

# Renewable Energy Potential in Tompkins County

## Energy Road Map

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**Climate Smart Communities Webinar**

# Today's Outline



- Energy Road Map
- Other Energy & Sustainability Initiatives



# Tompkins County

## Population

- City of Ithaca 30,014
- Tompkins County 101,564

Households 38,967

Size (sq. miles) 492

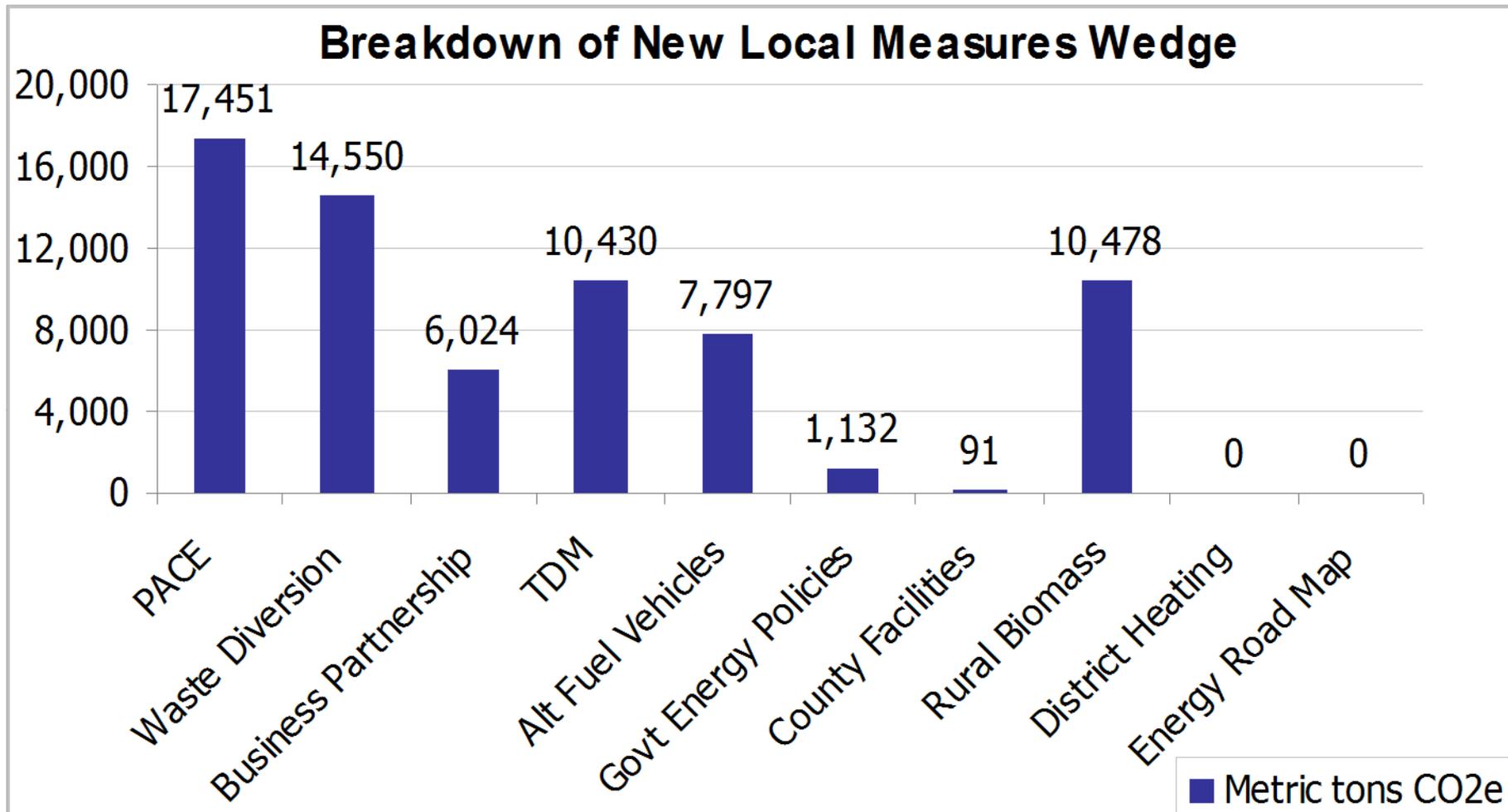


# Tompkins County Comprehensive Plan

## Energy and Greenhouse Gas Emissions Element - 2008

- Reduce greenhouse gas emissions 2% per year to achieve 80% reduction by 2050
- Reduce energy demand
- Encourage new development to be energy efficient and incorporate renewable energy
- Encourage development of local renewable energy sources and technologies
