Specific references to “reliability resources” and “gas fired thermal resources” In the 2030 Interim Climate Plan report (click HERE for report):

Page 36 - Reliably operating a cost-effective, ultra-low emissions electricity grid based on variable renewable resources requires a balanced portfolio of complementary resources and technologies. That portfolio includes specific reliability resources (i.e., infrequently used thermal generating capacity and/or new bulk storage) that will be needed to maintain reliability during infrequent, potentially multi-day, periods of very low offshore wind generation. A significant expansion of transmission and distribution systems (i.e., additional high-voltage interstate transmission) within and beyond Massachusetts will also be needed.

Page 41 - To support widespread electrification, New England must likely deploy more than 40 GW of solar resources by 2050, which will exceed the total area of available rooftops in the region. In Massachusetts, even with maximal rooftop deployment far in excess of historic levels, that will require the installation of ground-mounted solar on approximately 60,000 acres of land in Massachusetts over the next thirty years. Breakthroughs in solar panel efficiency could potentially reduce that area significantly, but if other necessary clean energy resources such as offshore wind, inter-state transmission, or thermal capacity are constrained, the amount of required ground-mounted solar could potentially double.

References to these resources in the 2050 Decarbonization Roadmap report:

Page 29 – Strategies needed to reliably supply low-to-zero carbon energy resources to Massachusetts residents. To support widespread electrification across the economy, large amounts of new, low-cost, zero-carbon–primarily renewable–electricity generation resources must be deployed, complemented by a range of new reliability resources. Barring major technological innovation, current physical constraints on their availability and production, as well as high cost, zero-carbon fuels use should be prioritized for particularly hard to decarbonize or difficult-to-electrify end uses. System planning is essential for ensuring that energy costs remain low for consumers.

Page 55 - Transition Needed for Decarbonization Near Term Implications • As more end uses rely on the electricity system, the carbon intensity of emissions from the electricity system will need to approach zero at the same time as installed generating capacity more than doubles. • Offshore wind and solar are the lowest cost low-carbon energy resources and will comprise the bulk of the Commonwealth’s and the region’s electricity generation in 2050; both must be deployed at scale (15-20 GW of each installed) in the Commonwealth over the next 30 years. • A balanced range of complementary resources and technologies, including imported hydropower and additional high-voltage interstate transmission, is required to reliably operate a cost effective, ultra-low emissions electricity grid based on variable renewable resources. • Specific reliability resources (infrequently used thermal capacity without carbon capture, and/or new bulk storage) will be needed

Page 60 - *Reliability Resources* Although highly reliable and predictable on a daily and seasonal basis, renewable resources such as wind and solar power must be complemented by a range of resources both on the demand-side and on the supply-side, due to their inherent variability and in order to ensure the reliability of the electricity grid in every hour of the year.

Page 61 - Two Days In February 2050: An Illustration Of Reliable Low Carbon Electricity Supply In An Electrified Future Figure 16 illustrates how an integrated portfolio of clean energy, flexibility, and other reliability resources are used to meet electricity demand with an electricity grid dominated by variable renewable generation. Two example days in 2050 are shown, February 1 and February 16, with the generation mix for each day in the top row and the overall demand in the bottom row. These generation mixes illustrate the performance and operation of a Net Zero-compliant 2050 generation fleet using actual New England weather data from 2012. The key difference between the two days is that there is ample wind resource available on February 1 and nearly none on February 16, as was the case in February 2012 and can be expected normally around a dozen times a year, for up to several days at a time.

Page 63 - Currently, the lowest cost method for maintaining reliability on the few days each year with very low renewable energy production is the intermittent use of thermal power plants, primarily gas-fired power plants. Due to the low capital costs associated with gas-fired electricity, their relatively low emissions profile, and because of the speed with which a gas plant can be turned on to produce electricity, these already-existing resources are compatible with providing electricity when wind power is unavailable. As the quantity of renewables on the system grows, Massachusetts' use of, and reliance on, gas-fired generation will decline precipitously; these units could continue to be both useful and valuable but serve in a new role as a long-duration reliability resource. In such a role, the use of gas-fired generation in 2050 would be minimal and fully consistent with achieving Net Zero emissions statewide.

Page 64 - The Energy Pathways Report analyzed a case where all thermal generation in New England was fully retired by 2050. In the absence of these units operating as a low-cost reliability resource, the analysis indicated the need for deploying a large quantity of novel and likely expensive, long-duration, grid-scale battery storage as well as a significant increase in new clean generation – mainly low-cost ground-mounted solar – needed to charge it. This new and unique large scale storage requirement added a 15% increase in overall system costs (about $4 billion dollars a year by 2050) which would be expected to be passed onto Massachusetts residents and businesses through utility bills (Figure 17). This scenario with No Thermal generation also increased costs because it required nearly 40 GW of ground-mounted solar in Massachusetts alone, likely consuming about 158,000 acres of land – or about 3% of Massachusetts' total land area – and more than double the land use requirements of other pathways analyzed (Figure 18).

Page 66 - Maintaining high levels of year-round system reliability on a grid dominated by renewable generation resources presents several additional challenges, particularly when considered under today's approach to grid operations. Thermal generators that have traditionally operated by following electricity demand will need to shift to a "peaking" or "gap-filling" reliability role in the coming decades as they operate fewer and fewer hours and cease to be providers of bulk electricity. In the Energy Pathways Report, thermal generators operating 50% of the time today are projected to operate around 5% of the time in a decarbonized system. While breakthroughs in long duration storage technologies could replace the need for retaining thermal capacity for reliability, the technology has yet to be proven at scale and is not necessary in order to achieve Net Zero. Forcing the retirement of all thermal capacity in the electricity system, rather than capping or managing emissions and operational profiles as part of new reliability service markets, represents an unnecessary operational risk to the regional energy system that is likely to ultimately result in higher costs for consumers and higher environmental impact.