task Force on Clean Heat by May 2021.
- MassDEP will develop and implement by 2023 a long-term declining emissions cap on heating fuels following consultation in 2021 with the Commission and Task Force on Clean Heat regarding the cap structure and levels consistent with meeting or exceeding GWSA required emissions reduction levels.
- The Commission and Task Force on Clean Heat will propose, by 2023, statutory, regulatory, and financing mechanisms needed to ensure the development of reliable and affordable clean heat solutions for the Commonwealth's buildings.

In addition to the structure and levels for long-term emissions caps on heating fuels, and the findings of the on-going DPU investigation working to safely and equitably align utility business models with the achievement of Net Zero in 2050, additional issues for consideration by the Commission and Task Force include:

- Innovative utility business models to affordably deploy clean heating systems and deep energy retrofits;
- Zero up-front capital solutions for low income and affordable housing residents;
- Performance and reporting standards and requirements for large, commercial, and industrial buildings;
- Long-term financing mechanisms to support and enable building decarbonization;
- Potential for sustainable and cost-effective market deployment of biofuels, renewable natural gas, and hydrogen for space heating;
- Market support for air- and ground-source heat pumps and other clean heat solutions;
- Supply chain and workforce development;
- Transparency, benchmarking, labeling, and rental standards.

\* \* \*

While other sectors in this report are presented with an emissions range, representing both uncertainty and a greater level of program optionality, driving the most aggressive pace possible in the building sector represents a key element to position the Commonwealth to achieve Net Zero by 2050 given the slow pace of building equipment turnover. The holistic sector caps identified here establish the boundaries of the emissions reductions the Commonwealth must achieve without dictating the means by which it will do so. This stands in contrast, for example, to more technology-specific policies discussed in the Transportation Sector, in which the

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<sup>40</sup> DPU 20-80, investigation by the Department of Public Utilities on its own Motion into the role of gas local distribution companies as the Commonwealth achieves its target 2050 climate goals.



relatively shorter lifespans of LDVs affords more flexibility to allow the ZEV market to scale more organically. The Commission and Task Force's work to recommend specific cap levels and the implementation approaches to reach them, will be undertaken with the understanding that the level of required emissions in the Building Sector implicates not only the ability of the Commonwealth to achieve 45% in 2030, but also its ability to achieve Net Zero in 2050.

INTERIM



AGB draft, 10.2.20

To: Public Facilities Committee  
From: Ann Berwick, Co-Director of Sustainability  
Re: Relative Cost of Gas versus Heat Pump System for New Residential Construction  
Date: October 5, 2020

I've tried here to answer four questions for **new residential construction**<sup>1</sup>:

1. Which is more expensive to purchase and install: a gas-fueled<sup>2</sup> or an electric heat pump system for heating, cooling, and hot water?
2. What are the relative annual operating costs of these systems?
3. If only a water heater is installed, is a heat pump or gas water heater more expensive?
4. On this stand-alone basis, how do the annual operating costs of these hot water heaters compare?

### **Executive Summary**

It's impossible to give a precise answer to these questions. Everyone who tries to estimate these costs, as well as studies of the issue, make different assumptions (for example, size and design of the house, local labor costs, local climate, amount of home insulation, quality of system installed, future prices of gas versus electricity).

That said, here's what various estimates tell us about heat pump technology in new residential construction:

- Equipment/installation costs for gas versus heat pump heating, cooling, and hot water systems are comparable.
- Annual operating costs for a heat pump heating, cooling, and hot water system is probably at least \$500 more than for a gas system. That is largely a function of the relative cost of electricity and natural gas.
- Equipment/installation costs for a gas versus a heat pump water heater, on a stand-alone basis, are hard to determine. This is the area where the estimates are least aligned, perhaps because I've been able to find more estimates for water heaters than for whole system installations.

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<sup>1</sup> For both annual operating costs and installation costs, it is important to note that estimates refer to new home construction and not to retrofits.

<sup>2</sup> Throughout, the comparison is of gas to heat pumps. No one would build a new home in Newton using oil or propane for heating. Heat pumps would always win on cost as compared to these other fuels.

- Comparing a more commonly used tank variety water heater to a heat pump water heater, the heat pump is more expensive by about \$1,000 to \$1,400.
  - Comparing a less commonly used tankless type of gas water heater to a heat pump water heater, by some estimates the gas heater is more expensive.
- Annual operating costs for a gas versus heat pump water heater, on a stand-alone basis, are very similar.