- Optimize energy efficiency and renewable energy use in County facilities

# Energy Strategy: 10 Local Measures



# Energy Road Map

***What is an Energy Road Map?*** A proactive plan to meet the community's long-term energy goals in the most effective and efficient means possible.

- 1) **Quantify** energy production potential of renewables
- 2) Fill identified knowledge **gaps**
- 3) Build future energy **scenarios**
- 4) Develop scenario **evaluation** criteria
- 5) Public discussions – **select** preferred scenario
- 6) Specify **actions** need to take or avoid

# Energy Road Map

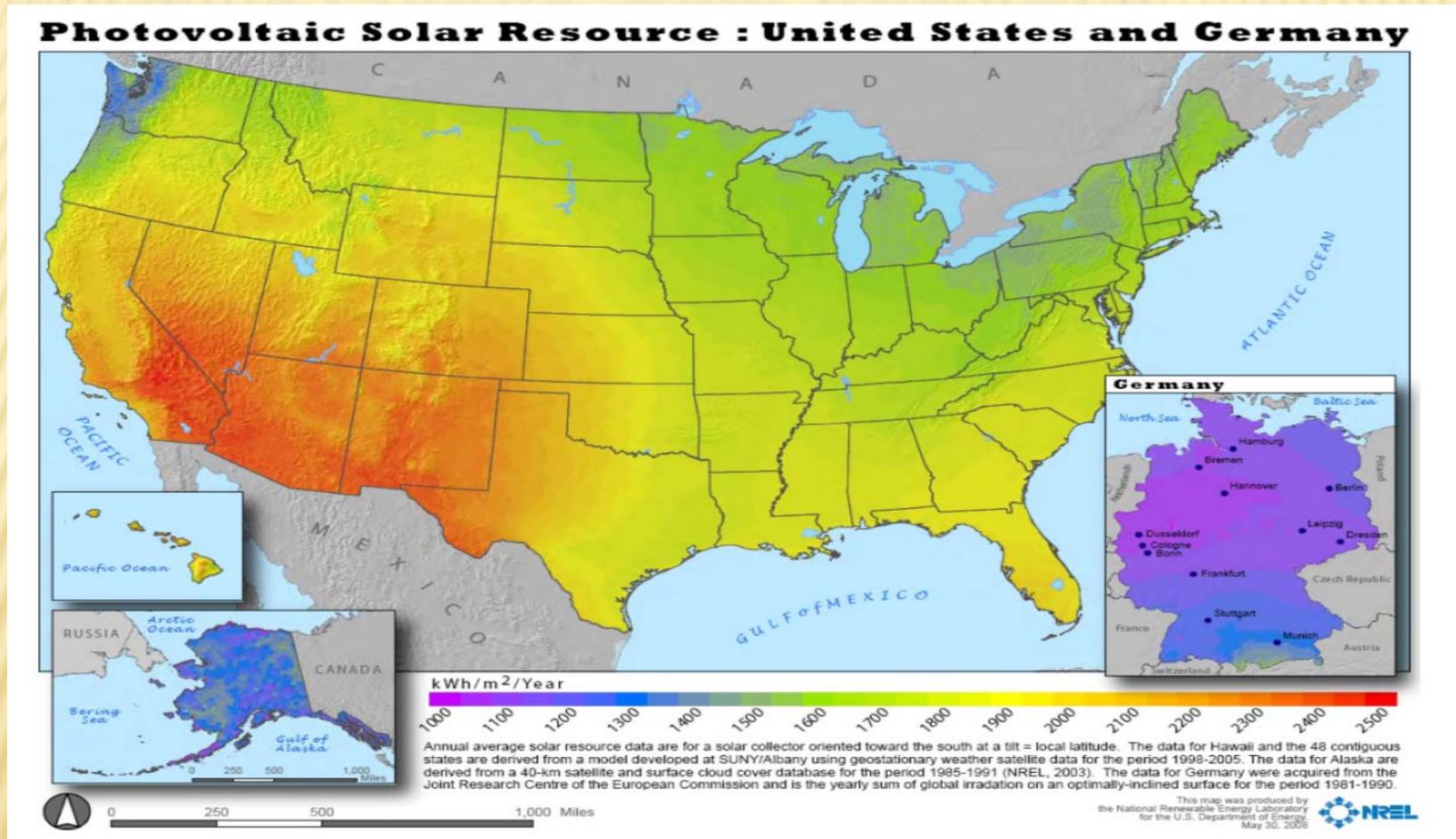
- Six Cornell graduate students to date
- Quantify energy production potential:
  - *Wind*
  - *Solar*
  - *Biomass*
  - *Geothermal*



