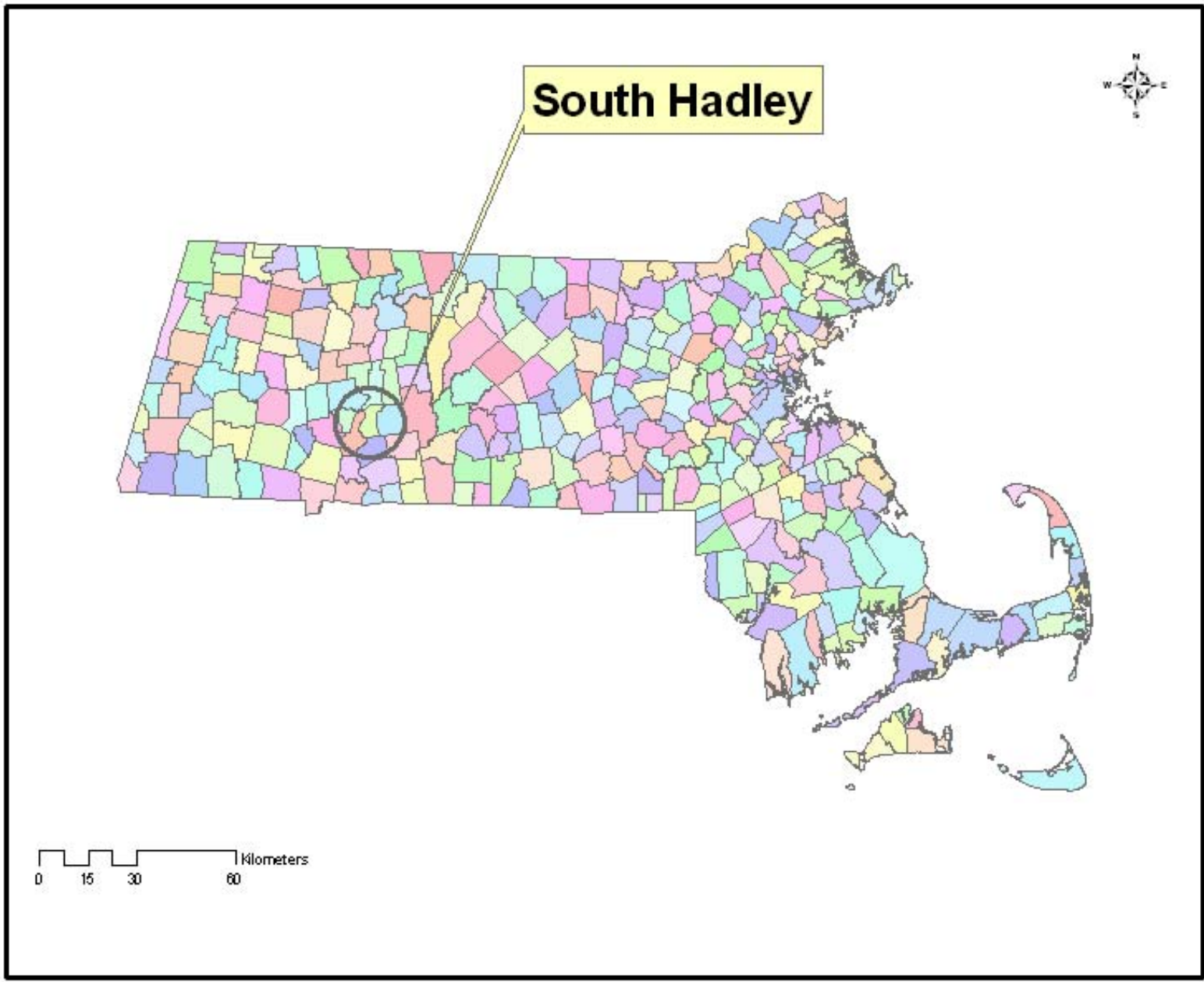


Renewable energy options for South Hadley, MA

Alex Strysky

GPH904

Spring 2011



South Hadley

0 15 30 60 Kilometers

South Hadley

Land area: 18.3 square miles

Population: 18,923 (2000 Census)

