

New Energy For Southern Vermont Forum: *Thermal Biomass Energy*

Presentation for Bennington County Regional Commission

March 21st, 2013

Adam Sherman
Biomass Energy Resource Center at VEIC



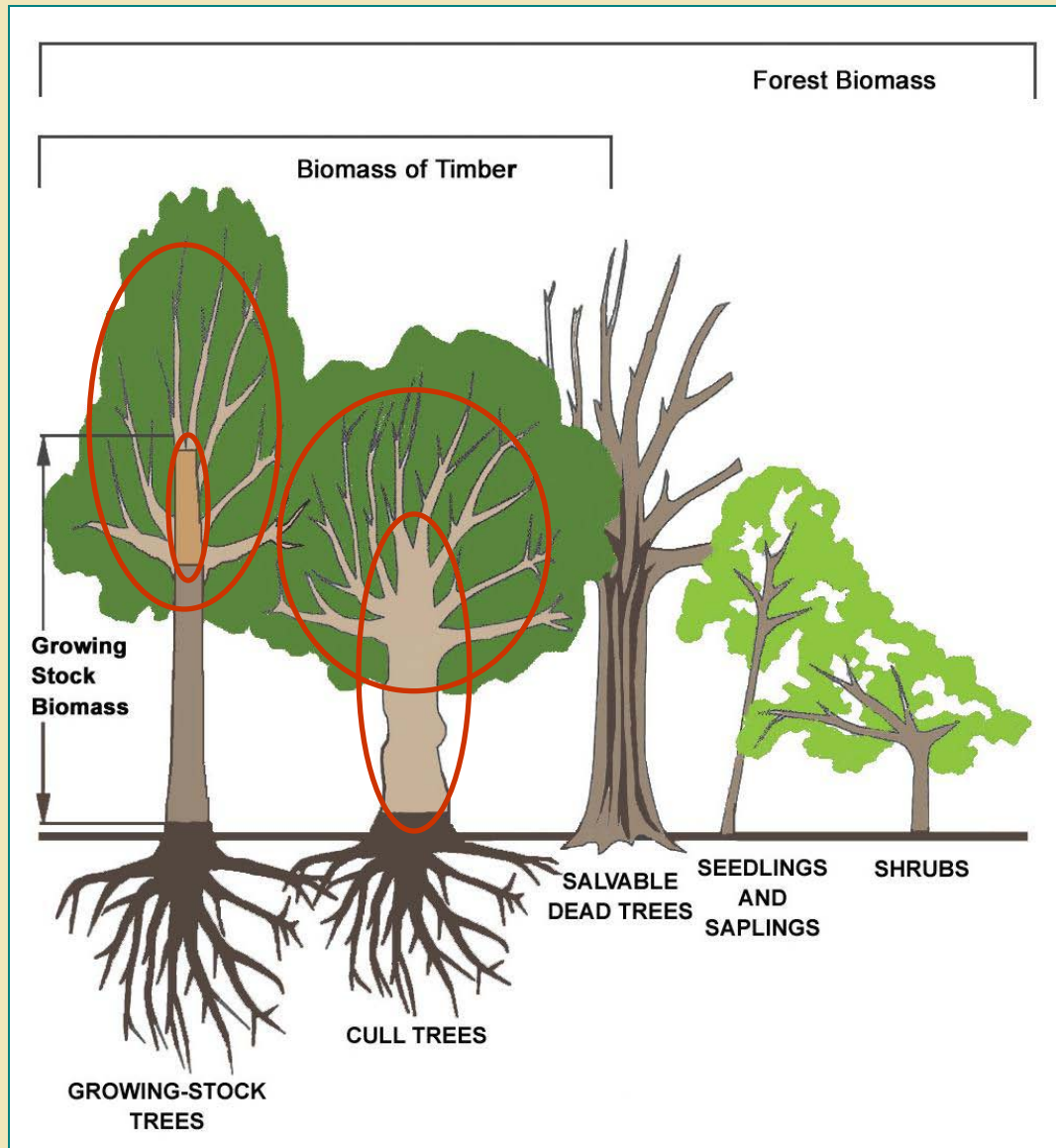
