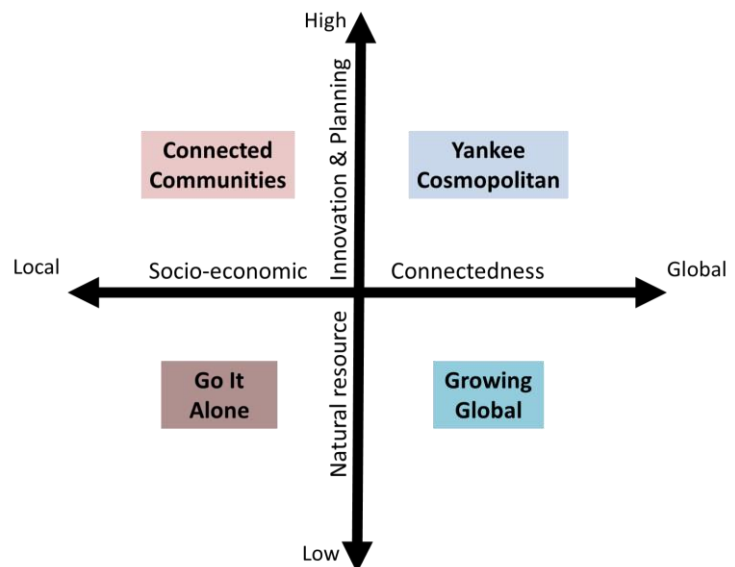


### Appendix 3. New England 2060 scenario narratives

This document presents four scenarios that describe potential changes in the New England landscape to the year 2060. The scenarios were developed with 120 stakeholders from the six New England states through a series of scenario-building workshops led by the Harvard Forest as part of the New England Landscape Futures Project and the [Scenarios, Services, and Society Research Coordination Network](#). The scenarios represent four plausible alternatives to current trends built around two drivers of landscape change that are considered highly uncertain and high-impact: Natural resource planning & innovation (high or low) and Socio-economic connectedness (global or local). These two drivers form the axes and endpoints for the scenario matrix shown below. Each quadrant represents a future scenario with names that reflect their position in the matrix.

**Fig. A3.1.** New England regional scenario matrix



#### Driver Definitions

**Socio-economic connectedness** refers to the extent to which population migration, culture, economic markets, goods and services, and trade and climate policy are globally oriented or locally oriented.

**Natural resource planning & innovation** refers to the extent to which governments engage in proactive land-use planning and invest in technological advances for land, energy, and water use. It also reflects the degree of private sector innovation in resource use and investment in ecosystem services. This driver also incorporates social attitudes of individuals toward land stewardship and sustainability.

#### Narratives and Tables

The pages that follow provide a narrative description of each scenario and a table comparing recent land use trends and land use trends for each scenario. Tables 1 – 4 contain the number of hectares that transition under each land use category when annual results are extrapolated over 50 years.

## Connected Communities

High natural resource planning & innovation / Local socio-economic connectedness

### *The World in 2060*

SCENARIO IN BRIEF: The New England population has increased slowly over the past fifty years and most communities are coping with climate change by anchoring in place rather than relocating, making local culture and the use and protection of local resources increasingly important to governments and communities. New England has been less affected by climate change than many other regions of the U.S. in this scenario. Concerns about global unrest and the environmental impacts of global trade have led New Englanders to strengthen their local ties and become more self-reliant. These factors combine with heightened community interest and public policies to strengthen local economies and fuel burgeoning markets for local food, local wood, and local recreation.

SETTLEMENT PATTERNS: From the early 2020s onward, local and regional governments have used tax incentives, public policies, and market subsidies to drive a shift toward sustainability and climate resilience.<sup>1</sup> This renewed focus on community planning and protection of natural resources has advanced ‘smart growth’ measures that balance development needs with the need to protect natural infrastructure<sup>2</sup>. New settlements tend to occur in planned urban centers<sup>3</sup>, resulting in higher density development (in-fill), and as pockets of clustered growth at the urban fringe.<sup>4</sup>

Reduced reliance on global trade and greater reliance on local natural resources has bolstered the availability of local jobs. Strong urban planning yields developments where more people can walk to work.<sup>5</sup> The growth of urban farms and urban green infrastructure has also improved the quality of life for city dwellers. With the shift toward a more community-focused lifestyle, long-distance travel has declined and “stay-cations” at local recreation areas have become more popular. New parks and wilderness areas in northern New England also attract wealthy tourists from elsewhere and promote the development of more and larger high-end lakeside and mountainside resorts.

