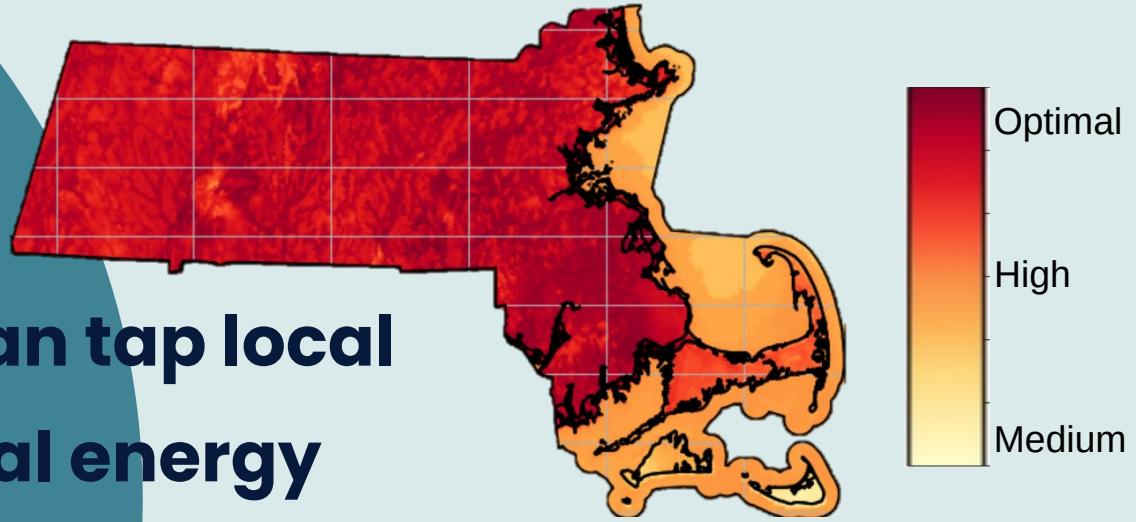
LeGUp Potential Study: Characterizing the Thermal Energy Network (TENs) Potential of Massachusetts

LeGUp Learnings

Archana Dayalu, Isabel Varela, Zeyneb Magavi

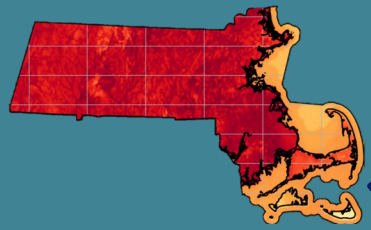
NOVEMBER 5th, 2026





Massachusetts can tap local renewable thermal energy resources that are ~12x the state's annual energy use

MA's low temperature thermal energy resources are distributed among the readily accessible energy reservoirs of the subsurface, the natural water systems, and the built environment.

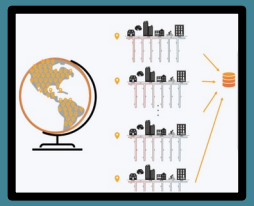


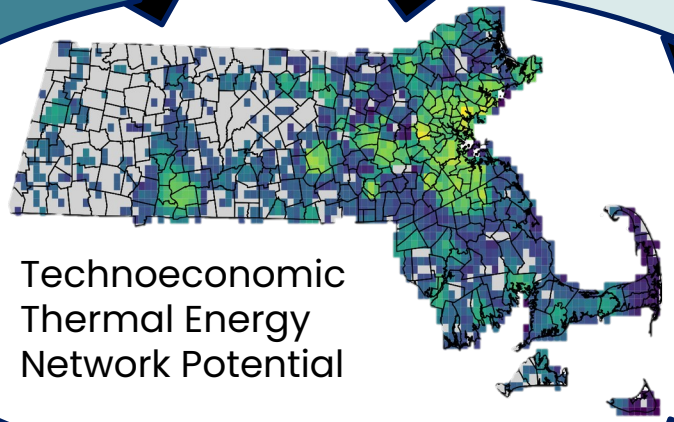

EVERSOURCE
nationalgrid
GEOTHERMAL



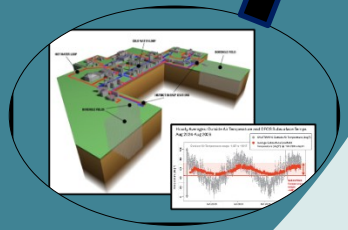




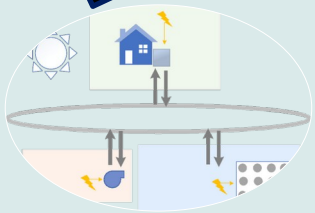



Technoeconomic
Thermal Energy
Network Potential






AVERT
AVoided Emissions and geneRation Tool
www.epa.gov/avert



heet

Demonstrate, Develop, Deploy: A Three-Stage Plan to Statewide Adoption by 2050

DEMONSTRATION

~10 projects

Prove the technology; measure everything

DEVELOPMENT

~100s of projects

Design the frameworks that scale

DEPLOYMENT *By 2050*

1000s of projects

Standard infrastructure, settled rules

FIVE COORDINATED ACTION TRACKS

Policy	phase-matched regulatory frameworks pilot authority to scalability
R&D	Geo DataBank; measured performance, cost, and grid-impact studies
Workforce	gas-to-geo skills transfer; drilling Center of Excellence; geo-HVAC training
Finance	cost categorization, used-and-useful standards, funding stack at street scale
Project pipeline	e.g.: Framingham + Flagg Loop; utility pilots; Kickstart communities, Franklin Field

Executive Order 654 (Mar. 2026) directs accelerated geothermal deployment: resource identification, permitting models, licensing pathways, and workforce.

