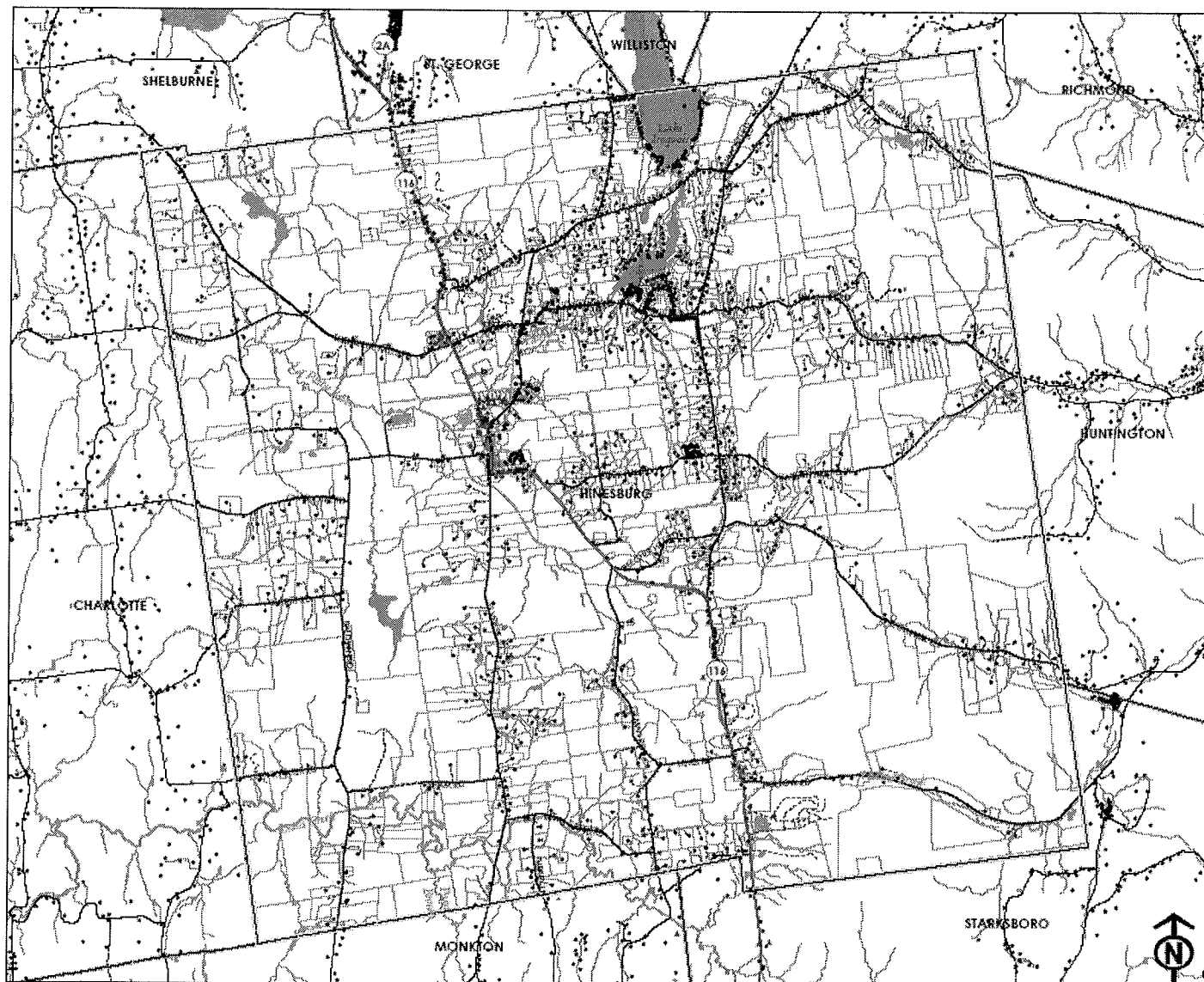


Hinesburg Sustainability Index

Initial Findings Spring 2008

Hinesburg 2008

- **Population of 4,500**
- **1,600 Households**
- **2.81 people per household**
- **25,250 Acres**
- **1,237 Acres Conserved Land**
- **192 Acres of Water**
- **13,887 Forest Acres**
- **8,000 Agricultural Acres**



