

Sustainability Indicators project

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Introduction

Sustainability indicators are tools that assist decision makers in proceeding towards sustainability. In conjunction with the Pioneer Valley Sustainability Network, we have developed a set of sustainability indicators. The indicators are currently classified under 6 fundamental objectives: to maximize *ecological health, cultural vitality, equity, social connectivity, and resource efficiency*. The indicators cover the Pioneer Valley region, including Hampden, Hampshire and Franklin counties. We obtained data for more than 75 % of indicators. This data will provide a baseline from which progress on sustainability can be measured by the community.

In this report we briefly explain the significance of each indicator and discuss the corresponding attributes that were measured. We then depict our data graphically at the county level for the Pioneer valley region. Finally, we propose a method to depict key data for each of these indicators which could be considered as a baseline.

We divide these indicators according to the availability of data into three groups.

Group I: Data available

1. Air quality
2. Water quality
3. Carbon emissions
4. Health status
5. Voter registration
6. Percent recycling
7. Affordable housing
8. Education
9. Local food production
10. Access to transportation
11. Income distribution

Group II: Data available but needs to be processed

1. Local access to parks
2. Biodiversity
3. Energy Use

Group III: Not clear that the data is currently available

1. Locally owned businesses

GROUP I

ENVIRONMENTAL QUALITY INDICATOR: Air Quality

Air quality demonstrates local condition of the environment and how that affects people who live in that area. Air quality reflects both lower energy consumption and cleaner energy sources as well as fewer and cleaner motor vehicles and lower greenhouse gas emissions. Additionally, it may also indicate more biking and walking that can contribute to physical and emotional health.

Attribute

Air Quality Index (AQI) is a measurement unit defined by the Environmental Protection Agency to indicate the air quality of a particular area. It tells how clean or unhealthy is the air in that area and what means to our health. The AQI has been divided into six main categories as shown below: It also tells if the air is suitable/ unsuitable for sensitive groups.

Table 1 Air quality criteria standardized by EPA

Air Quality Index Values	Air quality condition	Level of Health Concern
0 to 50	Good	Little or no health risk
51 to 100	Moderate	People who are sensitive to ozone or particulate matter may experience respiratory symptoms
101 to 150	Unhealthy for sensitive groups	People with lung diseases, older adults and children who are active outdoors are considered to be affected
151 to 200	Unhealthy	Everyone is at risk. Sensitive groups most affected
201 to 300	Very Unhealthy	Health alert triggered. Everyone may experience serious health hazard
301 to 500	Hazardous	Health warning triggered. Emergency situation

Data

There are monitoring stations at more than a thousand locations across the country. These stations collect concentration level of four key pollutants: carbon monoxide, sulphur dioxide, particulate pollution, and ozone. Carbon monoxide, Sulphur dioxide and Ozone are measured in ppm and Particulate matter is measured in $\mu\text{g}/\text{m}^3$. Environment Protection Agency (EPA) has developed a formula that converts the measured values of these pollutants into AQI values. AQI value of each pollutant is calculated using this equation. The highest AQI value is reported as the AQI for that day and the pollutant which has this value is regarded as the main pollutant. Please note that detailed explanation of calculation of AQI is explained in http://www.epa.gov/airnow/aqi_tech_assistance.pdf.

We obtained AQI values for Hampden and Hampshire counties for the year 2008. The chart below shows the number of days when AQI was good, moderate and unhealthy for sensitive groups. Please note that Franklin County does not have an air monitoring station.

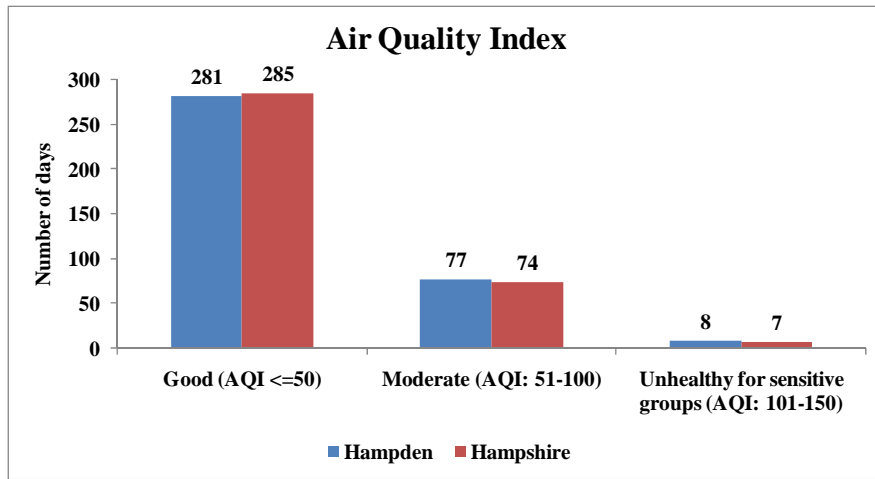


Figure 1 Air quality index for Hampden and Hampshire counties

Key Indicator

We propose to consider the number of days the air quality index has value greater than 50. The graph below represents this indicator.