Source: CELT Roadmap

Determining Statewide and Regional TENs Prioritization

Key Criteria for Social and Economic Feasibility



Thermal Energy Resources

- Geology and Hydrology
- Heat Sources
- Heat Sinks



Existing Infrastructure

- Buildings
- Energy
- Restrictions

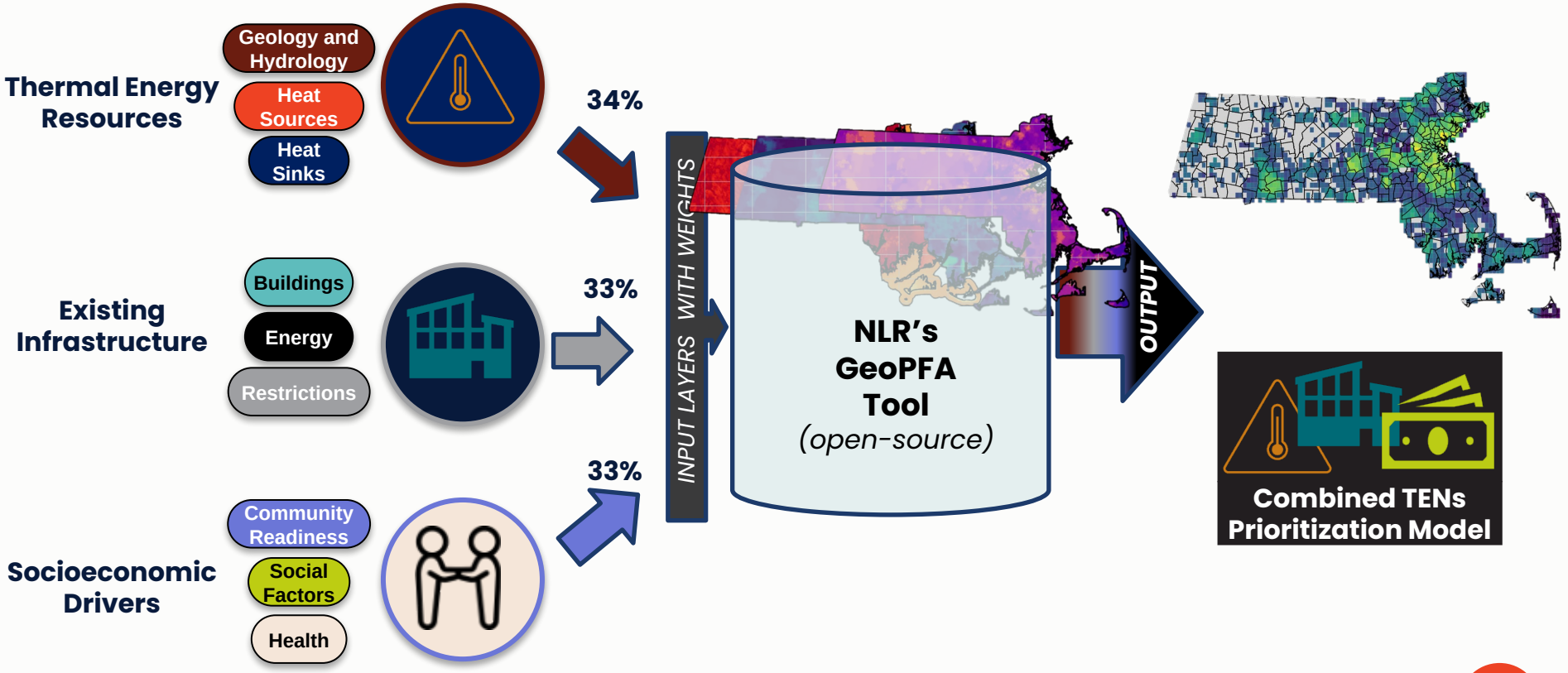


Socioeconomic Drivers

- Community Readiness
- Social Factors
- Health

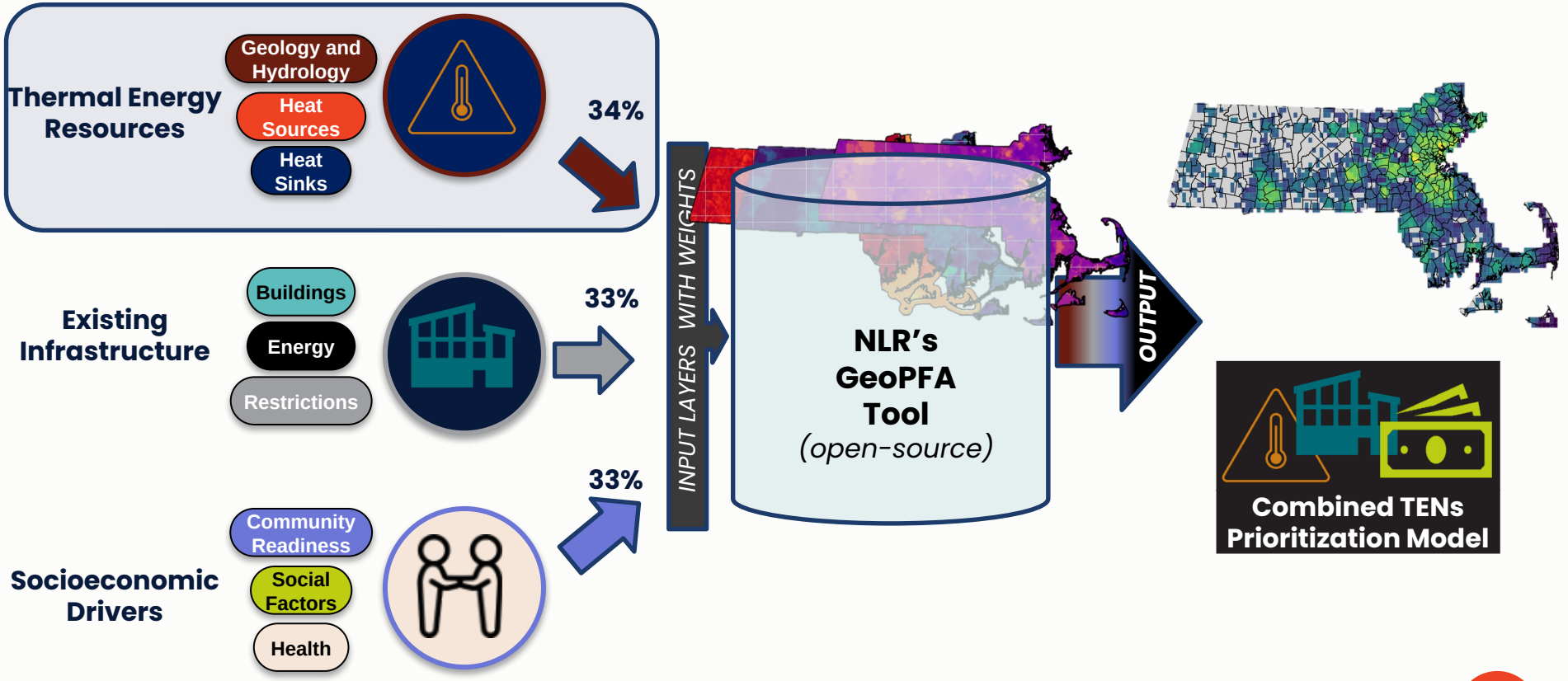
Data Sources: Mass DEP (2026); MHP (2026); MAPC (2026); MassMapper (2026); HEET/BU Dashboard (2026); ResStock/ComStock (2026)

Representative Statewide and Regional TENs Prioritization



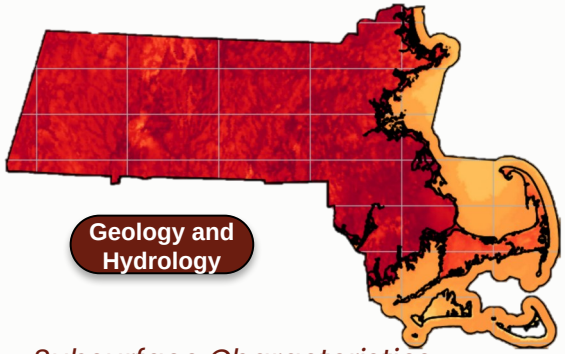
Software and Data Sources: NLR (2026); Mass DEP (2026); MHP (2026); MAPC (2026); MassMapper (2026); HEET/BU Dashboard (2026); ResStock/ComStock (2026); Dalla Santa et al. (2020); NOAA NCEI (2026)

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Component Analysis: Thermal Resources



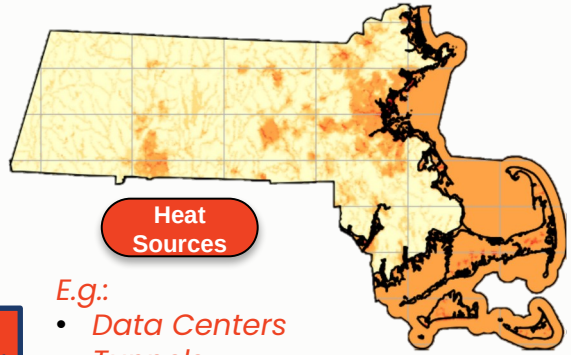
High

Moderate

- *Subsurface Characteristics (depth, thermal conductivity, density, heat capacity) of bedrock and overburden*
- *Bottom Temperatures*
- *Water Table Depth*