BASE MAP

LEGEND

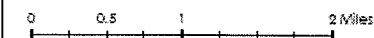
E911 point

- * Commercial
- * Industrial
- * Civic
- * Residential

Road Centrelines

- VT State Highway
- Class 2
- Class 3
- - - Class 4
- Private
- Driveway

- Hinesburg Town Boundary
- Town Boundaries
- Parcel Boundaries
- ~~~~ Rivers & Streams
- Lakes & Ponds



Notes and Data Sources:

E911 point data, (VCGI: Emergency/E911_BSIT), 2007. Hinesburg tax map parcel data, Hinesburg Planning and Zoning Office (H2P, 2006). Vermont Hydrography Dataset R/F 5,000 scale, B4.1.1 (VCGI: WaterHydro_VHID/Jul05, 2000). E911 road center lines (VCGI: Emergency/E911_RDS), 2007. Map compiled by LandWorks. Data is only as accurate as the original source. LandWorks does not guarantee the accuracy of this data and is not responsible for errors and omissions that may exist. This map identifies the presence and approximate location of features and is to be used for planning purposes only. It is not a replacement for surveyed information or engineering studies. VT SPCS, NAD 1983.

Date: October 8, 2007
 Revised: January 14, 2008
 Drawn by: LWS

Prepared for: Hinesburg Conservation Commission
 Prepared by: LandWorks, Middlebury, VT

HINESBURG GREENSPACE PLAN

Sustainability

The ability of a given environment to support all life in that environment indefinitely.

Support

Food

Energy

Water

Waste

Materials

Assumptions

- Planning for sustainability requires a long range view
- Global warming is a reality
- World oil and gas production is at peak or will reach peak this century
- All communities have an optimal population size
- This study does not address the human social component of resource use

Agriculture in Hinesburg

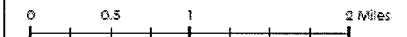
- Estimated 8000 acres (32%)
- Mostly in eastern part of town
- Organic and pasture based farming
- Labor and animal intensive



AGRICULTURAL SOILS

LEGEND

Road Centerline	Agricultural Soils
VT State Highway	Prime
Class 2	Statewide
Class 3	Statewide (a)
Class 4	Statewide (b)
Private	Statewide (c)
Hinesburg Town Boundary	
Town Boundaries	
Parcel Boundaries	
Rivers & Streams	
Lakes & Ponds	



Notes and Data Sources:

Vermont Hydrography Dataset RF 5,000 scale, EA 1.1 (VOG: WaterHydro_VHD July 0, 2005). 1911 road center lines (VOG: RoadAgencyR341_RDS, 2007). Hinesburg tax map parcel data, Hinesburg Planning and Zoning Office (H23) parcel, 2006. Agriculturally Important Soil Units from SSURGO Soil Data (VOG: GeoSoils_SOAG), 2007. Map compiled by LandWorks. Data is only as accurate as the original source. LandWorks does not guarantee the accuracy of this data and is not responsible for errors and omissions that may exist. This map identifies the presence and approximate location of features and is to be used for planning purposes only. It is not a replacement for surveyed information or engineering studies. VT SPDS, NAD 1983