ENERGY AND CLIMATE: On-going concerns about climate change have fueled a grass-roots green energy movement, resulting in increased local wind, biomass, and solar power development. Proactive planning ensures that only a small amount of open land has been converted to developed uses to support these renewable energy projects. Over time, technological advances have increased energy efficiency and decreased the footprint of energy development. A regional carbon tax has made transportation more expensive, making local food supplies and shorter commutes more attractive. This helps to promote greater reliance on local food, local wood products and local transportation options during the early 2020s and 2030s, with local wood biomass serving as a renewable transition fuel.

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<sup>1</sup> Probability of development is reduced by -40%:1k, -30%:2k, -20%:3k, and -10%:4k away from the coast.

<sup>2</sup> All FEMA +1 foot sea level rise, FWS wetlands, and NHD flood risk zones are ineligible for development.

<sup>3</sup> Probability of development is increased by 30% within 1k of a city center with population over 10,000, 29% within 2k, 28% within 3k, ramping down to 1% within 30k.

<sup>4</sup> Mean patch size for new development has been doubled. Isometry modifier increased from 1.1 to 1.2. The ratio of new vs. expansion patches has been increased by + 0.1 for all regions (a few regions max out at 100% by expansion).

<sup>5</sup> Probability of development is increased close to town centers. +30%:1k, +25%:2k, +20%:3k, +15%:4k, +10%:5k.

LAND PROTECTION: With the interest in localism there is a strong focus on the protection of wildlands for wildlife and ecosystem services.<sup>6</sup> With increased reliance on local resources and greater public investment in natural infrastructure, rates of private land protection through easements rise, and payments for ecosystem services, such as clean water, have surpassed the value landowners derive from resource extraction. Easements on lands that are harvested are a common means of shoring up local wood markets. State and local governments have invested greater public funding in land protection for forest health, flood control, and water quality.<sup>7</sup> Municipal governments are also protecting land for public parks near population centers.<sup>8</sup> Larger TIMOs<sup>9</sup> and REITs<sup>10</sup> have divested land to local governments and private landowners who manage for wood and water.

FARMING: Local agriculture has expanded to meet the growing demand for local food. A renaissance of small-scale community-based farming has occurred with new farms often situated on the outskirts of town<sup>11</sup>, growing mixed, diverse crops. Farming is highly efficient with plants engineered for the novel climate that require minimal water, fertilizer, and pesticide application. This renaissance has brought reinvestment in slaughterhouses and smokehouses to supply the region with meat from local sources.

FORESTRY: The harvesting and use of local wood is supported by the strong “buy local” movement as well as by new incentives for building with wood and a high carbon tax on imported wood products. As a result, timber harvesting rates across the region increase by 50% by 2060, particularly in the northern New England states. Investment timber owners are paid by governments and fund managers to manage sustainably for timber, watershed protection, and other ecosystem services. The existence of biomass energy markets makes the removal of traditionally low-value timber species and size-classes cost-effective, and there is a resurgence in community forests and woodlots near towns that are dedicated to producing high-value local wood products.

**Table A3.1.** New Transitions 2010-2060 (Connected Communities)

| State | Agriculture (ha)         | Development (ha)         | Conservation (ha)        | Harvest (ha)             |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|
|       | scenario / recent trends | scenario / recent trends | scenario / recent trends | scenario / recent trends |
| CT    | 15,263 / 6,341           | 18,507 / 76,120          | 185,536 / 109,859        | 61,517 / 40,966          |
| ME    | 112,906 / 45,569         | 32,375 / 125,462         | 2,858,841 / 2,774,258    | 735,283 / 726,184        |
| MA    | 18,227 / 7,002           | 41,576 / 136,875         | 482,542 / 273,983        | 58,250 / 59,717          |
| NH    | 28,881 / 10,353          | 22,715 / 98,908          | 628,918 / 546,110        | 111,190 / 106,122        |
| RI    | 2,176 / 845              | 3,807 / 16,780           | 64,102 / 40,181          | 7,008 / 6,680            |
| VT    | 27,910 / 12,806          | 7,470 / 30,503           | 1,003,275 / 430,652      | 102,314 / 112,768        |
| TOTAL | 205,364 / 82,917         | 126,451 / 484,648        | 5,223,213 / 4,175,044    | 1,075,562 / 1,052,437    |

