Tree Retention and Planting to Reduce Heating and Cooling Loads

Policy Summary: Since the Clean Energy and Climate Plan for 2020 was released, EEA—in partnership with the Department of Conservation and Recreation (DCR), the Department of Energy Resources (DOER), the Department of Housing and Community Development (DHCD), UMass Amherst, and several Gateway Cities and local non-profit organizations—has launched the Greening the Gateway Cities (GGC) urban tree planting program. The funding for this program is a mixture of DOER's Alternative Compliance Fund and the state capital and operating funds. At the 2016 investment rate of $8 million per year, the 57,000 target urban acres in the 26 Gateway Cities will have 5 trees per acre planted by 2026.

The EEA has recently worked with consultants to research and propose recommendations for a tree retention program. Retaining shade trees that otherwise would be removed during development or re-development is attractive, because research shows that removal of mature tree canopy around residences can quickly cause increased energy use. A tree retention program would provide best practices for tree retention during construction of housing within forested areas and within existing neighborhoods. It would provide model bylaws to municipalities, and propose incentives for municipalities and housing developers to encourage the retention of trees on construction sites using proven best practices.

	Savings from full policy implementation	% of 1990 level
Economy-wide GHG reductions in 2020	<<0.1 MMTCO$_2$e[54]	<<0.1%

Clean Energy Economy Impacts: At full implementation in 2016, the GGC program will create 132 jobs for tree planters, foresters and administrative staff. It is anticipated that these jobs will be maintained from 2016 to 2026 to complete the Gateway City plantings. Tree planting is one of the only energy efficiency tools where all investments go to the local economy (tree nurseries are close by, tree planting crews are hired from the cities where planting occurs, etc.). A USDA economic study of tree planting reported a 2:1 economic multiplier when direct and indirect economic benefits are calculated. For an $8 million annual investment, this will result in $16 million of economic benefit to the Gateway Cities economies (and surrounding nurseries and their suppliers) per year for a 10 year period for a total of $160 million economic benefit. A benefit/cost analysis for the energy savings for this program found a 2.2 to 1 benefit to cost ratio over the 30 years of the program (present value at 4% discount rate and 1.5% increase in energy costs), and does not take into account economic or other benefits of tree planting.

Rationale: Many modeling studies conclude that planting trees in residential areas reduces summer cooling and winter heating costs. A large-scale tree planting program by the electric

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[54] The GHG reduction is shown as <<0.1 MMTCO$_2$e (<<0.1%), because no significant reductions are expected by 2020.

utility in Sacramento, CA planted over 500,000 trees since the 1990's, and has seen significant reductions in summer cooling energy, including peak load reductions. The EEA and DCR utilized the Asian Longhorned Beetle disaster in Worcester, MA to measure electricity usage before and after tree removal. This study showed that each 1% of canopy cover reduced summer electric usage by over 1%. A study in Hutchinson, MN measured neighborhood canopy cover and actual home energy usage, and found a similar correlation.

The benefit-to-cost ratio for retaining a mature tree that under business as usual would be removed is even more beneficial than planting trees. It takes an average of 30 years to grow a mature tree that will occupy about 550 square feet. Retaining mature trees when new homes are built would provide immediate heating and cooling savings.

Design Issues: The implementation of energy efficiency measures is more challenging in low income communities where there are high percentage of renters, old housing stock, and challenges with matching rebate offers. Neighborhoods where the majority of residents are renters have a unique challenge as both tenants and landlords must see the benefits to energy efficiency tools. The GGC has successfully implemented tree planting in high renter neighborhoods due to the unique appeal of new trees. The challenge with a tree density goal involves buy-in by many residents, especially renters and landlords, as most of the trees are planted in private yards where they can be cared for by residents and planting conditions are preferable to city streets. Based on research and the results of pilot implementation of the GGC program in three cities over the past four planting seasons, the program has adopted a goal of planting 5 trees per acre. This intensity of planting will result in approximately 5% of new urban tree canopy within the 57,000 target acreage in 30 years, when trees are fully grown. The GGC is the first of such program to have a neighborhood per-acre tree density target to reach energy efficiency goals.