# Tompkins County Energy Opportunities - Solar



# Tompkins County Solar Resource



Germany: 17,320 MW installed PV capacity

US: 3,954 MW installed PV capacity

# Tompkins County PV Leader

## Leading PV Counties of New York

	County	<u>No. of Systems</u>
1	Dutchess	379
2	Ulster	376
3	Westchester	352
4	Erie	315
5	Columbia	232
6	Albany	232
7	<u>Tompkins</u>	<u>211</u>

## Leading PV Counties of New York

	County	<u>Population</u>	<u>Systems per 10,000 Residents</u>
1	Columbia	63,096	36.8
2	<b><u>Tompkins</u></b>	<b><u>101,564</u></b>	<b><u>20.8</u></b>
3	Ulster	182,493	20.6
4	Dutchess	297,488	12.7
5	Albany	304,204	7.6
6	Westchester	949,113	3.7
7	Erie	919,040	3.4



# Solar Potential: Commercial

- ✘ Building footprint data
- ✘ 120 ft<sup>2</sup> of roof area per kW
- ✘ Total electricity potential: 95 million kWh, 27% of sector demand in 2008

	Building	Area (ft <sup>2</sup> )	Capacity Potential (kW)	Annual Energy Potential (kWh)
1	Ithaca Mall	575,559	4,796	5,275,954
2	Cayuga Mall	211,315	1,761	1,937,051
3	Home Depot	198,220	1,652	1,817,013
4	Lowe's	188,861	1,574	1,731,224
5	Triphammer Mall	173,081	1,442	1,586,576
6	Walmart	156,883	1,307	1,438,095
7	Tops Plaza	124,966	1,041	1,145,519
8	Wegman's	122,195	1,018	1,120,122
9	East Hill Plaza	117,451	979	1,076,633
10	*Big K-Mart	112,934	941	1,035,228
	<b>Total:</b>	<b>1,981,463</b>	<b>16,512</b>	<b><u>18,163,414</u></b>

# Solar Potential: Industrial

- ✘ Same process as commercial
- ✘ Total electricity potential: 24 million kWh, 17% of sector demand in 2008

	Building	Area (ft <sup>2</sup> )	Capacity Potential (kW)	Annual Energy Potential (kWh)
1	Borg Warner	552,395	4,603	5,275,954
2	*Morse Chain/Emerson Power Transmission Site	278,409	2,320	1,937,051
3	Borg Warner	227,005	1,892	1,817,013
4	Vanguard Printing	176,082	1,467	1,731,224
5	South Hill Business Campus	136,574	1,138	1,586,576
6	*Morse Chain/Emerson Power Transmission Site	106,979	891	1,438,095
7	Cargill Deicing Technology	87,079	726	1,145,519
8	TransAct Technologies	75,239	627	1,120,122
9	Therm Incorporated	73,091	609	1,076,633
10	Cargill De-icing Technology	63,659	530	1,035,228
	<b>Total:</b>	<b>1,776,511</b>	<b>14,804</b>	<b><u>16,284,682</u></b>

