Keeping the Home Fires Burning:
Sustainable Development for the UP

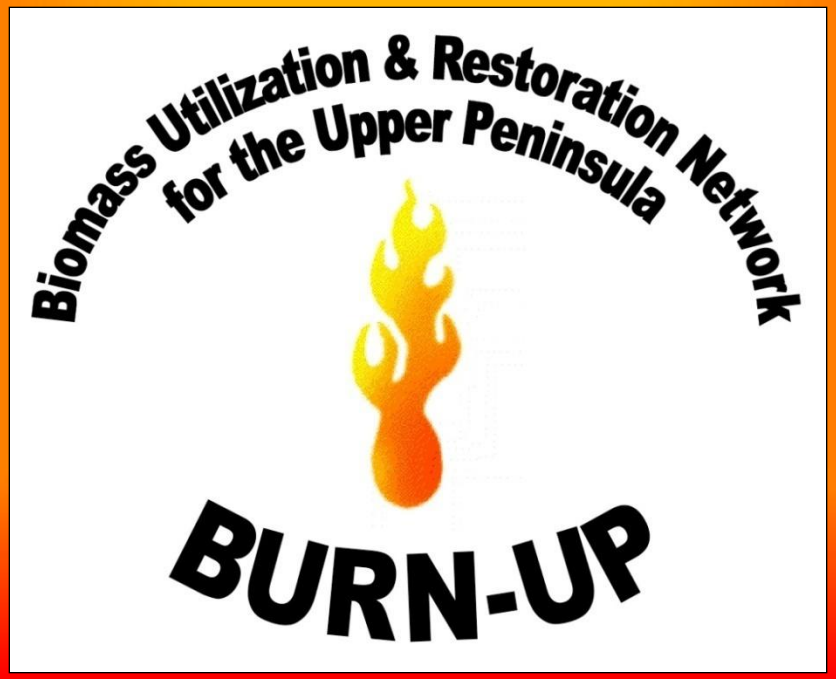
Presented by:
Christopher Burnett, Ph.D.
Big Creek Consulting Forestry
BURN-UP Project Director

Presented at:
4th Annual Sustainable Forestry Conference
Florence, Wisconsin
April 2008

~ OUTLINE ~

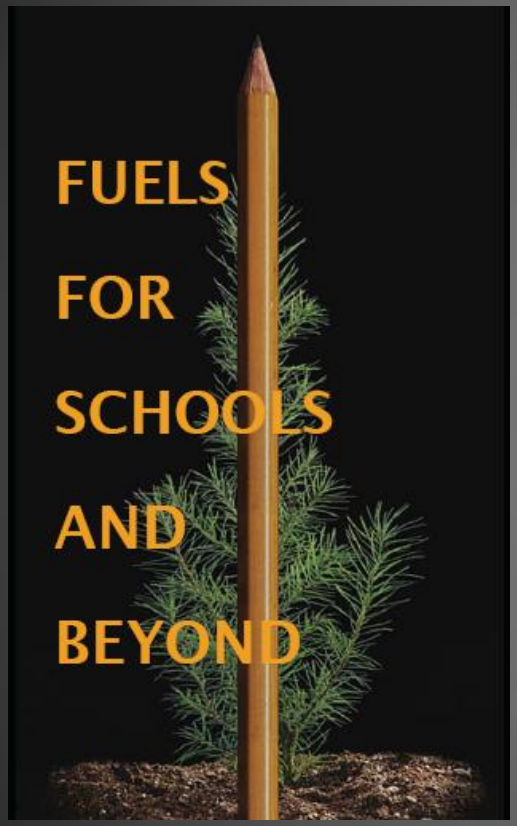
I. The BURN-UP Project: Phase 1
II. Woody Biomass Supply Issues
III. Ecological Sustainability Issues
IV. Economic & Social Sustainability Issues
V. Taking Action

I. BURN-UP Project: Phase 1



Western Fuels for Schools

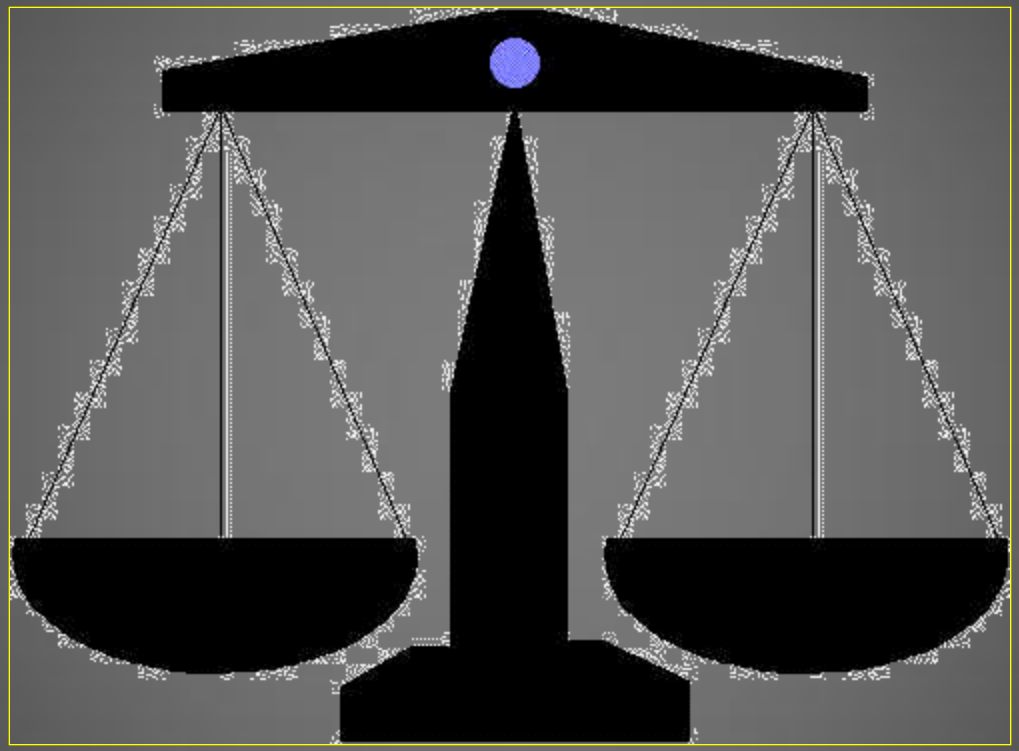
http://www.fuelsforschools.org



BURN-UP Project
Phase 1 Objectives

1. Assemble a steering committee of expert advisors.
2. Produce & distribute a fact sheet on heating UP schools with wood.
3. Conduct a survey of UP School heating systems.
4. Sponsor tours of wood-heated UP School.
5. Provide preliminary engineering studies for schools (&/or other facilities) that are considering converting to wood heat.
6. Conduct woody biomass harvesting workshops.
7. Develop woody biomass harvesting guidelines.
8. Develop & maintain a UP woody biomass website.

RC&D = Balanced Approach



Resource Conservation:
Sound harvesting, efficient use

Resource Development:
Outreach, education, networking

Objective 1.
Steering Committee

Upper Peninsula Resource Conservation and Development Council

Conservation Districts

USDA

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP

DNR

MICHIGAN STATE UNIVERSITY EXTENSION

MichiganTech
Forest Resources & Environmental Science

The Nature Conservancy
Protecting nature. Preserving life.™

Northern Institute of Applied Carbon Science

THE FORESTLAND GROUP, LLC

Upper Peninsula Resource Conservation and Development Council

Steering Committee People

Biomass Utilization & Restoration Network for the Upper Peninsula BURN-UP

Objective 2.
Fact Sheet on Wood Heat for UP Schools

Upper Peninsula Resource Conservation and Development Council

Heating U.P. Schools with Woody Biomass

- Save Money
- Improve the Environment
- Increase National Security

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Upper Peninsula Resource Conservation and Development Council

Success Stories: UP Schools that heat with wood

C-L-K Schools
Calumet-Laurium-Keweenaw

County: Houghton & Keweenaw

Town: Calumet

Number of Students: 1,200

Square Feet: *251,000*

Years Heating with Wood: 17 (since 1990)

Types of Wood Used: Sawmill & other waste wood

Type of System: 100 hp wood-fired boiler with natural gas back-up

Uses of Wood Heat: Hot water & steam space heat, domestic hot water

Savings: $100's a day

Evaluation: "We are totally committed to using wood for fuel."

North Dickinson Schools

County: Dickinson

Town: Felch

Number of Students: 400

Square Feet: 100,000 + garages

Years Heating with Wood: 14 (since 1993)

Types of Wood Used: chips

Type of System: 100,000 BTU boiler with propane back-up

Uses of Wood Heat: Forced air space heat and domestic hot water

Savings: About $20,000 a year

Evaluation: "We have a good thing going. Using wood heat frees up a lot of resources for student instruction."

Other Schools:

North Central Area Schools, Powers

County: Menominee

Years Heating with Wood: *15+* (since at least 1992).

Evaluation: *"We have no plans to stop heating with wood despite the extra maintenance efforts."*

Whitefish Twp School, Paradise

County: Chippewa

Years Heating with Wood: *15* (since 1992).

Evaluation: *"We are very enthusiastic about heating with wood due to the big-time cost savings we are realizing."*

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

Objective 3.
Survey of UP School Heating Systems

ENERGY SYSTEM SURVEY of U.P. Schools

BIOMASS UTILIZATION and RESTORATION NETWORK for the UP (BURN-UP)

Introduction – This survey will be used by the BURN-UP project to help identify U.P. schools that could realize substantial financial benefits by converting to wood heat. Some of the U.P. schools that are currently saving greatly by heating with wood are profiled in the enclosed fact sheet. Based on the results of this survey, the BURN-UP Project will provide engineering assistance to a few U.P. schools that are promising candidates for conversion to wood heat. Even if you know that wood energy does not make sense for your facility at this time, please complete at least Section 1 and return the survey. If you have multiple separate heating systems, please make a copy of the survey for each system. If you need more space, feel free to add pages.

Many thanks you for your cooperation!

SE Michigan RC&D Boiler Study

FINAL REPORT

EXPLORING WOODY BIOMASS RETROFIT OPPORTUNITIES IN MICHIGAN BOILER OPERATIONS

9/28/2007

Submitted to:

Jessica Simons
Southeast Michigan RC&D Council
7203 Jackson Road
Ann Arbor, MI 48103-9506

Project Partners:

USDA Forest Service Wood Education & Resource Center
USDA Forest Service Economic Action Program
Southeast Michigan RC&D Council
Michigan Department of Natural Resources
Michigan Department of Labor & Economic Growth
Michigan Biomass Energy Program

Submitted by:

CTA Architects and Engineers
Emergent Solutions
Christopher Allen + Associates
Loracs Creations
Geodata

Used to help target likely candidates

Objective 4. Pre-Feasibility Studies

Upper Peninsula Resource Conservation and Development Council

Biomass Utilization & Restoration Network for the Upper Peninsula BURN-UP

780 Commerce Drive Suite C Marquette MI 49855
Phone: 906-226-2461 X 122 Fax: 906-226-7040
Email: burn-up@charterinternet.com Website: www.upwoodybiomass.org

REQUEST FOR PROPOSALS (RFP)

At least 3 schools

To Provide Pre-Feasibility Assessments for the Integration of Biomass Energy Systems

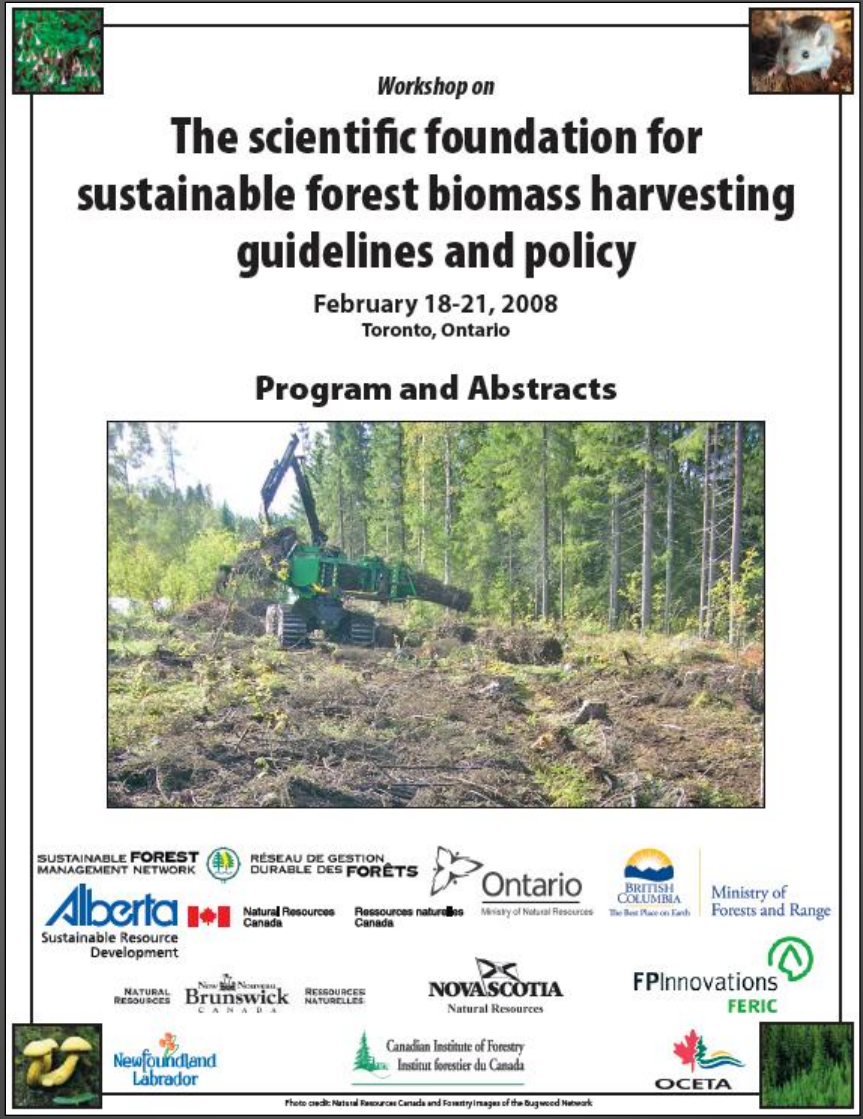
Objective 5.
Woody Biomass Harvest Demos

