Draft Carbon Free Boston Report Outline
06-08-2018

6. Energy
    a. Introduction and overview
        i. General overview
            1. Purpose
                a. Examine the carbon content of three major energy systems: grid, gas, district energy
                b. Examine options for city policies to achieve a net zero carbon
            2. Energy systems delivering into Boston services (net energy service needs)
            3. Examination of net energy system supply decarbonization options
                a. Technology options
                b. Options for switching end uses
                c. Infrastructure costs and scale effects
            4. Options cannot be fully analyzed in isolation, must consider total CFB package
        ii. Overview of policy/technology pathway choices for Boston energy systems
            1. Main policy/technology pathways to net zero carbon
                a. Decarbonize the power grid, maximize transfer of non-electric end uses to electricity, decarbonize minimum remaining non-electric end uses
                b. Decarbonize the power grid, decarbonize gaseous fuels where economical/feasible, use gaseous fuels for future end uses
            2. All policy/technology pathways to net zero carbon involve
                a. Decarbonizing the electric grid maximally
                b. Decarbonizing gaseous fuels to the extent feasible/economical
                c. Fuel shifting where feasible/economical
            3. Policy/technology pathways are different blends of these options over time
    b. Electric power system
        i. Introduction
            1. Electric grid has been getting cleaner in ISO-NE
            2. Brief summary of zero-carbon electric supply options
            3. Projected electric grid carbon intensity through 2050 under GWSA
            4. Comparison of Brattle, ISO-NE, Synapse, and M.J. Bradley simulations of grid capacity changes
        ii. Electrification, self-generation, and resulting demand shifts
        iii. Analysis of Electric Options
            1. Purchase of renewable electricity
            2. Projections of long-term wholesale and retail costs of supply options and supply time profiles by day/season

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3. Simplified analysis of policy/technology pathway options by milestone data (for each 10-year time step)

c. Natural Gas System
   i. Introduction and background
      1. Assume gaseous fuel supplies for the City must be zero-carbon by 2050
      2. Options: biomethane, hydrogen to methane, hydrogen direct
      3. City must be vigilant on science and regulation to certify zero-carbon status
      4. Policy/technology pathway options must include delivery infrastructure
   ii. Current status of technologies, costs, and potential
   iii. Major Pathways
   iv. CFB Policy Options
      1. Monitor developments and advocate for state, federal, and international research and development
      2. Identify and promote opportunities to pilot demos and procurements for all three of fuel types if certified zero-carbon, costs affordable, and potential for future, cost-effectiveness
      3. Reevaluate developments and opportunities every three years

d. District energy
   i. Definition of district energy systems
      1. Value of district energy
      2. Value of cogeneration
      3. Utility frameworks for non-campus operations
      4. Barriers to district energy
      5. Current district energy systems
         a. Technology, locations, buildings served
         b. Emissions
      6. Future district energy technologies
         a. Swappable carbon neutral (to be certified) technologies
            i. Biogas
            ii. Biomass
            iii. Heat pumps (water, geothermal)
            iv. Hydrogen
            v. Waste
            vi. Geothermal
         b. Synergies between technologies
         c. Harvard/Allston case studies
         d. Potential to connect to existing systems
      7. Policies and actions needed for Carbon Neutrality
         a. Players and potential roles
            i. City Government
            ii. State Government
            iii. Utilities
            iv. Private Sector
            v. Public Sector
         b. Current systems

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   i. Conversion of old systems from district to distributed energy
   ii. Switch fossil district systems to renewable sources
c. New systems
   i. District energy requirement
   ii. Future conversion (fuel switching)
   iii. Tradeoffs
d. Regulatory considerations
   i. Open competition models
   ii. Mandates

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