Population density: 1,034 people per square mile

Potential Sources of Renewable Energy

- Solar
- Wind
- Biomass

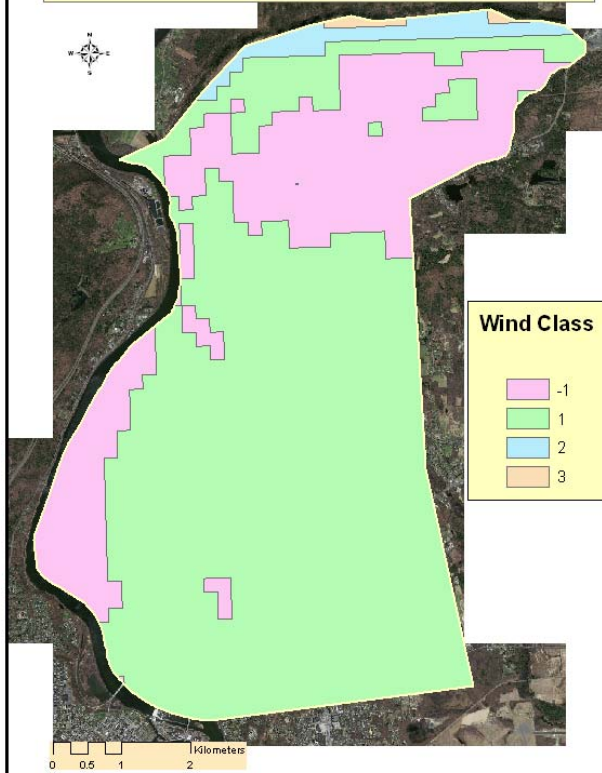
Local zoning considerations

- Solar collectors are allowed uses in all zoning districts
- Zoning bylaws encourage the use of solar energy by protecting access to sunlight
- Wind turbines require special permits and are subject to other restrictions