# Solar Potential: Schools

- ✘ Similar to commercial/industrial
- ✘ Used aerial images to estimate roof percentage available for PV arrays
- ✘ Total electricity potential: 43 million kWh, 13% of sector demand in 2008

	Building	Area (ft <sup>2</sup> )	Percent of Roof Available	Net Capacity Potential (kW)	Net Electricity Potential (kWh)
1	Ithaca High School	222,484	70%	1,298	1,427,608
2	Dryden High School	179,743	50%	749	823,824
3	TC3	157,088	70%	916	1,007,982
4	Cornell Vet School	138,050	50%	575	632,728
5	Charles O. Dickerson High School	116,211	80%	775	852,212
6	Groton Elementary School	96,574	90%	724	796,736
7	Duffield Hall (Cornell)	94,771	20%	158	173,746
8	Barton Hall (Cornell)	91,762	50%	382	420,577
9	Bartels Field House (Cornell)	90,568	90%	679	747,184
10	Boynton Middle School	89,901	60%	450	494,455
	<b>Total</b>	<b>1,212,337</b>		<b>6,706</b>	<b>7,377,053</b>

# Solar Potential: Residential

- ✘ Very difficult to estimate
- ✘ Assume:
  - + 80% of housing units in urban areas of Tompkins County have potential for PV systems
  - + All rural homes have potential for PV systems

TC Housing Units		80% Scenario
Urban	8,797	3,788
Rural	16,249	16,249
Total	25,046	<b>20,037</b>

# Solar Potential: Residential

- ✘ Assume:
  - + Urban homes have potential for a 3 kW system
  - + Rural homes have potential for a 7 kW system

	Urban	Rural
Homes	3,788	16,249
Avg system size (kW)	3	7
Total Installed Capacity (MW)	11	113
Energy potential (kWh)	12 million	124 million
Total Potential Energy (kWh)	136 million	
% of Total Demand	46%	

# Total Solar Potential

## Ultimate Photovoltaic Potential by Sector

	Capacity Potential (MW)	Energy Potential (million kWh)	Percent of Electricity Demand
Commercial	86	95	27%
Industrial	22	24	17%
Schools	39	43	13%
Residential	124	136	46%
<b>Total</b>	<b><u>271</u></b>	<b><u>298</u></b>	<b><u>38%</u></b>

# Tompkins County Energy Opportunities - Wind



# Large Wind: Choosing Sites

## Siting Considerations

### Developer Preferences

- Wind speed considerations
- Financial considerations
- Construction Challenges

### Municipal Concerns

- Environmental Protection
- Cultural resource protection
- Avian Populations
- Abutter protection
- Public Safety