Date: October 8, 2007
 Revised: January 14, 2008; March 5, 2008
 Drawn by: NIS

Prepared for: Hinesburg Conservation Commission
 Prepared by: LandWorks, Middlebury, VT

HINESBURG GREENSPACE PLAN

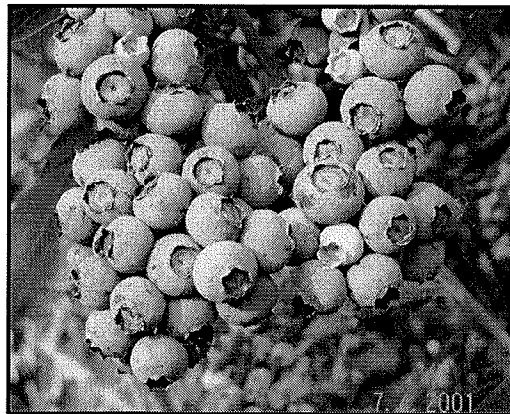
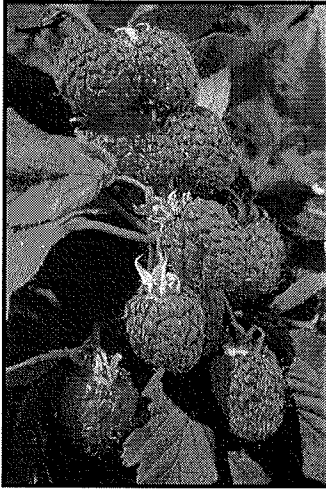
Hinesburg Agriculture 2008

4,500 people

2,500 calories/day/person

		<u>g/day/person</u>	<u>ton/yr/town</u>	<u>acres</u>	
Starch		270	487	610	
Dairy		81	146	102	
Meat/ Fat		103	186	930	
Fruit		75	135	42	
Vegetables		<u>35</u>	<u>63</u>	<u>13</u>	
Total		564	1017	1697	

Fruit yield for native or adapted species



	Approximate Annual Yield per plant
Semi-dwarf Apple	4 bushels
Pear	4 bushels
Grape	13 lbs
Elderberry	7lbs
Rhubarb	4 lbs
Raspberry	2 pints
Blackberry	2 pints
Blueberry	5 pints
Strawberry	1 pint

If every home has $\frac{1}{2}$ acre and dedicates $\frac{1}{4}$ acre to edible landscaping:

- 8 Apple Trees
- 5 Pear Trees
- 20 blueberry bushes
- 10 raspberry bushes
- 10 blackberry bushes
- 10 elderberry bushes
- 12 Rhubarb
- 48 Strawberry plants
- 2 grape vines
- Kitchen garden
- Room to spare

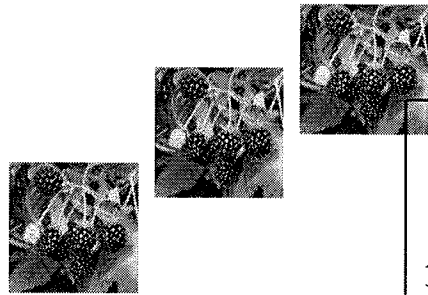


With this planting plan fruit yield would be:



	Approximate Annual Yield per plant	# plants per 1/2 acre	Yield per 1/2 acre
Semi-dwarf apples	4 bushels	8	32 bushels (1,344 lbs)
Pear	4 bushels	5	20 bushels (840 lbs)
Grape	13 lbs	2	26 lbs
Elderberry	7lbs	10	70 lbs
Rhubarb	4 lbs	12	48 lbs
Raspberry	2 pints	10	20 pints
Blackberry	2 pints	10	20 pints
Blueberry	5 pints	20	100 pints
Strawberry	1 pint	48	48 pints

And if everyone in Hinesburg did this:



	Approximate Annual Yield per plant	# plants per 1/2 acre	Yield per 1/2 acre	Yield if all 1600 Homes in Hinesburg do this
Semi-dwarf apples	4 bushels	8	32 bushels (1,344 lbs)	51,200 bushels (2,150,400 lbs)
Pear	4 bushels	5	20 bushels (840 lbs)	32,000 bushels (1,344,000 lbs)
Grape	13 lbs	2	26 lbs	41600 lbs
Elderberry	7lbs	10	70 lbs	112,000 lbs
Rhubarb	4 lbs	12	48 lbs	76,800 lbs
Raspberry	2 pints	10	20 pints	32,000 pints
Blackberry	2 pints	10	20 pints	32,000 pints
Blueberry	5 pints	20	100 pints	160,000 pints
Strawberry	1 pint	48	48 pints	76,800 pints

On average Hinesburg could easily yield:

	Approximate Annual Yield per plant	# plants per 1/2 acre	Yield per 1/2 acre	Yield if all 1600 Homes in Hinesburg do this
Semi-dwarf apples	4 bushels	5	20 bushels (840 lbs)	32,000 bushels (1,344,000 lbs)
Pear	4 bushels	3	12 bushels (504 lbs)	19,200 bushels (856,800 lbs)
Grape	13 lbs	2	26 lbs	41,600 lbs
Elderberry	7lbs	6	42 lbs	67,200 lbs
Rhubarb	4 lbs	7	28 lbs	44,800 lbs
Raspberry	2 pints	6	12pints	19,200 pints
Blackberry	2 pints	6	12 pints	19,200 pints
Blueberry	5 pints	11	55 pints	88,000 pints
Strawberry	1 pint	25	25 pints	40,000 pints