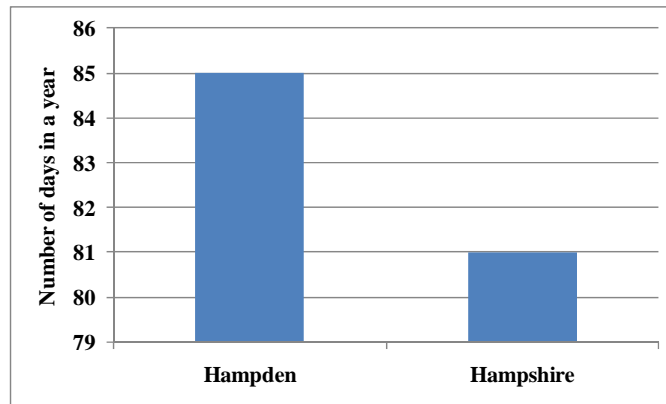


Figure 2 AQI greater than 50 for Hampden and Hampshire counties

Source of data

Environment Protection Agency (EPA)

Contact person

We obtained the data by emailing Jake Summers from EPA at summers.jake@epa.gov. He sent us the data in a pdf file which consisted of AQI value for the two counties for 2008. The following is his contact information:

Jake Summers

National Air Data Group, OID/OAQPS/OAR/EPA, C339-04

Research Triangle Park, NC 27711

(919) 541-5695 (Phone)

Water Quality

Water nourishes human communities, wildlife and the natural and built landscape. It contributes to aesthetic and recreational values that often translate into higher property values. Drinking water quality is a community and public health asset. Protecting water quality in our streams, ponds, lakes, rivers and aquifers is the focus of much regulatory policy at all levels of government.

Attribute

We obtained data from a water quality monitoring project conducted by the University of Massachusetts Amherst Water Resource Research Center. In this project, water temperature and bacteria in the form of Escherichia coli (E. coli) at various sites are measured. E. coli is measured in the number of colonies per 100 ml of the sample measured. The table below shows the Massachusetts criteria for E.coli from Tristate Connecticut Water shed initiative project. The state of New Hampshire reports a third criteria for water quality which contains values in between 235 and 1260. This range is suitable for boating but not swimming. . However, Massachusetts State does not have E.coli criteria for this range. Thus, we use only two range; below 235 and above 1260. Details of the criteria can be found in the following website: <http://www.umass.edu/tei/mwwp/ctrivermonitoring.html>.

Table 2 Massachusetts criteria for E. coli

Single sample maximum (colonies/100 ml)	Condition
235	suitable for primary water contact
1260	unsuitable for recreation (boating or swimming)

Data

There are six monitoring stations in Hampden, five in Franklin and three in Hampshire. The data is recorded once every three days. The measurement is taken during summer months, mainly from April to October. We obtained E. coli data for the 14 water monitoring stations. The graph below depicts the percentage of measured samples that have their E.coli below 235 or above 1260.

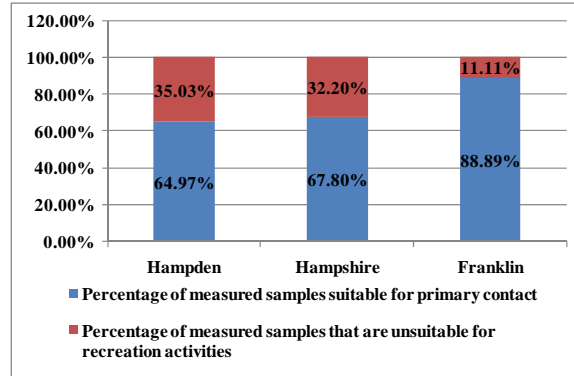


Figure 3 E.coli data for Water quality indicator

Key indicator

We consider the second category of measured samples where the water sample is unsuitable for recreation activities like boating or swimming. The graph below indicates the percentage of the measured samples that are unsuitable for recreation activities only.

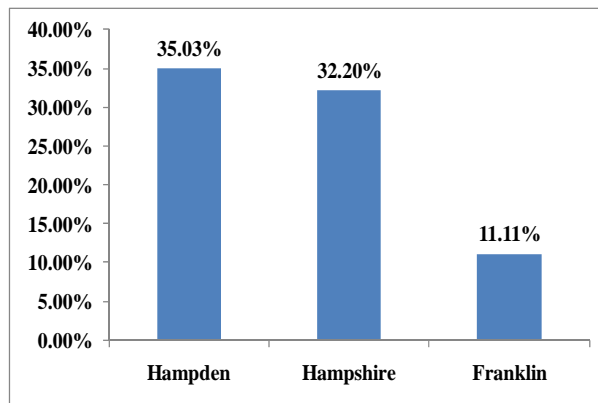


Figure 4 Percentage of samples with E. coli greater than 1260 per 100 ml

Source of data

The data is posted regularly in the following website:

<http://www.umass.edu/tei/mwwp/ctrivermonitoring.html>

Contact person

We contacted Paula Sturdevant at Water Resources Research Center, University of Massachusetts Amherst. Jerry Schoen emailed us the data in the form of excel sheet attachment. Following is the contact information;

- 1- Paula Sturdevant Rees, Ph.D.
 Director, Water Resources Research Center
 Director, Education & Outreach, CASA

Blaisdell House, 310 Hicks Way

University of Massachusetts, Amherst, MA 01002

413.545.5528

rees@ecs.umass.edu

2- Jerry Schoen

MassWWP Coordinator

Blaisdell House

UMass, Amherst MA 01003

413-545-5532

jschoen@tei.umass.edu

Green House Gas emissions (GHG)

Carbon emissions directly impact climate change, which in turn impact human and ecological health in the valley and around the world. Currently in the U.S. damages from carbon emissions are not included in the cost of energy consumption, creating emission levels that are socially inefficiently.

Attribute

We obtained green house gas emissions data for the three counties from the Vulcan project report that was produced at Purdue University. The Vulcan report carbon emissions data relies on the information obtained from EPA through Clean Air Act Legislation.