20%

40%



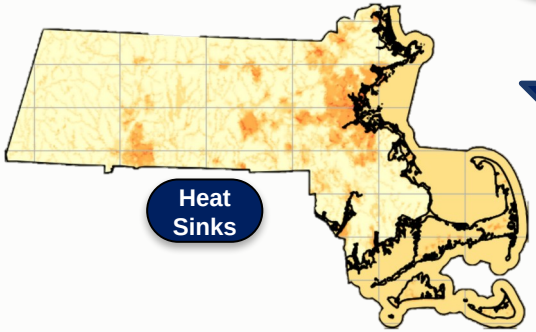
High

Moderate

E.g.:

- *Data Centers*
- *Tunnels*
- *Sewers*
- *Ice Rinks*
- *Industrial Waste Heat (in dev at OCIR)*
- *Rivers, Lakes, Ponds, Coasts**

40%



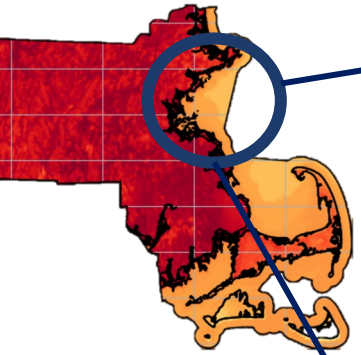
High

Moderate

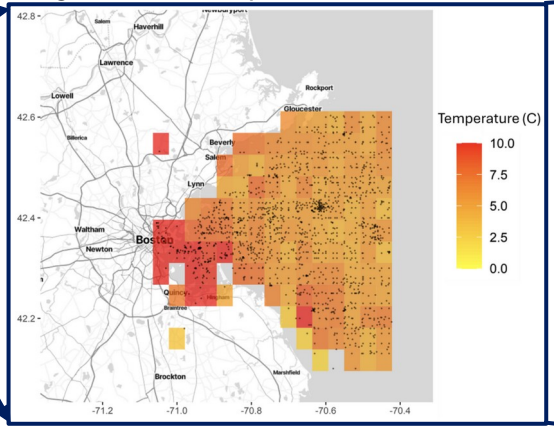
E.g.:

- *Swimming Pools*
- *Tunnels*
- *Sewers*
- *Rivers, Lakes, Ponds, Coasts**

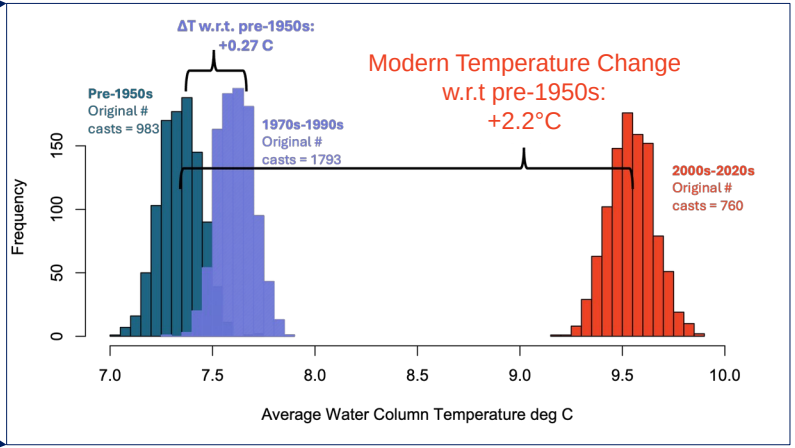
Component Analysis: Thermal Resources



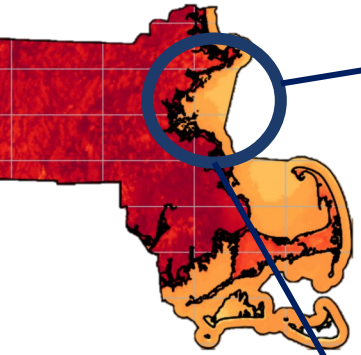
Avg Bottom Temperatures (1912-2022)



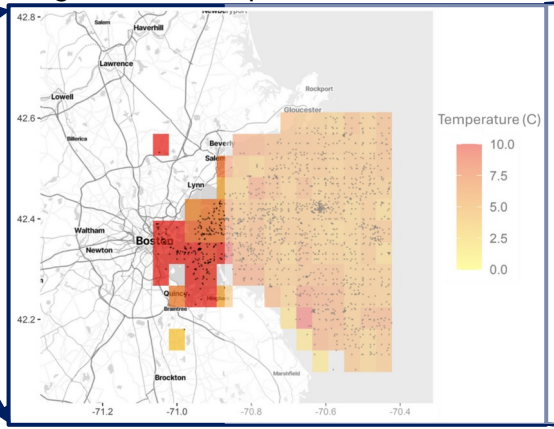
Water Column Averages:
pre-1950s, 1970s-1990s, 2000s+



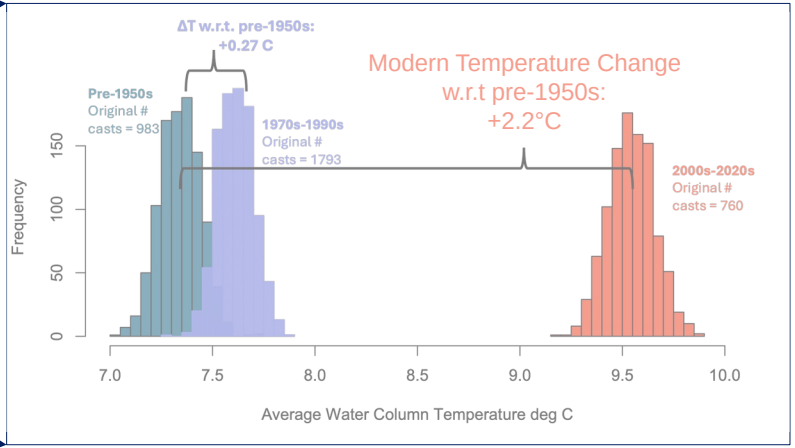
Component Analysis: Thermal Resources



Avg Bottom Temperatures (1912-2022)