Water Resources

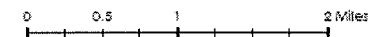
- Surface water
- Ground water
- Wetlands



SURFACE WATERS

LEGEND

— VT State Highway	▨ Flood Hazard Areas
— Class 2	▨ Wetlands - Updated
— Class 3	▨ Scrub shrub
— Class 4	▨ Emergent
— Private	▨ Forested (Dead)
— Hinesburg Town Boundary	▨ Submergent
— Town Boundaries	▨ Wetlands - VSWI
— Parcel Boundaries	▨ Class 2
— Rivers & Streams	
▨ Lakes & Ponds	



Notes and Data Sources:

Vermont Hydrography Dataset: RF 5,000 scale, EA 1:1 (VCGI; WaterHydro_VHID /vrb), 2003. Vermont's Significant Wetlands Inventory derived from 1983's aerial photography (1:80,000), (VCGI; WaterWetlands_VSWI), 1996. Updated wetlands derived from NAPP 1993 CIR Aerial Photography (1:40,000), by University of Massachusetts, Amherst, (HGG:unassess), 1996. Only mapped wetlands are shown. Many unmapped wetlands may also be present. ED11 road center lines (VCGI; BaseGeometry11_B203), 2007. Floodplain data (PEMA FIRM, Town of Hinesburg), 2005. Hinesburg tax map parcel data, Hinesburg Planning and Zoning Office (HZIP:parc_2005), 2005.

Map compiled by LandWorks. Data is only as accurate as the original source. LandWorks does not guarantee the accuracy of this data and is not responsible for errors and omissions that may exist. This map identifies the presence of features and is to be used for planning purposes only. It is not a replacement for surveyed information or engineering studies.

VT SPCS, NAD 1983

Date: October 8, 2007
 Revised: January 14, 2008
 Drawn by: NS

Prepared for: Hinesburg Conservation Commission
 Prepared by: LandWorks, Middlebury, VT

HINESBURG GREENSPACE PLAN

Ground water recharge
areas need to be
protected

Electrical Energy

Hinesburg's Cow Power Potential

- 3,237 acres of permanent pasture
- 3 cows per acre = 1,079 cows in pasture
- 3,158 cows total potential
- 1,383 kWh/yr per cow

Cow Power Hinesburg 2008

Dairy Cows	41
Beef Cows	<u>930</u>
	971

1,383 Kwh/cow/yr

$$971 \times 1,383 = 1,343,893 \text{ kwh/yr}$$

$$1,343,893 \times .5\text{yr} = 671,946 \text{ kwh/yr}$$

Environmental Benefits

- Methane is 20x more harmful than CO₂!
- Decreased soil erosion
- Increased soil fertility
- Improved human health
- Improved animal health
- Restore animal habitats

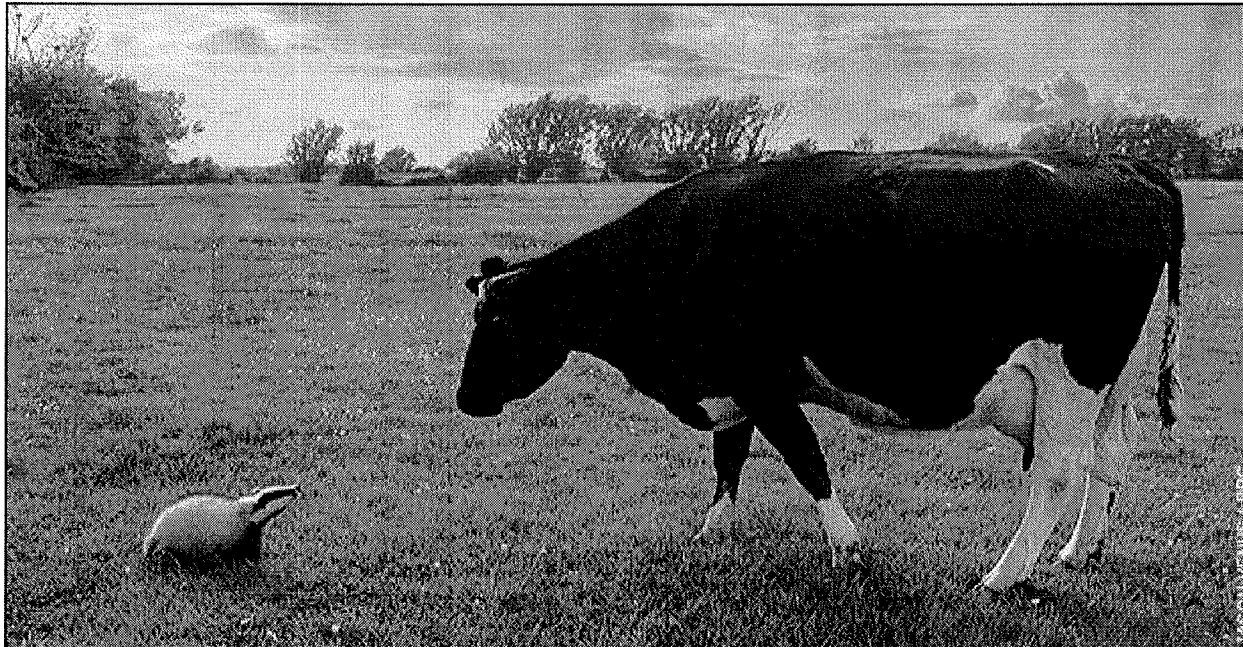


Photo courtesy of: www.telegraph.co.uk

Wind Power in Hinesburg 10 kw Turbine

Annual Energy Output

$$\begin{aligned}(\text{Kilowatt-Hours/year}) &= (0.01328) \times (\text{Rotor Diameter}^2) (\text{Annual Average Wind Speed}^3) \\&= (0.01238) \times (22\text{ft}^2) (11.4\text{mph}^3) \\&= (0.01238) \times (484 \text{ square feet}) \times (1481.544) \\&= \mathbf{9,522.65369088 \text{ kWh/year}}\end{aligned}$$

(Wind Energy Technologies, December 2006).

Wind Power in Hinesburg