Tree retention has several challenges to be effective. A baseline for business as usual needs to be established via tree inventories within the municipalities and a database for avoidable tree loss. Model best practices for construction approaches that can avoid tree damage or removal during construction typical of Massachusetts communities need to be developed utilizing well-tested best practices from other similar regions. Based on examination of similar programs across the country, EEA's consultants have developed a model by-law that includes commonly employed tree retention strategies such as requirements for minimum tree density, tree removal fees, and requirements for developers to place bonds on certain trees. Another outstanding design issue is how to structure an incentive program that could encourage developers to maintain tree cover beyond the minimum required level. This could be done by increasing density bonuses or adjusting setback requirements for developers who maintain tree cover beyond the required levels. A few communities do have tree retention bylaws, and there needs to be further examination of their effectiveness.

GHG Impact: The GGC program is scheduled to expand to eleven cities by the end of 2016 and will plant 8,800 trees per year. At this rate, the 57,000 acres will be planted by 2026. Based on tree size by 2050, it is estimated that the GGC program will be responsible for a reduction of

473,600 metric tons of CO_2e per year by 2050. The EEA is not projecting measureable GHG reductions by 2020.

Each average mature tree that is retained instead of being removed under business as usual represents about 1% of the canopy on an acre of residential land. Research by EEA shows that each 1% of canopy cover in a neighborhood will save 0.1 $MMTCO_2e$.

Other Benefits: Urban tree planting and retention have been demonstrated to have additional benefits including reducing air pollution, reducing stormwater and flooding, extending pavement life, reducing summer "Heat Island Effect" impacts, reducing peak load energy demand, and increasing property values and municipal tax revenues.

Costs: The GGC program will cost $8 million per year when fully implemented at the end of 2016. From 2014 to 2016, the program will expend $10 million. From 2017 to 2026, the program will cost $80 million. Thus, the total program cost will be $90 million. These costs assume a mix of program administration, direct costs (principally with DCR tree planting crews but also including local non-profits, private firms, and municipalities) that leverage the program with assistance with street tree planting and tree care.

More analysis is needed before piloting a tree retention program geared at reducing a significant amount of GHG emissions when compared to the business as usual.

Equity Issues: The GGC program focuses only on Environmental Justice (EJ) neighborhoods within the poorest cities in the Commonwealth. The program will provide 132 jobs per year for over 10 years. Crews are hired from the neighborhoods where planting is occurring so additional economic benefits accrue from this program in EJ neighborhoods. Early results indicate that many tree crew members are able to get full time jobs in the landscaping industry or local city DPW's due to training received.

Environmental Justice neighborhoods have the lowest tree canopy cover across the state. For example, Chelsea has just 9% canopy cover while the average suburban neighborhood has more than 40% canopy cover. With less access to open space and parks in the Gateway Cities, the GGC program will measurably enhance the quality of life for Gateway City residents.

While tree retention would principally focus on suburban neighborhoods, a companion tree retention program could assist the Gateway City EJ neighborhoods in protecting existing tree canopy from a largely different set of threats.

Experience in Other States: The GGC program has reviewed other significant urban tree planting programs across the U.S. such as New York, Philadelphia, and Washington D.C. Staff have also contacted other energy saving tree planting programs such as the well established program in Sacramento, CA. The GGC program has utilized the experiences of other urban tree planting programs in designing the approach and best practices of the program.

The EEA's consultants conducted a thorough literature review of other states and municipalities that have implemented tree retention programs for housing development and re-development.

Legal Authority: The Massachusetts Public Shade Tree Law G.L. Chapter 87 gives guidance to tree planting in cities and towns and municipalities authority over shade trees within the right of way of municipal streets.

Implementation Issues: Unique issues with tree planting and retention are described in the Design Issues section above. There are also a number of questions about how to structure a tree retention program, which could be addressed through a pilot educational program that would encourage a range of model best practices and bylaws and test a range of incentives to determine their effectiveness.

Uncertainty: There is a high degree of certainty regarding the positive results that will occur when a significant number of mature trees are retained in a municipality. There is uncertainty as to how to measure positive results compared with the baseline and which educational or incentives programs will be the most effective. These uncertainties can be resolved via a carefully thought out pilot program.

The EJ neighborhoods within the Gateway Cites were chosen because they have the oldest, least insulated housing stock that would benefit the most from an extensive tree planting program. The average housing stock in the Gateway Cities dates from 1939 to 1963. Given the lack of insulation in this housing stock and the challenges with implementing energy efficiency, it is uncertain if the results of tree planting and retention could exceed the predicted GHG reductions, because the two study areas (Worcester, MA and Hutchinson, MN) have newer housing stock than the average Gateway City housing stock. Another uncertainty is the impacts of climate change. With predictions for significant increases in the number of above 90 degree days and the amount of air conditioning predicted to be installed, the GHG savings may be greater than is predicted in the current climate.