Summer 2008

Upper Peninsula Resource Conservation and Development Council

Objective 6.
Woody Biomass Harvest Guidelines

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

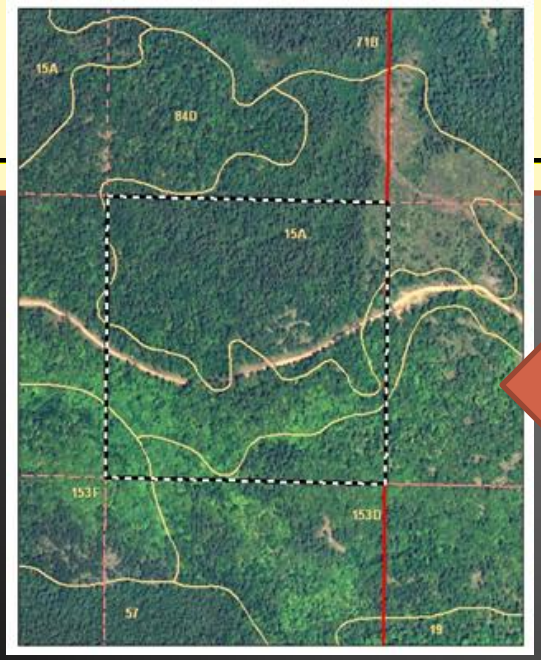


State Guidelines for Woody Biomass Harvest

- Minnesota – 2007, revision planned
- Wisconsin – 2008?
- Michigan – 2008?
- Maine – in process
- Missouri – in process
- Canadian Provinces - mixed

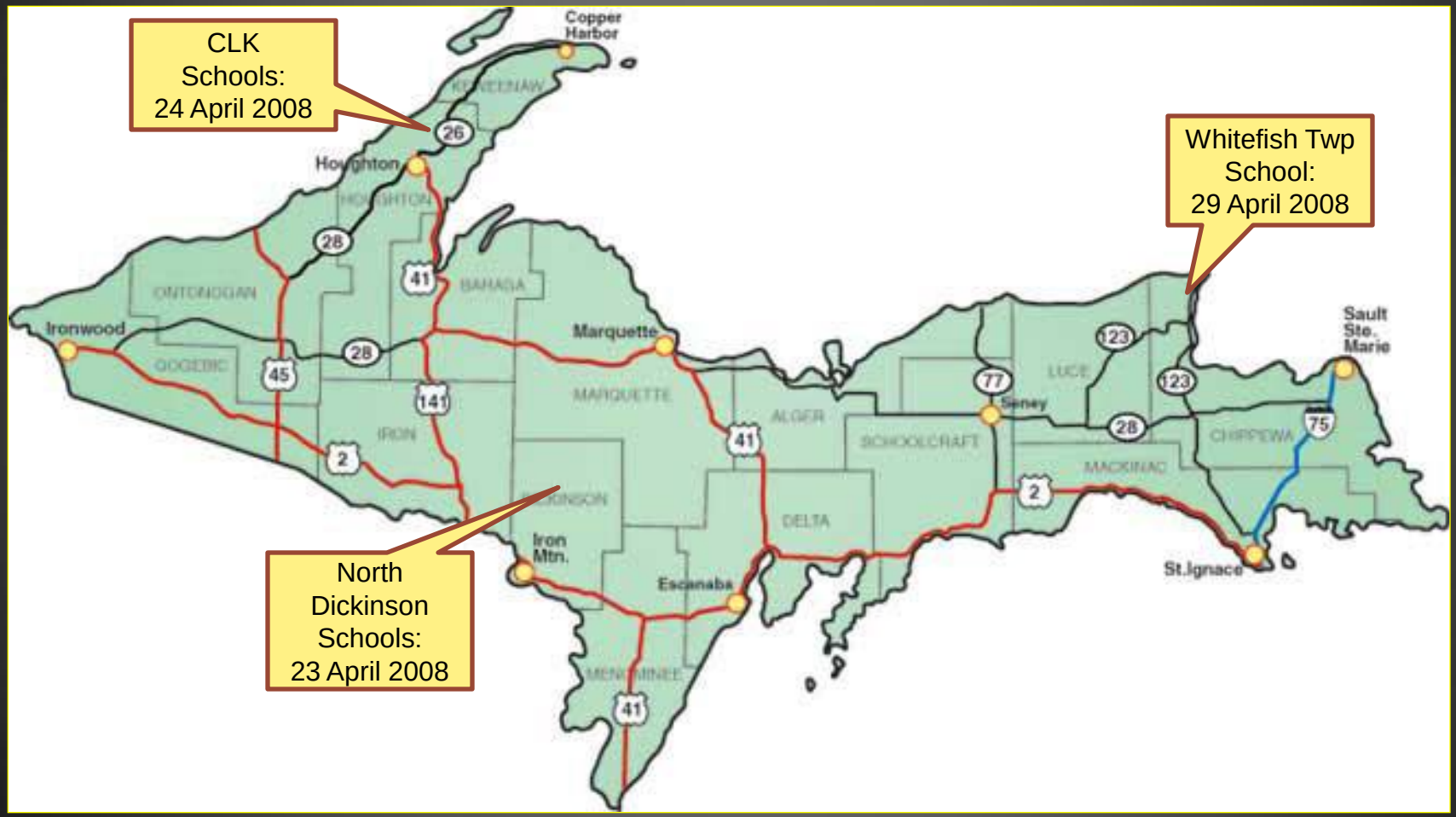
Suitability Rating for Woody Biomass Harvest by Soil Mapunit

Suitability Dimension	Soil Properties/Interpretations	Low Score	High Score	% Weight	Suitability Detail
Productivity	Effective Cation Exchange Capacity (ECEC)	1	5		Nutrient content
Productivity	Calcium Carbonate (CaCO3)	1	5		Nutrient availability
Productivity	Organic Matter	1	5		Multiple positive effects
Productivity	Available Water Supply (AWS)	1	5		Capability to store water for plants
Productivity	Depth to Any Restrictive Soil Restricitve Layer	1	6		Quantity of soil for plant growth
Productivity	SUBTOTAL	5	26	68%	Productivity
Erosion Resistance	Kw (inverse classes)	1	4		Soil-erodibility factor, whole soil
Erosion Resistance	Representative Slope (inverse classes)	1	4		
Damage Resistance	SUBTOTAL	2	8	21%	Erosion Resistance
Hydrologic Capacity	SUBTOT: Hydrologic Soil Group	1	4	11%	Hydrologic Capacity (infiltration)
	TOTAL	8	38	100%	
				span	OVERALL NUMERIC RATING:
	DRAFT>	0	8	8	Not suited
	DRAFT>	9	18	9	Poorly suited
	DRAFT>	19	28	9	Moderately suited
	DRAFT>	29	38	9	Well suited



Detailed digital soils maps are now available for the whole UP

Objective 7.
Wood-Heated School Tours



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Calumet-Laurium-Keweenaw Schools

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Upper Peninsula Resource Conservation and Development Council

North Dickinson School

Biomass Utilization & Restoration Network for the Upper Peninsula

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Objective 8. Website UPWoodyBiomass.org

Upper Peninsula Resource Conservation and Development Council

BURN-UP
Biomass Utilization & Restoration Network for the Upper Peninsula

About Us | Biomass Exchange | Biomass Users | Biomass Harvests | Information Sets

Log In | Print This Page | Search: Go

About Us

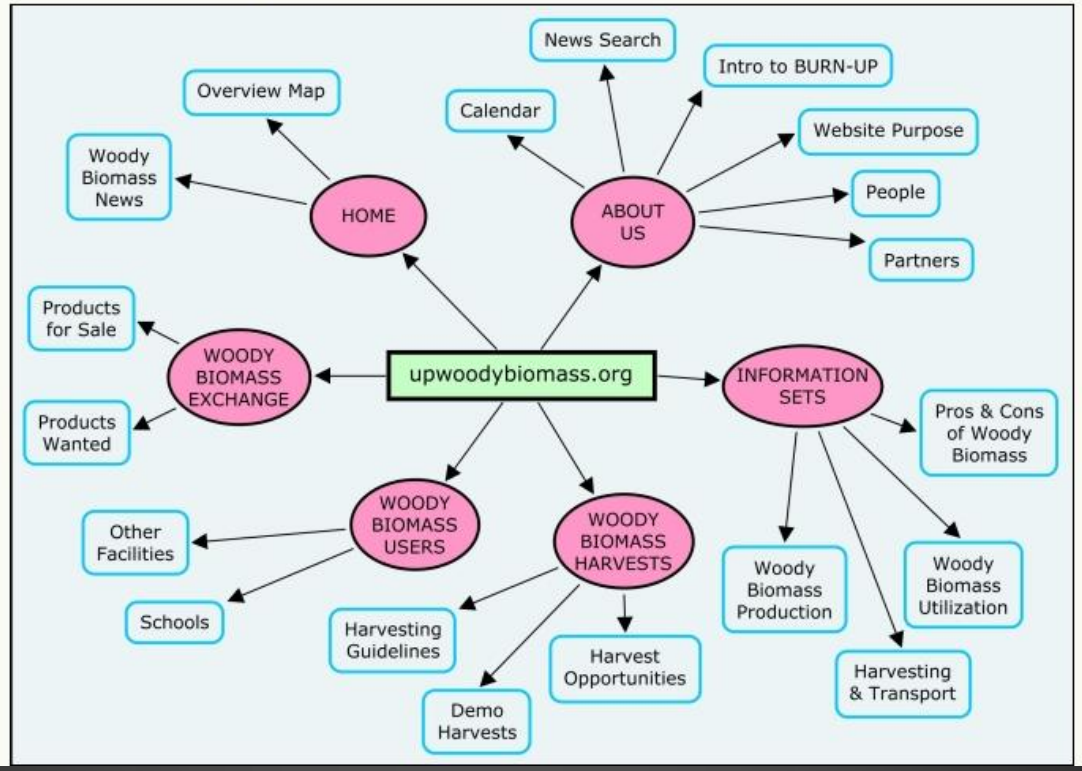
Biomass Exchange

Biomass Users

Welcome to the BURN-UP website

OVERVIEW MAP

Here is an overview of what you can find on this website.



Upper Peninsula Resource Conservation and Development Council

Market Development

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

UP Woody Biomass Exchange Map

The map below shows all current locations of woody biomass products for sale or products wanted. You can scroll and zoom with the controls on the map. **Click an icon on the map** for details on a specific entry:

Product for Sale / Product Wanted

Item Details

last updated: 3/31/2008 9:29:20 AM

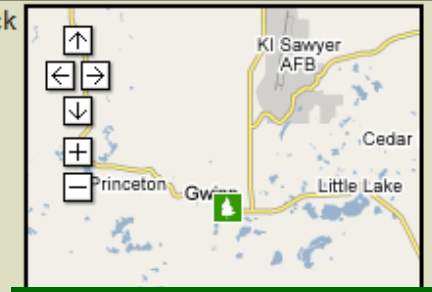
Product for Sale ID #5

Wood pellets

Pellets: Three grades of wood biomass pellets are in stock
Quantity: A large supply is available
Available: Available year around
Frequency: Continually
Delivery? Yes
County: Marquette

Contact:

Joe D'Ambrosio
D'Ambrosio LLC
85 North Pine Street
Gwinn, MI 49841
Phone: 906-346-5341
Email: joeandsons@netzero.net
Please contact using: Phone



Item Details

last updated: 3/31/2008 9:24:45 AM

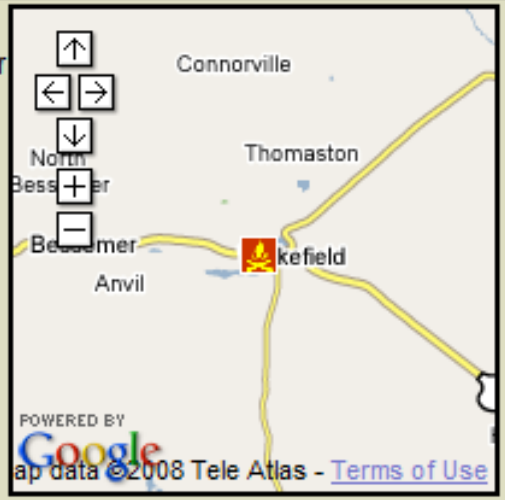
Product Wanted ID #4

Wood chips

Chips: Wood chips for school boiler
Hopper holds 30 tons Need to fill hopper about every 3 days
Quantity: 800-900 tons/year
Available: Fall 2008 heating season
Frequency: Daily
Delivery? Yes
County: Gogebic

Contact:

Larry Kapugia or Dale Torkko
Wakefiled-Marenisco School District
715 Putnam St.
Wakefield, MI 49968
Phone: (906)224-9421
Please contact using: Phone