According to this data inventory, the green house gas emissions are expressed in million Tonnes of carbon (that is in metric tons). The graph below shows GHG emissions per capita for all the three counties. The graph also shows carbon tonnage for 6 different classifications, namely, commercial, industrial, electricity, residential, on-road, non-road and aircraft. It can be observed from the graph that Franklin county has the highest GHG emissions per capita than the other two counties. Out of the seven classifications, on road and industrial

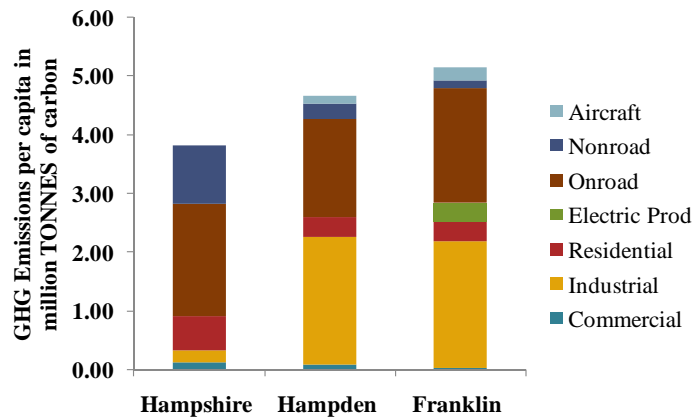


Figure 5 Green House Gas emissions per capita

Source of data

Vulcan fossil fuel CO2 inventory prepared by Purdue University.

Website: <http://www.purdue.edu/eas/carbon/vulcan/research.php>

HEALTH INDICATOR: Health Status

Health status may be the single most important indicator of a community's long-term sustainability. It combines environmental, social, and economic factors, including gross and subtle influences on personal physical and emotional well-being. It is also an indicator of environmental exposures and access to good nutrition, preventative health care and health treatment.

Attribute

We consider asthma hospitalization rate to indicate the health status for the three counties. We found that Massachusetts Community Health Information Profile (Mass CHIP) is an online data inventory which gives free access to community-based health information. This is aimed at assessing health needs for the community and in evaluating health programs.

The latest information that we could obtain for this indicator was from the year 2006. Data for the year 2008 is expected to be available by summer 2010. Mass CHIP publishes the data once in two years. The first graph below shows the percentage and count of asthma hospitalization. The count (that is, the absolute number of patients hospitalized due to asthma condition) is plotted on the right hand y-axis.. Percentage rate on the primary y-axis is obtained by dividing this count by the population of the appropriate county. For example, Franklin county had just over 100 hospitalizations, which represents a rate of about 0.165%.

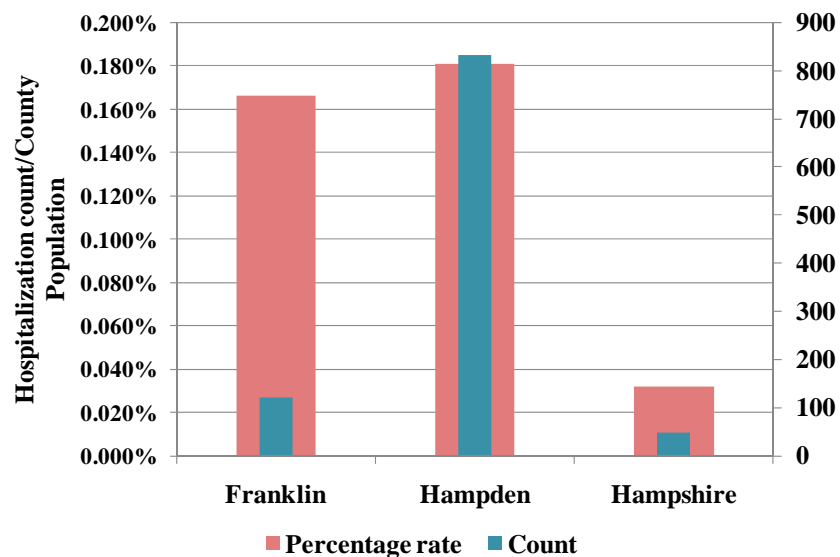


Figure 6 Asthma Hospitalization rate and the count

Key Indicator

We propose to consider hospitalization count per hundred people as the key indicator to demonstrate health condition in the three counties. We observe clearly from the graph that the Hampden County has the highest percentage compared to the rest.

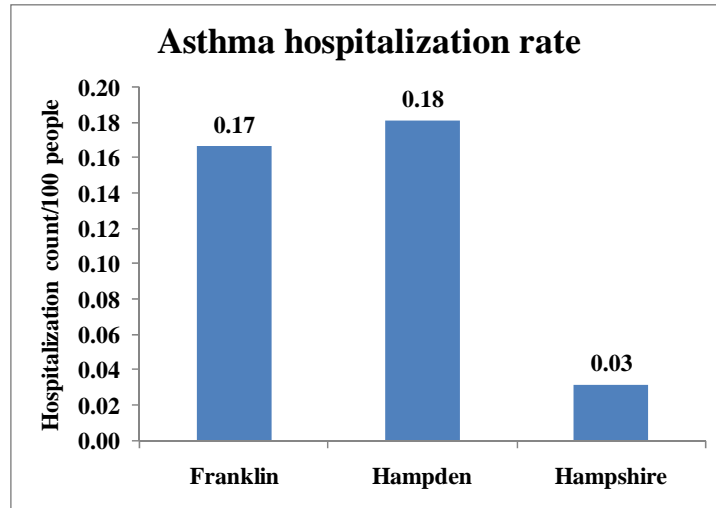


Figure 7 Hospitalization count per 100 people for all the three counties

Source of data

Mass CHIP (2006)

Website:

http://www.mass.gov/?pageID=eohhs2terminal&L=4&L0=Home&L1=Researcher&L2=Community+Health+and+Safety&L3=MassCHIP&sid=Eeohhs2&b=terminalcontent&f=dph_masschip_r_custom_reports&csid=Eeohhs2

CIVIC ENGAGEMENT INDICATOR: Voter registration

People vote if they feel it matters and have adequate time and access to polling places. If the first criterion is not met people feel alienated from government. If the second criterion is not met, it may imply that people are overworked, under compensated or that voting is not a priority. If the third criterion fails there may be an issue of discrimination.