The Working Landscape in Vermont



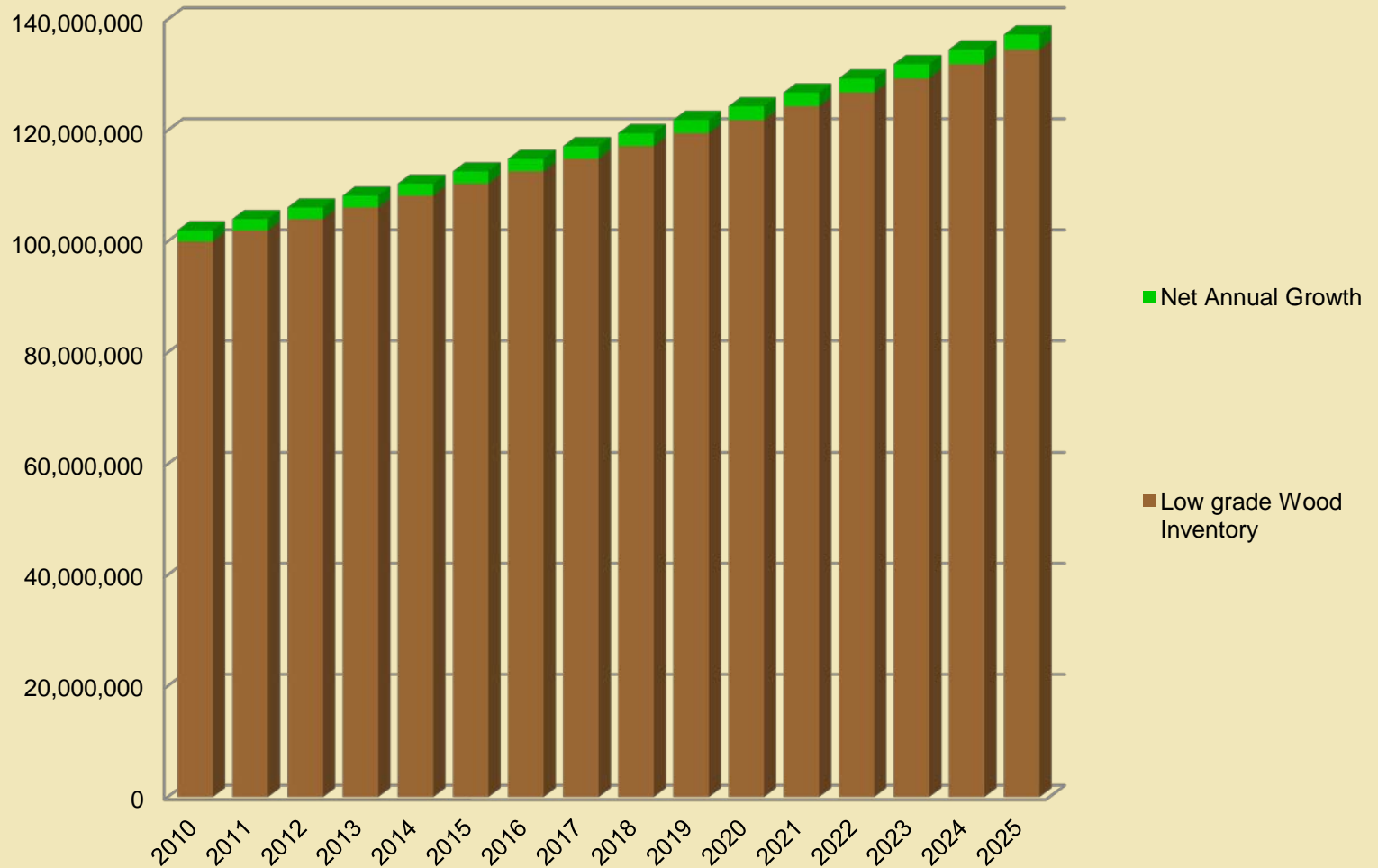
Importance of Managed Forests as part of the Working Landscape



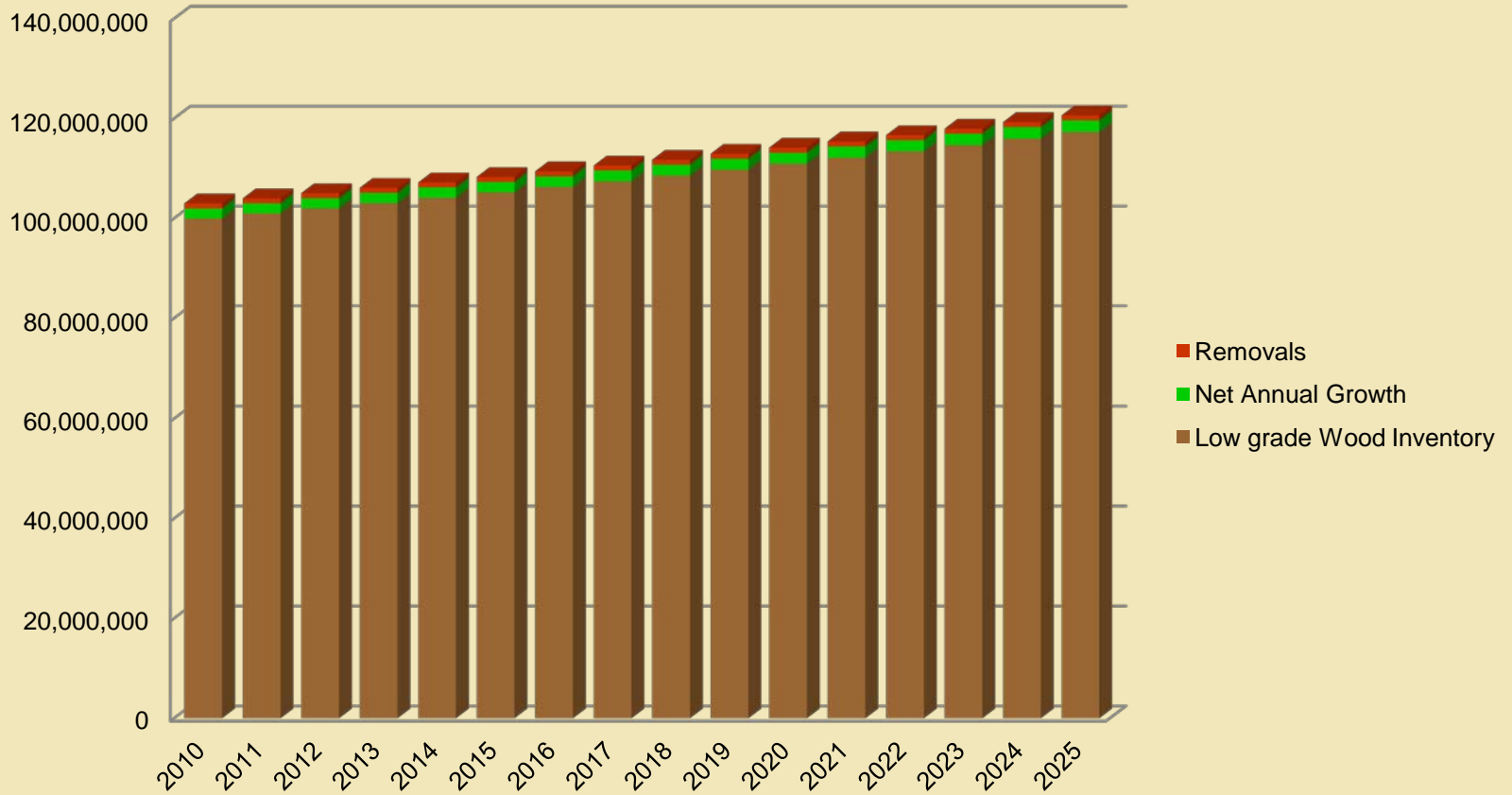
Low-grade Portion of Forest Biomass Inventory Ecologically Appropriate for Harvest