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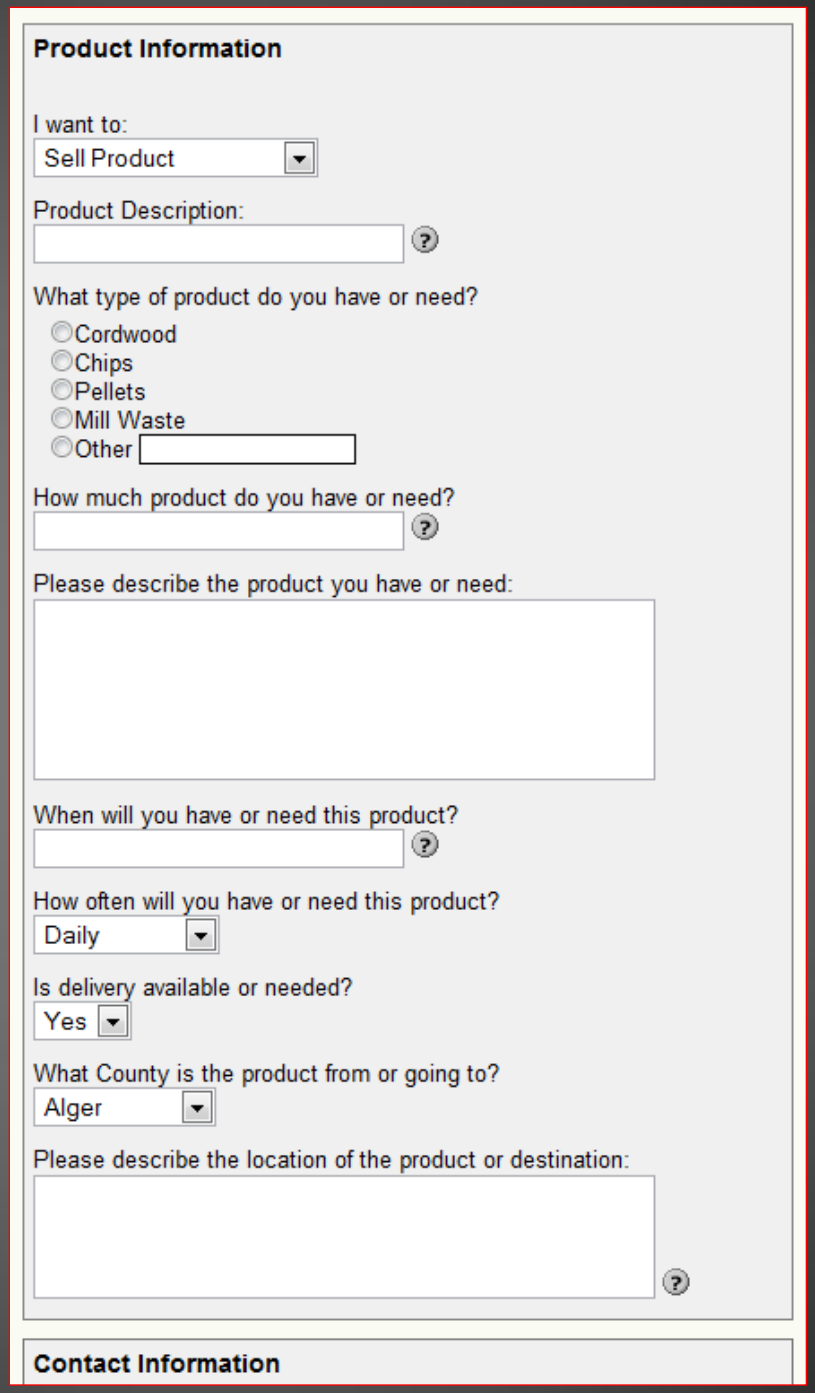
Biomass Utilization & Restoration Network for the Upper Peninsula BURN-UP

Add An Item



Product Information

I want to:
Sell Product

Product Description:

What type of product do you have or need?
- Cordwood
- Chips
- Pellets
- Mill Waste
- Other

How much product do you have or need?

Please describe the product you have or need:

When will you have or need this product?

How often will you have or need this product?
Daily

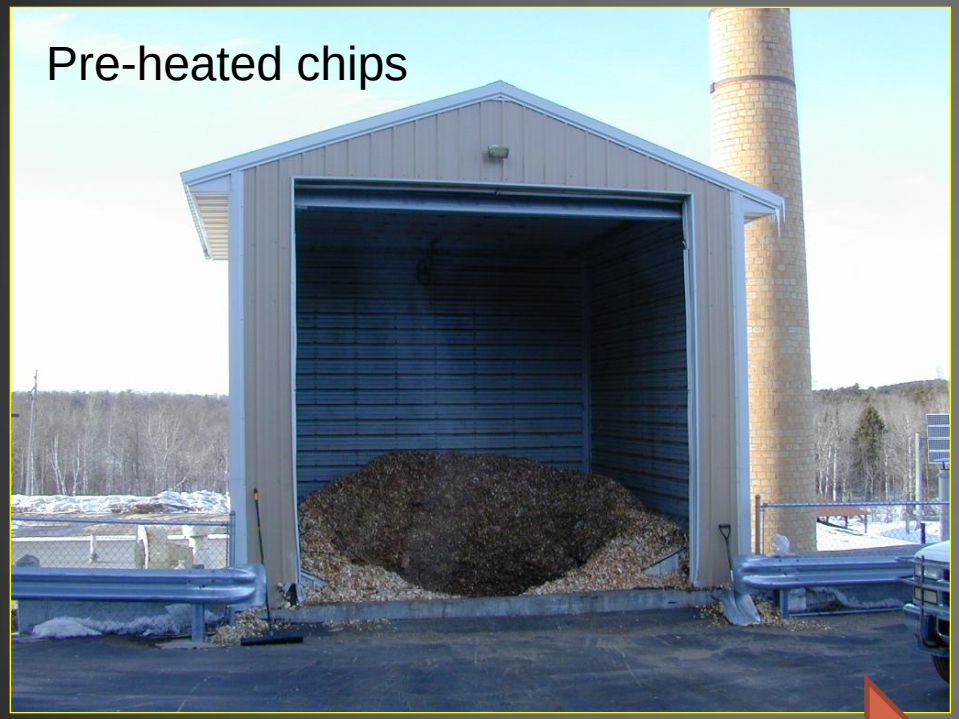
Is delivery available or needed?
Yes

What County is the product from or going to?
Alger

Please describe the location of the product or destination:

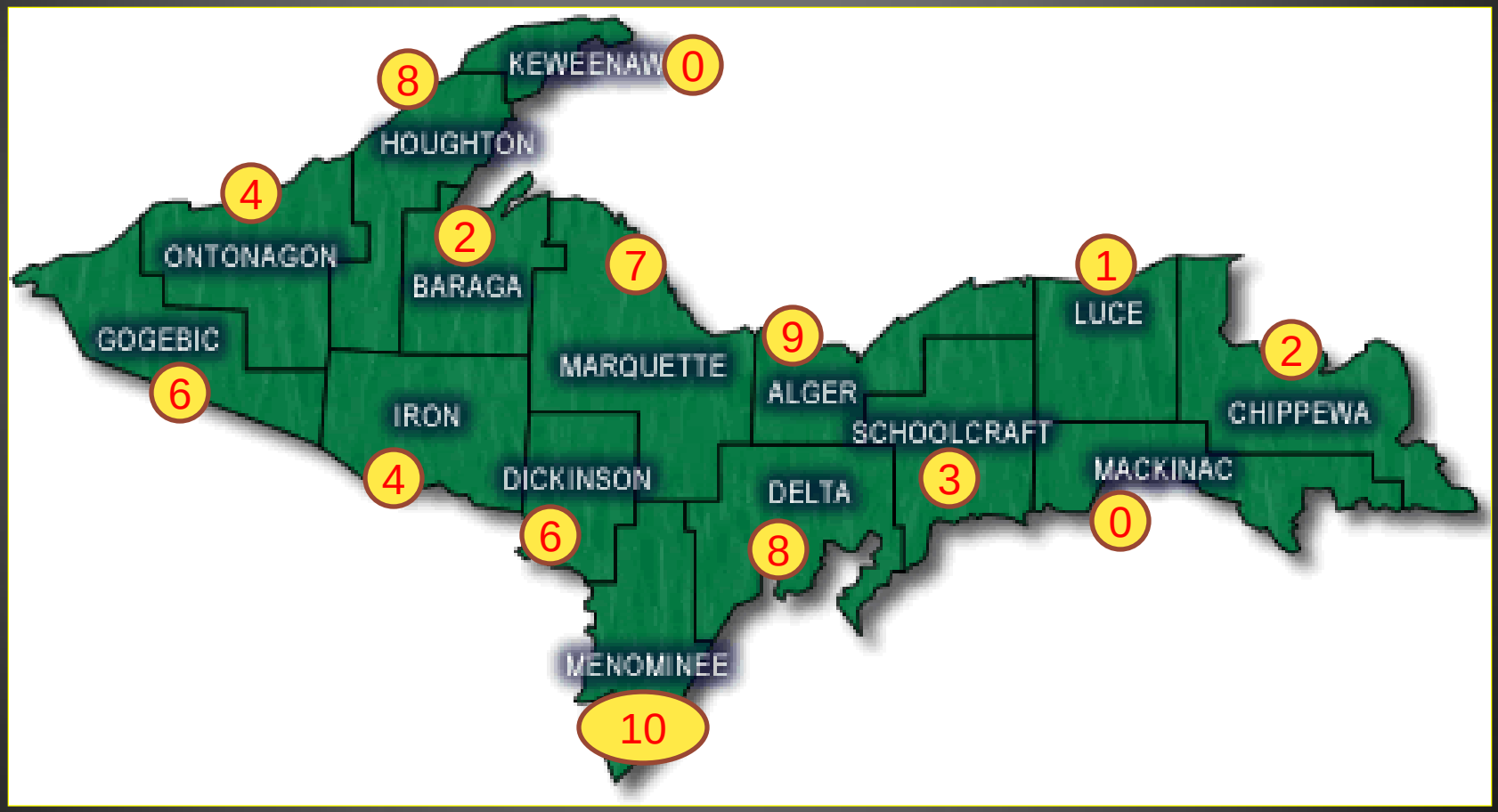
Contact Information

Other Users:
Pinecrest Health Care Facility
Powers, MI



Wood-powered air conditioning

UP Wood-Fired Boilers
N=70



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UP Boilers N=4,706

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

Table 1. Types of fuels used in boilers in Michigan's Upper Peninsula by county[1]

COUNTY	NAT GAS	PROPANE	OIL	ELECTRIC	COAL	OTHER	WOOD	ALL
ALGER	144	0	10	5	1	0	9	169
BARAGA	132	0	9	3	1	0	2	147
CHIPPEWA	373	0	35	6	0	2	2	418
DELTA	508	0	22	8	5	0	8	551
DICKINSON	371	0	12	3	0	1	6	393
GOGEBIC	355	0	25	8	1	0	6	395
HOUGHTON	538	0	22	12	0	0	8	580
IRON	205	0	6	5	0	0	4	220
KEWEENAW	23	0	18	0	0	0	0	41
LUCE	64	0	7	5	0	0	1	77
MACKINAC	141	0	7	13	0	0	0	161
MARQUETTE	954	0	43	18	9	0	7	1031
MENOMINEE	228	0	9	4	2	0	10	253
ONTONAGON	116	0	17	2	1	0	4	140
SCHOOLCRAFT	118	0	5	2	2	0	3	130
UP TOTALS	4270	0	247	94	22	3	70	4706
UP PERCENTS	91%	0%	5%	2%	0%	0%	1%	100%

[1] Based on: Exploring Woody Biomass Retrofit Opportunities in Michigan Boiler Operations (Southeast[illegible]an RC&D Council)

Upper Peninsula Resource Conservation and Development Council

Existing Wood Use
Potential Wood Use with Boiler Conversions

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

Table 2. Wood use in boilers in Michigan's Upper Peninsula by county[1]

COUNTY	Existing Wood Boiler Capacity (btus)	Approximate Existing Wood Use (tons per year)	Wood Boiler Capacity of projects w/ paybacks of <20 yrs (btus)	Potential Additional Wood Use (tons per year)	Potential Total Wood Use (tons per year)
ALGER	51,255,740	12,472	5,748,667	1,399	13,871
BARAGA	298,000	73	3,316,000	807	879
CHIPPEWA	1,530,000	372	48,070,000	11,697	12,069
DELTA	11,047,000	2,688	3,516,000	856	3,544
DICKINSON	50,624,000	12,319	19,454,167	4,734	17,052
GOGEBIC	580,000	141	125,000	30	172
HOUGHTON	27,891,000	6,787	6,866,333	1,671	8,458
IRON	11,272,000	2,743	131,167	32	2,775
KEWEENAW	-	-	-	-	-
LUCE	135,000	33	16,097,000	3,917	3,950
MACKINAC	-	-	6,931,301	1,687	1,687
MARQUETTE	94,622,000	23,025	47,825,667	11,638	34,662
MENOMINEE	54,189,000	13,186	3,067,000	746	13,932
ONTONAGON	3,650,000	888	8,370,000	2,037	2,925
SCHOOLCRAFT	10,310,000	2,509	36,667	9	2,518
UP TOTALS	317,403,740	77,235	169,554,968	41,258	118,493

150% Increase

[1] Based on: Exploring Woody Biomass Retrofit Opportunities in Michigan Boiler Operations (Southeast Michigan RC&D Council)

Upper Peninsula Resource Conservation and Development Council

Biomass Utilization & Restoration Network for the Upper Peninsula BURN-UP

Information Search

You may use the following form to retrieve any of the various categories of Infomation Items that have appeared on the Home page. You may narrow your search by specifying one or more of the criteria. To see everything, click the Show All button. You may browse all Information Items by category in the Infomation Sets section of of website.