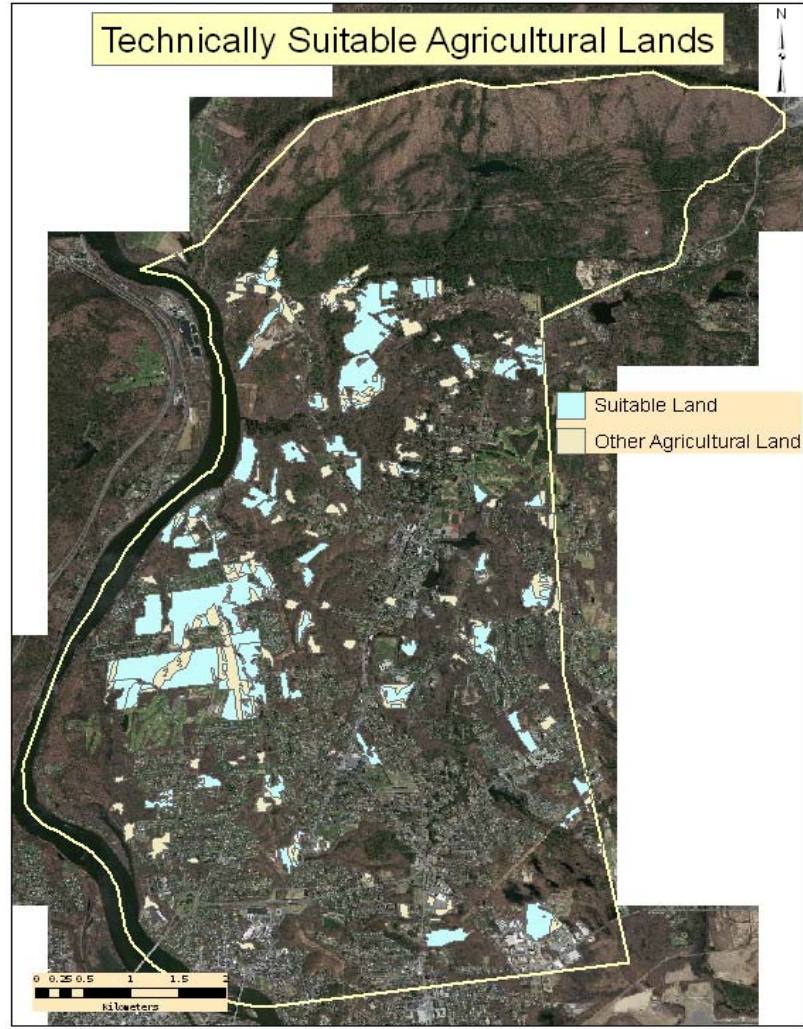
South Hadley Electric Light Department

- Municipal utility serving South Hadley
- Buys more than 140 million kWh per year from various sources for its 8,000 customers
- Local service network does not have capacity for large-scale input of local power source
- Developing program to provide technical assistance and financial incentives for small solar PV installations

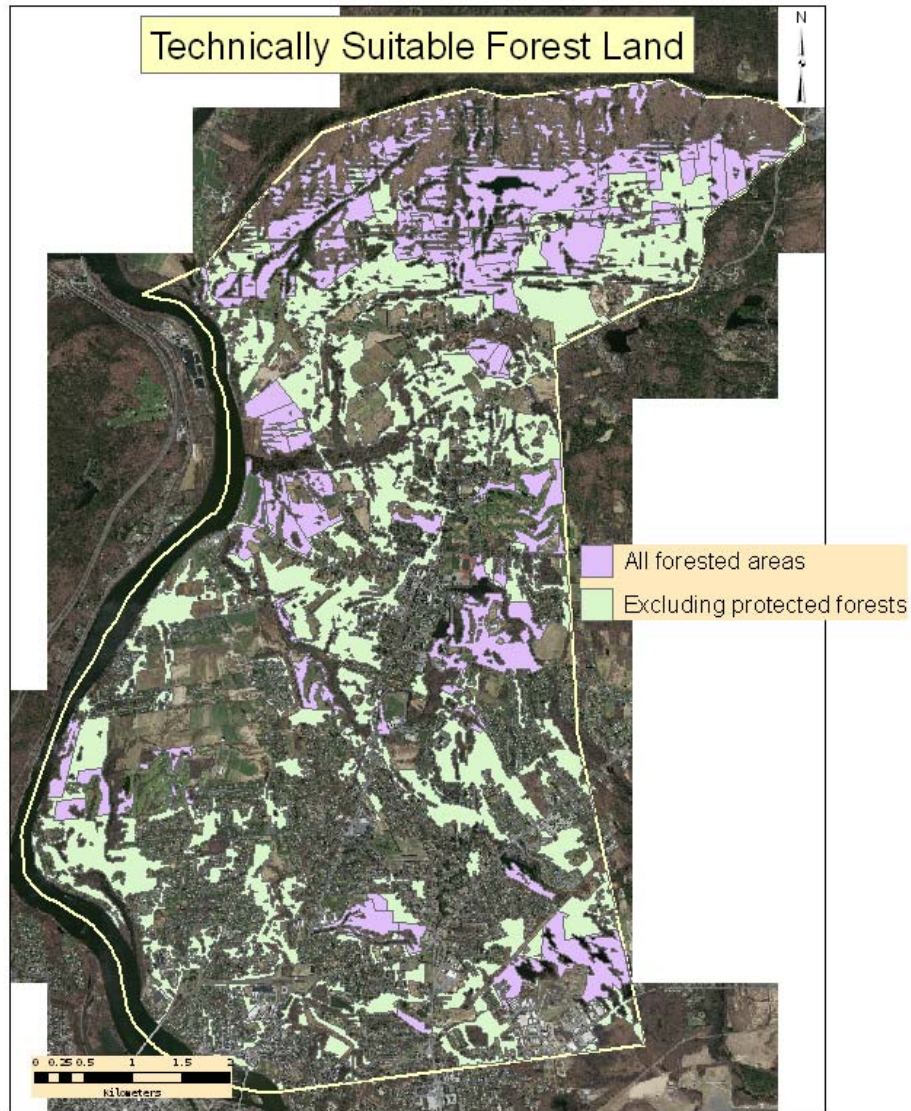
Wind Power Density Class at 50m



Technically Suitable Agricultural Lands



Technically Suitable Forest Land



Technically Suitable Biomass Harvest Areas

	Agricultural	Forest
Total	452 ha	2255 ha
Technically Suitable	306 ha	1744 ha (including protected areas) 1103 ha (excluding protected areas)