## Model Parameters

### Weighted Variables

- Wind Speed
- Slope
- Proximity to Transmission Line
- Land Use

### Prohibited Areas

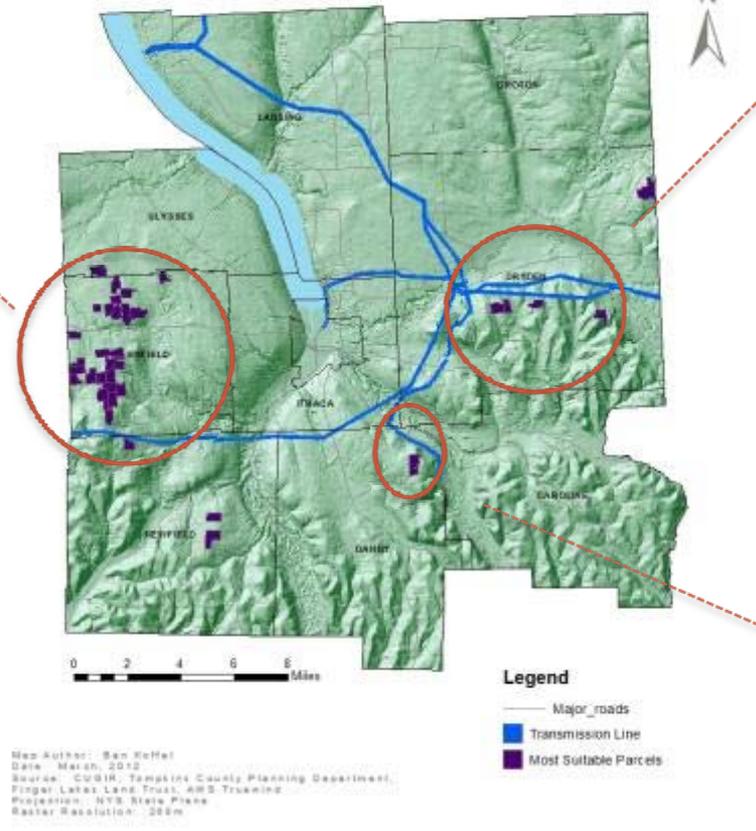
- Property line setbacks
- Critical Environmental Areas
- Airports
- Important Bird Areas
- Scenic Viewsheds

Best Sites

# Large Wind: Results



Most Suitable Parcels for Large-Scale Wind  
Tompkins County, NY



## Enfield

- Parcels: 25
- Technical Potential: 35MW
- Likelihood of Development: High (currently under development)

## Dryden

- Parcels: 3
- Technical Potential: 7MW
- Likelihood of Development: Low

## Total Output

- ~**40MW** installed capacity
- Electricity for up to **30%** of households in county

## Danby

- Parcels: 1
- Technical Potential: 5MW
- Likelihood of Development: Low

# Small Wind: Choosing Parcels



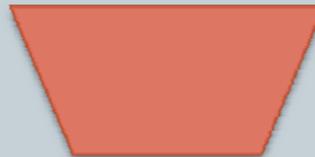
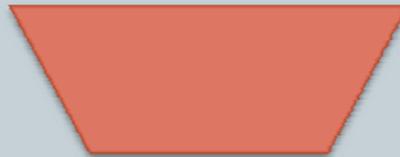
## Property-Line Setbacks

## Protected Areas

- Public open space
- Critical Environmental Areas
- Important Bird Areas
- Unique Natural Areas
- Airport