HELP

Title:

Category:

Info Set:

Implications
- General/Economic
- Soil & Water Conservation
- Habitat & Biodiversity
- Air/Climate

Production
- Forestry Aspects
- Forestry Assistance
- Inventories

Harvest & Transport
- Loggers
- Equipment & Methods

Utilization
- Residential
- Commercial/Community
- Industrial
- Energy Consultants

Date Posted: on

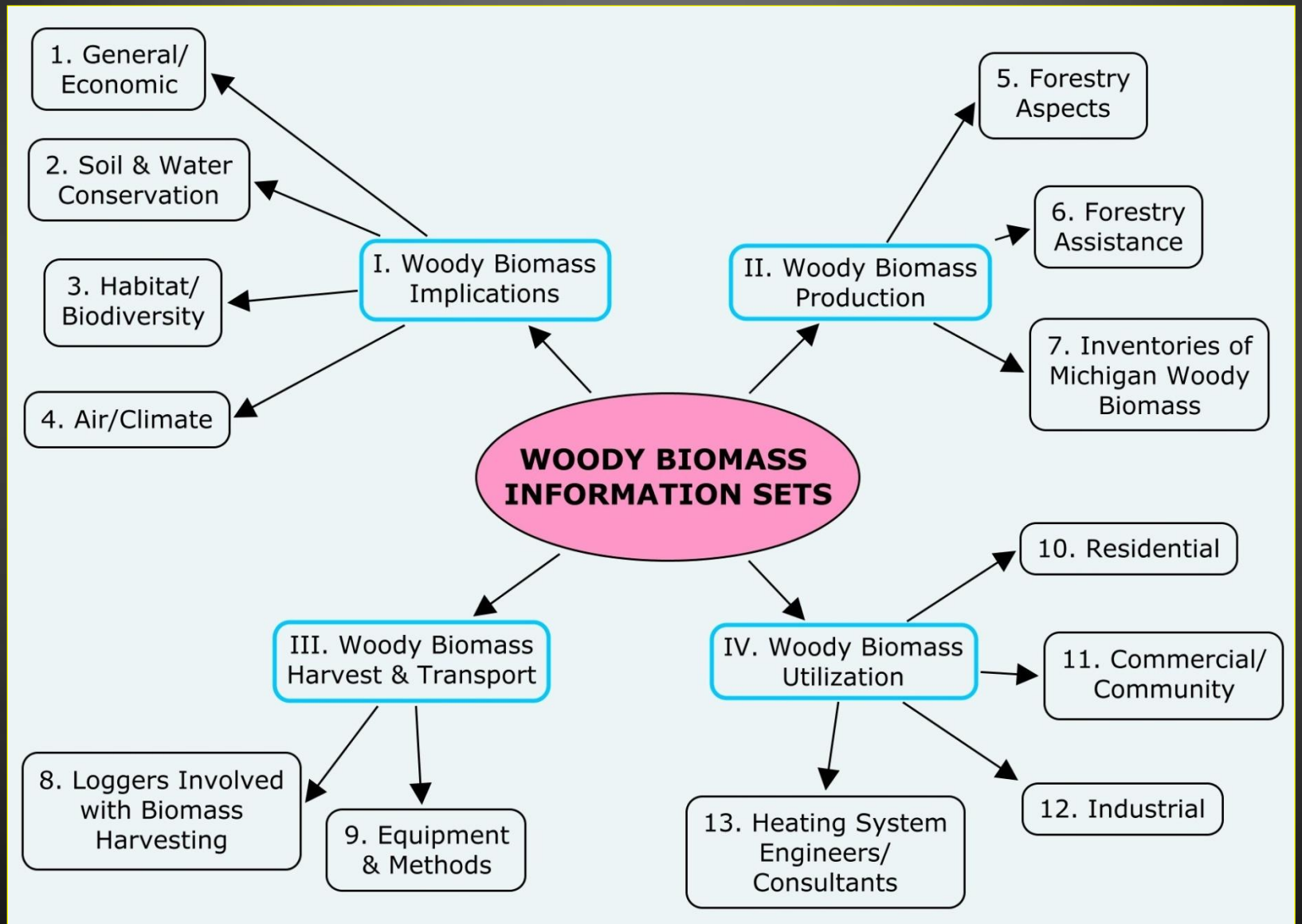
Keywords:

Image Caption:

Search | Show All | Clear

Woody Biomass Information Search

Woody Biomass Information Sets



II. Woody Biomass Supply Issues

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Another Balancing Act:
Supply follows Demand
"Build the boilers & the chips will come"

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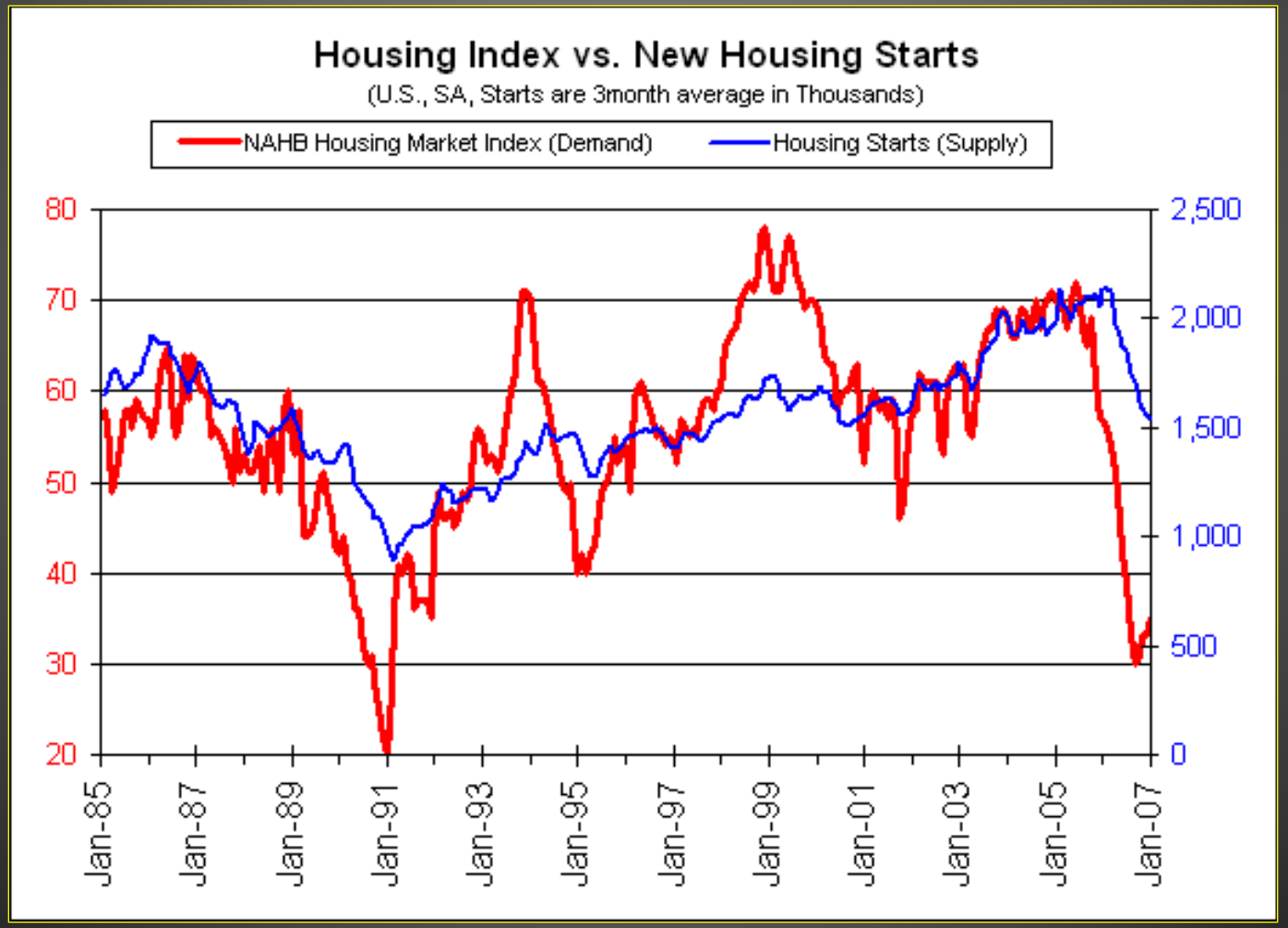
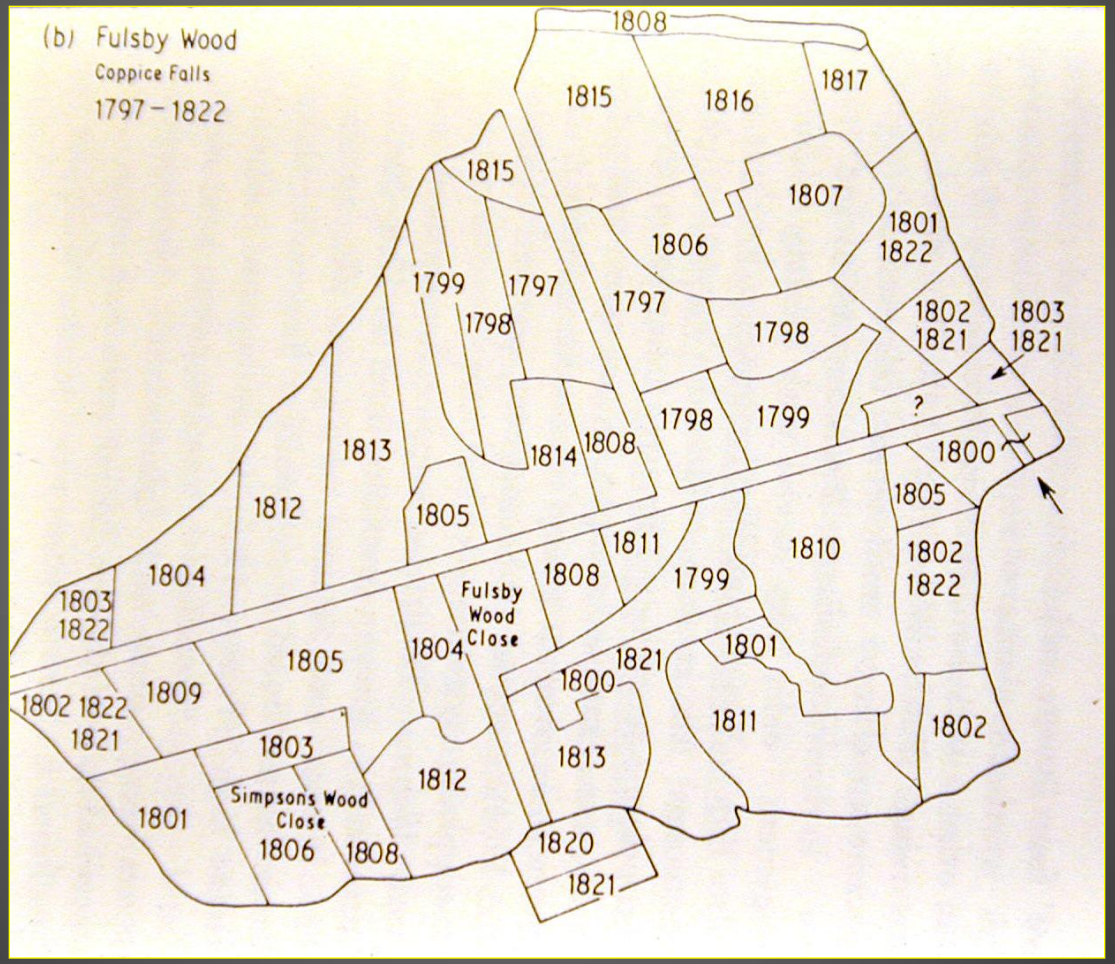
BURN-UP



Upper Peninsula Resource Conservation and Development Council

Sustainable Fuelwood System: Pre-Industrial Europe (1797-1822)

Biomass Utilization & Restoration Network for the Upper Peninsula BURN-UP



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Boar Hunt in a Compound Coppice

Pre-industrial slash bundler

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP

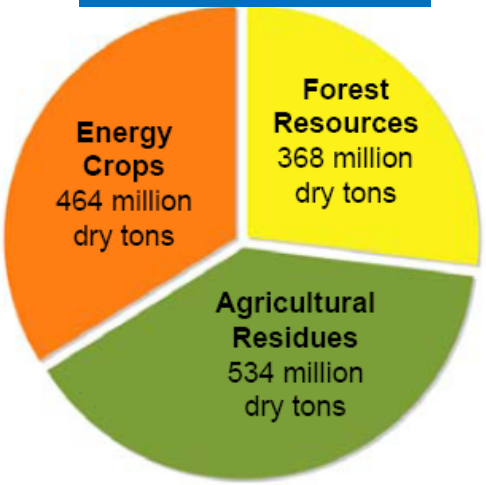
Feedstock opportunities in Michigan

Biomass, Biofuels and Bioenergy:
Feedstock Opportunities in Michigan

Robert E. Froese, Ph.D., R.P.F. – froese@mtu.edu – **February 2007**

Forest Resources & Environmental Science
Michigan Tech

USA: ~3 thirds



The US Department of Agriculture and Department of Energy estimate that enough biomass is available from urban waste, agricultural and forest sources in the United States to produce enough biofuels to displace 30% of current gasoline consumption. Of the 1.3 billion dry tons per year potentially available, dedicated energy crops and forest resources contribute 464 and 368 million dry tons per year, respectively.

Bioenergy Feedstocks in Michigan

Forecast Bioenergy Feedstock Supply in Michigan in dry tons per year.

Biomass Feedstock		Potential Supply	Currently Available and Unutilized	Available at $25/ton Farmgate Price
Forestry	Sawmill and pulp mill residues	1,764,796	Negl.	405,903
	Logging residues	869,468	869,468	113,031
	Thinning residues	1,875,978	1,875,978	243,877
Forestry Total		4,510,243	2,745,447	762,811
Urban Wood Waste		1,311,382	1,311,382	314,732
Dedicated Energy Crops		4,418,226	Negl.	44,182
Grand Total		10,239,851	4,056,829	1,121,725

Sources: USDA, DOE, Walsh (2006) and Michigan Technological University.