Conceptual Forest Inventory and Net Annual Growth over Time



Conceptual Forest Inventory, Growth, and Removals over Time



Wood Resource Assessment



	Forestland (Acres)	Annual Growth Low Grade Wood (Green Tons)	Annual Harvesting Low- grade Wood (Green Tons)	NALG Wood (Green Tons)
Bennington, VT	362,196	150,486	52,754	91,731
Rutland, VT	433,186	202,323	51,180	132,981
Windsor, VT	510,487	266,600	184,819	104,055
Windham, VT	431,556	257,163	90,947	141,367
Washington, NY	267,438	116,114	70,000	49,606
Rensselaer, NY	251,749	80,538	65,000	20,796
Berkshire, MA	454,039	315,214	50,000	251,674
TOTAL	2,710,651	1,388,438	564,700	792,210

Traditional Wood Fuels

Chunkwood



PROS: Simple, cost effective, easy to self-supply

CONS: Manual feed, less efficient combustion, less convenient

Chips



PROS: Cost effective fuel, by-product supply, great for heating large facilities

CONS: High capital costs, not effective for residential heating

Pellets



PROS: Energy dense fuel, clean burning, efficient, and convenient











CONS: Slightly higher cost per MMBtu

How Much Heating Oil Used in Bennington County could be Replaced with Local Wood?

Rough Assumptions *

- 37,000 population in 2010
- 2.2 people per household
- 60% of homes heating with oil
- 750 gallons heating oil per home

= 7.5 million gallons of heating oil annually just for residential
= 908,181 MMBtu/yr
= 92,000 green tons of wood
= Over \$26 million dollars annually spent on heating oil
(@\$3.50/gallon)

Technology	Cordwood Boilers	Pellet Boilers	Single Facility Woodchip Heating	District Heating w/Woodchip Boilers	Industrial CHP
					
Typical heat output capacity	20,000 – 100,000 Btu/hr	100,000 Btu – 5MMBtu/hr	2 – 30 MMBtu/hr	10 – 100 MMBtu/hr	10 -1,000 MMBtu/hr
Applications	Home heating and farm buildings	Home heating & small commercial buildings	Schools, hospitals, office buildings, etc.	College campuses and downtown communities	Industrial manufacturing facilities
Fuel Type					
Annual Fuel Use	2-15 cords	2-20 tons	100 – 10,000 tons	500- 50,000 tons	1,000 – 1,000,000 tons
Fuel Sourcing	Locally harvested firewood	Premium pellets	Paper grade and screened bole chips	Bole chips and whole-tree chips	Whole-tree chips and hog fuel
Average Efficiency	65%	80%	75%	75%	28% -- 75%

CAMPUS WOODCHIP HEATING SYSTEM

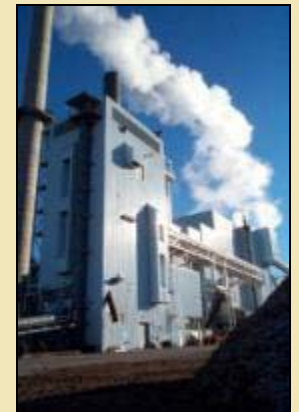
Bennington College

BENNINGTON, VERMONT, UNITED STATES

- ❑ Heating Capacity (output): 4.0 MW
(14 MMBtu/hr)
- ❑ Year Installed: 2008
- ❑ Annual Woodchip Use: 4,000 green tons
- ❑ Thermal Output: Steam for heating and
DHW for 388,000 square feet of buildings
- ❑ Amount of Oil Displaced: Off-sets 400,000
gallons of oil annually



The Vermont Wood Energy Experience



STATS

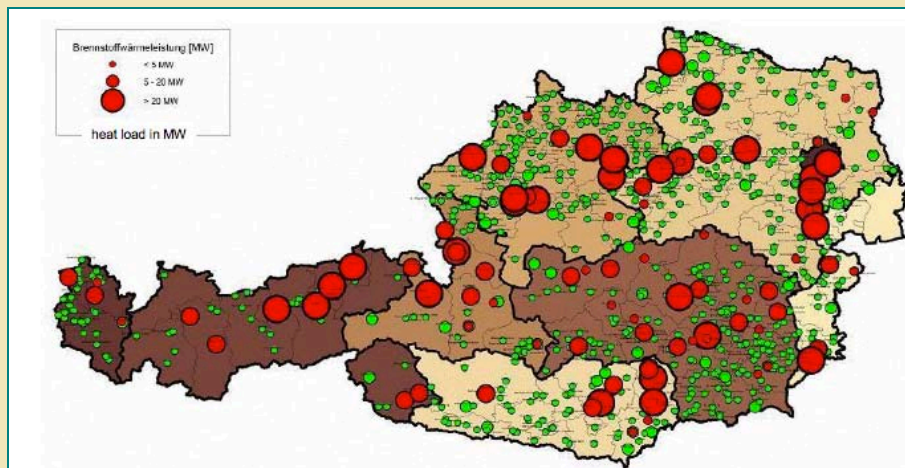
- 2 Power Plants
- 41 Public Schools
- 1 Hospital
- 5 State Office Complexes
- 3 Housing Complexes
- 3 College Campuses
- Dozens of Businesses