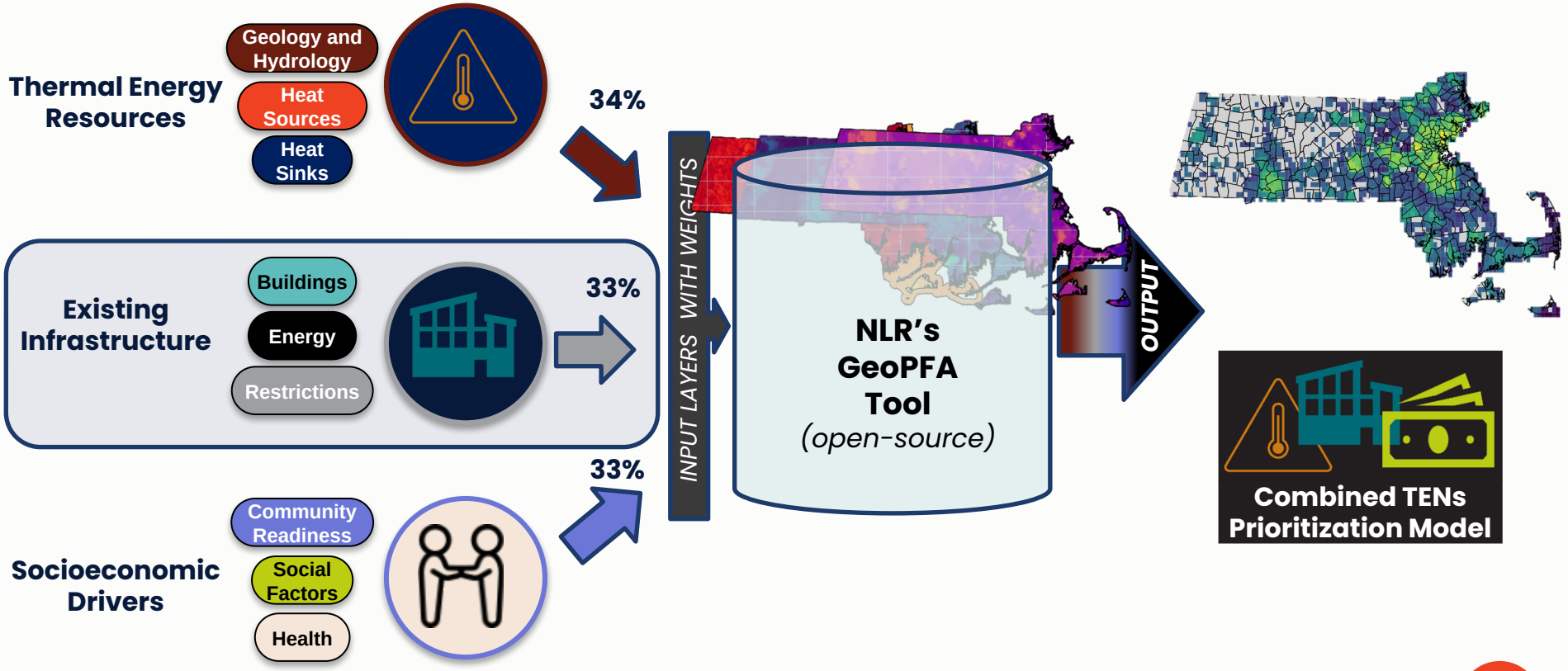
Water Column Averages:
pre-1950s, 1970s-1990s, 2000s+



Since the pre-1950s, Boston's INNER Harbor has warmed by +3.2 ° C…

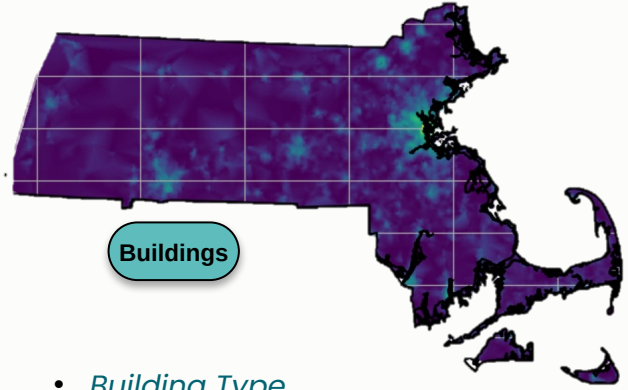
Annually, 1-4 million typical Boston homes can be heated by this excess heat

Representative Statewide and Regional TENs Prioritization



Software and Data Sources: NLR (2026); Mass DEP (2026); MHP (2026); MAPC (2026); MassMapper (2026); HEET/BU Dashboard (2026); ResStock/ComStock (2026); Dalla Santa et al. (2020); NOAA NCEI (2026)

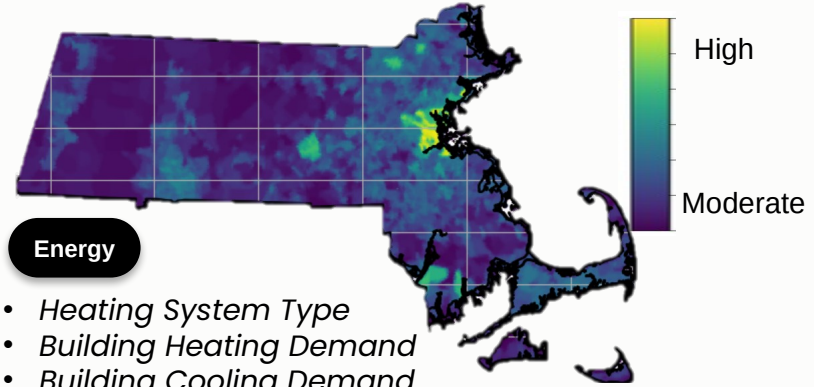
Component Analysis: Existing Infrastructure



- *Building Type*
- *Building Density*
- *Seaport Locations*

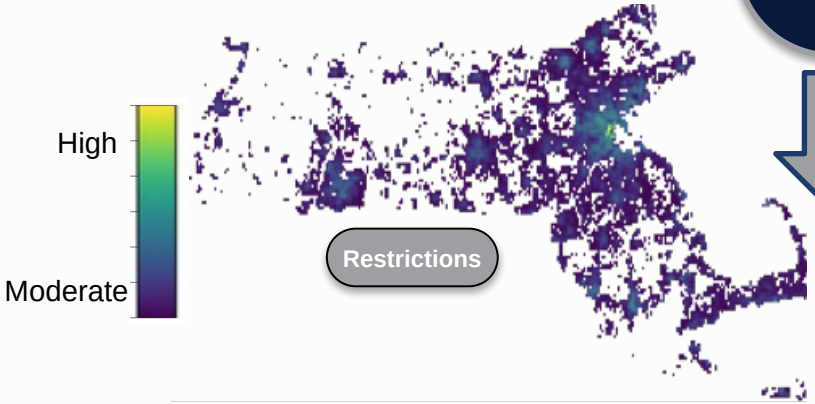
60%

40%



- *Heating System Type*
- *Building Heating Demand*
- *Building Cooling Demand*
- *Gas Infrastructure (age and leaks)*
- *Grid constraints**

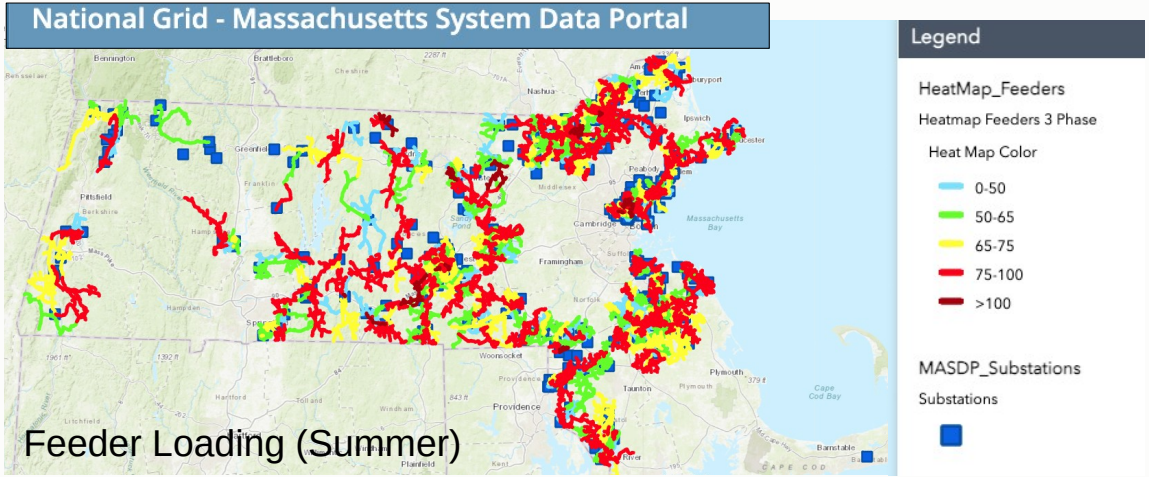
Yes/No



E.g.