Attribute

We use percentage of registered voters for every county per population of that county for this indicator. It can be seen from the graph below that Franklin County has an increase of around 4 % of registered voters in a span of two years. Hampshire County has an increase of around 3.8 %, followed by Hampden County which has an increase of roughly 2 %.

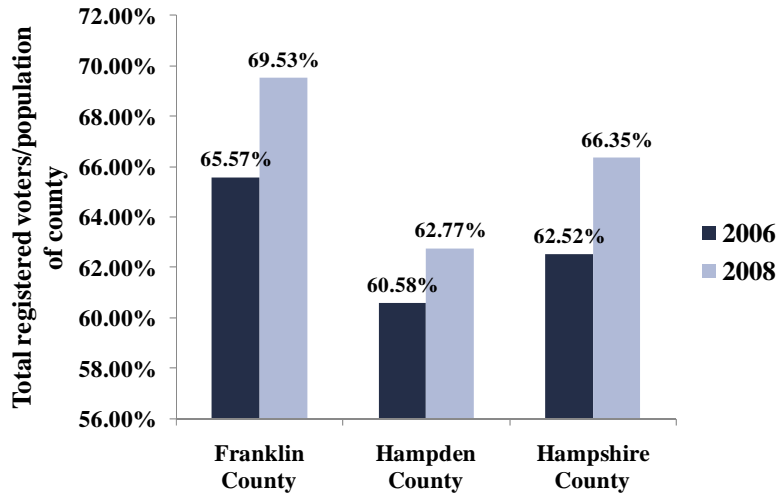


Figure 8 Voters registration percentage

Source of data

We obtained the data in an excel sheet from Jackson Molly, Pioneer Valley Planning Commission (PVPC). The source of data mentioned in the excel file was Massachusetts Department of Revenue.

WASTE INDICATOR: Percent Recycling

Our rate of recycling serves as a proxy for our commitment to ecological health and resource efficiency. It tells us about how quickly and in what direction our throw-away society is changing and whether we recognize that waste leads to unsustainable conditions. It shows if we are willing to make effort to achieve a more sustainable future.

Attribute

This indicator is measured in terms of percentage recycling rate for all the municipalities in the pioneer valley region. We obtained recycling rates for 64 out of 69 municipalities in the entire Pioneer valley region considering Franklin, Hampden and Hampshire counties. We have plotted percentage recycling rate for the entire pioneer valley region and also plotted for individual counties.

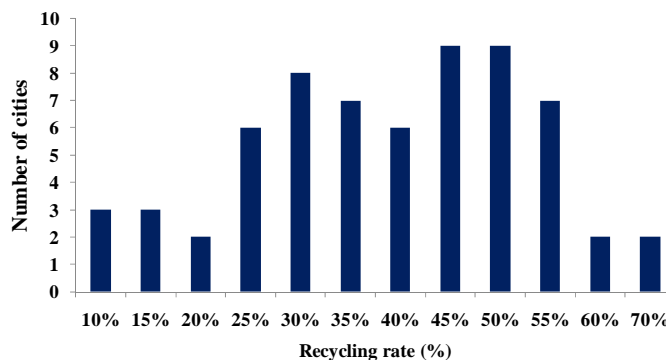


Figure 9 Recycling rate for the pioneer valley region at municipality level

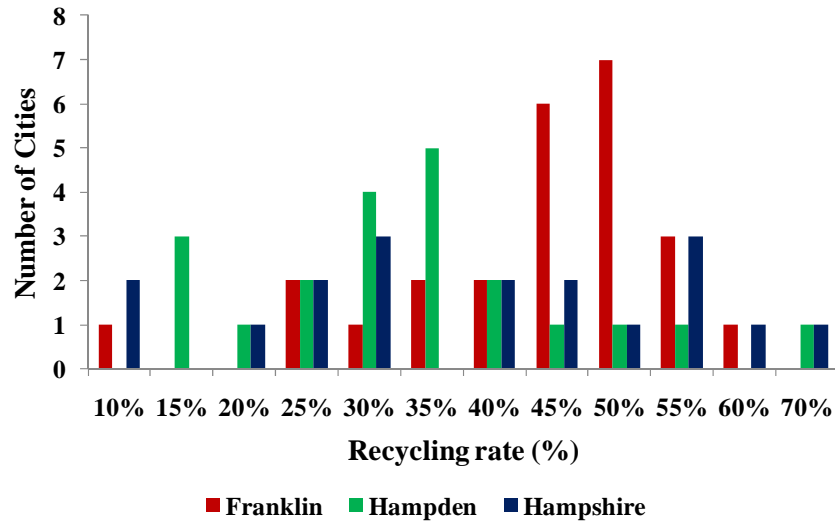


Figure 10 Recycling rate for the three counties at municipality level

Key indicator

We propose to consider the number of municipalities having recycling rate above 50 % to be represented as a key feature for this indicator. Below is the graph which shows number of municipalities plotted versus recycling rate for Franklin, Hampden and Hampshire counties.