Success Factors

- 25 + years
- Strong political and public support
- High oil prices and volatility
- VT Fuels for Schools Program (partnerships of agencies and orgs)
- Relatively little natural gas infrastructure
- Transition to commodity fuel supply

The Austrian Example: *A Model for Vermont?*

- ❑ Thousands of wood boilers
- ❑ Hundreds of farmer owned district heating systems
- ❑ Dozens of businesses manufacturing heating systems
- ❑ A robust wood energy economy integrated with tourism and working landscape



WOODCHIP DISTRICT HEATING SYSTEM

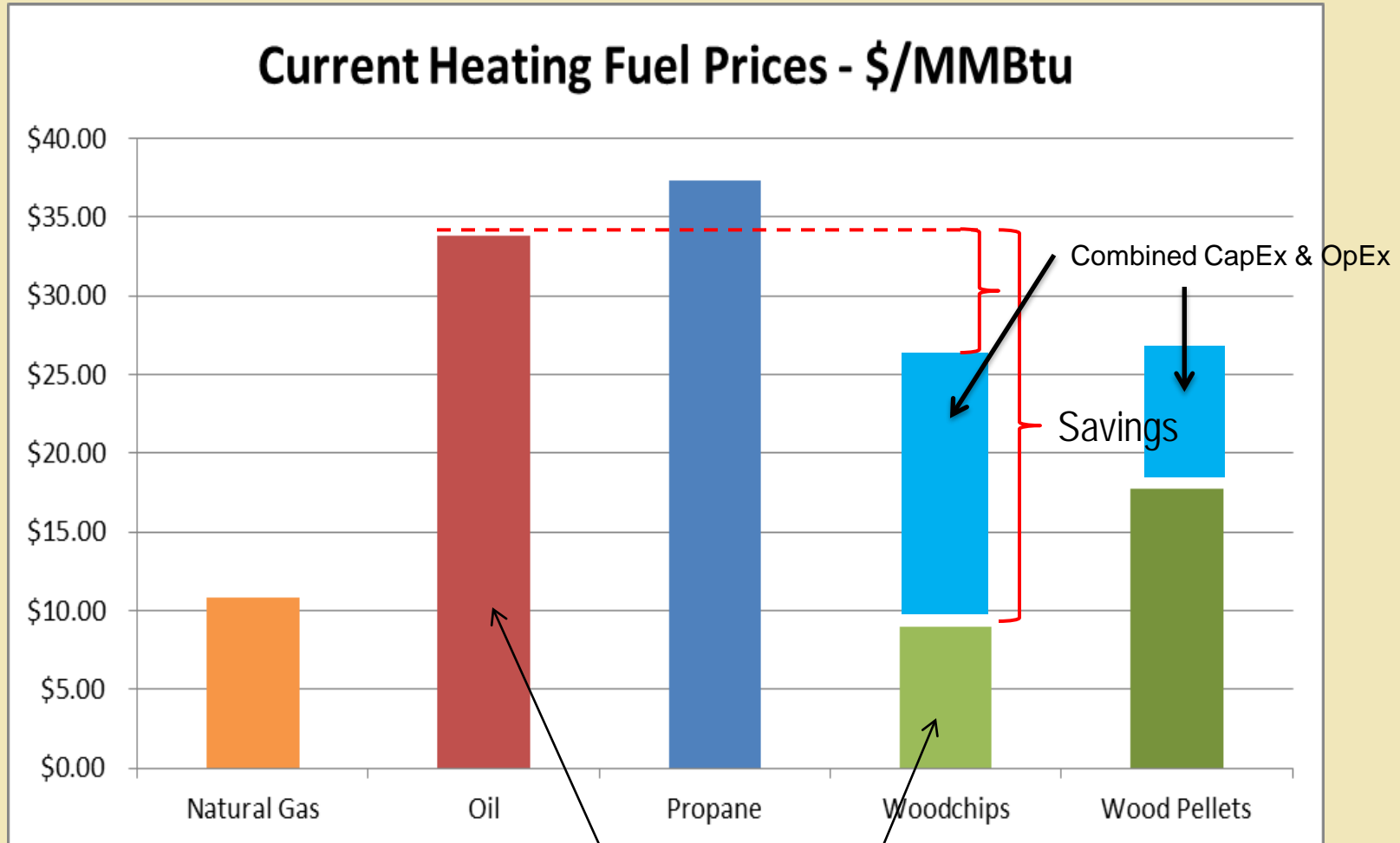
Cooperatively Owned System

BUCHKIRCHEN, AUSTRIA

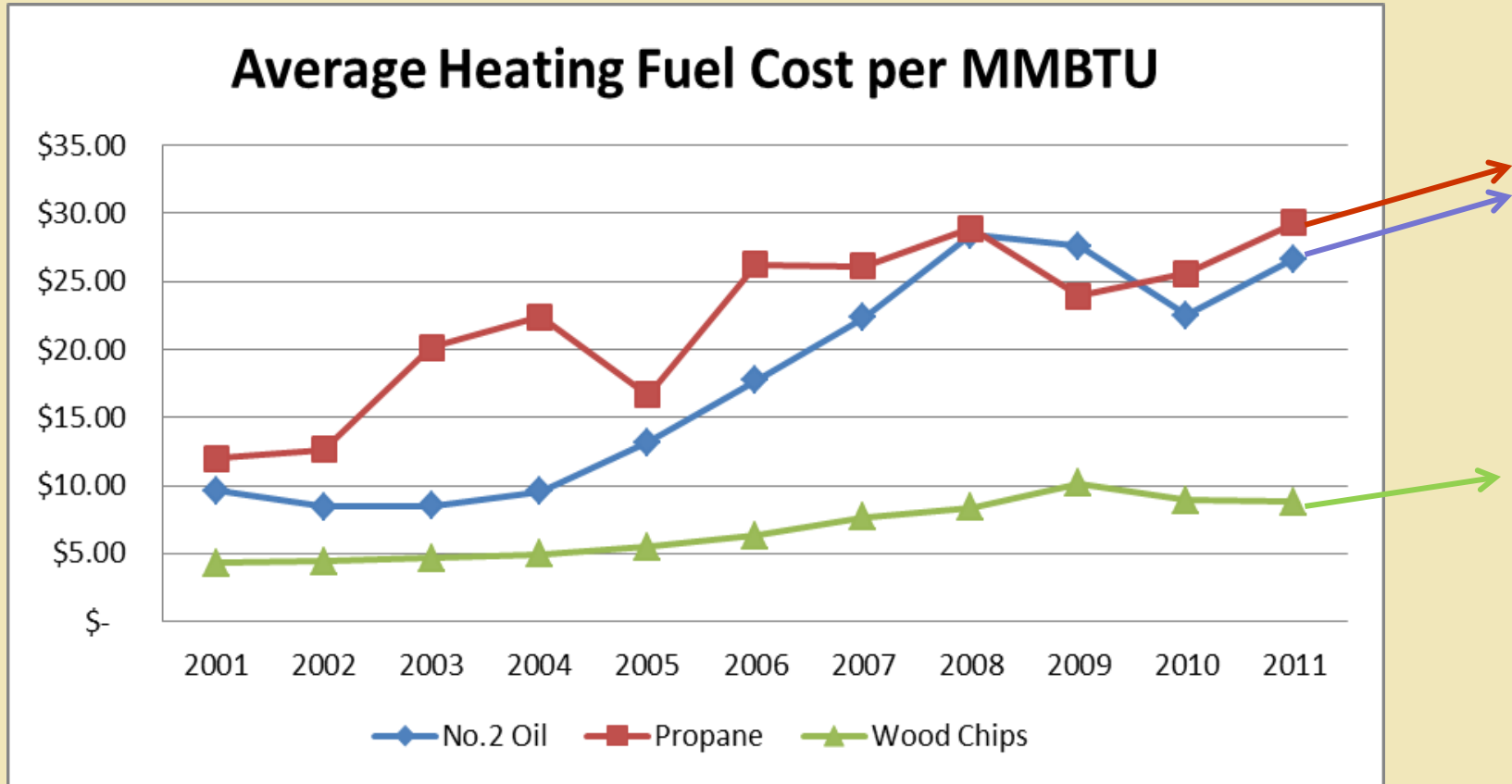
- **Heating Capacity (output):** One 650 kW (2.2 MMBtu/hr) boiler and one 150 kW (500,000 Btu/hr) boiler
- **Emissions Reduction and Combustion Control Equipment:** Multi-cyclone, moving grates
- **Year Installed:** 2006
- **Thermal Output:** Hot water for heating
- **District Heating Network Length:** 1.8 km (1 mile)
- **Number of Customers:** 25
- **Annual Fuel Use:** 1,300 Green Tons Chips
- **Capital Cost:** \$1.3 million (15 year payback)



Cost of Heating Fuels



Vermont School Heating Fuel Price History



Parting Comments

- Biomass energy is not perfect—it is better.
- Replace oil and propane with local renewable fuel
- Create local jobs
- Lower carbon footprint
- Keep dollars in local economy
- Create local, stable markets for low-grade and small diameter wood products