<sup>6</sup> Probability of conservation types Private Reserves, Private Working Forests, and Small Private Multi-Use forests have probability increased by 10% in all high priority conservation areas (State Wildlife Action Plans).

<sup>7</sup> Probability of conservation type Public Multi Use increase by 20% in all high priority conservation areas (State Wildlife Action Plans) and in the top 25% Forest to Faucets defined high importance watersheds, plus a further increase of 10% in FEMA and NHD flood zones.

<sup>8</sup> Probability conservation type Public Park is increased by 30% within 1k of city centers with populations over 10,000, 29% within 2k, 28% within 3k, ramping down to 1% within 30k.

<sup>9</sup> Timber Investment Management Organization

<sup>10</sup> Real Estate Investment Trust

<sup>11</sup> Probability of new agriculture is increased by 30% within 1k of urban areas, 29% within 2k, 28% within 3k, ramping down to 1% within 30k.

## Yankee Cosmopolitan

High natural resource planning & innovation / Global socio-economic connectedness

### *The World in 2060*

SCENARIO IN BRIEF: New England has experienced substantial population growth spurred by climate and economic migrants who are seeking areas less vulnerable to heat waves, drought, and sea-level rise<sup>12</sup>. Most migrants are international but some have relocated from more climate-affected regions in the U.S. At the same time, a strong track record in research and technology has made New England a world leader in biotech and engineering, creating a large demand for skilled labor. The region's relative resilience to climate change and growing employment opportunities has made New England a major economic and population growth center of the U.S. Abundant forests remain a central part of New England's identity, and support increases in tourism, particularly in Vermont, Maine, and New Hampshire.

SETTLEMENT PATTERNS: Proactive city planning as well as public and private investment in infrastructure have helped to meet the needs of New England's growing population through well-planned housing, transportation hubs, and municipal services near city centers.<sup>13 14 15</sup> These well-planned urban hubs are attractive places to work and live. This, together with the increasingly global community, creates diverse neighborhoods with unique cultural, business, and natural amenities. As the population influx continues through the 2030s and 2040s, the pace of development begins to exceed the planning and physical capacity of many cities and development patterns devolve into sprawl.<sup>16</sup> Except for areas with high tourism, the population of rural areas is steady or declining throughout northern New England, resulting in little new permanent development in that part of the region.

ENERGY AND CLIMATE: A global shift toward sustainability with strong global climate agreements has created robust global carbon markets and carbon storage by forests is now highly valued. The strong carbon offset market encourages regional brokers to work with small-scale forest and farm landowners to bundle and market their carbon storage. Policies and private sector investments in new technology help to curtail greenhouse gas emissions and support the development of low-carbon renewable energy technologies. As part of this 'green' economy shift, New England has seen the propagation of significant numbers of renewable energy sites throughout each state to meet the energy needs of a growing population. Wind turbines span shorelines and ridgelines near growth centers. Large solar arrays built during the 2020s consume large tracts of land but eventually give way to less expansive, more efficient systems in response technological innovation and heightened demand for land for housing.

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<sup>12</sup> Probability of development is reduced by 20% within 500m of the coast, -19% 1000m from the coast, -18% 1500m from the coast, down to -1% 20k from the coast. All NOAA +1 foot coastal flood zones have no chance of development.

<sup>13</sup> Probability of development is increased by 30% within 1k of city centers with populations over 10,000, 29% within 2k, 28% within 3k, ramping down to 1% within 30k.

<sup>14</sup> Reduced probability of development on prime agricultural soils by 10%.