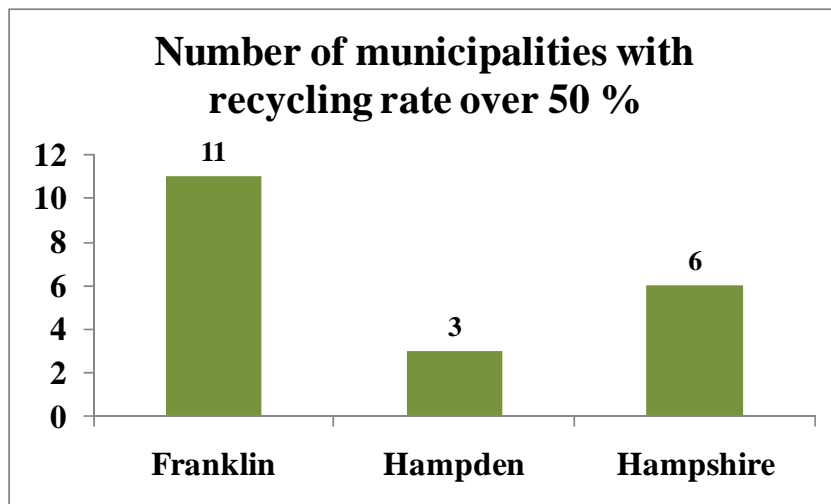


Figure 11 Recycling rate over 50 % for the three counties at municipality level

Source of data

Mass DEP solid waste management group . The data is available at the following website:

<http://www.mass.gov/dep/recycle/priorities/dswmpu01.htm#recycling>

Affordable Housing

Housing affordability concerns physical, economic, and social barriers for low-income individuals and households. Social benefits of affordability include diversity, stability, opportunities for elders, and positive impacts on health and education. Financial benefits include ability to participate in the local economy, labor force and viability of local industry.

Attribute

According to many government agencies, people who pay more than 30% of their income on housing costs are considered to be housing cost burdened. The U.S. Census Bureau provides estimates on this statistic based on a survey of a sample of the population with the American Community Survey. Data for this indicator includes all home owners who have mortgages. Monthly owner costs include payment for mortgages, real estate taxes, various insurances, utilities, fuels, mobile home costs, and condominium fees. A housing unit is owner occupied if the owner or co-owner lives in the unit even if it is mortgaged or not fully paid for. All occupied units which are not owner occupied, whether they are rented for cash rent or occupied without payment of cash rent, are classified as renter-occupied.

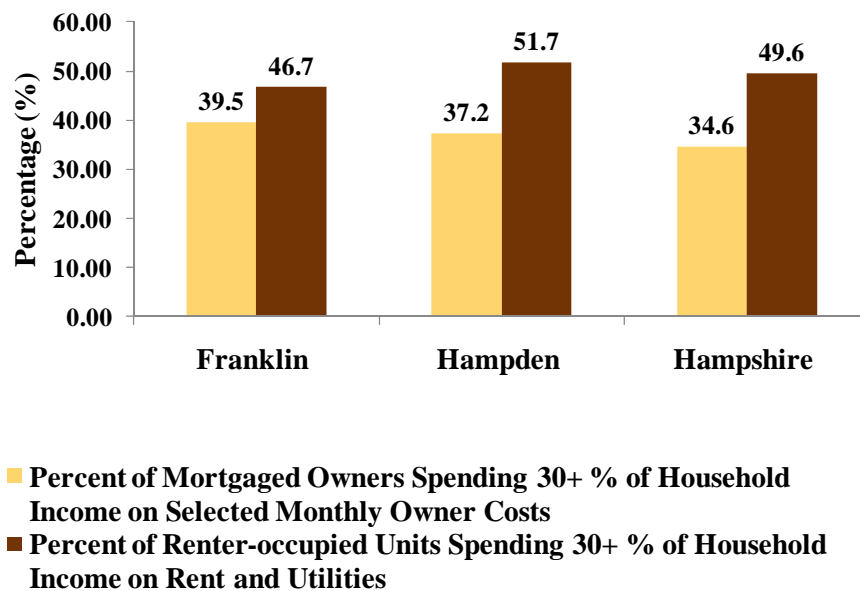


Figure 12 Housing affordability at the county level

Key Indicator

We calculate a weighted average of owners and renter units for which more than 30 % of the income is spent on rent or monthly owner costs. The graph below shows these numbers. Hampden County has the highest number of units compared to Hampshire and Franklin Counties.

Table 3 Physical and financial characteristics of housing at the county level

Counties	Owner-occupied	Renter-occupied	Owner-occupied housing units	Renter-occupied housing units	Units for which more than 30 % of income is spent on rent or owner costs
Franklin	39.50%	46.70%	21,029	8,850	12,439
Hampden	37.20%	51.70%	110,716	63,591	74,063
Hampshire	34.60%	49.60%	39,209	18,356	22,671