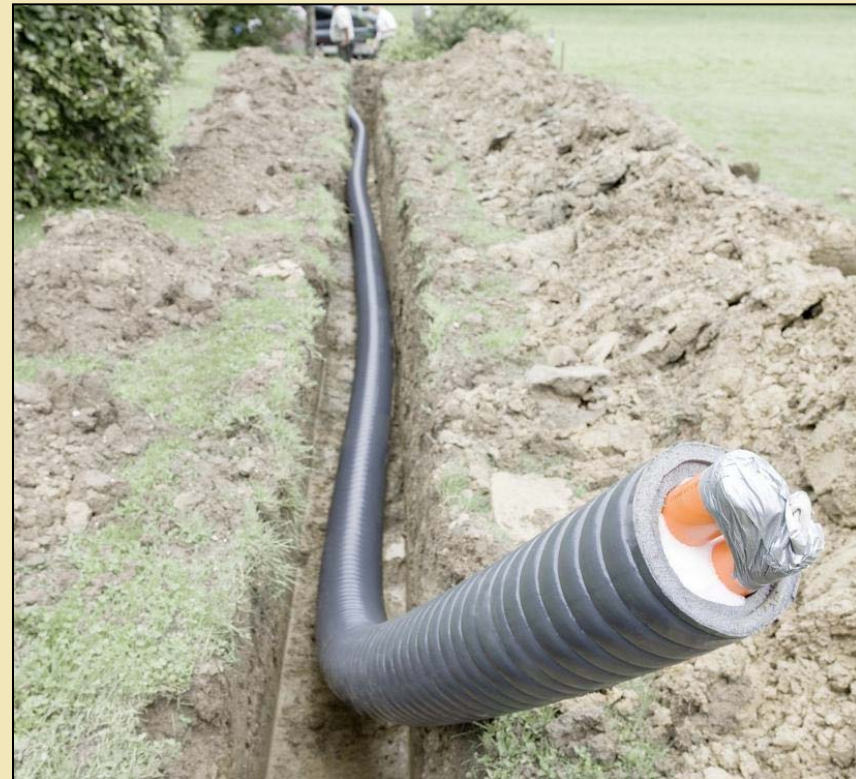


Questions?

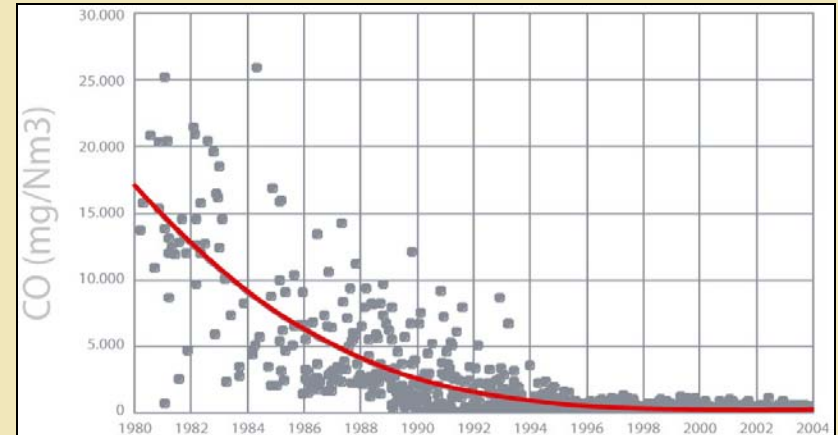
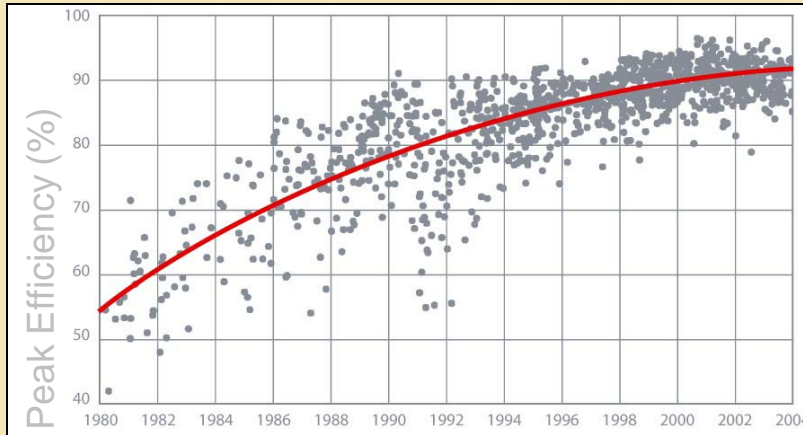
Contact Information

Adam Sherman
Biomass Energy Resource Center at VEIC
128 Lakeside Ave. Suite 401
Burlington, VT 05401
[\(802\) 540-7863](tel:8025407863)
asherman@biomasscenter.org
www.biomasscenter.org

Modern Hot Water District Heating Piping



Air Emissions



Source: Dr. Christian Rakos, ProPellet, Austria

- Modern advanced combustion technology has increased efficiency and lowered CO emissions
- State of the art and particulate emission control technologies are available and more cost effective than in the past
- Use of an ESP can lower PM emissions below oil fuel emission levels and possibly lower required stack heights
- Boilers less than 4.5 MMBH currently do not require State permits however, Act 250 permitting may closely review emissions