I draw two overall conclusions:

1. An expert from New Ecology, Inc.<sup>3</sup> opined to me, “There is more variability among the gas and electric system options than there is between the two on price.” This seems to me, when all is said and done, the most useful conclusion.
2. Heat pump technology is not, given current policy, a money-saver; nor are its additional costs, if any, burdensome in the context of new home construction in Newton (at well less than 1% of annual home ownership costs). Of course, all of these cost comparisons could look quite different—and more favorable for heat pump technology—with a price on carbon and a greener electric grid.

## Discussion

These are my information sources:

- Jeremy Koo (Cadmus Group) and Jesse Gray (Brookline Town Meeting member) presented their estimates to the Public Facilities Committee of the Newton City Council.
- The NMR Group published a report on the relative costs of gas versus heat pump systems (based on new home construction in Worcester)<sup>4</sup>.
- Bill Ferguson estimated costs separately from these three, based on empirical inquiry as opposed to modeling. (Bill’s estimates are for installation, but not annual operating expenses.)
- For different types of water heaters, Consumer Reports gives equipment, purchase, and operating costs<sup>5</sup>.
- I spoke with various energy experts.

However, it emerged that both Jeremy’s and Jesse’s estimates derive from the same NMR report, although they contain significant adjustments: in Jeremy’s case, for labor costs in

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<sup>3</sup> Email communication from Tom Chase, New Ecology, Inc., to Ann Berwick, July 29, 2020.

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<sup>5</sup> “Tankless Water Heaters vs. Storage Tank Water Heaters,” Consumer Reports, January 25, 2019, <https://www.consumerreports.org/water-heaters/tankless-water-heaters-vs-storage-tank-water-heaters/>.

Newton (as compared to labor costs in Worcester, as modeled in the NMR report) and for ducting<sup>6</sup>; in Jesse's case, for the availability of State rebates and incentives.

I also reviewed the Rocky Mountain Institute (RMI) report, *The Economics of Electrifying Buildings* (2018)<sup>7</sup>, and discussed the relative cost issues with staff at New Ecology, Inc. and with other experts.

### **Equipment/installation costs for gas versus heat pump heating, cooling, and hot water systems**

Although I cannot answer the question precisely as to which system costs more to install in a new home, here's the available information:

- As among the estimates in Table 1 *for a heat pump system*, NMR's/Jesse's (approximately \$12,000) and Bill's (\$14,160)<sup>8</sup> are the most closely aligned. Jeremy's (\$23,300) is an outlier. Note that NMR's/Jesse's estimates derive from modeling and that Bill's are empirical, which should increase confidence in the estimates. It's possible that Jeremy over-adjusted for the cost of ducting/labor as between Worcester and Newton, in his (explicit) effort to be conservative.
- For a *gas system* as shown in Table 1, and putting aside Jeremy's high number for a gas system, the estimates range from \$11,700 to \$16,700. **In other words, the installation costs of the heat pump and gas systems are comparable.**
- There are at least two reasons why all of these estimates—and not just Jeremy's—may be on the high side for a heat pump system:
  - None of these estimates takes into consideration the cost of a gas hook-up, which a new all-electric home could avoid.<sup>9</sup>

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<sup>6</sup> This includes a significant increase in total labor hours needed to install a new whole-building ductwork system (determined through RSMMeans and in consultation with Newton building experts), and an adjustment in labor costs to reflect the higher cost of labor in Newton compared to Worcester as assumed in the original NMR study (sourced from RSMMeans City Cost Index 2020).

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<sup>9</sup> Most streets in Newton already have gas infrastructure, so the cost of a gas hook-up that could be avoided for an all-electric house is for a gas "service," not a gas main (highly variable for a service, but estimated at between \$1,500 and \$3,000).

- At least at present, Massachusetts rebates for heat pumps are higher than for gas systems.<sup>10</sup>
- As discussed in the section below on water heaters standing alone, NMR's and Jeremy's estimates include the assumption that the water heater is the tankless variety.

### **Annual operating costs for gas versus heat pump heating, cooling, and hot water systems**

As for annual operating costs, it appears that Jesse and Jeremy relied solely on the NMR report, concluding that **the heat pump system costs \$500 more per year than the gas system.** (Bill does not provide estimates for annual operating costs.) This is a function of the relative price of gas versus electricity. Gas prices are currently low, but it is difficult to predict the future price differential. Experts I've discussed this with believe this number may be on the slightly low side.