- *Very Low Building Density*
- *Superfund Sites*

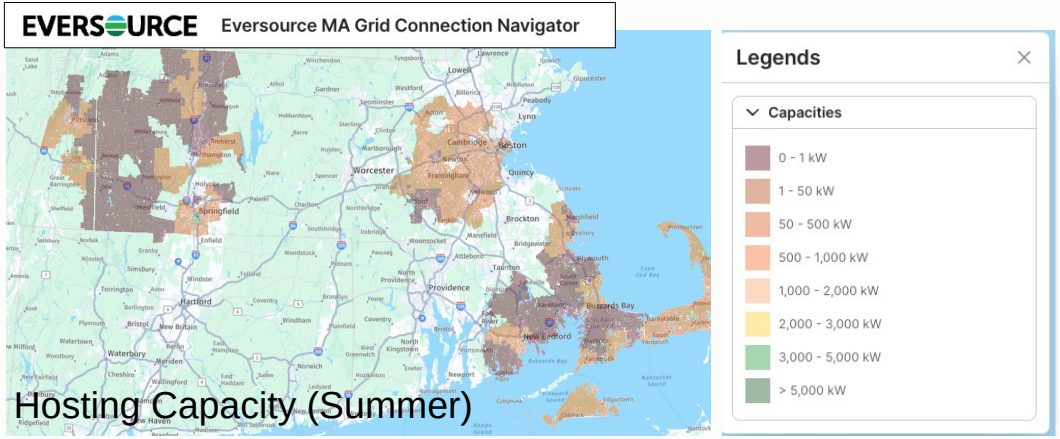
Component Analysis: Existing Infrastructure



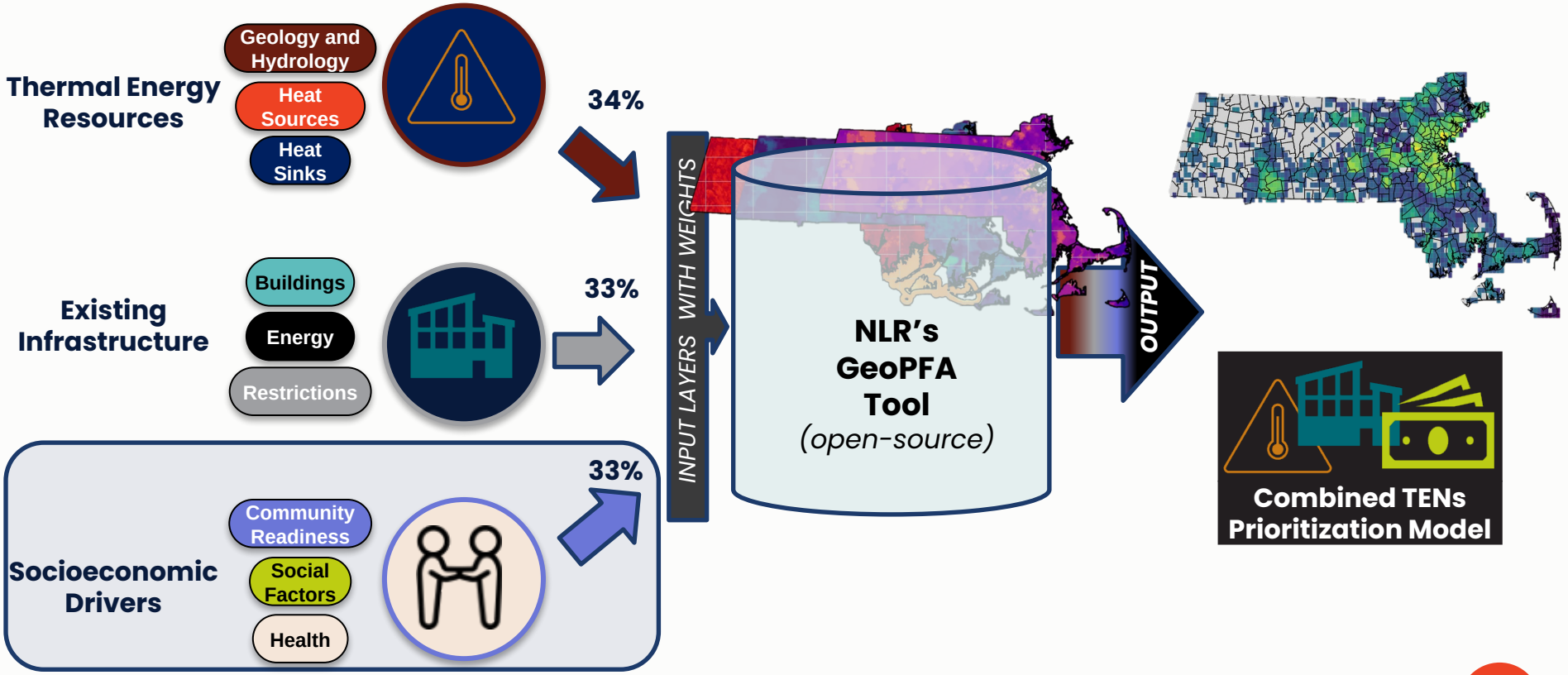
KEY DATA NEED!

Utility Grid Constraint Data:

- *Viewable, but not currently downloadable*
- *Key information for future tool development*

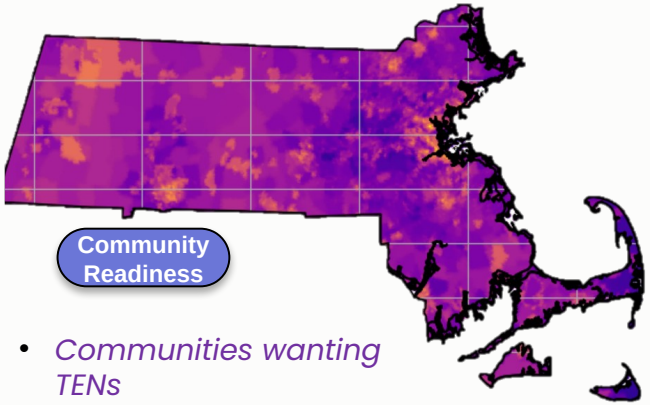


Representative Statewide and Regional TENs Prioritization



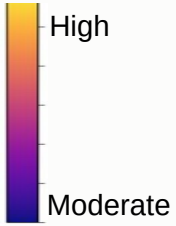
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Component Analysis: Socioeconomic Drivers



Community Readiness

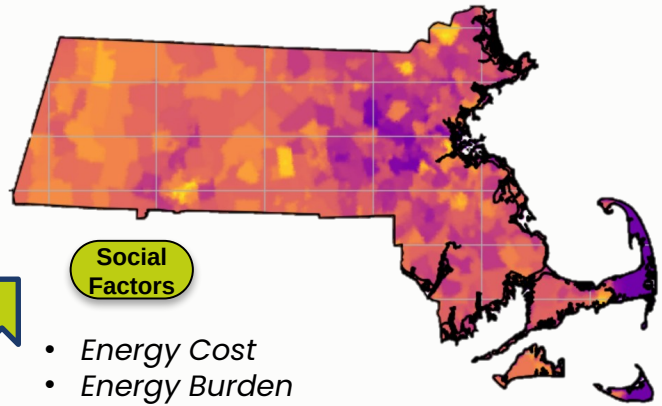
- *Communities wanting TENs*
- *EJ Rank*
- *Percent Renters*