Biomass, Biofuels and Bioenergy:
Feedstock Opportunities in Michigan

Robert E. Froese, Ph.D., R.P.F. – froese@mtu.edu – **February 2007**

Upper Peninsula Resource Conservation and Development Council

The Ideal Biomass Crop?

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

The Ideal Biomass Crop?	Forest Residues	Corn	Short-rotation Woody Crops	Perennial Grasses
Highly productive	no	yes	yes	yes
Widely available	yes and unutilized	limited	near none	near none
Site impact	low	very high	low	low
Low energy inputs	very low	very high	low-moderate	low
Noninvasive	yes	not relevant	genetically-modified	usually
Few pests or disease	usually	no	moderately	usually
Uses existing technology	yes	yes	somewhat	somewhat
Need storage facilities	harvest year-round	yes	harvest year-round	yes

Biomass, Biofuels and Bioenergy:
Feedstock Opportunities in Michigan

Robert E. Froese, Ph.D., R.P.F. – froese@mtu.edu – **February 2007**

Upper Peninsula Resource Conservation and Development Council

Ethanol from Corn: Not so Super

Biomass Utilization & Restoration Network for the Upper Peninsula

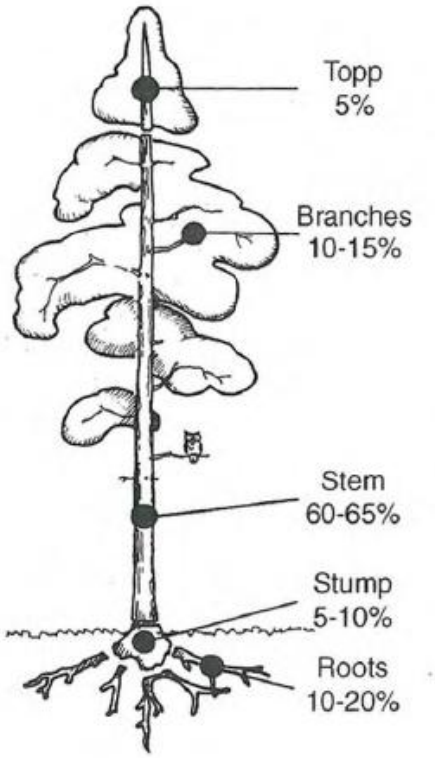
BURN-UP

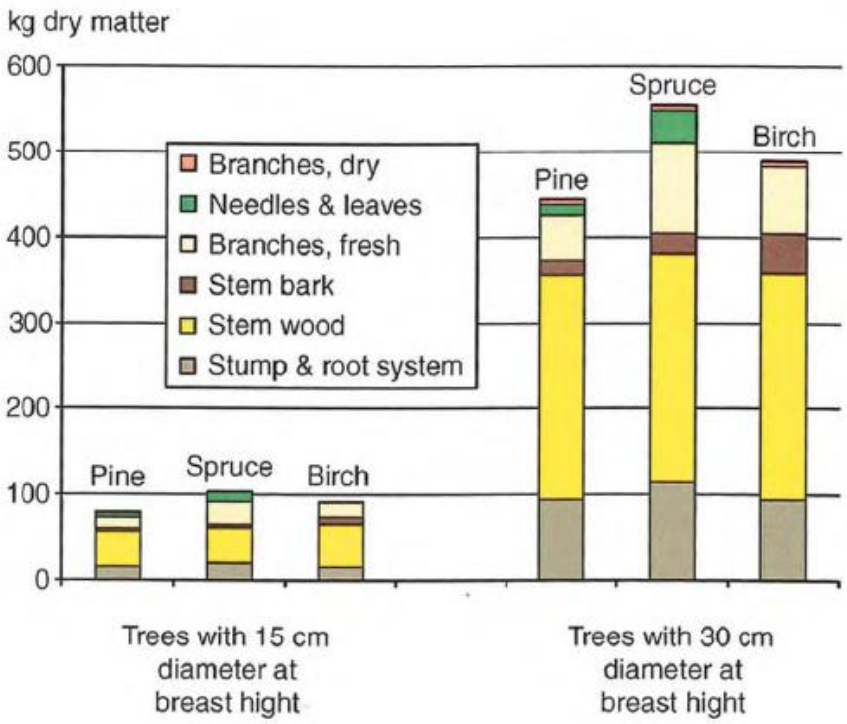
Four main sources of forest biomass
(directly from the forest)

1. Slash (tops and branches) left after harvesting mature trees
2. Slash and small trees from thinnings
3. Unmerchantable wood (species or low quality wood with no other market)
4. Wood impacted by natural disturbance, such as fire or insect infestation

Woody Biomass Components

Biomass available after cutting down the trees





A General Overview of Swedish Bioenergy Industry

Michigan February 2008
Kjell Andersson

Upper Peninsula Resource Conservation and Development Council

We have a lot to learn about efficiently…

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP

Handling forest residues

A General Overview of Swedish Bioenergy Industry

Michigan February 2008

Kjell Andersson

✓Transporting Woody Biomass

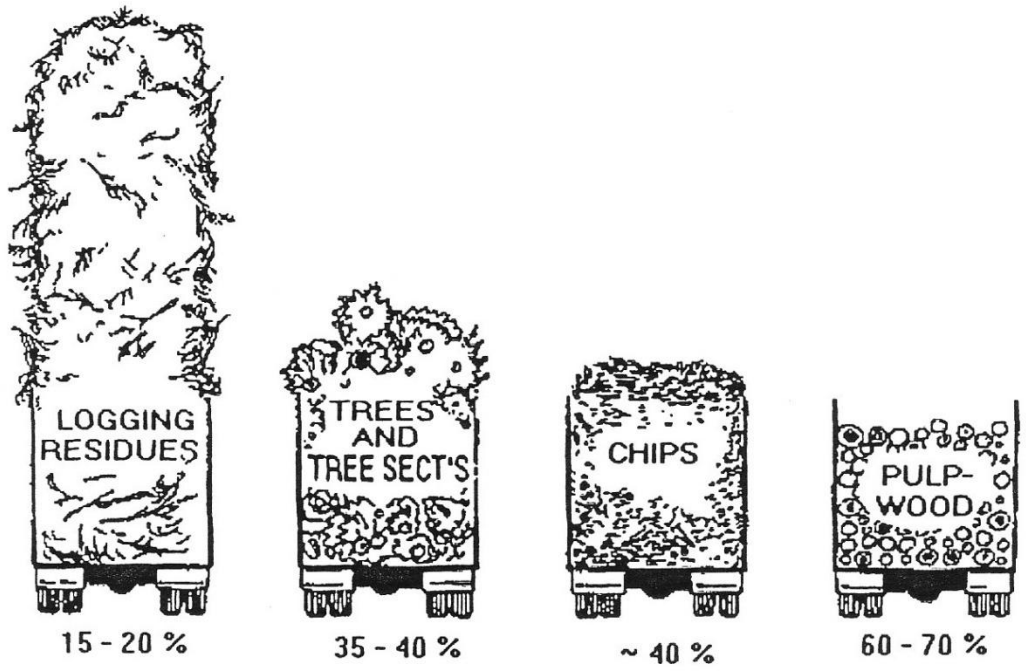


Figure 3.2-7. Proportion of solids in uncompacted logging residues and tree-sections, wood chips and conventional pulpwood. All loads have the same solid content. (After Nilsson 1983).

Charcoal – Reduced weight, Concentrated BTU's

Colliers with charcoal mound

Mahogany charcoal kilns

One way to reduce hauling costs

Residues from felling stacked to dry over summer, to be chipped

A General Overview of Swedish Bioenergy Industry

Michigan February 2008
Kjell Andersson

Improvement in cost structure for roadside chipping (Sweden)

Table 4.2 Roadside Shipping costs €(2002)/GJ

	1983	2003	Reduction	Annual
Forwarding	1.61	0.68	58%	
Chipping	1.89	1.27	33%	
Transportation	1.23	1.04	15%	
Stumpage & other	0.95	0.85	11%	
	5.68	3.84	32%	1.94%

This is why we need harvesting demos & workshops

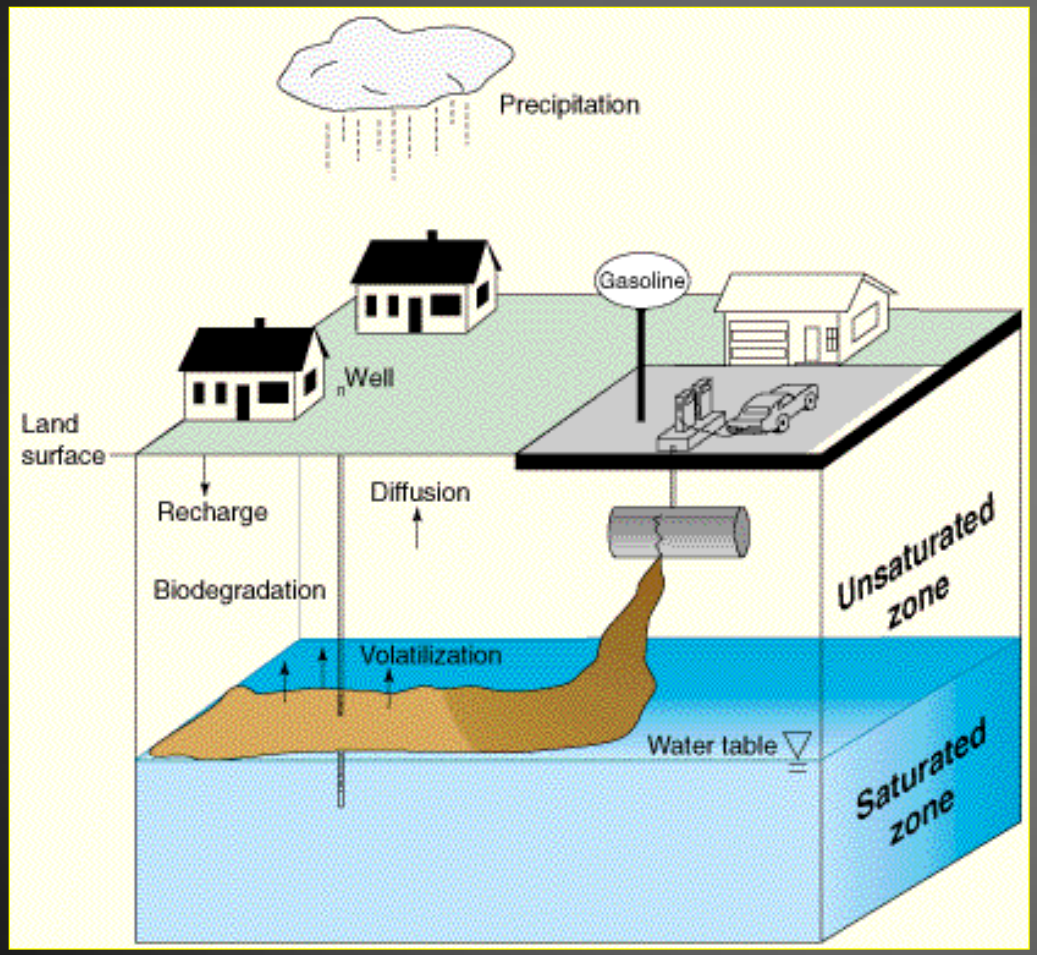
III. Ecological Sustainability Issues

Upper Peninsula Resource Conservation and Development Council

Fossil fuels threaten water resource sustainability

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP



LUST
Leaking Underground Storage Tanks

Statewide N=9,000+ or >100 LUST's per county

http://www.deq.state.mi.us/sid-web/

Upper Peninsula Resource Conservation and Development Council

Sustainable?
(over millions of years)

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Upper Peninsula Resource Conservation and Development Council

Fossil fuels threaten the sustainability of atmospheric resources

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP

Upper Peninsula Resource Conservation and Development Council

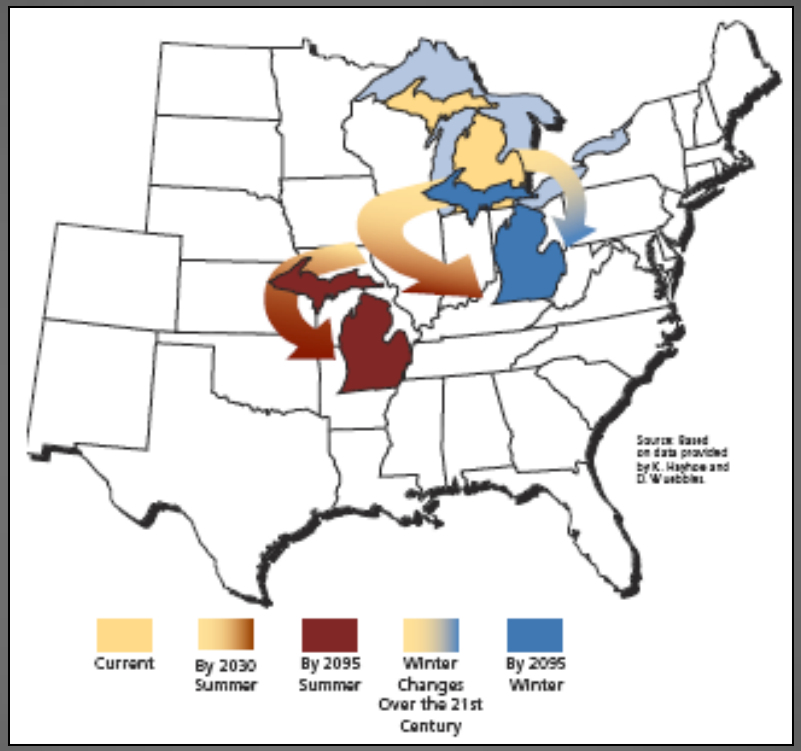
Michigan's Migration Route due to Global Warming

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

Quick fact: The 1990s was the hottest decade of the 20th century and probably of at least the last 1,000 years.