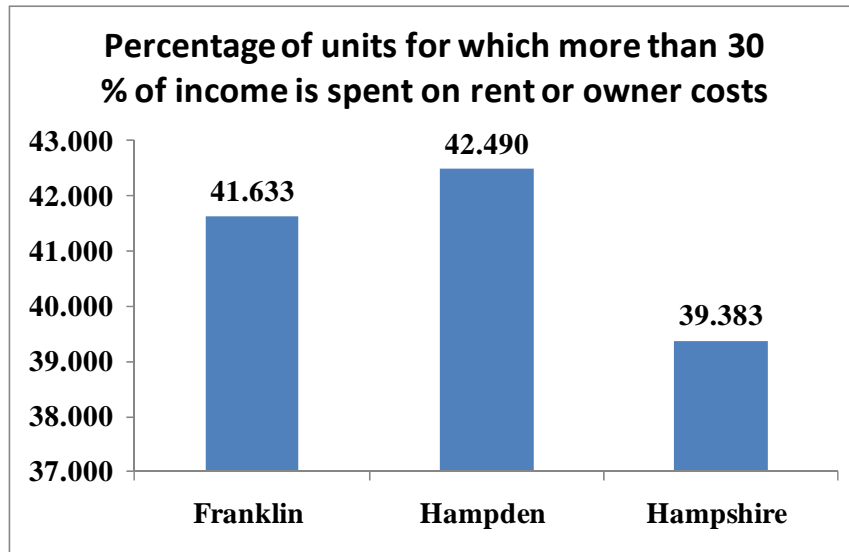


Figure 13 Key indicator for housing affordability

Source of data

U.S. Census Bureau’s American Community Survey through the American FactFinder. The following websites will give information regarding financial and physical characteristics of housing:

Websites:

- Website that shows the occupancy rate for the Franklin county. Information for other counties can be obtained by changing the geographical location.

http://factfinder.census.gov/servlet/GCTTable?_bm=y&-context=gct&-ds_name=ACS_2008_3YR_G00_&-mt_name=ACS_2008_3YR_G00_GCT2513_US9T&-tree_id=3308&-redoLog=true&-_caller=geoselect&-geo_id=04000US25&-format=ST-2T&-_lang=en

- Website that shows the Percent of Mortgaged Owners Spending 30 Percent or More of Household Income on Selected Monthly Owner Costs

http://factfinder.census.gov/servlet/STTable?_bm=y&-context=st&-qr_name=ACS_2008_3YR_G00_S2501&-ds_name=ACS_2008_3YR_G00_&-tree_id=3308&-redoLog=true&-caller=geoselect&-geo_id=05000US25011&-format=&-lang=en

- Website that shows the Percent of Renter-Occupied Units Spending 30 Percent or More of Household Income on Rent and Utilities

http://factfinder.census.gov/servlet/GCTTable?_bm=y&-context=gct&-ds_name=ACS_2008_3YR_G00_&-mt_name=ACS_2008_3YR_G00_GCT2515_US9T&-tree_id=3308&-redoLog=true&-caller=geoselect&-geo_id=04000US25&-format=ST-2T&-lang=en

Education: Graduation rate

The number of completed years of schooling offers multiple insights into social sustainability. A good education leads to better mental, emotional, and physical health and is a measure of equity. Educational attainment tells us whether our young people will be able to assume good positions in the workforce and achieve a good standard of living.

Attribute

We consider graduation rate for this indicator, as stated by the Massachusetts School and District profile. There are different ways by which we can show this indicator. First, we have plotted graduation rate for the entire pioneer valley region. We could obtain data for 60 out of 69 municipalities. The second graph depicts the graduation rate for the three counties.

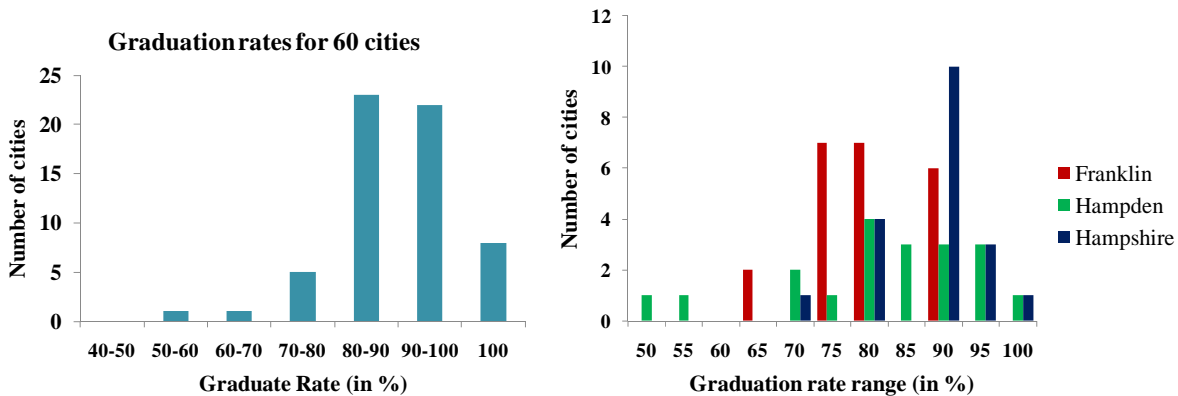


Figure 14 Graduation rate for the pioneer valley region Figure 15 Graduation rate at the county level

Key Indicator

Fig 16 depicts number of municipalities having graduation rate over 80 %, 85% and 90 % for all the three counties. Four municipalities in the Franklin county has its graduation rate over 85 % . Hampden county has 10 municipalities having graduation rate over 85 % . This number increases to 14 for graduation rate over 90 % . Fig 17 represents the average per population.