40%

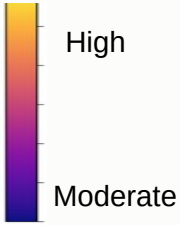


40%

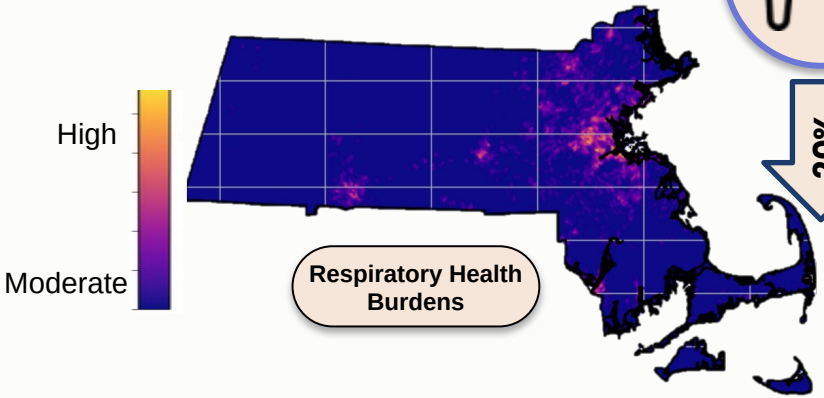


Social Factors

- *Energy Cost*
- *Energy Burden*
- *Household Income*



20%



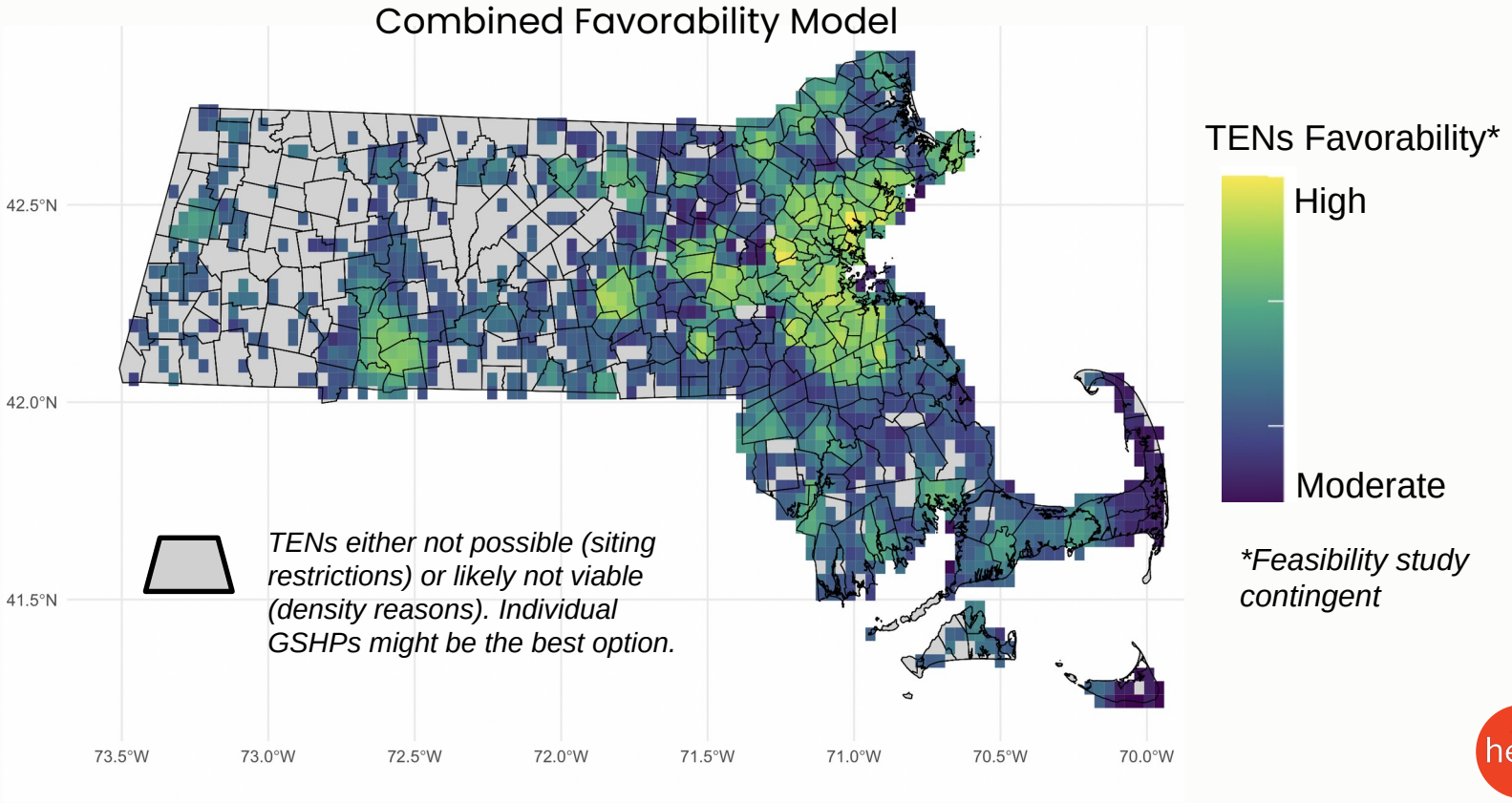
Respiratory Health Burdens

heet

Software and Data Sources: NLR (2026); Mass DEP (2026); MHP (2026); MAPC (2026); MassMapper (2026); HEET/BU Dashboard (2026); ResStock/ComStock (2026)

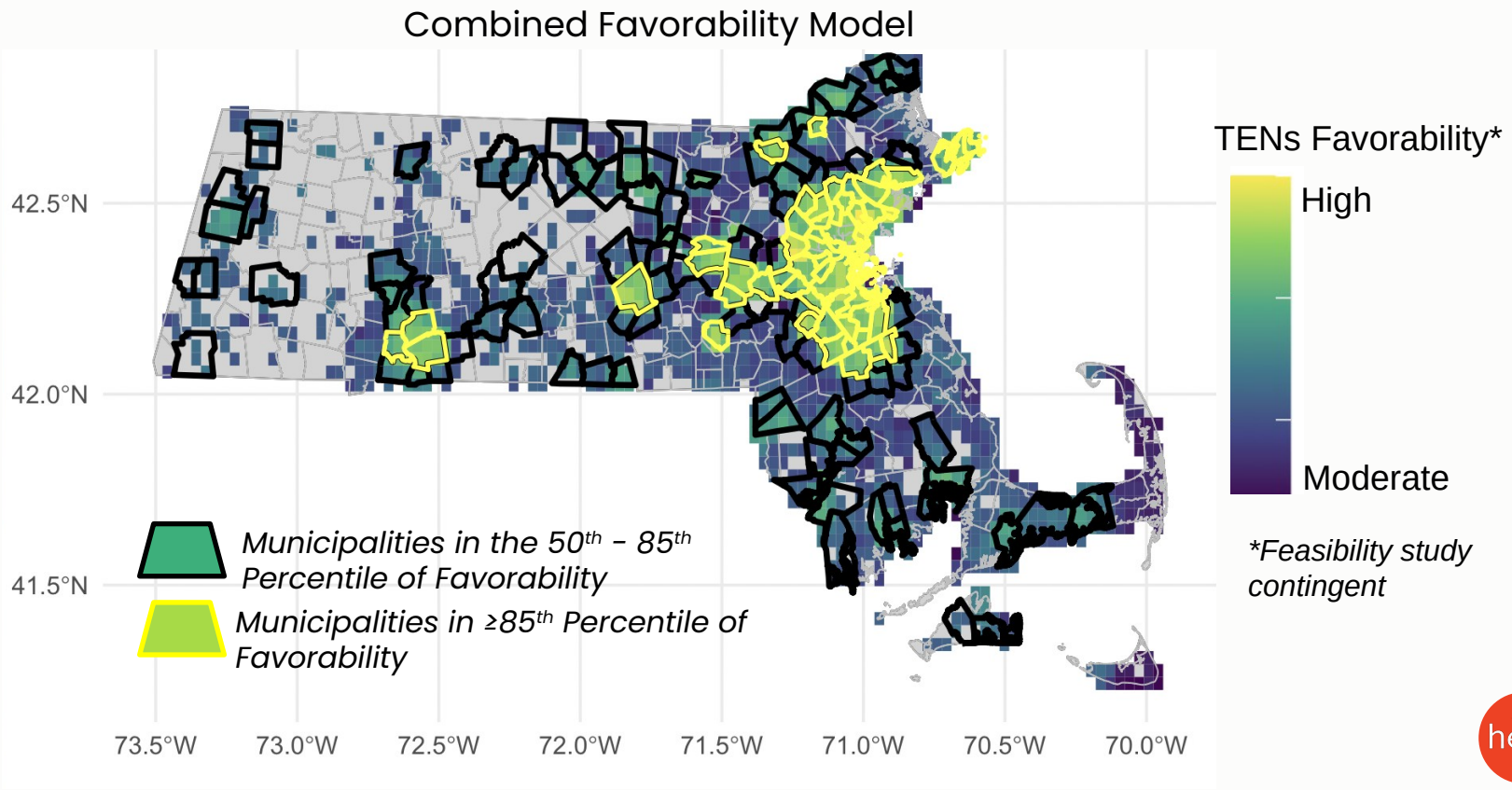
Combined: The State's Technoeconomic Potential for TENs