Quick fact: U.S. carbon dioxide emissions were 14% higher in 2000 than in 1990.

Quick fact: A single acre of forest can sponge up 5.5 tons of carbon dioxide per year.



Quick fact: The United States emits more greenhouse pollution than 151 developing nations combined.

Quick fact: U.S. greenhouse gas emissions per capita are more than twice those of Germany or Britain and roughly eight times those of China.

Union of Concerned Scientists

esa

This fact sheet is based on the findings of *Confronting Climate Change in the Great Lakes Region*, a report published in April 2003 by the Union of Concerned Scientists and the Ecological Society of America. The report was written by regional experts under the leadership of George Kling (University of Michigan). Other experts from Michigan included Donald Zak and Mark Wilson, both at the University of Michigan.

Dr. George Kling (734) 647-0894 · Dr. Donald Zak (734) 763-4991
Dr. Mark Wilson (734) 763-2103

The full report is available from UCS at www.ucsusa.org/greatlakes or call (617) 547-5552.

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Wood Fuels vs. Fossil Fuels

Biomass Utilization & Restoration Network for the Upper Peninsula
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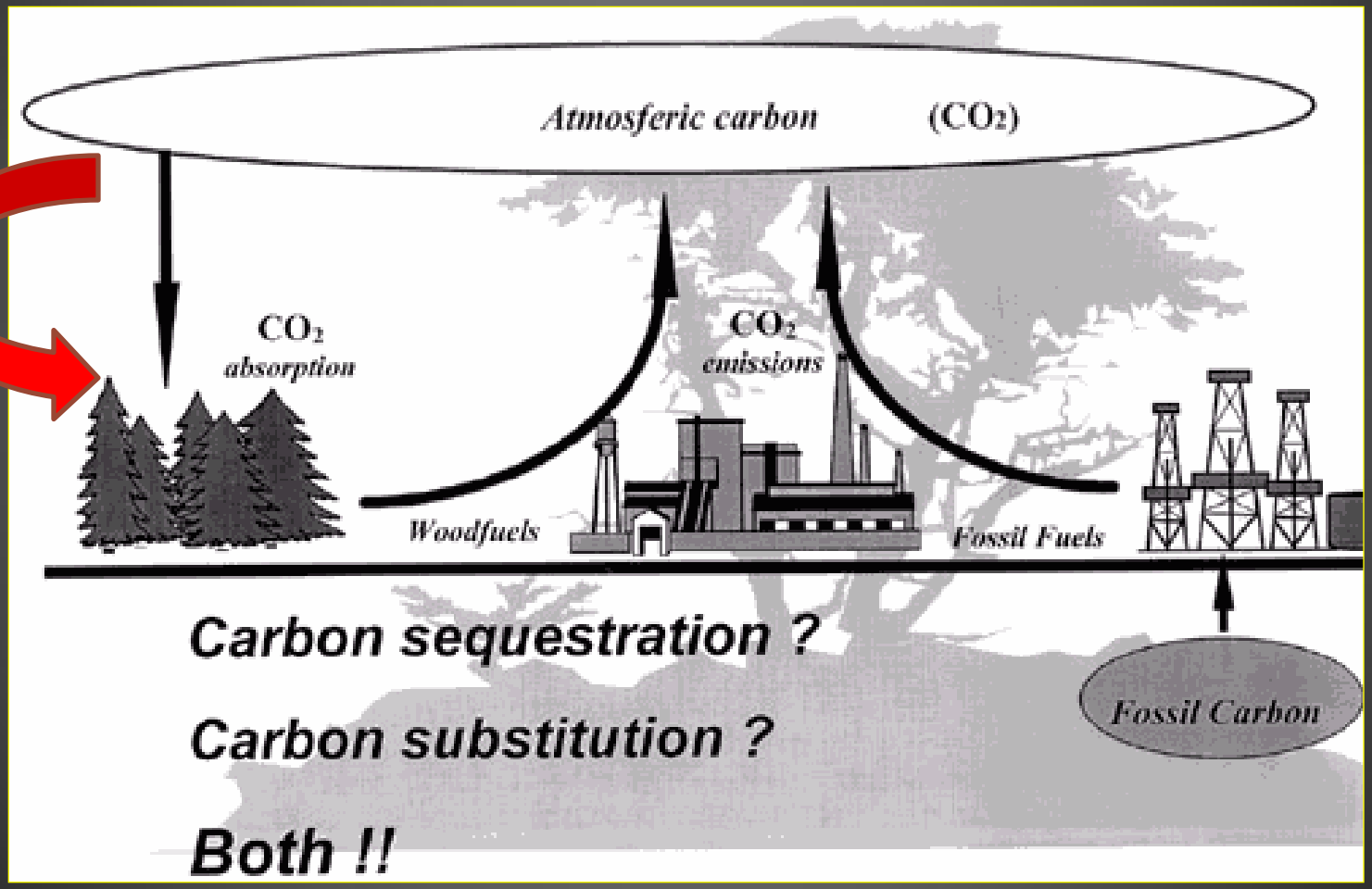
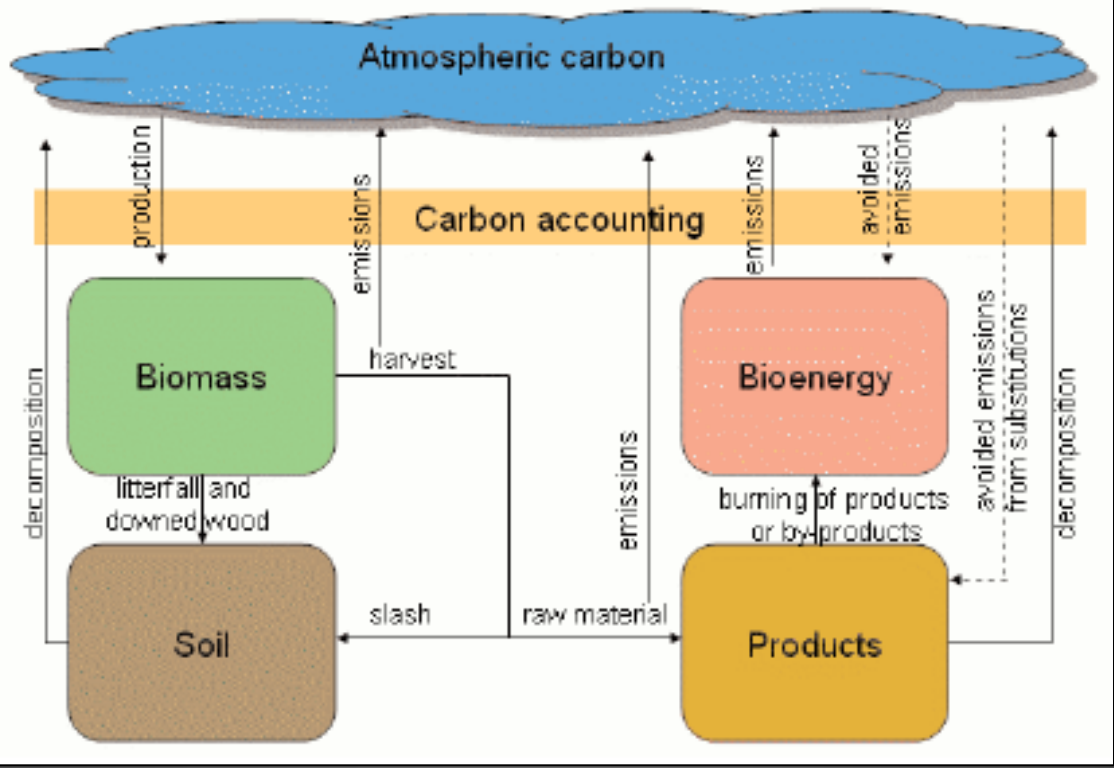


Upper Peninsula Resource Conservation and Development Council

Carbon Cycle Model

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Figure 6. Carbon Cycle Model [140]



Climate Change, Carbon, and the Forests of the Northeast

by Robert T. Perschel, Alexander M. Evans and Marcia J. Summers

forestGUILD

Forest Nutrient Budgets

Well known

Well known

Poorly known

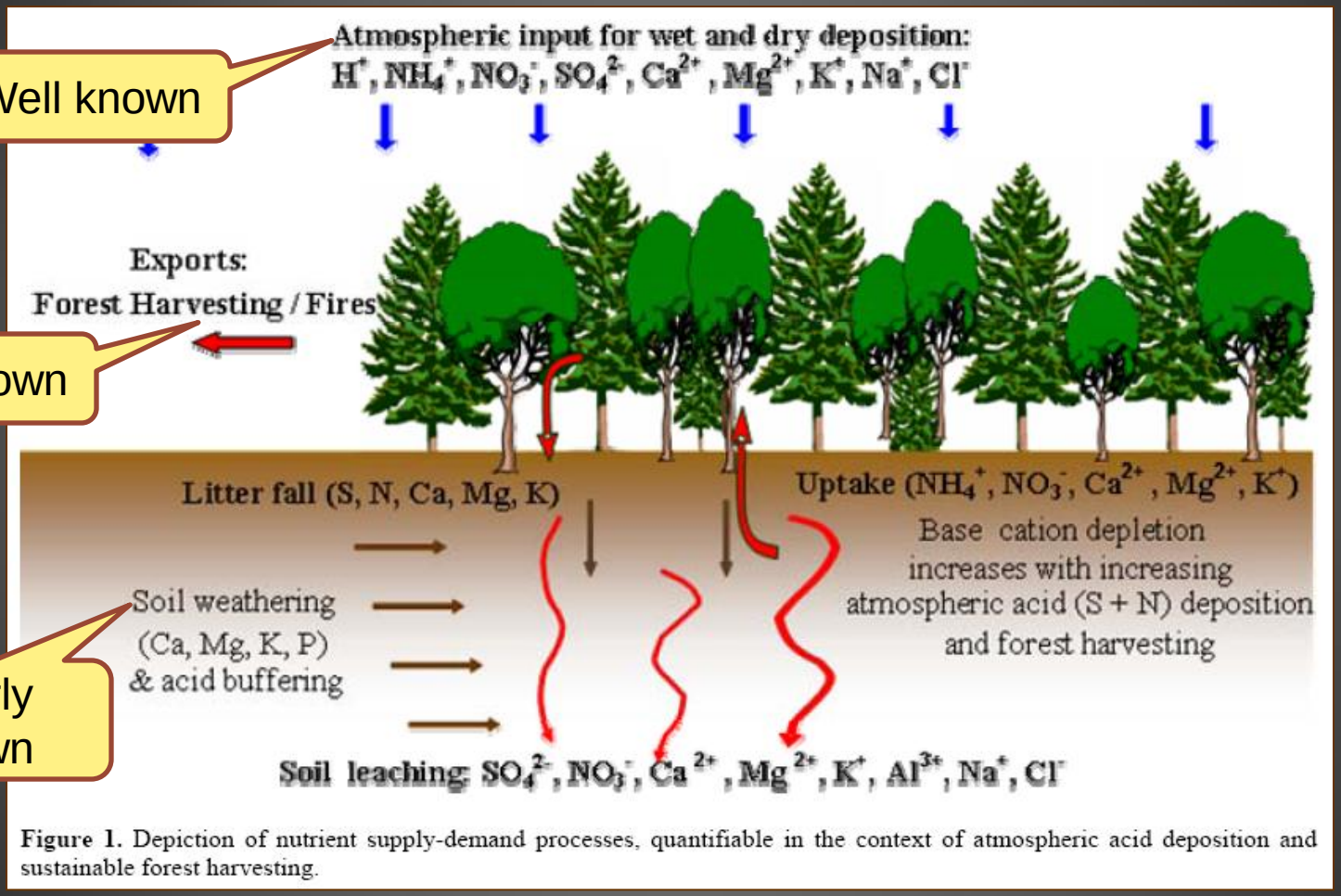


Figure 1. Depiction of nutrient supply-demand processes, quantifiable in the context of atmospheric acid deposition and sustainable forest harvesting.

Modeling and mapping forest nutrient supplies and demands for New Brunswick Crown lands, for forest operational planning purposes

Paul A. Arp, Jae Ogilvie, Faculty of Forestry and Env. Management, UNB, Fredericton, NB E3B 6C2
Shawn Morehouse, NB-DNR Timber Management Branch, Fredericton

Upper Peninsula Resource Conservation and Development Council

Swedish Guidelines for Harvesting Woody Biomass

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Skogsstyrelsen
NATIONAL BOARD OF FORESTRY

Recommendations for the extraction of forest fuel and compensation fertilising

Upper Peninsula Resource Conservation and Development Council

Swedish Guidelines for Harvesting Woody Biomass

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP

Preserve the nutritive balance in forestry land

The National Board of Fo

- compensation fertilisin
  extracted and most of t
  to spread them out.

  One extraction per rota
  fertilising, provided tha

  Compensation fertilisin
  → When extracting fr
  → When extracting fr
  → When extracting th
  regeneration felling

  The needles may be tak
  → Once during the ro
  → From areas with a l
  compensation fertil

Nutrient compensation

The National Board of Forestry is of the opinion that:

- Compensation fertilising should, primarily, be carried out through the provision of ashes. However, other products that contain mineral nutrients can also be used. Ashes and mineral products may also be combined.
- Most of the ashes used in products to be spread about in the forest should originate from the combustion of fore
  amount of ashes from other fuels is n
  ashes that determines its suitability.
- The ashes should to be stabilised and
- In compensation fertilising, the dose
  on the loss of liming effect and the to
  Mg^{2+}, K^{+}) in branches, tops and needl
  stemwood should be taken into consi
  compensation.
- In order to avoid short-term negative
  (dry matter) in ashes should be return
  total compensation requirement is gre
- In compensation fertilising, the total
  undesirable substances per rotation sh
  removed with the total biomass.
- During the extraction of forest fuel it may be necessary to compensate for removed nitrogen and thereby counteract a reduction in growth increment. Guidelines for nitrogen input can be found in SKSFS 1991:2. (A revised issue of this publication is planned for 2002.)
- In compensation fertilising, nitrogen leaching and loss of input nutrients ought to be prevented by the choice of the work method, product and the point of time for the measures to be taken.