<sup>15</sup> All FEMA and NHD flood risk zones have probability of development reduced by 20%.

<sup>16</sup> Clustered development for the first 20 years only. Mean patch size for new development has been doubled. Isometry modifier increased from 1.1 to 1.2. The ratio of new vs. expansion patches has been increased by +0.1 for all regions (a few regions max out at 100% by expansion). From 2030 onward, patterns follow recent trends.

LAND PROTECTION: Smart growth, high-density urban development, and carbon offset markets have facilitated a doubling in rates of land protection within high priority conservation areas<sup>17</sup> throughout the 2020s and 2030s. New urban parks track with new development.<sup>18</sup> Bundled carbon markets result in many new conservation easements. Land protection priorities focus on the maintenance of ecosystem services, particularly in southern New England where cities depend on watershed lands for low-cost, clean drinking water.<sup>19</sup> Even so, land protection is under pressure from rapid population growth and, aside from small public parks, most land protection for ecosystem services occurs in low-population areas, with conflicts between ecosystem service protection and development hindering land protection in other regions.

FARMING: In this globally connected world, there is little drive for self-sufficiency in food supplies, and the U.S. relies on imports for most products, except for specialized local food such as organic milk, apples, maple syrup, and potatoes. Innovative farming practices support increased production without much additional agricultural acreage. In northern New England a modest increase in agriculture occurs near existing farms and some small patch farming emerges near towns to feed local niche markets.<sup>20,21</sup>

FORESTRY: Rates of timber harvesting for wood products have decreased in the region, particularly in southern New England where parcelization and non-timber forest values drive land management priorities. Technological innovations in energy generation and storage limit the demand for wood biomass energy. Much of the land owned by TIMOs and REITs has been enrolled in carbon markets to capitalize on the boom in carbon offset prices. Development of sugar bushes has expanded as maple syrup has become a valuable global commodity and New England remains suitable for sugar maple trees despite changing climate. Consistent with a world with competing demands for forest uses, forestry practice laws designed to protect a range of ecosystem services have become more stringent in all states and the limited harvesting that occurs follows an ‘ecological forestry’ paradigm, including longer rotations with more leave trees and slash left on-site to balance carbon storage with commodity production.

**Table A3.2.** New Transitions 2010-2060 (Yankee Cosmopolitan)

| State | Agriculture (ha)         | Development (ha)         | Conservation (ha)         | Harvest (ha)             |
|-------|--------------------------|--------------------------|---------------------------|--------------------------|
|       | scenario / recent trends | scenario / recent trends | scenario / recent trends  | scenario / recent trends |
| CT    | 6, 313 / 6, 341          | 155, 798 / 76, 120       | 163, 813 / 109, 859       | 18, 137 / 40, 966        |
| ME    | 45, 349 / 45, 569        | 93, 037 / 125, 462       | 2, 135, 258 / 2, 774, 258 | 462, 105 / 726, 184      |
| MA    | 6, 689 / 7, 002          | 251, 633 / 136, 875      | 418, 4422 / 273, 983      | 26, 380 / 59, 717        |
| NH    | 11, 374 / 10, 353        | 119, 745 / 98, 908       | 505, 223 / 546, 110       | 66, 787 / 106, 122       |
| RI    | 922 / 845                | 36, 759 / 16, 780        | 59, 382 / 40, 181         | 3, 012 / 6, 680          |
| VT    | 12, 154 / 12, 806        | 22, 335 / 30, 503        | 397, 548 / 430, 652       | 71, 087 / 112, 768       |
| TOTAL | 82, 801 / 82, 917        | 679, 307 / 484, 648      | 3, 679, 666 / 4, 175, 044 | 647, 510 / 1, 052, 437   |

<sup>17</sup> Probability of conservation has been increased by 20% on all high priority conservation areas (State Wildlife Action Plans).

<sup>18</sup> Probability of new public park creation is increased by 30% within 1k of city centers with populations over 10,000, 29% within 2k, 28% within 3k, ramping down to 1% within 30k.

<sup>19</sup> Probability of conservation has been increased by 20% in MA, CT, and RI in the top 25% Forest to Faucets defined high importance watersheds.