Thermal Resources + **Existing Infrastructure** + **Socioeconomic Drivers**



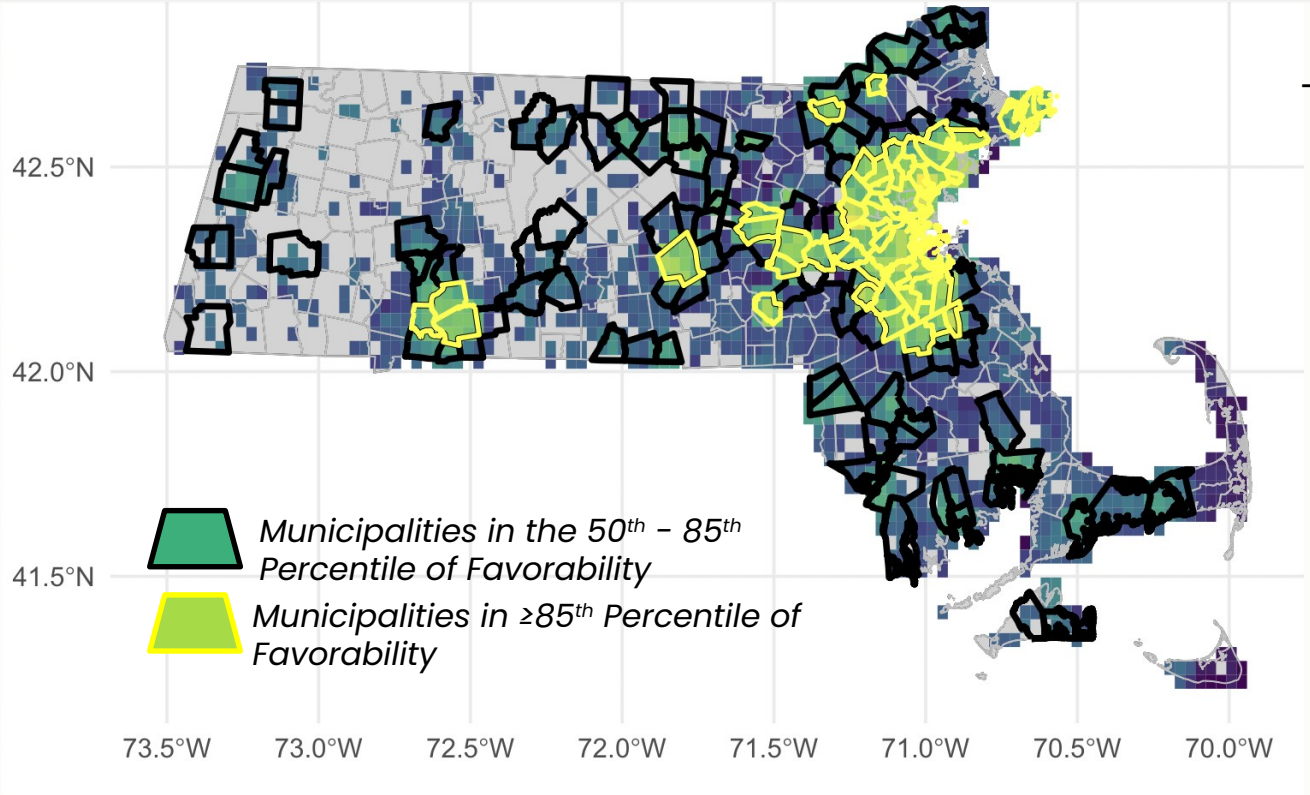
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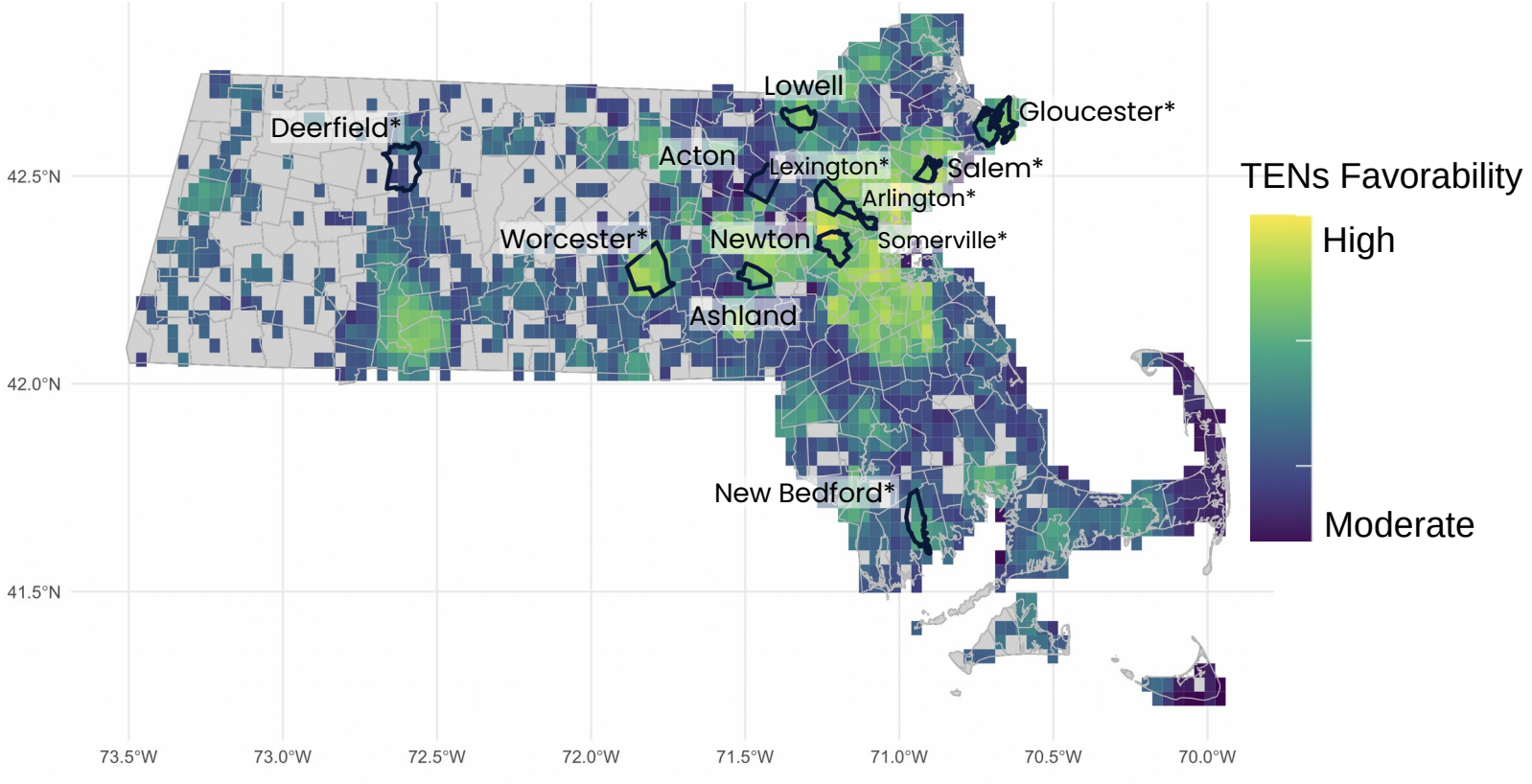
Combined: The State's Technoeconomic Potential for TENs