By contrast, one other observation comes from the Rocky Mountain Institute report, *The Economics of Electrifying Buildings* (2018), which concludes: "In many scenarios, notably for most new home construction,... **electrification reduces costs over the lifetime of the appliances** when compared with fossil fuels" (emphasis added). Table 2 reflects this, with cost estimates based on the city in the RMI study with a climate most similar to Newton's, i.e., Providence, RI. The RMI estimates suggest that electrification is cost-competitive with gas for new residential construction. However, we are aware that some of its assumptions are optimistic, e.g., for the installed cost of heat pumps.

### **Equipment/installation costs for gas versus heat pump water heater, on a stand-alone basis**

The equipment and installation cost estimates for a gas water heater, whether a tank or a tankless variety, versus a heat pump hot water heater are, frankly, hard to interpret.

The gas water heater cost estimate in the NMR report (\$2,512) is based on the less commonly used tankless heater as opposed to the more familiar tank variety. Consumer Reports' estimate for the purchase and installation of a tankless hot water heater is \$1,987. Consumer Reports' and Bill's estimates for a tank variety water heater are \$1,300 and \$1,700, respectively. Tankless water heaters are less common but growing in popularity, according to Consumer Reports. Thus, it seems clear that the NMR report, and Jeremy, are on the high side for the type of water heater that is most commonly installed.

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<sup>10</sup> I have not included the availability of rebates in the calculations, because they may vary substantially over relatively short time periods.

For heat pump water heater equipment/installation, the numbers range from approximately \$1,600 (Consumer Reports and NMR) to \$2,700 (Bill), but experts I've conferred with seem to think that Bill's estimate is more accurate. I've been unable to explain the magnitude of this difference. If Bill's estimate is correct, a heat pump hot water heater is more expensive than both tank variety and tankless hot water heaters. If NMR is more accurate for a heat pump hot water heater, then the costs of a gas water heater and heat pump water heater are comparable, even using Bill's relatively high estimate for a heat pump water heater.

### **Annual operating costs for gas versus heat pump water heater, on a stand-alone basis**

As appears from Table 3, the annual operating costs for a gas water heater, whether a tank or tankless variety, as compared to a heat pump water heater, are extremely close.

### **Conclusion**

Having struggled to reconcile these various estimates, I think that to some extent the search for precision obscures rather than elucidates the meaningful conclusions.

From the discussion above, here's what the numbers tell us:

- Equipment/installation costs for gas versus heat pump heating, cooling, and hot water systems are comparable.
- The annual operating cost for a heat pump heating, cooling, and hot water system is probably at least \$500 more than for a gas system. That is largely a function of the relative cost of electricity and natural gas.
- Equipment/installation costs for a gas versus a heat pump water heater, on a stand-alone basis, are hard to determine. This is the area where the estimates are least aligned, perhaps because I have more estimates.
  - If we use Bill's figure for a gas water heater, assume the tank heater variety and, conservatively, use Bill's figure for a heat pump water heater, the heat pump heater is \$1,000 more expensive than the gas water heater.
  - If we use Consumer Reports' figure for a gas water heater, assume the tank heater variety and, conservatively once again, use Bill's figure for a heat pump water heater, the heat pump heater is \$1,400 more expensive.
  - However, according to some estimates, the heat pump water heater is less expensive than the tankless type of gas water heater, by varying amounts.
- Annual operating costs for gas versus heat pump water heaters, on a stand-alone basis, are very similar.

In all cases, the differences in cost are minimal when taken in the context of an important point that Jeremy makes. Recall that what we are discussing here is new construction. The median

price of a new home in Newton is approximately \$1.2 million.<sup>11</sup> Jeremy's calculations, which use his cost estimates for a gas versus mini-split heat pump system (which, as already noted, are higher than the other projections included here), estimate the annual cost of homeownership (including heating, cooling, water, sewer, electricity, insurance, property taxes, mortgage) for a gas home is \$72,969, as compared to \$73,544 for an all-electric home. This estimate implies a difference of \$575 in annual home ownership costs, or 0.78% of yearly homeownership costs. We emphasize that this is using Jeremy's cost estimate for a heat pump system, which is higher than the other estimates. In other words, whatever difference, up or down, exists between the costs of a gas and a heat pump system for a new home is extremely small compared to the annual costs of homeownership in Newton. This observation does not take into consideration the point made above, that a price on carbon and a greener electric grid would be favorable for the cost of heat pump technology.

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### Cost Estimate Tables

To the extent possible, the cost estimates that follow in the tables below are for a single-family home that complies with the Massachusetts Stretch Energy Code, with two floors, an unfinished basement, and 2,500 square feet of living space.