<sup>20</sup> All non-prime agricultural soils are ineligible for new agriculture.

<sup>21</sup> Zero probability of new agriculture within Census Urban Areas, but increase by 30% within 1k, 29% within 2k, 28% within 3k, down to 1% within 30k of the urban area boundary.

## Growing Global

Low natural resource planning & innovation / Global socio-economic connectedness

### *The World in 2060*

SCENARIO IN BRIEF: By 2060, a steady stream of migrants has driven up New England's population, with newcomers seeking to live in areas with few natural hazards, ample clean air and water, and low vulnerability to climate change. This influx of people has taken the region by surprise and local planning efforts have failed to keep pace with development. The region has experienced increasing privatization of municipal services as state and local governments struggle to keep up with the needs of the burgeoning population. Trade barriers were lifted in the 2020s to counter economic stagnation and the volume of global trade has multiplied over the past 40 years as a result of increasing globalization. However, all attempts at global climate change negotiations and renewable energy commitments have failed in this globally divided world.

SETTLEMENT PATTERNS: New England is characterized by sprawling cities with poor transportation infrastructure, inefficient energy use, and haphazard expansion of residential development. Walkability in most cities is low and cars remain necessary to access services in most parts of the region.<sup>22</sup> Little has been done to address stresses on civil infrastructure. Development pressures and loss of open space are particularly acute in southern New England around Boston, Nashua, Springfield and Hartford. However, northern New England cities are not immune, and Portland and Burlington have experienced heightened expansion.<sup>23</sup>

ENERGY AND CLIMATE: In this world with little innovation and no global commitment to climate action, conventional fossil fuel energy sources dominate and remain abundant and cheap. Despite the environmental costs associated with conventional energy, levels of transportation and mobility remain high both locally and globally. New England has experienced some investment in new renewable energy, but much more development of natural gas and overland transmission lines. Haphazard harvesting of forests for woody biomass has increased.

LAND PROTECTION: With the region's growing population and low natural resource planning, investment in natural infrastructure continues to be low and land protection rates have been in sharp decline. Where new land conservation occurs, it is mostly for tax purposes and in remote areas under little threat of development. Existing parks and protected lands are heavily used and ecologically degraded. New residential and commercial development around parks serve the wealthy and perforate forests around protected lands.<sup>24</sup> Efforts to 'green-up' cities focus on protecting recreation areas rather than natural infrastructure. Conservation easements on private lands have been legally challenged so that landowners can exploit natural gas and other energy resources.

FARMING: U.S. food exports surge in response to changing global agricultural commodity markets, and drive the conversion of forestland to farmland. These new agricultural lands mostly extend out from existing farmland<sup>25</sup>, and typically take the form of large-scale, intensive production farms for commodity crops by leading multi-

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<sup>22</sup> Increase probability around highways by 20%-100m 15%-200m 10%-300m 5%-400 so that cities sprawl along transportation corridors.

<sup>24</sup> Probability of new development has been increased by 10% within 90m of all conservation area boundaries.

<sup>25</sup> All prime agricultural soil and non-prime soils within 300m of prime soil are eligible for conversion to agriculture.

national agri-businesses.<sup>26</sup> Consumers continue to demand a wide variety of high quality products available year-round and at low-cost. With cheap fossil fuel, imported agricultural products remain the dominant source of food for the region.

FORESTRY: The growth of the national housing market has led to an increase in the area of forestland that is harvested each year. This growth largely occurs in rural areas. In the northern New England states large-scale industrial forest management and clear-cutting rates have increased. Warmer growing conditions have led to experimentation with fast-growing softwoods such as loblolly and southern pine plantation forestry. However, the success of these plantations has been variable due to the long time horizon before a return on investment is realized. Accordingly, many large plantations have been converted to agriculture before reaching maturity. Conventional forestry has increased commensurate with expanded biofuel markets, often harvesting low value species. Nonetheless, rising property values and associated new development has driven forestry out of southern New England.