~ 2/3 of MA's building stock is located in highest municipal favorability zones!



Kickstart: 12 early-stage community TENs assessments

Acton
Arlington*
Ashland
Deerfield*
Gloucester*
Lexington*
Lowell
New Bedford*
Newton
Salem*
Somerville*
Worcester*



*Community also conducted Feasibility Study through HEET's Kickstart Program

Demonstrate, Develop, Deploy: A Three-Stage Plan to Statewide Adoption by 2050

DEMONSTRATION

~10 projects

Prove the technology; measure everything

DEVELOPMENT

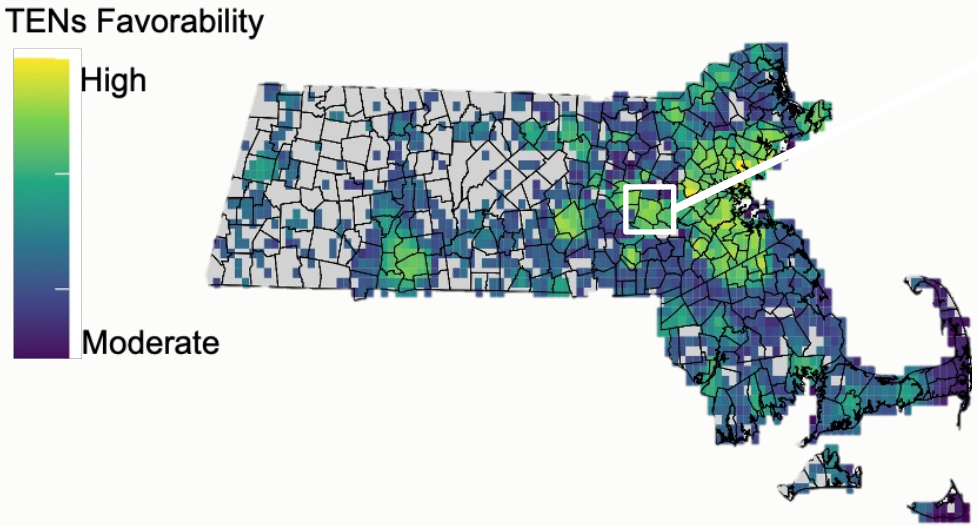
~100s of projects

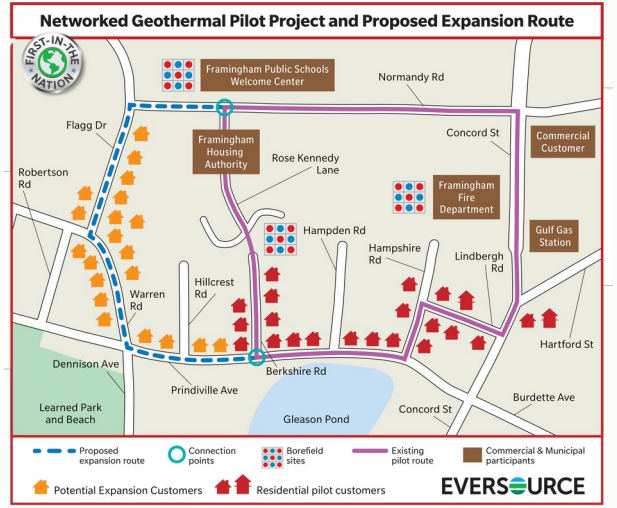
Design the frameworks that scale

DEPLOYMENT *By 2050*

1000s of projects

Standard infrastructure, settled rules





heet

Demonstrate, Develop, Deploy: A Three-Stage Plan to Statewide Adoption by 2050

DEMONSTRATION

~10 projects

Prove the technology; measure everything

DEVELOPMENT

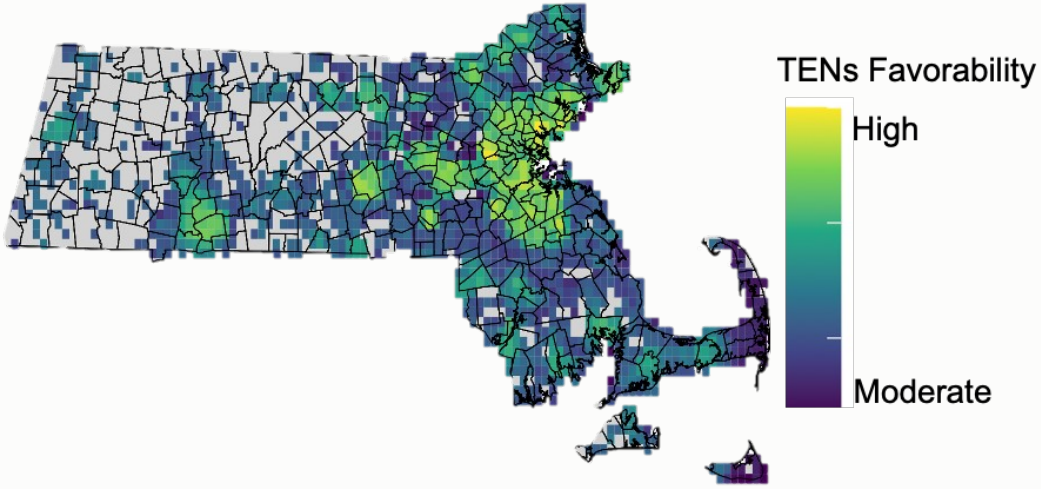
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Design the frameworks that scale

DEPLOYMENT *By 2050*

1000s of projects

Standard infrastructure, settled rules



Executive Order 654 (Mar. 2026) directs accelerated geothermal deployment: resource identification, permitting models, licensing pathways, and workforce.

Key Learnings

- Massachusetts has renewable thermal energy resources that are ~12x its annual energy consumption and available everywhere.
- The Potential Tool is key to guiding sensible technoeconomic assessments for accelerating MA's planned geothermal deployment.
- About two-thirds of MA's building stock is located in the highest municipal favorability zones
- HEET's Kickstart program has already engaged with twelve state municipalities for TENs development.

References

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- CELT Roadmap (2026). Strategic Scaling of Geothermal Energy Networks (GENs) in the Commonwealth of Massachusetts: Draft Roadmap for the Clean Energy and Environment Legacy Transition (CELT) Initiative. 12 June 2026