**Table 1: Cost comparison, installation and annual, for gas vs. ducted heat pump heating and cooling, and hot water**

	<b>Gas furnace and hot water, with central AC, installed cost</b>	<b>Heat pump system, installed cost</b>	<b>Difference in installed costs</b>	<b>Gas furnace and hot water, with central AC, annual cost</b>	<b>Heat pump system, annual cost</b>	<b>Difference in annual costs</b>
<b>Gray/Brookline</b>	\$11,700	\$12,100 adjusted to remove rebates)	Heat pump system \$400 more expensive	\$1,500	\$2,000	Heat pump system \$500 more expensive

<sup>11</sup> This figure appears to refer to new home sales in Newton, not to new construction alone. Many newly constructed homes in Newton are much larger than the existing homes sold, making Jeremy's estimate of the cost of an all-electric home as a percentage of the cost of home ownership likely to be conservative. However, his estimate is close enough for the purposes of the point made here.

<b>NMR report,</b> tankless water heater	\$11,724	\$12,478	Heat pump system system \$754 more expensive	\$1,511	\$2,007	Heat pump system, \$496 more expensive
<b>Koo/Newton,</b> tankless water heater	\$20,000 (adjusted for ductwork labor costs)	\$23,300 (adjusted for ductwork labor costs)	Heat pump system \$3,300 more expensive	\$1,511	\$2,007 (\$1,362 with solar)	Heat pump system \$496 more expensive
<b>Bill's estimates,</b> Rheem 50-gal tank style ( no annual cost estimates provided)	\$16,700	\$14,160	Heat pump system \$2,540 less expensive	Not provided	Not provided	

**Table 2: Another point of comparison (net present costs) for gas versus heat pump heating, cooling, and hot water**

	<b>Gas system</b>	<b>Heat pump system</b>	
<b>RMI REPORT COMPARISON OF 15-YEAR NET PRESENT COSTS OF WATER HEATING AND SPACE CONDITIONING FOR PROVIDENCE RI (THOUSAND \$)</b>	\$16,600	\$14,300	Heat pump system \$2,300 less expensive net present costs

**Table 3: Cost comparison, installation and annual, for gas vs. heat pump hot water, stand-alone installation**

	Gas water heater, installed cost	Heat pump water heater, installed cost	Difference in installation costs	Gas water heater, annual cost	Heat pump water heater, annual cost	Difference in annual costs
<b>Gray/Brookline</b> (no separate water heater costs provided)						
<b>Bill's estimates,</b> Rheem 50-gal <b>tank style</b> gas (no annual cost estimates provided)	\$1700	\$2,700	Heat pump \$1,000 more expensive	Not provided	Not provided	
<b>NMR report (tankless gas)</b>	\$2,512 <sup>12</sup>	\$1,680	Gas heater \$832 more expensive	\$127	\$146	Heat pump \$19 more expensive
<b>Koo/Newton (tankless gas)</b>	\$2,900 <sup>10</sup>	\$1,800	Gas heater \$1,100 more expensive	\$127	\$146 (\$99 with solar)	Heat pump \$19 more expensive (Heat pump \$28 less expensive with solar)
<b>Consumer Reports (tankless gas)</b>	\$525-\$1,150 plus \$800-\$1,500  Median = \$1,987	\$1,200 for equipment but doesn't specify installation amount	Difficult to ascertain, because installation cost not included	\$195	\$240	Heat pump \$45 more expensive
<b>Consumer Reports (tank style gas 50-gal)</b>	\$600 plus \$700 = \$1,300	\$1,200 for equipment but doesn't specify	Difficult to ascertain, because installation	\$245	\$240	Gas \$5 more expensive

<sup>12</sup> However, Jeremy's view is that for a tank style as opposed to a tankless hot water heater, Bill's estimate is "close" to what he "would guess." Email communication to Ann Berwick, September 15, 2020.



		installation amount	cost not included			
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TO: Public Facilities Committee  
FROM: Councilors Alison Leary & Emily Norton  
RE: Building Electrification: Next Steps  
DATE: February 17, 2021

The Public Facilities Committee has been discussing the concept of building electrification since December 2019, because replacing fossil fuels with renewable sources of energy is a key strategy for reducing greenhouse gas emissions.