**Table A3.3.** New Transitions 2010-2060 (Growing Global)

| State | Agriculture (ha)         | Development (ha)         | Conservation (ha)        | Harvest (ha)             |
|-------|--------------------------|--------------------------|--------------------------|--------------------------|
|       | scenario / recent trends | scenario / recent trends | scenario / recent trends | scenario / recent trends |
| CT    | 0 / 6,341                | 56,320 / 76,120          | 20,989 / 109,859         | 115,017 / 40,966         |
| ME    | 0 / 45,569               | 92,326 / 125,462         | 555,960 / 2,774,258      | 1,557,321 / 726,184      |
| MA    | 0 / 7,002                | 108,871 / 136,875        | 54,944 / 273,983         | 168,868 / 59,717         |
| NH    | 0 / 10,353               | 71,899 / 98,908          | 102,836 / 546,110        | 294,180 / 106,122        |
| RI    | 0 / 845                  | 12,058 / 16,780          | 8,775 / 40,181           | 18,703 / 6,680           |
| VT    | 0 / 12,806               | 22,110 / 30,503          | 91,427 / 430,652         | 316,069 / 112,768        |
| TOTAL | 0 / 82,917               | 363,585 / 484,648        | 834,931 / 4,175,044      | 2,470,157 / 1,052,437    |

<sup>26</sup> Mean new agricultural patch size has been increased by 1000%. The ratio of new vs. expansion has been increased by + 0.25 for all regions (some regions max out at 100% by expansion).

## Go It Alone

Low natural resource planning & innovation / Local socio-economic connectedness

### *The World in 2060*

SCENARIO IN BRIEF: Population growth in the region has remained fairly low and stable over the past 50 years as the lack of economic opportunity, high energy costs, and tightened national borders have deterred immigration and the relocation of people from within the U.S. to New England. The concurrent shrinking of national budgets and lack of global economic connections have left little leeway to deal with challenges such as high unemployment, demographic change, and climate resilience. Within New England this has resulted in the rolling back of natural resource protection policies and the drying up of investments in new technologies and ecosystem protections in response to a lack of regulatory drivers. Over the last 50 years, the region has seen the significant degradation of ecosystem services as a result of poor planning, increased pollution, and heavy extractive uses of local resources using conventional technologies.

SETTLEMENT PATTERNS: Rates of land development have slowed by about 25 percent compared to the 1990-2000s. Where development has continued, it is characterized by unplanned residential housing that perforates the landscape. Regional planning entities have closed shop and towns and unorganized townships must deal with development issues and municipal services on their own and with dwindling budgets. In most counties, public authorities lack the funds for the maintenance and extension of critical infrastructure such as roads, culverts and sewers. Over time, this infrastructure has begun to deteriorate, particularly in the poorer and more rural areas of New England.

ENERGY AND CLIMATE: Energy costs have continued to rise over the last half-century driven by crumbling conventional energy infrastructure, controversy over new energy development projects, and reduced access to global energy markets that persist in this more state-based world. International efforts to reduce greenhouse gas emissions have failed and conventional energy sources still dominate. High energy costs and poor infrastructure have made it expensive to travel and ship goods. It has become difficult for people to get around and there is resurgent localism in response. Lack of funding for climate change adaptation (e.g. upsizing road culverts) has also left rural communities stranded by rising floodwaters. Given the costs associated with mobility, relocating to more favorable areas is only an option for the affluent. Areas adversely affected by extreme weather endure long and steep economic declines. There is often a strengthening sense of community as people band together in times of scarcity, but many have still seen a considerable decrease in their quality of life.

LAND PROTECTION: Government entities have divested from land protection efforts and there has been little to no new land protection across the region. The protections offered by private land conservation easements often go unmonitored by now-defunct easement holders and are then challenged in court, such that there has been a net reduction in protected private land in areas experiencing development pressure.

FARMING: Growing instability in the global food supply has necessitated a shift toward local and subsistence food production. Counter-intuitively though, the amount of farmland in the region has declined due to the reduced presence of commercial agriculture in the region.