## Appropriate Slope

## Sufficient Wind Speed



2,100 Residential parcels

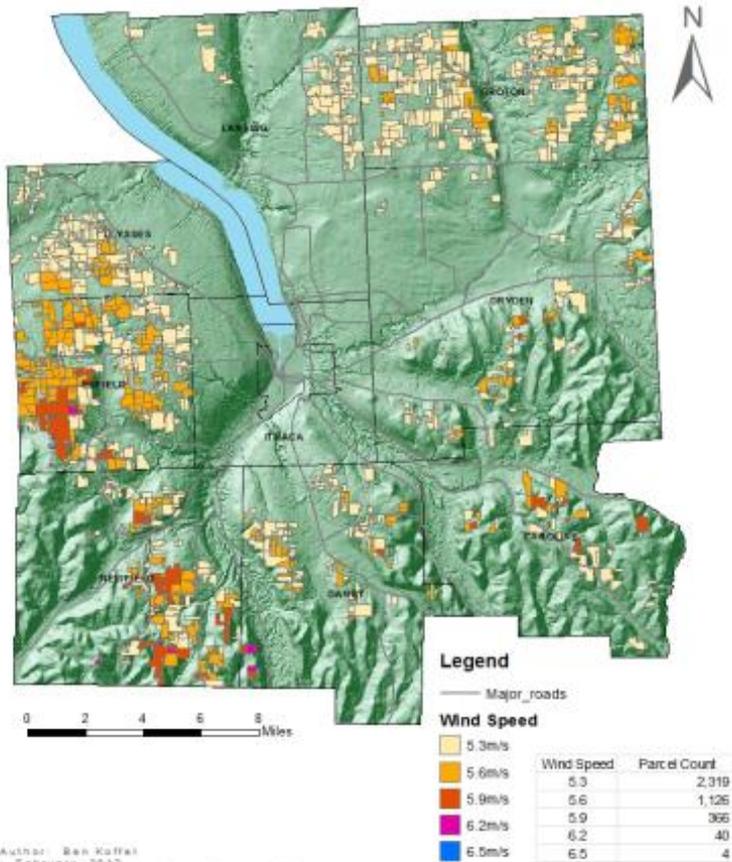
1,600 Agricultural parcels

Wind speeds range from 5.25m/s-6.6m/s

38MW installed capacity

# Small Wind: Most Potential to Go Unrealized

Most Suitable Parcels for Small-Scale Wind  
Tompkins County, NY



Wind Speed	Parcel Count	Potential Installed Capacity	Household electricity provided by wind
5.3 m/s	2,319	23MW	32%
5.6 m/s	1,126	11MW	43%
5.9 m/s	366	3.6MW	57%
6.2 m/s	40	.4MW	74%
6.5 m/s	4	.04MW	100%
<b>Total</b>	<b>3,855</b>	<b>38.55MW</b>	

- **Largest Barrier: Cost**
  - Wind turbines are a large investment
  - Wind may not be cost-competitive with solar
  - Most suitable parcels have low wind speeds

# Medium-Scale Wind: Specialized Application



- **Parcels with large on-site demand**
  - Large farms (particularly dairy farms)
  - Schools
  - Hospitals
  - Other institutions
- **Greater cost, but greater generation potential**

# Tompkins County Energy Opportunities - Biomass



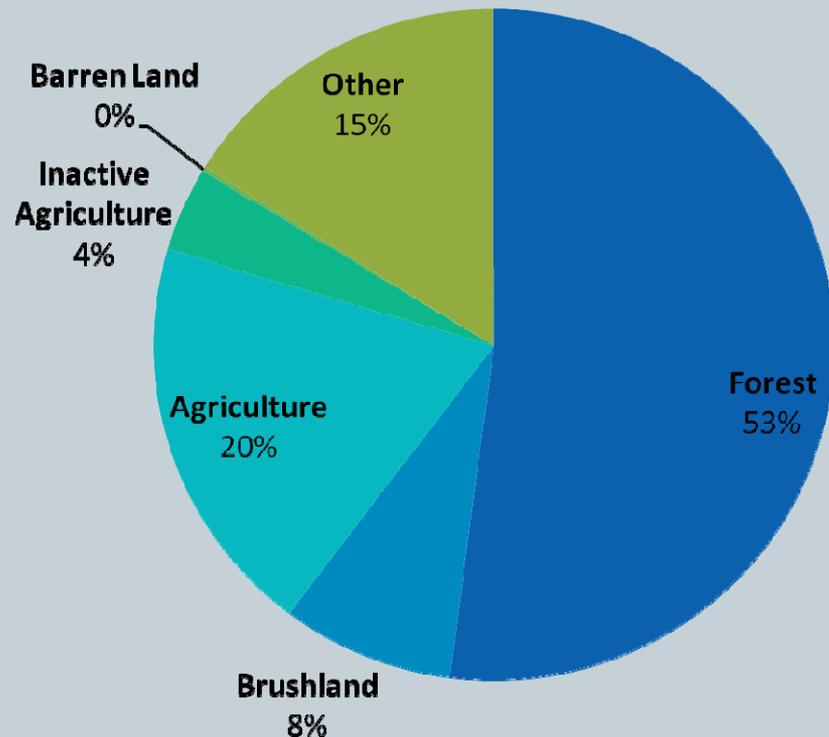
# Biomass – Steps for Analysis

1. Amount of land available for biomass
  - Forestland - wood
  - Brushland – brush and grass
  - Inactive agricultural land – planted biomass and grass
  - Active agricultural land – planted biomass and ag residue
2. Tons of dry material that could be produced on that land
3. Heat content of that material
4. Domestic heating estimated by biomass source

# Land Use in Tompkins County



- 305,368 total acres (excluding lake)
- “other” includes residential, commercial, etc.
- Avoid competition with agriculture
- Emphasis on sustainability



“Tompkins County Land Use and Land Cover .” Department of Planning. 2007.