Preserve biological diversity

The National Board of Forestry is of the opinion that:

- It is important that trees and bushes that have previously been left untouched in consideration of the natural and cultural environments are not damaged.
- Wet forest land and other forests with a high natural values should be exempt from extraction operations if their natural values are affected negatively.
- Extraction should not include species of trees that are less common. This applies to a particular stand as well as in the landscape.
- When extracting forest fuel, a ce
  It is especially important to leav
  dimension branches from decidu

Limit damage caused by vehicles and prevent damage caused by insects

The National Board of Forestry is of the opinion that:

- It is important that the technique and point in time for forest fuel extraction and compensation fertilising are chosen so that the risk of damage to the ground and to remaining trees is limited.
- Large-dimension, fresh coniferous wood should be handled separately when extracting forest fuel.
- Stacks with forest fuel should not be stored immediately adjacent to the edge of a stand comprising the same species of tree as that stored in the stacks.

Upper Peninsula Resource Conservation and Development Council

Ash Recycling

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Ash recycling from clean wood fuels

- A way to compensate for woodfuel removal
- A way to fertilize stands for higher yield
- A substitute or complement for liming
- An environmentally positive way to get rid of a waste problem

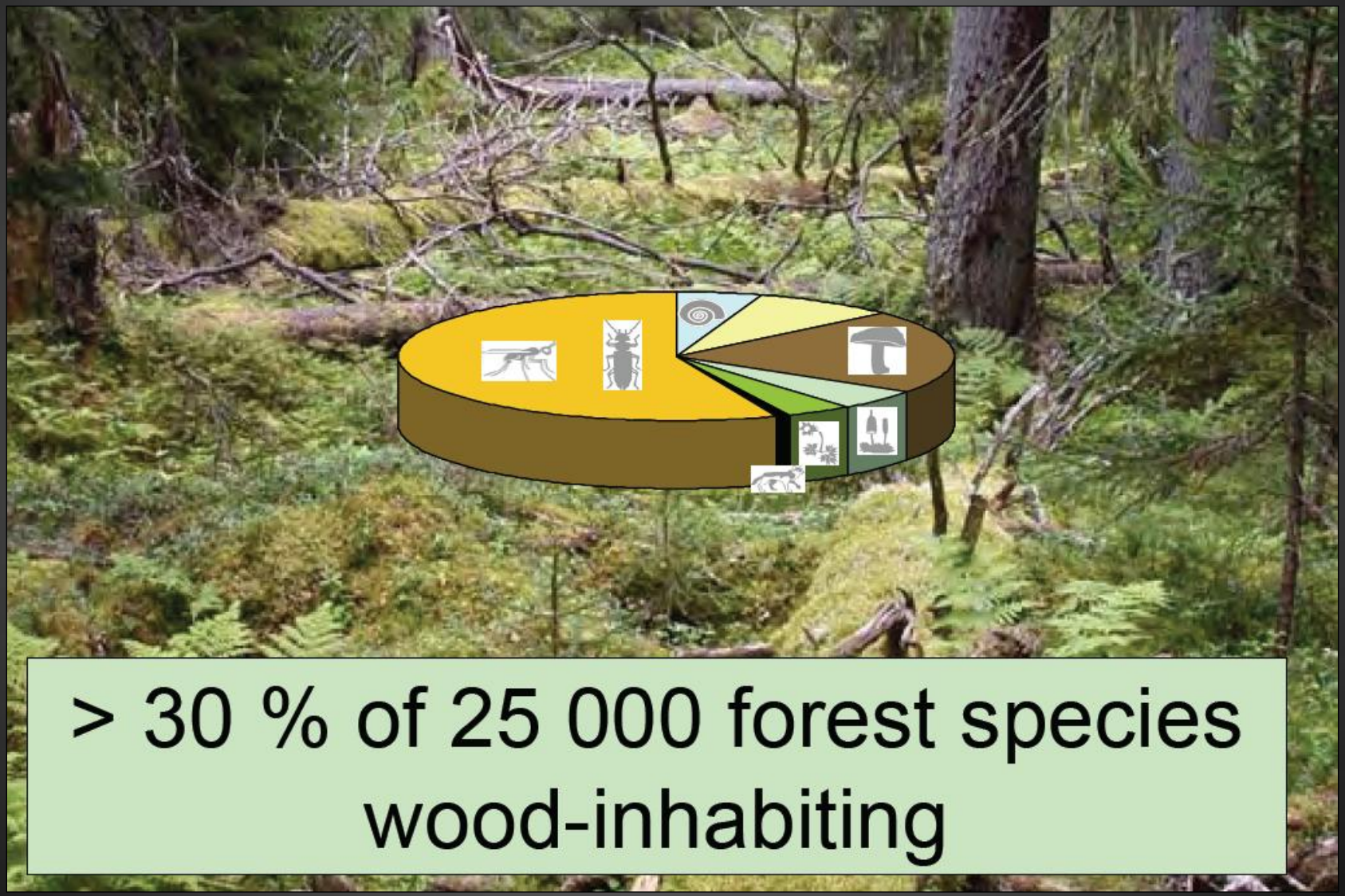
Either way - a strong increase in ash recycling is a positive development!

SVEBIO

A General Overview of Swedish Bioenergy Industry

Michigan February 2008
Kjell Andersson

Biodiversity in Sweden
“xylophiles”



> 30 % of 25 000 forest species wood-inhabiting

Upper Peninsula Resource Conservation and Development Council

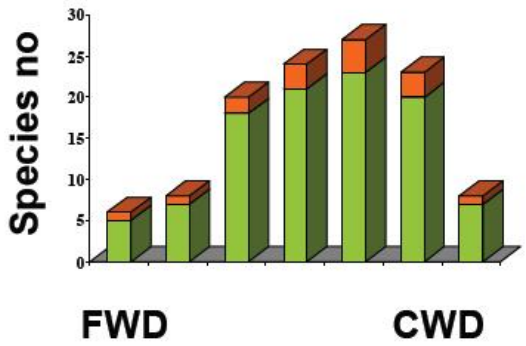
Swedish Species Information Centre

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Dead wood – key element

Food web basis

Living trees | Dead wood



Anders Dahlberg, SLU
Swedish University of Agricultural Sciences
Swedish Species Information Centre

SLU

Minnesota FRC

SFRA Programs

- Forest managment guidelines
- Landscape program
- Monitoring
- Forest Research
- Interagency Information
- Cooperative
- Continuing Education

Calendar of Events

Contact the MFRC
2003 Upper Buford Circle
St. Paul, MN 55108
(651) 603-0109
fax: (651) 603-0110

HOME

Minnesota Forest Resources Council

Biomass Guideline Committee

The Minnesota Forest Resources Council (MFRC) has completed development of its biomass harvesting guidelines for forestlands, brushlands and open lands.

These new guidelines are **designed to be included in the MFRC's 2005 forest management guidebook** titled *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines for Landowners, Loggers and Resource Managers.* The new biomass guidelines are presented as two additional chapters to the 2005 guidebook:

- Biomass Harvesting on Forest Management Sites
- Woody Biomass Harvesting for Managing Brushlands and Open Lands

While the new biomass chapters have not been integrated into the rest of the 2005 guidebook, the existing guidelines **have** been fully integrated into the two new chapters. The biomass harvest chapters include extensive references to both the *General Guidelines* and the *Timber Harvesting* guidelines. As is the case with the rest of the activity-specific forest management guidelines in the guidebook (such as *Timber Harvesting* and *Forest Road Construction and Maintenance*), it is essential that the biomass harvest guidelines be considered and implemented in close conjunction with the *General Guidelines* (the green tabbed section of the guidebook).

For additional hard copies of the two biomass harvest chapters, as well as copies of the entire 2005 *Guidelines*, contact the Minnesota Forest Resources Council at 651-603-6761.

Upper Peninsula Resource Conservation and Development Council

Down Wood:
Essential Regeneration Sites

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Upper Peninsula Resource Conservation and Development Council

Large Woody "Debris" (LWD): Essential Habitat in Streams

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Forest Certification Systems
"The teeth" in voluntary guidelines

Certification Status and Intentions in Canada

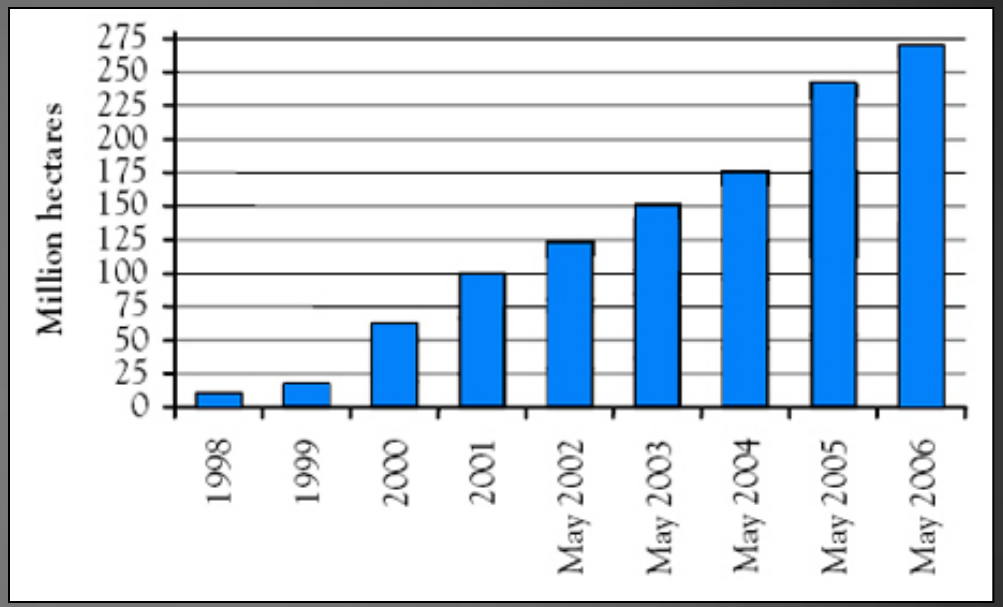
FSC

CANADIAN STANDARDS ASSOCIATION

SFI

ISO 14001 Environmental Management System Standard

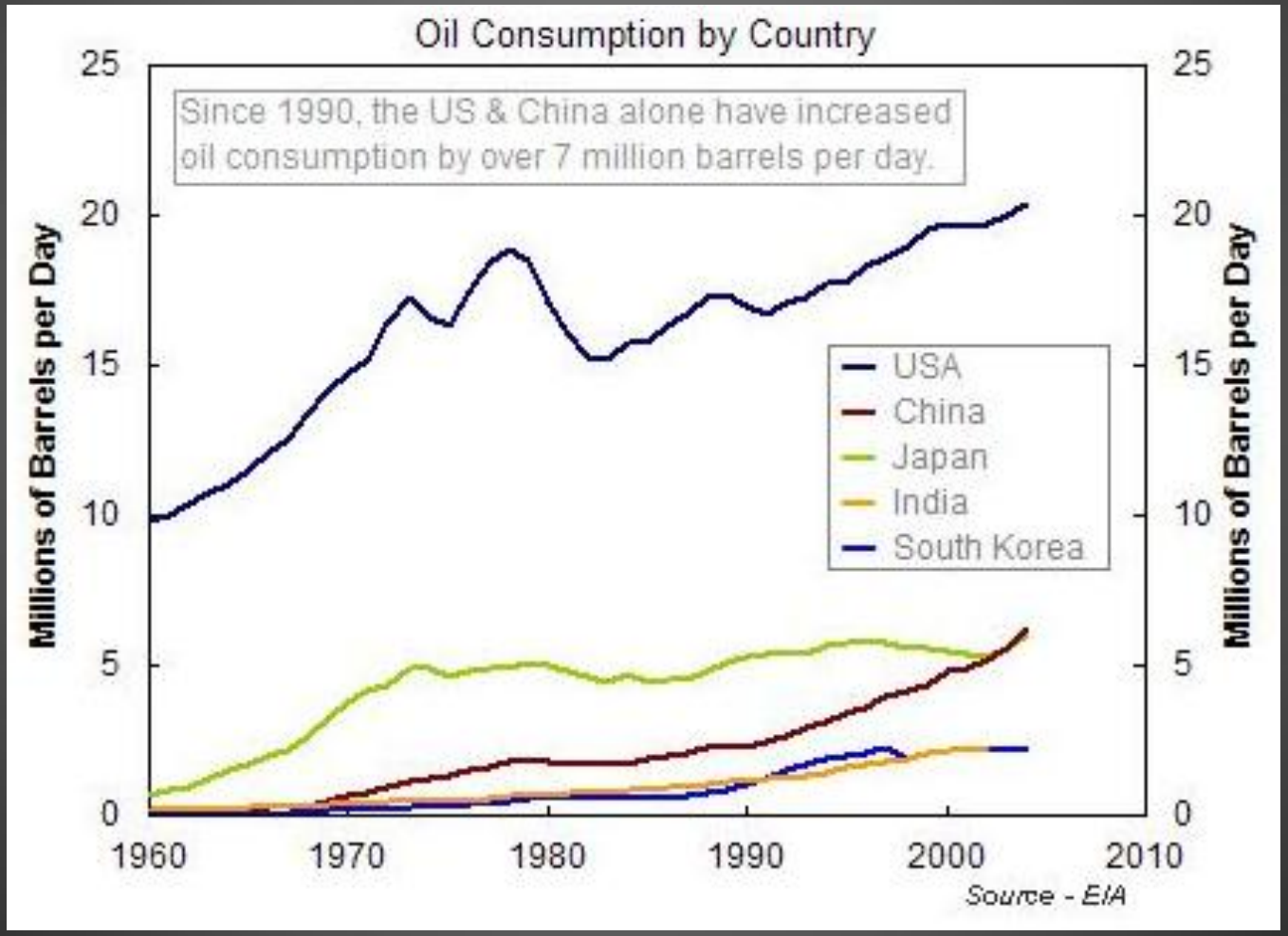
Growth in forest area certified



Certification is the process whereby an independent auditing body (third party) conducts an inspection and awards a certificate using independently developed standards and objectives.