- **10kw Turbines** **9,500 kwh/yr**
- **30kw Turbines** **28,500 kwh/yr**
- **225kw Turbines** **458,000 kwh/yr**

Wind Power in Hinesburg

- 100 10kw units 950,000 kwh/yr
 - 20 30kw units 570,000 kwh/yr
 - 10 225kw units 4,580,000 kwh/yr
- Total 6,370,000 kwh/yr

Solar Calculations

- Based on:
 - 5 KW Photovoltaic System
 - Produces 6,200 Kwh/yr/home
 - Average Home consumes 7,786 Kwh/yr
 - 1600 Households in Hinesburg
- 25% Suitable (South-facing and 45° angle)
 - 400 homes x 6,200 Kwh/yr/home =
2,480,000 Kwh/yr

Solar In Hinesburg 2008

- Residential Homes 2,480,000 kwh/yr
- Larger Systems 1,000,000 kwh/yr

Total 3,480,000 kwh/yr

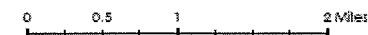
Micro Hydro



SURFACE WATERS

LEGEND

VT State Highway	Flood Hazard Areas
Class 2	Wetlands - Updated
Class 3	Scrub shrub
Class 4	Emergent
Private	Forested
Hinesburg Town Boundary	Forested (Dead)
Town Boundaries	Submergent
Parcel Boundaries	Wetlands - VSWI
Rivers & Streams	Class 2
Lakes & Ponds	



Notes and Data Sources

Vermont Hydrography Dataset R/F 5,000 scale, Ed. 1.1 (VCGI; WaterHydro_VHD July 0, 2003). Vermont's Significant Wetlands Inventory derived from 1993 aerial photography (1:80,000), (VCGI; WaterWetlands_VSWI), 1996. Updated wetlands derived from NAPP 1993 CIR Aerial Photography (1:40,000), by University of Massachusetts, Amherst, (HGC; umass.edu), 1996. Only mapped wetlands are shown. Many unmapped wetlands may also be present. E911 road center lines (VCGI; ReimageryR911_RDS), 2007. Floodplain data (FEMA FIRMS, Town of Hinesburg, 2005). Hinesburg text map parcel data, Hinesburg Planning and Zoning Office (HGP; parcel_2005). RM. Map compiled by LandWorks. Data is only as accurate as the original sources. LandWorks does not guarantee the accuracy of this data and is not responsible for errors and omissions that may exist. This map identifies the presence of features and is to be used for planning purposes only. It is not a replacement for surveyed information or engineering studies. VT SPCS, NAD 1983.

Date: October 8, 2007
 Revised: January 14, 2009
 Drawn by: NS

Prepared for: Hinesburg Conservation Commission
 Prepared by: LandWorks, Middlebury, VT

HINESBURG GREENSPACE PLAN

Hydro in Hinesburg

- 11 sites
- Estimated 11 potential sites
- 10,000 kwh/yr each site

Total 110,000 kwh/yr

Biomass Electrical Production

- Estimated 300 tons/ yr
- 1.5 tons generates 1 mwhr/yr
- $300/1.5 = 200$ mwhrs/yr
- Total 200,000 kwhrs/yr

Total Energy Production from Renewables

RESOURCE	Energy Production (Kwh/yr)
Forest Resources	200,000
Cow Power	671,946
Micro-Hydro	110,000
Wind Power	6,370,000
Solar	<u>3,480,000</u>
Total	10,831,946

Electrical Energy Use in Hinesburg

- Average/ house 2006/ 2007 7,786 kwh/yr
- $1600 \times 7,786 = 12,457,600$ kwh/yr town
- Assume 25% efficiency