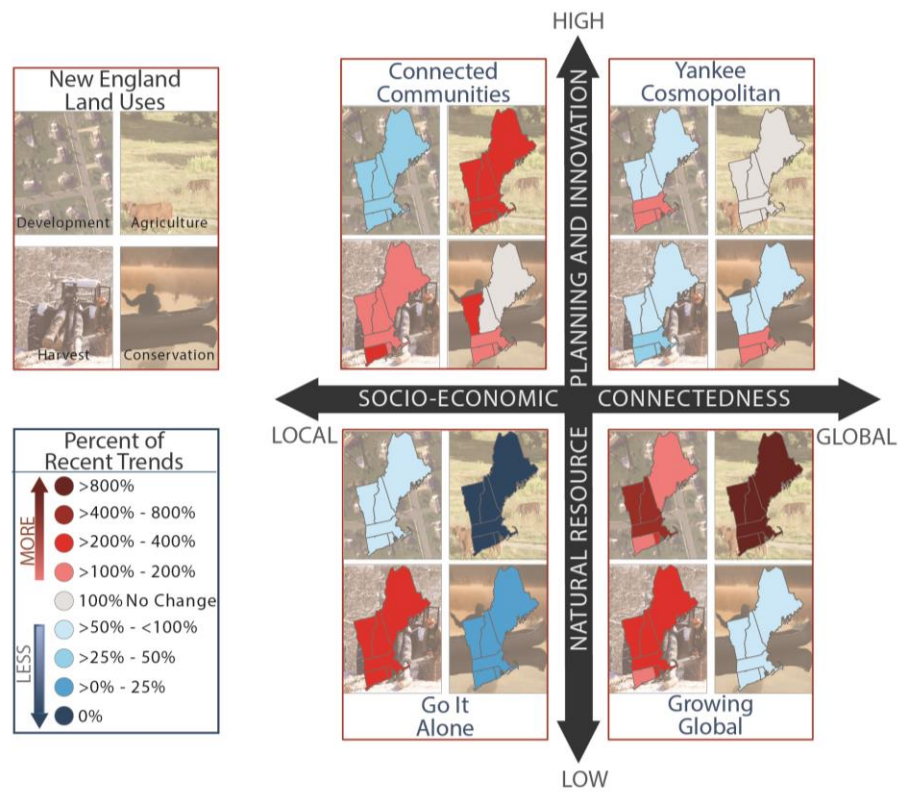
FORESTRY: In regions where the economy and real estate prices have collapsed, the people who remain need to extract what they can from the land. Therefore, timber harvesting rates have increased dramatically, precipitated



by the need to use local resources for energy. There are few incentives to practice long-term silviculture and forests are heavily utilized for biomass energy, mostly for conventional firewood. The management and maintenance of TIMO and corporate forestry lands has declined because it is too expensive to harvest and transport wood products to distant population and energy centers.

**Table A3.4.** New Transitions 2010-2060 (Go It Alone)

| State        | Agriculture (ha)         | Development (ha)           | Conservation (ha)            | Harvest (ha)                 |
|--------------|--------------------------|----------------------------|------------------------------|------------------------------|
|              | scenario / recent trends | scenario / recent trends   | scenario / recent trends     | scenario / recent trends     |
| CT           | 61,979 / 6,341           | 152,035 / 76,120           | 66,376 / 109,859             | 74,486 / 40,966              |
| ME           | 442,492 / 45,569         | 244,287 / 125,462          | 1,660,664 / 2,774,258        | 1,497,019 / 726,184          |
| MA           | 64,832 / 7,002           | 385,648 / 136,875          | 158,571 / 273,983            | 156,599 / 59,717             |
| NH           | 121,190 / 10,353         | 410,381 / 98,908           | 348,491 / 546,110            | 236,376 / 106,122            |
| RI           | 10,044 / 845             | 48,983 / 16,780            | 26,640 / 40,181              | 17,405 / 6,680               |
| VT           | 131,528 / 12,806         | 127,504 / 30,503           | 244,219 / 430,652            | 251,467 / 112,768            |
| <b>TOTAL</b> | <b>832,066 / 82,917</b>  | <b>1,368,839 / 484,648</b> | <b>2,504,960 / 4,175,044</b> | <b>2,233,352 / 1,052,437</b> |



**Fig. A3.2.** Land cover and land use change by scenario