- The Newton Climate Action Plan (adopted 2019) lists building electrification as an important component to fight climate change and achieve net zero greenhouse gas emissions by 2050.
- Building electrification is referenced in Governor Baker's [Interim Clean Energy and Climate Plan for 2030](#): "increasing building energy efficiency and electrifying end uses, especially heating, represent a significant opportunity to decrease emissions from this sector while reducing homeowner costs and increasing comfort."

Over the last year we have held meetings with speakers discussing high efficiency electric powered heating and cooling technologies and their relative costs. From these presentations it is clear there are many technologies available for heating one's home and/or water. As Sustainability Co-Director Ann Berwick's October 5, 2020 memo lays out, the cost estimates were quite varied, but as we are only talking about new construction and major renovations, the cost differential for heat pump technologies versus gas-fired combustion is well under 1% of the annual operating costs of a new home in Newton. In addition it is expected that over time costs for heat pumps will come down with increased market demand, as they have for all other new technologies (computers, cell phones, solar panels, wind turbines).

### **Possible Next Steps**

The City Council may initiate a home rule petition.

One of the options we discussed early on in committee was to seek an ordinance requiring that new construction and major renovations use only electric-powered, high efficiency heating technologies (i.e., heat pumps) to reduce or eliminate the on-site combustion of fossil fuels (oil or natural gas). Unfortunately it appears Newton does not have authority under State law to take such a step, as evidenced by Attorney General Healey striking down [Brookline's by-law](#) requiring electrification in new construction.

What the City Council may do is send a home rule petition to the State Legislature requesting authority for the City of Newton to pass an ordinance requiring the electrification of heating and cooling in new construction and significant renovations. Arlington and Brookline have already approved Home Rule petitions. Lexington, Acton, Concord, and Belmont are moving forward. A couple of others cities are moving forward as well, but don't have confirmed dates for consideration.

Anyone following the recent news might reasonably ask, “Will a net-zero stretch code obviate the need for a building electrification ordinance?” The state legislature voted in favor of an ambitious climate change bill in December that was subsequently vetoed by Governor Baker, but the legislature recently [approved the same Bill](#). It was approved by a veto-proof majority so it will likely pass, although possibly with amendments. It includes a directive to create a “net-zero” stretch code, but this code would not necessarily eliminate the need for an electrification requirement. This is because, at one end of the spectrum, a net-zero stretch code could be written so as to explicitly require electrification; at the other end, a net-zero code could allow low-value offsets to compensate for significant on-site deficits. It is highly unlikely that a net-zero code will require electrification, and likely that it will include a good deal of flexibility.

The Council should consider whether it wishes to initiate a home rule petition, along with several neighboring communities.

AGB draft, 10.2.20

To: Public Facilities Committee  
From: Ann Berwick, Co-Director of Sustainability  
Re: Relative Cost of Gas versus Heat Pump System for New Residential Construction  
Date: October 5, 2020

I've tried here to answer four questions for **new residential construction**<sup>1</sup>:

1. Which is more expensive to purchase and install: a gas-fueled<sup>2</sup> or an electric heat pump system for heating, cooling, and hot water?
2. What are the relative annual operating costs of these systems?
3. If only a water heater is installed, is a heat pump or gas water heater more expensive?
4. On this stand-alone basis, how do the annual operating costs of these hot water heaters compare?

### **Executive Summary**

It's impossible to give a precise answer to these questions. Everyone who tries to estimate these costs, as well as studies of the issue, make different assumptions (for example, size and design of the house, local labor costs, local climate, amount of home insulation, quality of system installed, future prices of gas versus electricity).

That said, here's what various estimates tell us about heat pump technology in new residential construction:

- Equipment/installation costs for gas versus heat pump heating, cooling, and hot water systems are comparable.
- Annual operating costs for a heat pump heating, cooling, and hot water system is probably at least \$500 more than for a gas system. That is largely a function of the relative cost of electricity and natural gas.
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- Comparing a more commonly used tank variety water heater to a heat pump water heater, the heat pump is more expensive by about \$1,000 to \$1,400.
  - Comparing a less commonly used tankless type of gas water heater to a heat pump water heater, by some estimates the gas heater is more expensive.
- Annual operating costs for a gas versus heat pump water heater, on a stand-alone basis, are very similar.

I draw two overall conclusions:

1. An expert from New Ecology, Inc.<sup>3</sup> opined to me, “There is more variability among the gas and electric system options than there is between the two on price.” This seems to me, when all is said and done, the most useful conclusion.
2. Heat pump technology is not, given current policy, a money-saver; nor are its additional costs, if any, burdensome in the context of new home construction in Newton (at well less than 1% of annual home ownership costs). Of course, all of these cost comparisons could look quite different—and more favorable for heat pump technology—with a price on carbon and a greener electric grid.