Yield and Energy Content of Forest Biomass

Usable Fraction	Yield (odt/yr)	Energy Content (kWh/yr)
0.01%		
Excluding protected areas	7.7	33,943
Including protected areas	12.2	53,669
0.05%		
Excluding protected areas	386	1,697,172
Including protected areas	610	2,683,470
1.0%		
Excluding protected areas	772	3,394,344
Including protected areas	1,221	5,366,940

Estimate of biomass yields (odt/yr) from technically suitable agricultural land

**Potential Yields
(odt/ha/yr)**

Usable fraction of agricultural land

	1%	10%	20%
6.75	21	207	413
11.25	32	344	689
15.75	48	482	964

Estimate of energy content (kWh/yr) from biomass harvested from technically suitable agricultural land

**Potential Yields
(odt/ha/yr)**

Usable fraction of agricultural land

	1%	10%	20%
6.75	92,321	910,022	1,815,647
11.25	149,472	1,512,307	3,029,009
15.75	211,020	2,118,988	4,237,975

Potential Energy Production from Biomass

From Forest: Values range from almost 34,000 kWh/yr to over 5,300,000 kWh/yr

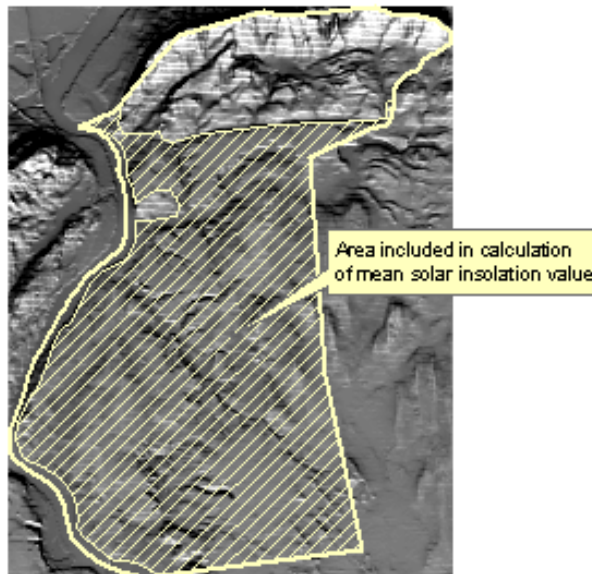
From Agricultural: Ranges from approximately 92,000 kWh/yr to over 4,200,000 kWh/yr