 $12,457,600 \times .75 = 9,343,200$

Electrical Energy

- Potential Production 10.831 million kwh/yr
- Demand 9.343 million kwhr/yr
- Balance 1.488 million kwh/yr

Micro Grid

- A network of small, on-site generators
- Connection of small renewable energy generators to the grid
- Capable to sell back to grid during off peak hours and buy during peak hours
- Suited for consumers in close proximity
- Capable of disconnecting from grid, safe during state wide blackouts

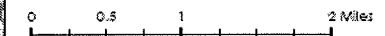
Forest Resources



LAND COVER

LEGEND

Road Centerline	Open Water
VT State Highway	Urban/Bare
Class 2	Agriculture/Non-forest
Class 3	Deciduous Forest
Class 4	Coniferous Forest
Private	Mixed Forest
Hinesburg Town Boundary	Wetland - forest
Town Boundaries	Wetland - emergent
Parcel Boundaries	
Rivers & Streams	
Lakes & Ponds	



Notes and Data Sources:

2002 Land Cover/Land Use Dataset for Vermont, Ed. 2002A, (VCGI: Land/LandUse_LCLU2002), 2002. Hinesburg for map parcel data, Hinesburg Planning and Zoning Office (HBP: puzc_2000), 2006. R011 road center lines (VCGI: EmergencyR011_RDS), 2007. Vermont Hydrography Dataset RP 5,000 scale, Ed. 3.1 (VCGI: WaterHydro_VHD/mid), 2003.

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Date: October 8, 2007
 Revised: February 26, 2008
 Drawn by: NLS

Prepared for: Hinesburg Conservation Commission
 Prepared by: LandWorks, Middlebury, VT

HINESBURG GREENSPACE PLAN

Forest Resources

- **Forested acres** **13,887**
- **Net annual yield** **3,253 Tons**
3,253 x .90 = **2,927 Tons**

Assume 3,000 Tons/ year

Net Forest Yield per Year

- 10% 300 Tons electrical production
- 10% 300 Tons construction/ materials
- 80% 2,400 Tons heating

One ton has 12 mbtu

$2,400 \times 12 \text{ mbtu} = 28,800 \text{ mbtu}$

Home Heating

- **Assume 50 mbtu/house/yr**
- **$28,800 / 50 = 576$ homes heated by wood**

Switch Grass

- 5 ton yield/ acre
- 11.305 mbtu/ ton
- $5 \times 11.305 = 56.75$ mbtu/acre
- Need 1,024 acres to heat 1,024 homes

Summary

- **Ag Land for Food** **1,697 acres**
 - **Ag Land for Fuel** **1,024 acres**
 - **Ag Land for Fibers** **1,000 acres**
- 3,721**

$$8000 - 3721 = 4,279 \text{ Acres}$$

Summary

- Potential Production 10.831 million kwh/yr
- Demand 9.343 million kwhr/yr
- Balance 1.488 million kwh/yr

$$1,488,000 / 4000 \text{ kwh/yr} = 372 \text{ homes}$$

Summary

- **372 homes 2.81 people/ home**

$372 \times 2.81 = 764$ additional people

Summary

- **Add Net Zero Energy Homes**

Ag Land for Food	1,697 acres
Ag Land for Fibers	<u>1,000</u> acres
	2,697

2,697 acres/ 4,500 people
.59 acres/ person

Summary

4,279 acres / .59 acres per person

7,252 people

Hinesburg's Carrying Capacity

$$4,500 + 764 = 5,264$$

$$4,500 + 7,252 = 11,752$$

**Thanks to the UVM
Students of ENSC 185**