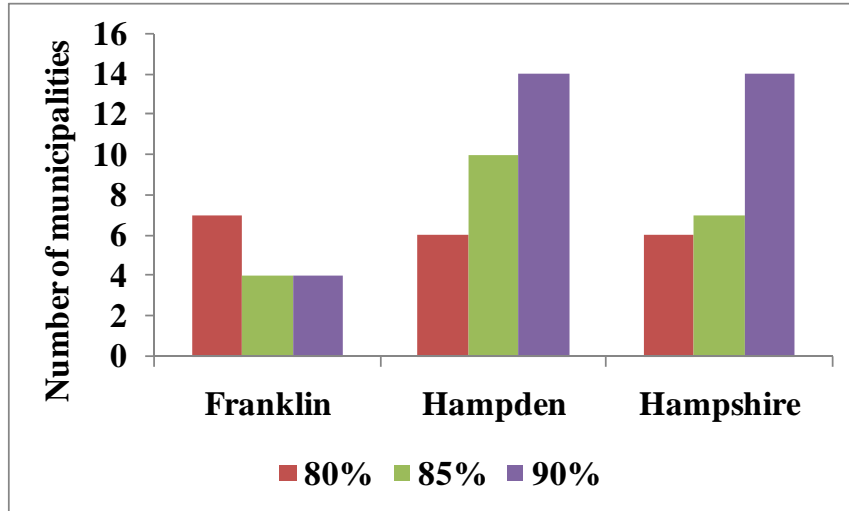


Figure 16 Key indicator for graduation rate

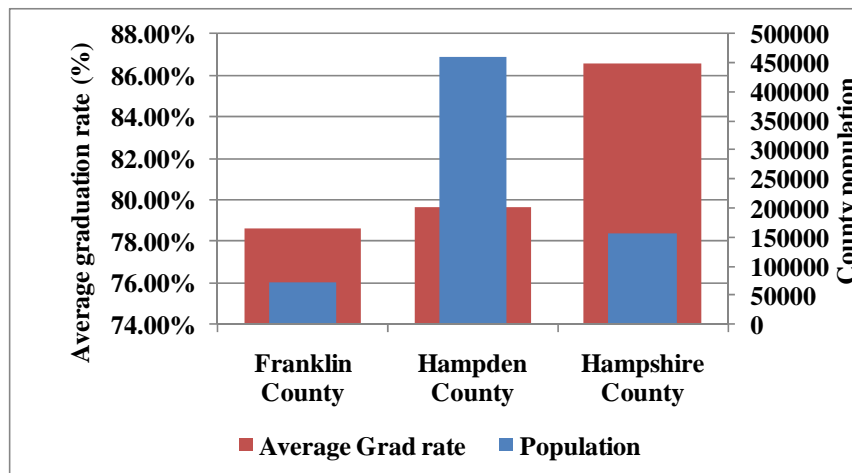


Figure 17 Average graduation rate at the county level

Source of data

Massachusetts School and district profile

Data can be obtained online from the following website:

http://profiles.doe.mass.edu/state_report/gradrates.aspx

Local food production

Successful local farmers indicate which communities care about and support the local agricultural economy. Locally grown food may have a smaller carbon footprint through reduced transportation and packaging. It tends to be fresher and more nutritious, resulting in improved health. Farms serve as ecological custodians and preserve open space of developing indicators.

Attribute

The acreage designated as ‘‘land in farms’’ consists primarily of agricultural land used for crops, pasture, or grazing. It also includes woodland and wasteland not actually under cultivation or used for pasture or grazing, provided it was part of the farm operator’s total operation. Land in farms is an operating unit concept and includes land owned and operated as well as land rented from others. The table below shows the number of farms, total size of farms, the average size and acreage/population.

Table 4 Metrics for local food production

Metrics	MA	Franklin	Hampden	Hampshire
Number of farms	7,691	741	508	711
Total size of farms (acres)	517,879	79,465	36,841	52,756
Average size of farms (acres)	67	107	73	74
Population	6,449,755	71,602	457,908	153,147
acreage/population	0.080	1.110	0.080	0.344

Key Indicator

The key indicator is the acreage of farms per capital.

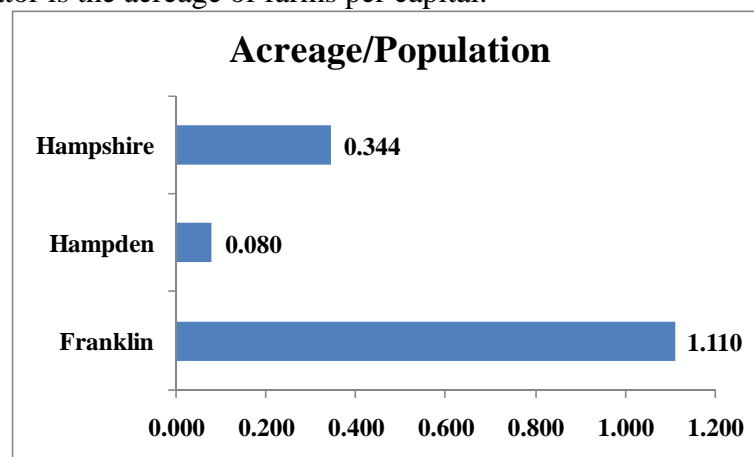


Figure 18 Farm acreage per population of the county

Source of data

We obtained the data from the electronic version of US Department of Agriculture, Census of Agriculture 2007 report. Availability at website

http://www.agcensus.usda.gov/Publications/2007/Full_Report/usv1.pdf

Access to Transportation: Vehicle Miles travelled

Access to resource efficient transportation options, especially public transportation, can maximize social equity, increase social connectivity, maximize safety, and maximize resource efficiency. Public transit and ridesharing reduce vehicles numbers on the road. Transportation efficiency benefits society and reduces its impacts that account for 20-25% of greenhouse gas emissions and 20-25% of average US household expenditures.

Attribute

Total Daily Vehicle miles travelled for the three counties are actual High Performance Monitoring System (HPMS) figures through last year 2008.