Combined Total: 126,000 kWh/yr to 9,500,000 kWh/yr

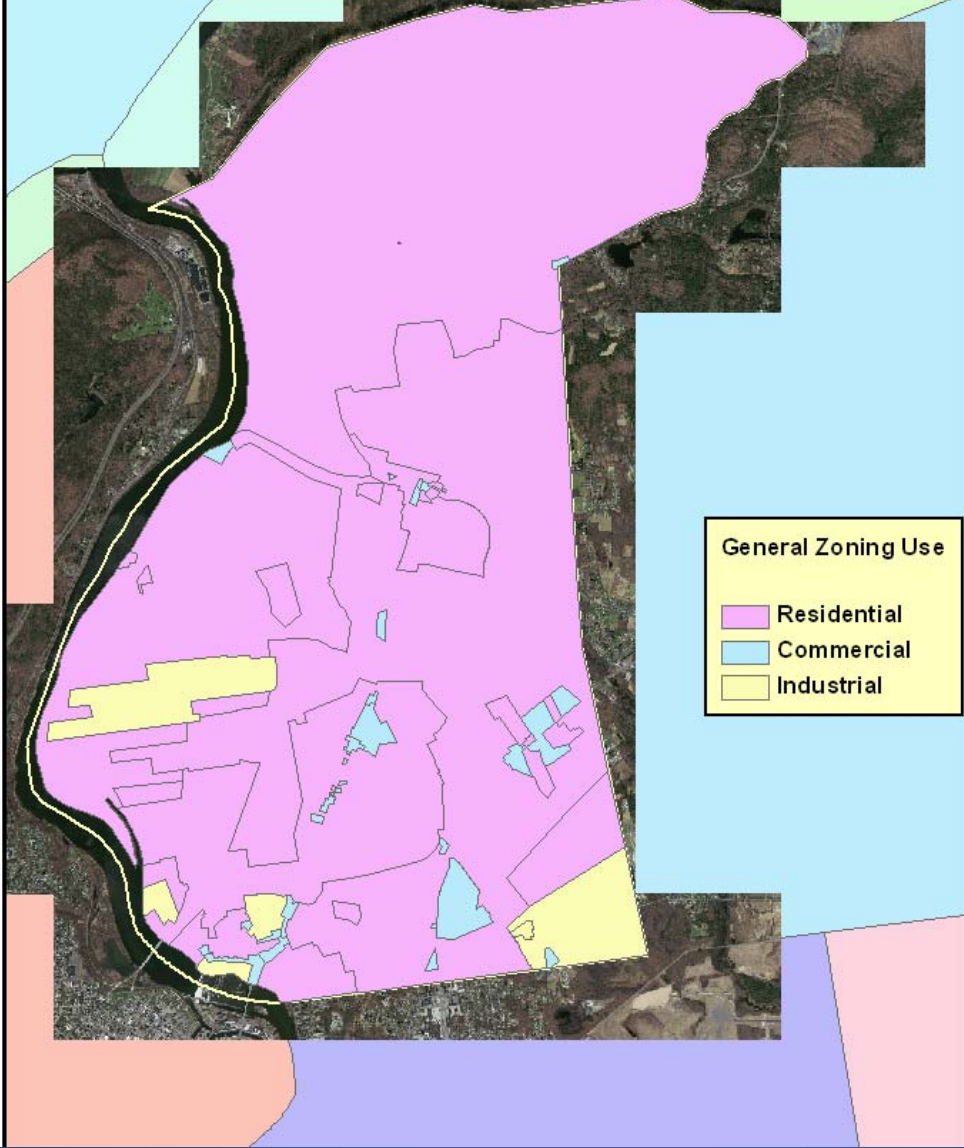
Estimation of Rooftop Solar Potential

1. Generate solar map of South Hadley using Solar Analyst
2. Calculate average solar radiation for the town using Zonal Statistics
 - Exclude non-inhabited areas with extreme solar values
3. Determine per capita roof area
 - Calculated separately for Residential, Commercial, and Industrial general use zones
 - Digitize roof areas in an area representative of each general use zone and calculate roof area
 - Use 2000 population from census blocks to determine population of the area based on proportion of the general use land area in the census block
4. Determine total roof area for South Hadley using town population
5. Determine solar energy generation based on:
 - roof area available for solar panels
 - solar panel efficiency
 - solar radiation