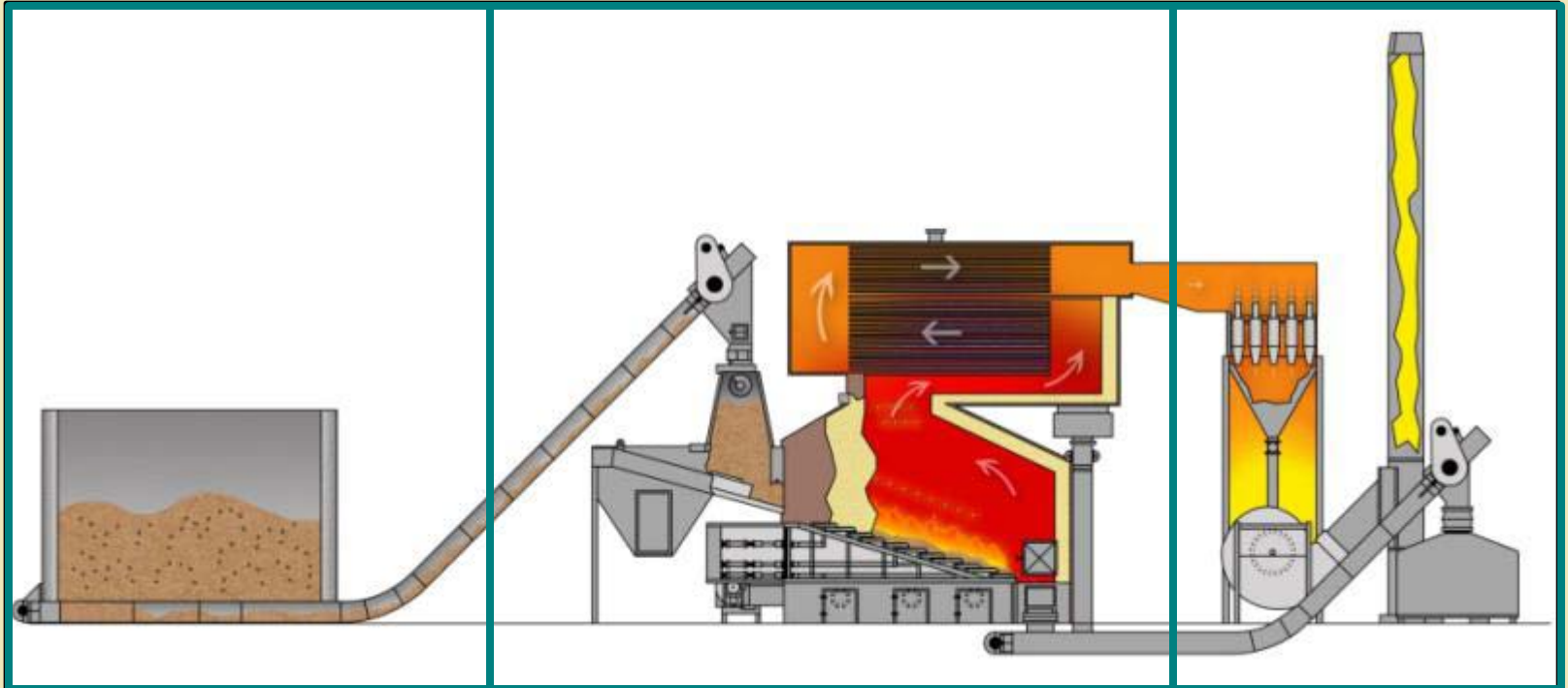
Woodchip Price		Oil Price		Propane Price		Natural Gas Price	
per Green Ton		per Gallon		per Gallon		per Therm	
\$	15.00	\$	0.26	\$	0.19	\$	0.21
\$	20.00	\$	0.34	\$	0.25	\$	0.27
\$	25.00	\$	0.43	\$	0.32	\$	0.35
\$	30.00	\$	0.51	\$	0.38	\$	0.41
\$	35.00	\$	0.60	\$	0.44	\$	0.48
\$	40.00	\$	0.68	\$	0.50	\$	0.54
\$	45.00	\$	0.76	\$	0.56	\$	0.61
\$	50.00	\$	0.86	\$	0.62	\$	0.69
\$	55.00	\$	0.94	\$	0.68	\$	0.75
\$	60.00	\$	1.03	\$	0.74	\$	0.83
\$	65.00	\$	1.10	\$	0.80	\$	0.89
\$	70.00	\$	1.19	\$	0.86	\$	0.96
\$	75.00	\$	1.28	\$	0.92	\$	1.03
\$	80.00	\$	1.37	\$	0.98	\$	1.09
\$	85.00	\$	1.44	\$	1.05	\$	1.17
\$	90.00	\$	1.53	\$	1.11	\$	1.22
\$	95.00	\$	1.64	\$	1.19	\$	1.30
\$	100.00	\$	1.70	\$	1.26	\$	1.38

Biomass Heating System Configuration Options

Fuel Storage

Combustion Equipment

Emissions Control Equipment & Stack



Pellet Silos
Slab chip bins
Below grade chip bins

Stoker/fixed grate
Stoker/moving grate
Pneumatic/suspension
Fluidized bed

Single cyclone
Multi-cyclone
Baghouse
ESP

Interconnection with District Heating Plant



Residential Heat Transfer Station with Metering

Fuel Sources and Quality



Urban Wood



Whole-tree Chips



Bole Chips



Paper-grade Chips

Pellet Fuel Manufacturing

Currently only one pellet mill in Vermont:

- Vermont Wood Pellet located in Clarendon, VT
- Produces approx. 20,000 tons/yr

Rest of supply is imported:

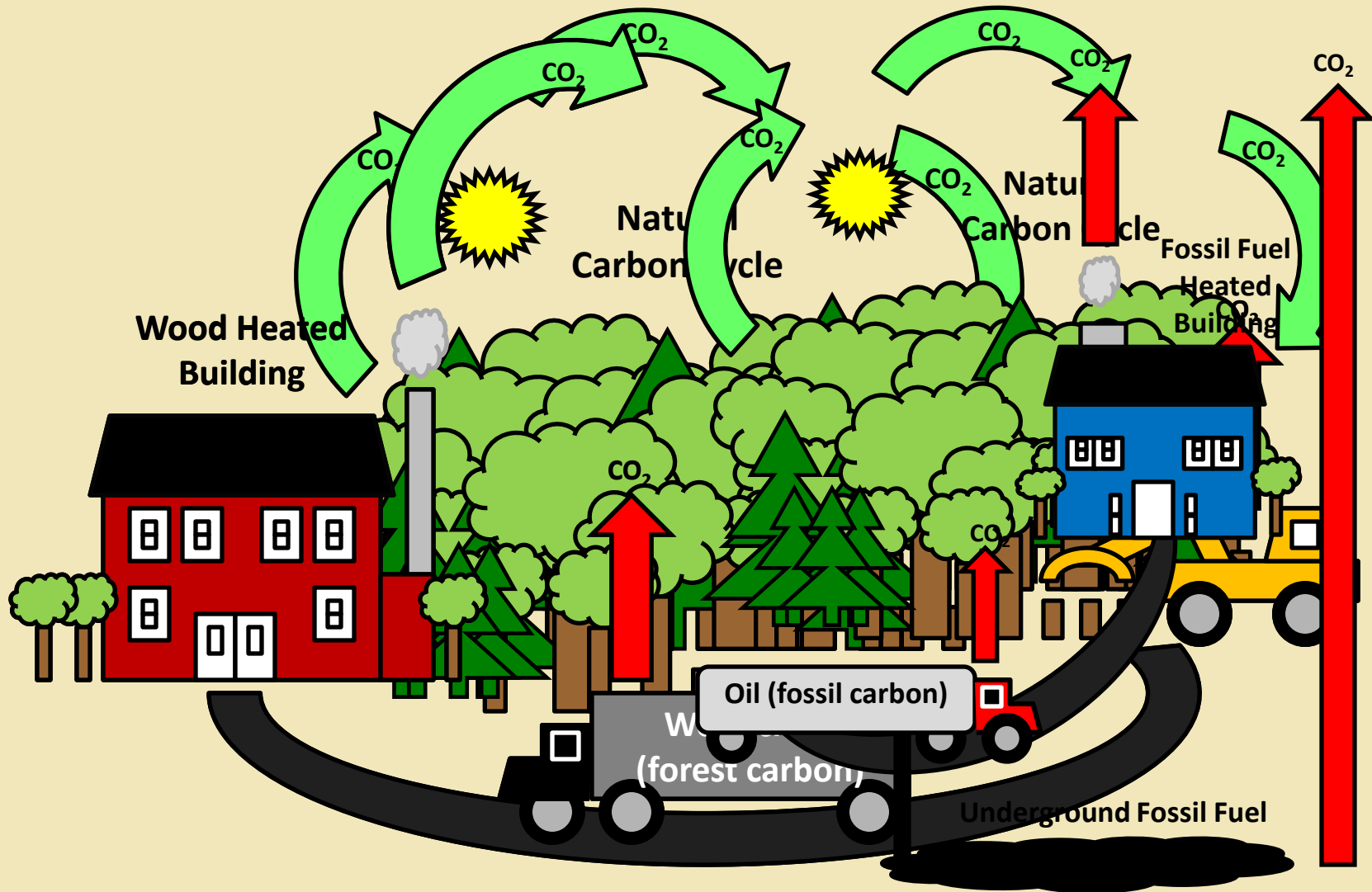
- Quebec
- New Hampshire
- Maine
- New York
- and beyond

There is a growing number of brokers and pellet distributors in the region.

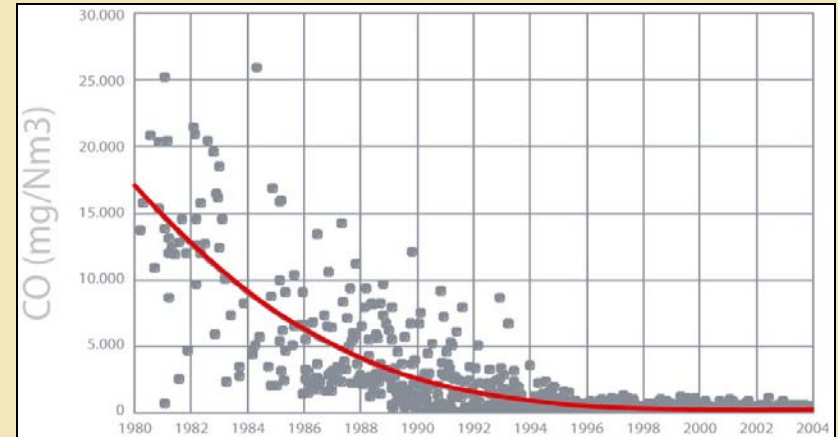
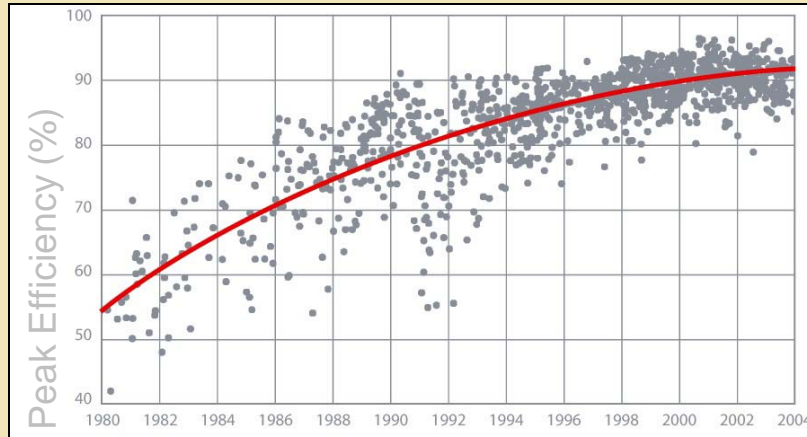


The Carbon Cycle

Biomass Heated Buildings vs. Fossil Fuel Heated Buildings



Better Technology = Fewer Emissions



Source: Dr. Christian Rakos, ProPellet, Austria

- Modern advanced combustion technology has increased efficiency and lowered CO emissions
- State of the art and particulate emission control technologies are available and more cost effective than in the past



Forest Impacts



- Real versus Perceived Impacts?
- Stem-only or Whole-tree Harvest?
- Slash or Roundwood Utilization?

Need to Clearly Communicate Local Silviculture Practices and any Existing Standards that Help Protect:

- Water Quality
- Wildlife Habitat
- Long Term Site Productivity
- Biodiversity