One approach to address climate change involves a comprehensive land use program to conserve, restore and strengthen aspects of nature that remove greenhouse gases (GHGs) from the air (carbon sequestration), thereby reducing the pollution that causes climate change while also providing a range of additional benefits to the public. The IAC Land Use and Nature-Based Solutions Working Group is working in parallel with the Executive Office of Energy and Environmental Affairs (EEA) and the US Climate Alliance to achieve the Global Warming Solutions Act's (GWSA) GHG goals by:

1. Quantifying the carbon sequestration and energy reduction benefits of nature-based solutions for accounting in GHG benchmarks and goals;
2. Identifying best management practices for conserving, creating, restoring and employing nature-based solutions to both optimize the removal of GHGs from the air and realize the multiple additional benefits of these solutions (air quality, energy reduction, stormwater management, etc.).
3. Developing a suite of policies based on identifying policy gaps and opportunities related to the best management practices for achieving the emissions reduction goal.

Definitions and Justification

Smart land use and nature-based solutions help reduce greenhouse gas emissions. They also weave a fabric of resilience through our communities to help withstand flooding, drought and extreme temperatures. These strategies promote healthier, more livable communities by mitigating air pollutants, capturing stormwater, enhancing water quality, and providing respite and recreation in natural areas.

The IAC Land Use and Nature-Based Solutions Working Group recommends operating under the following definitions:

- **Land Use**: the total of arrangements, activities, and inputs that people undertake in a certain land cover type. Categories of land-use types (cropland, forest land, wetlands, and peri-urban land) inform the potential for carbon sequestration from system management, conversion, and enhancement.[1]
- **Nature-based solutions**: strategies that conserve, create, restore and employ natural resources to enhance climate resilience. Nature-based solutions mimic natural processes or work in tandem with man-made engineering approaches to address natural hazards and to sequester and store greenhouse gases.[2]

Massachusetts already has assets at the nexus of nature-based solutions and land use that enhance safety, avoid costs and advance the goals of the GWSA. For example, in the 15 communities of Metro Boston (i.e., the Metro Mayors Coalition), the urban forest stores 962,000 tons of carbon, worth $125 million[3], and captures an additional 23,000 tons of carbon/year, worth nearly $3 million. Added benefits include 527 million gallons of avoided stormwater runoff, worth $4.7 million[4], and 1.75 million

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[1] IPCC *land use* definition modified from Food and Agriculture Organization and United Nations Environment Program http://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=45

[2] This definition is parallel with the definition in Executive Order 569 and is also similar to the definition the included by the Legislature in the Water Infrastructure Law of 2014 for Green Infrastructure.

[3] Economic value= $143 /metric ton value of carbon storage or capture * social cost of carbon, an economic value quantifying in dollars the long-term damage due to a ton of carbon in a given year (EPA).

[4] iTree Landscape. Economic value of avoided runoff= (The difference between runoff with existing vegetative cover by Land Use Data minus the runoff where impervious surface replaces vegetative cover) * value of runoff (Hirabayashim 2015)

pounds per year of air pollutants removed, worth $11 million[5,6] Across the Commonwealth, forests capture 15% of Massachusetts' yearly carbon emissions.[7]

Carbon Sequestration Quantification and Accounting

The Commonwealth is engaged in the US Climate Alliance's Natural and Working Lands Learning Lab, a collaboration between conservation organizations and state agencies (EEA). The purpose of the Learning Lab is to help Alliance member-states identify potential carbon gains within their borders and the associated costs, and to develop customized state-level "Action Matrix" for reducing emissions and enhancing carbon sequestration with nature-based solutions. .

Technical experts are performing county-level data-driven modeling of carbon sequestration by existing assets and land management practices, as well as performing geospatial analyses to identify areas with the greatest nature-based carbon mitigation opportunities. [8] Once quantified, participants will work to identify policy gaps and opportunities to maximize carbon sequestration through best management practices in forests, farms and wetlands. Outcomes and deliverables from the process will help inform future policy, best management practices, and potential regulations required to achieve carbon sequestration goals. Recommendations will also be aligned for integration with current climate, housing and clean energy initiatives.

Advancing Carbon Sequestration through Management and Policy

Massachusetts has diverse community types, from dense urban and industrial cities to rural areas with large expanses of farms and forests. Using the aforementioned data and goals, the IAC Land Use and Nature-Based Solutions Working Group recommendations will include policy and regulation at the intersection of the natural and built environment that spans Massachusetts' range of community types. Deliverables will include 2-4 policy suggestions per community type for the GWSA 10-Year Update that are aligned with the Municipal Vulnerability Preparedness Program, the Green Communities Program and the Housing Choice Initiative.

At the landscape level, the Working Group will recommend the most effective mechanisms for natural and working lands to increase carbon sequestration, cost-effectiveness, and livability (water and air quality). Recommendations may include smart-growth policies, such as natural resource protection overlay districts; transfer of development rights; transit-oriented development; and open space residential developments. The Working Group will recommend natural system restoration to enhance carbon sequestration and deliver multiple ecosystem service/climate resilience benefits. Examples of such projects might include salt marsh restoration and thin-layer deposition; wetland area restoration for flood protection; and forest area conservation and restoration to increase our timber supply and provide a home for fish and wildlife.

Finally, the Working Group recommendations may include Net Zero accounting for new development where landscape design integrates carbon sequestration and energy reduction. Some examples might include green infrastructure overlay districts for stormwater management and urban heat island mitigation; site design standards to maximize natural cooling, carbon and stormwater capture; and park and open space design for carbon sequestration and climate resilience. Other opportunities may include recommending collaborative urban forestry across jurisdictions to maximize tree canopy cover and promote active transportation corridors and transit-oriented development to minimize vehicle miles. All of these efforts will maximize the Commonwealth's investment in carbon sequestration, livability, and climate resilience.

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[5] iTree Landscape. Pollution Removal Economic Benefit=pollution removal (g/m^2 from tree cover) * value of pollution mitigation ($/m^2 of tree cover where values determined by EPA BenMAP)

[6] iTree Landscape, 2018. Model run on June 19, 2018.

[7] MassDEP, 2008-2010 Massachusetts Greenhouse Gas Emissions Inventory, 2013; emissions figures are for 2010.

[8] Daley, Jad. 2018. USCA Natural and Working Lands Initiative Learning Lab. American Forests.