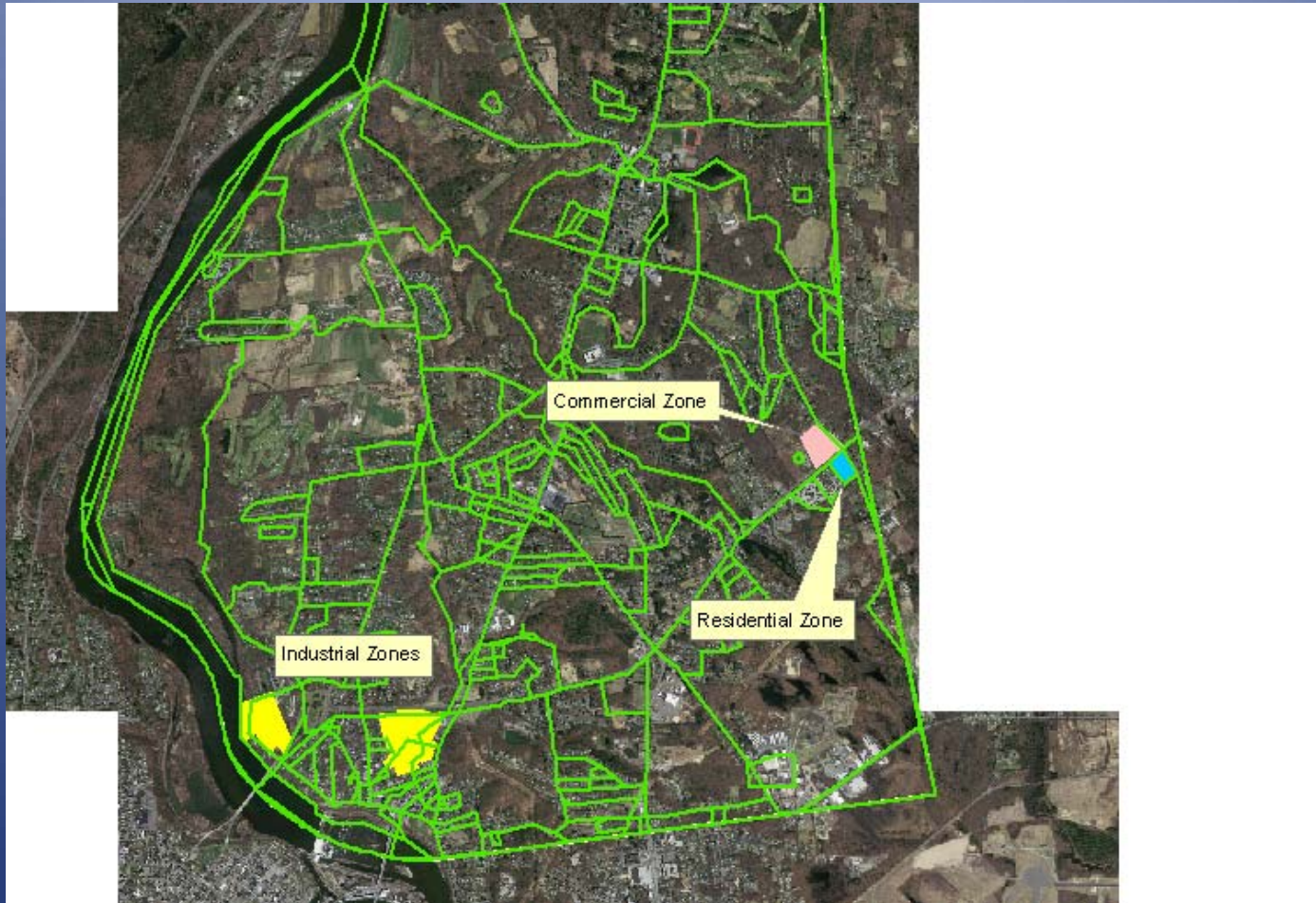
Solar Insolation Map



Generalized Zoning Map



Rooftop Area Calculation Zones



Residential Roof Area Measurement



Per Capita Roof Area

Sampled Use Zone	Roof Area (sq m)	Population	Per Capita Roof Area (people/sq m)
Residential	2,831	25	113
Commercial	4,581	22	208
Industrial	49,341	141	350

Potential Rooftop Solar Power Generation in South Hadley

Zoning use	Roof Area (sq m)	Available roof area (sq m)	Solar Yield with 16% PV panel efficiency (kWh/yr)
Residential	2,028,463	507,116	97,771,965
Commercial	56,784	28,392	5,473,978
Industrial	244,650	122,325	23,584,260
Total	2,329,897	657,833	126,830,203

Mean solar insolation for South Hadley = 1,205 kWh/sq m/yr

South Hadley Landfill

Transmission Line



Municipal Boundary

Potential Solar Generation at Landfill

Available space for PV panel Deployment (sq m)	Solar Yield with 10% PV panel efficiency (kWh/yr)
101,200	12,194,600

Mean solar insolation for South Hadley = 1,205 kWh/sq m/yr

Conclusions

- Wind power not promising due to poor wind speeds and zoning restrictions
- Biomass has a small potential but might provide incremental benefit in combination with landfill gas plant
- Small rooftop solar is most feasible source and is supported by zoning policy, service capacity, and incentives

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