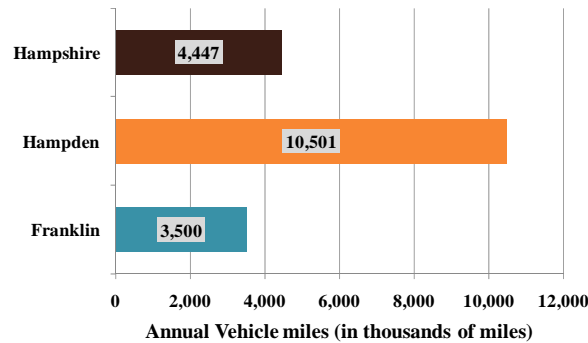


Figure 19 Annual vehicle miles travelled at the county level

Key Indicator

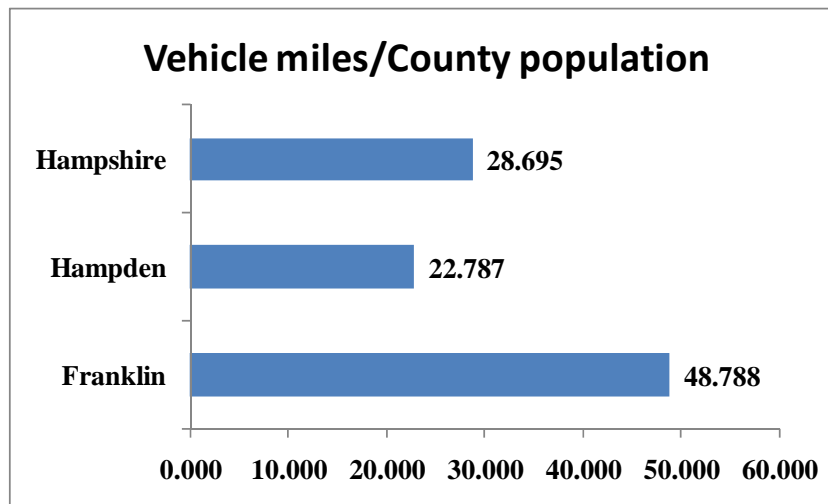


Figure 20 Annual vehicle miles travelled per county population

Source of data

We contacted Bob Frey at the Massachusetts Department of Transportation and obtained data in an excel format.

Following is the contact information:

Bob Frey

Manager of Transportation Analysis, Massachusetts Department of Transportation - Office of Transportation Planning

10 Park Plaza Room 4150 Boston MA 02116

Phone 617.973.7449

Email bob.frey@state.ma.us

Web www.mass.gov/massdot

Income distribution

Income distribution tells us about the percentage of families living in poverty, about access to living wages and whether income is broadly distributed or concentrated. These issues affect the social connectivity and stability of communities in our region and tell us if our community members can afford the necessities of a decent life style.

Key Indicator

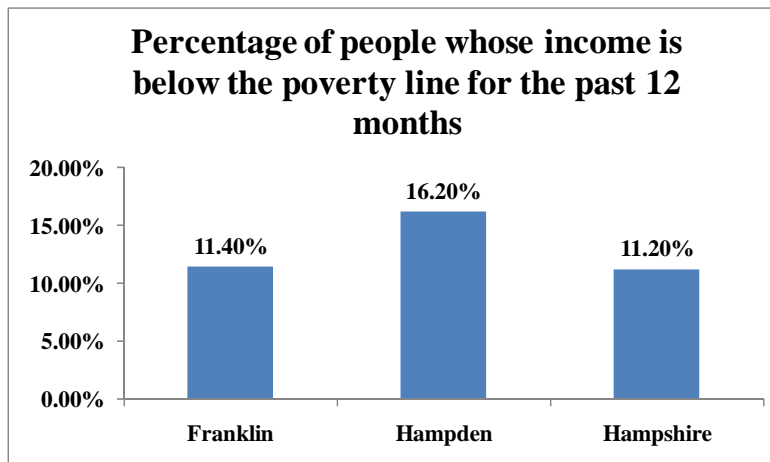


Figure 21 Income distribution statistics

Source of Data

We obtained the data from US census Bureau available at the following website:

http://factfinder.census.gov/servlet/ADPTable?_bm=y&-qr_name=ACS_2008_3YR_G00_DP3YR3&-geo_id=05000US25015&-gc_url=&-ds_name=ACS_2008_3YR_G00_&-_lang=en

Data for other counties can be obtained by changing the geographical location

Conclusion

We successfully obtained data for 12 out of 16 indicators that can be considered as a baseline for the future years. We have also proposed a key data that can be displayed for every indicator.

Group II has the following indicators:

- Local access to parks

We need assistance of a Mass GIS specialist in order to obtain the park acreage/population

- Biodiversity

We need assistance of a Mass GIS specialist in order to obtain percentage of wildlife habitat per total land area

- Energy use

DOE is expected to release a tool called EIRS (Energy Information Report System) by summer 2010. This tool will give us insight about energy usage at the municipality or county level.

References

1. Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index(AQI), EPA-454/B-09-001 February 2009
2. Air quality Index, a guide to air quality and health, EPA-456/F-09-002 August 2009
3. Census of Agriculture 2007, Massachusetts state and county data, Volume 1 , Geographic area series, February 2009
4. www.epa.gov
5. <http://www.umass.edu/tei/mwwp/ctrivermonitoring.html>
6. http://profiles.doe.mass.edu/state_report/gradrates.aspx
7. http://factfinder.census.gov/home/saff/main.html?_lang=en