## Discussion

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Newton (as compared to labor costs in Worcester, as modeled in the NMR report) and for ducting<sup>6</sup>; in Jesse's case, for the availability of State rebates and incentives.

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### Cost Estimate Tables

To the extent possible, the cost estimates that follow in the tables below are for a single-family home that complies with the Massachusetts Stretch Energy Code, with two floors, an unfinished basement, and 2,500 square feet of living space.

**Table 1: Cost comparison, installation and annual, for gas vs. ducted heat pump heating and cooling, and hot water**

	<b>Gas furnace and hot water, with central AC, installed cost</b>	<b>Heat pump system, installed cost</b>	<b>Difference in installed costs</b>	<b>Gas furnace and hot water, with central AC, annual cost</b>	<b>Heat pump system, annual cost</b>	<b>Difference in annual costs</b>
<b>Gray/Brookline</b>	\$11,700	\$12,100 adjusted to remove rebates)	Heat pump system \$400 more expensive	\$1,500	\$2,000	Heat pump system \$500 more expensive

<sup>11</sup> This figure appears to refer to new home sales in Newton, not to new construction alone. Many newly constructed homes in Newton are much larger than the existing homes sold, making Jeremy's estimate of the cost of an all-electric home as a percentage of the cost of home ownership likely to be conservative. However, his estimate is close enough for the purposes of the point made here.

<b>NMR report,</b> tankless water heater	\$11,724	\$12,478	Heat pump system system \$754 more expensive	\$1,511	\$2,007	Heat pump system, \$496 more expensive
<b>Koo/Newton,</b> tankless water heater	\$20,000 (adjusted for ductwork labor costs)	\$23,300 (adjusted for ductwork labor costs)	Heat pump system \$3,300 more expensive	\$1,511	\$2,007 (\$1,362 with solar)	Heat pump system \$496 more expensive
<b>Bill's estimates,</b> Rheem 50-gal tank style ( no annual cost estimates provided)	\$16,700	\$14,160	Heat pump system \$2,540 less expensive	Not provided	Not provided	

**Table 2: Another point of comparison (net present costs) for gas versus heat pump heating, cooling, and hot water**

	<b>Gas system</b>	<b>Heat pump system</b>	
<b>RMI REPORT COMPARISON OF 15-YEAR NET PRESENT COSTS OF WATER HEATING AND SPACE CONDITIONING FOR PROVIDENCE RI (THOUSAND \$)</b>	\$16,600	\$14,300	Heat pump system \$2,300 less expensive net present costs

**Table 3: Cost comparison, installation and annual, for gas vs. heat pump hot water, stand-alone installation**

	Gas water heater, installed cost	Heat pump water heater, installed cost	Difference in installation costs	Gas water heater, annual cost	Heat pump water heater, annual cost	Difference in annual costs
<b>Gray/Brookline</b> (no separate water heater costs provided)						
<b>Bill's estimates,</b> Rheem 50-gal <b>tank style</b> gas (no annual cost estimates provided)	\$1700	\$2,700	Heat pump \$1,000 more expensive	Not provided	Not provided	
<b>NMR report (tankless gas)</b>	\$2,512 <sup>12</sup>	\$1,680	Gas heater \$832 more expensive	\$127	\$146	Heat pump \$19 more expensive
<b>Koo/Newton (tankless gas)</b>	\$2,900 <sup>10</sup>	\$1,800	Gas heater \$1,100 more expensive	\$127	\$146 (\$99 with solar)	Heat pump \$19 more expensive (Heat pump \$28 less expensive with solar)
<b>Consumer Reports (tankless gas)</b>	\$525-\$1,150 plus \$800-\$1,500  Median = \$1,987	\$1,200 for equipment but doesn't specify installation amount	Difficult to ascertain, because installation cost not included	\$195	\$240	Heat pump \$45 more expensive
<b>Consumer Reports (tank style gas 50-gal)</b>	\$600 plus \$700 = \$1,300	\$1,200 for equipment but doesn't specify	Difficult to ascertain, because installation	\$245	\$240	Gas \$5 more expensive

<sup>12</sup> However, Jeremy's view is that for a tank style as opposed to a tankless hot water heater, Bill's estimate is "close" to what he "would guess." Email communication to Ann Berwick, September 15, 2020.

		installation amount	cost not included			
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