# 1. Amount of land - Biomass

- Three methods explored to estimate the number of acres of land likely to be available for biomass production in Tompkins County
- Results ranged from 6,963 - 13,926 acres

## 2. Biomass Yield Rates

Wood Chips From Existing Forests (dry tons/year)	Dedicated Energy Crops (dry tons/year)	Corn Stover (dry tons/year)	Total Biomass (dry tons/year)
87,006	115,682	4,288	206,976

Peter Woodbury. "Analysis of Sustainable Feedstock Production in New York State." NYSERDA. March 2010.

- Emphasis on sustainable harvesting
- Substantial decrease in carbon emission

# 3. Heat Content of Biomass - Forest

- Average heat content 6061 BTU/lb. or 14.1 MJ/Kg
- Applies to dried wood
- Study of 600 acres of County-owned forested land
- 25 tree species in actual list

Wood Species	% in Forests	Heat Density (MMBTU/chord)	Mass Density (lb./chord)	Heat Content (BTU/lb.)
Red Maple	5.74	18.7	2290	8166
Sugar Maple	4.5	24	2120	11321
White Ash	3.03	23.6	2240	10536
Black Cherry	1.4	20	2670	7491
Northern Red Oak	1.26	24	3690	6504
Hemlock	8.94	15.9	3100	5129
Black Birch	0.703	21.7	3200	6781
Beech wood	2.36	24	3120	7692
Quaking Aspen	3.16	14.7	3480	4224
Basswood	0.866	13.5	2870	4704
White Pine	5.45	14.3	4330	3303
Pitch Pine	1.1	17.1	3300	5182
Black Locust	4.27	27.3	3240	8426
Scots Pine	1.73	18.1	3250	5569

“Tompkins County Forest Management Plan.” Department of Planning. October 2007.

1 chord=3.62m<sup>3</sup> 1 BTU = 1,055 Joules

## 4. Domestic Heating Using Biomass

- Using results of steps 1-3 for forest wood, calculated that 18,277 housing units could be heated using locally sourced wood. Represents:
  - 45% of all housing units in Tompkins County
  - 22% of all thermal demand
- This level of analysis has not yet been done for other sources of biomass

# Preliminary Incomplete Results

- Solar could provide 38% of all electricity demand
- Wind (small scale) 1%
- Wind (large scale) 5%
- Forest biomass could provide 22% of all thermal demand
  
- Currently refining biomass
- Analyzing geothermal resource

# Tompkins County



- Other Energy and Sustainability Efforts

# County Facility Energy Improvements and Policies

- ***Solar Liberty*** - 7 solar PV arrays (200 kW total)
- ***LEED Silver Certified*** Health Department
- Green Building Policy
- Green Fleet Policy
- Solar PV – Library
- Performance contract with Johnson Controls
- Solar thermal - Health, Mental Health, Solid Waste
- Solid Waste Management Plan - 75% diversion goal
- Airport “Green” Master Plan – 1<sup>st</sup> FAA-funded in U.S.



# Initiative with Partners

## **EPA Climate Showcase Communities project:**

- Documenting and applying lessons learned from 20 Years of developing EcoVillage at Ithaca
- Third EcoVillage Neighborhood
- Aurora Pocket Neighborhood
- Proposed development of County-owned property
- Model Pedestrian Neighborhood Zoning
- Energy Code recommendations
- <http://community-that-works.org>

# Contact Information

Tompkins County Planning Department

<http://www.tompkins-co.org/planning>

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