IV. Economic & Social Sustainability Issues

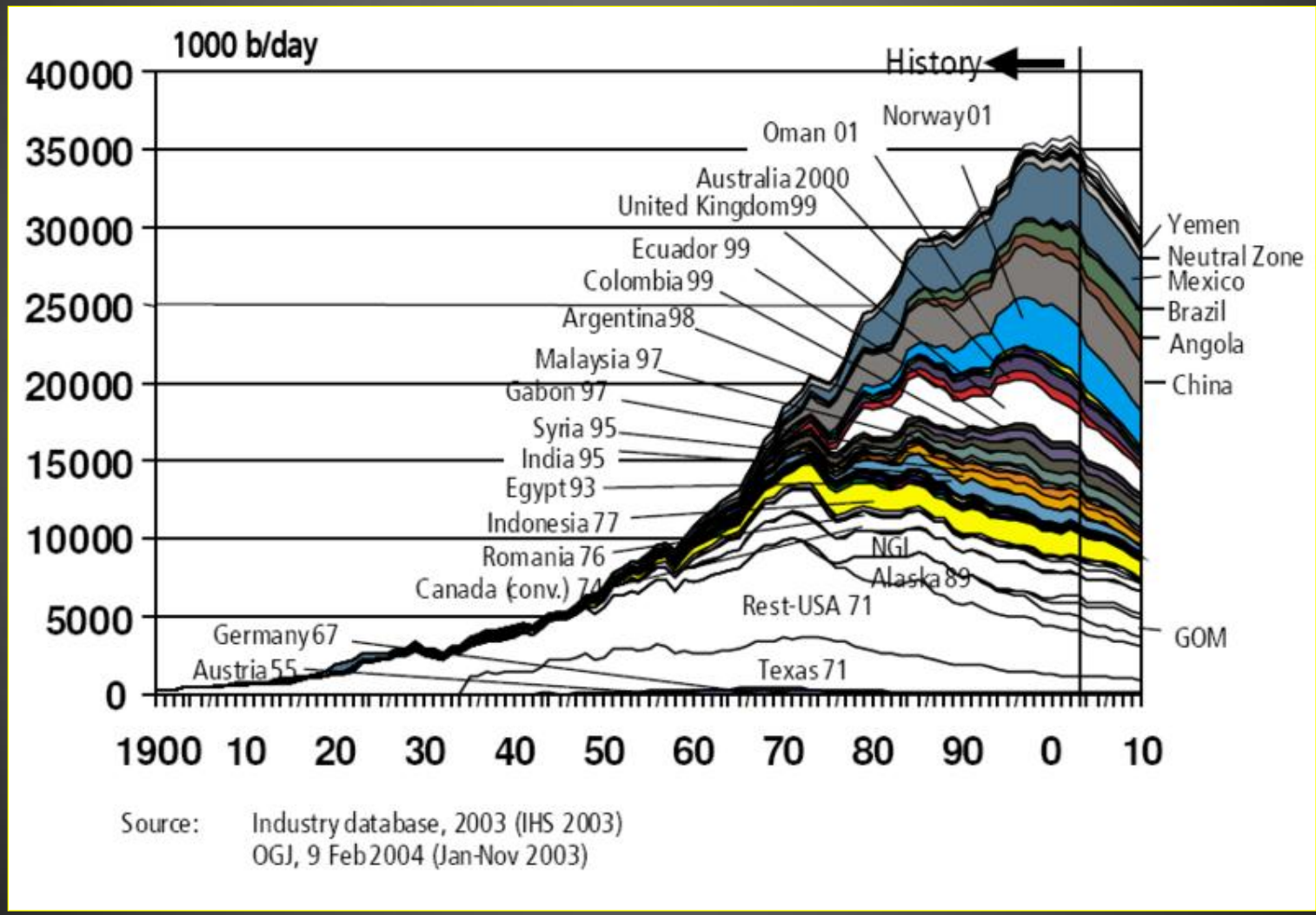
Oil Demand: 1960-2005



Upper Peninsula Resource Conservation and Development Council

Global Oil Production Trends

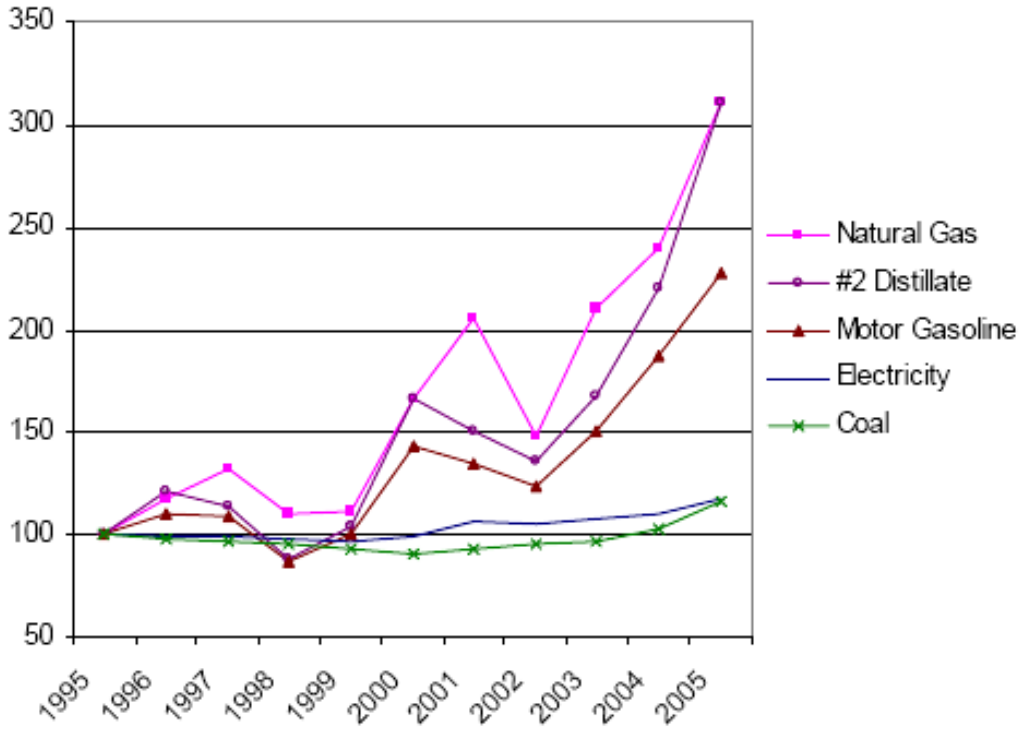
Biomass Utilization & Restoration Network for the Upper Peninsula BURN-UP



Source: Industry database, 2003 (IHS 2003)
OGJ, 9 Feb 2004 (Jan-Nov 2003)

USA Rising Fossil Fuel Costs

Figure I-1
Indices of Selected Energy Price Levels in the U.S., 2000-2005
(1995=100)

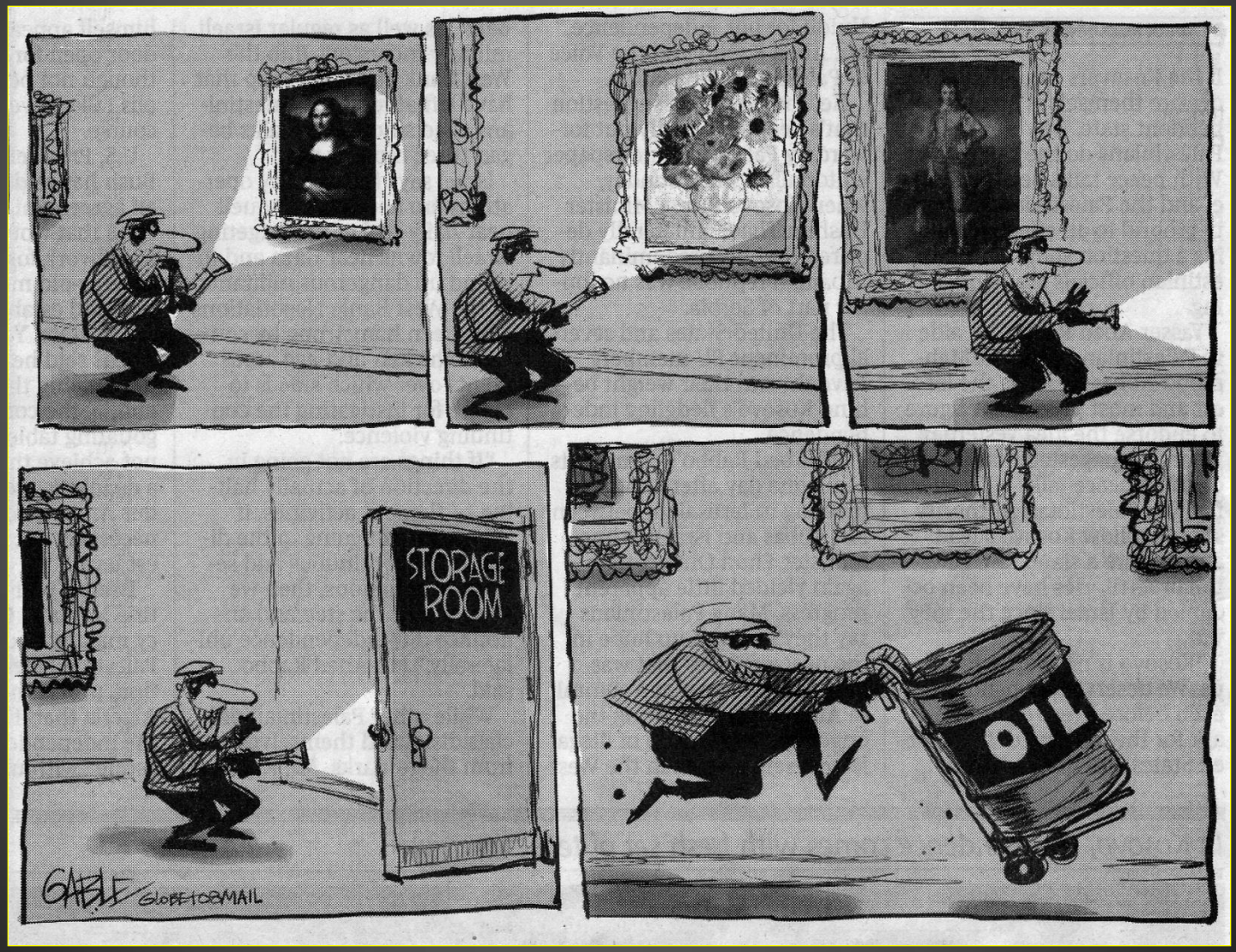


Source: U.S. Energy Information Administration and Management Information Services, Inc., 2006.

Upper Peninsula Resource Conservation and Development Council

Oil will outvalue art?

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

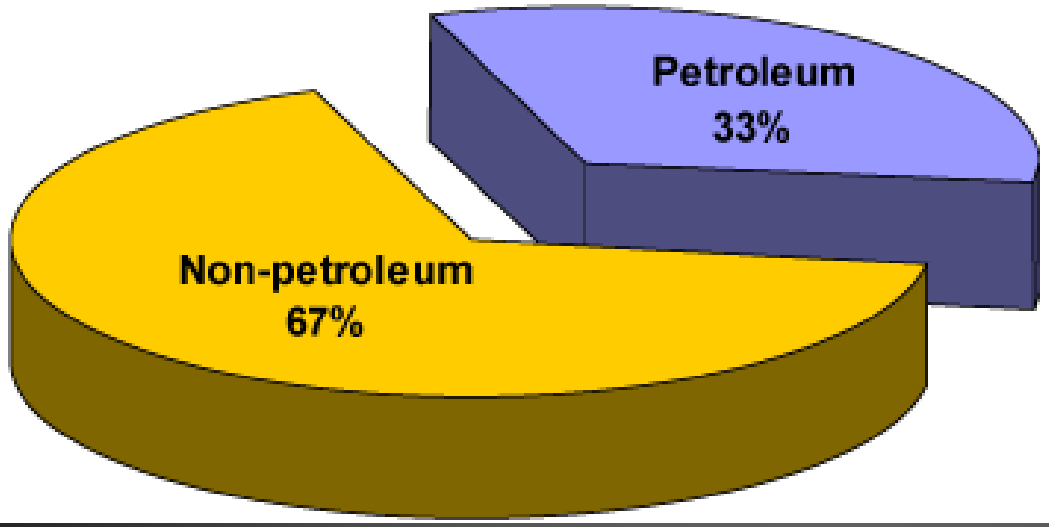


Trade Deficit

U.S. Trade Deficit

Oil imports are the largest component of the U.S. trade deficit, accounting for more than one-quarter of the entire trade deficit in 2006. The 2006 petroleum deficit was $271 billion, an increase of 18 percent from 2005. Projections show the price of oil will remain strong as petroleum demand continues to increase across growing world economies.

2006 U.S. Trade Deficit

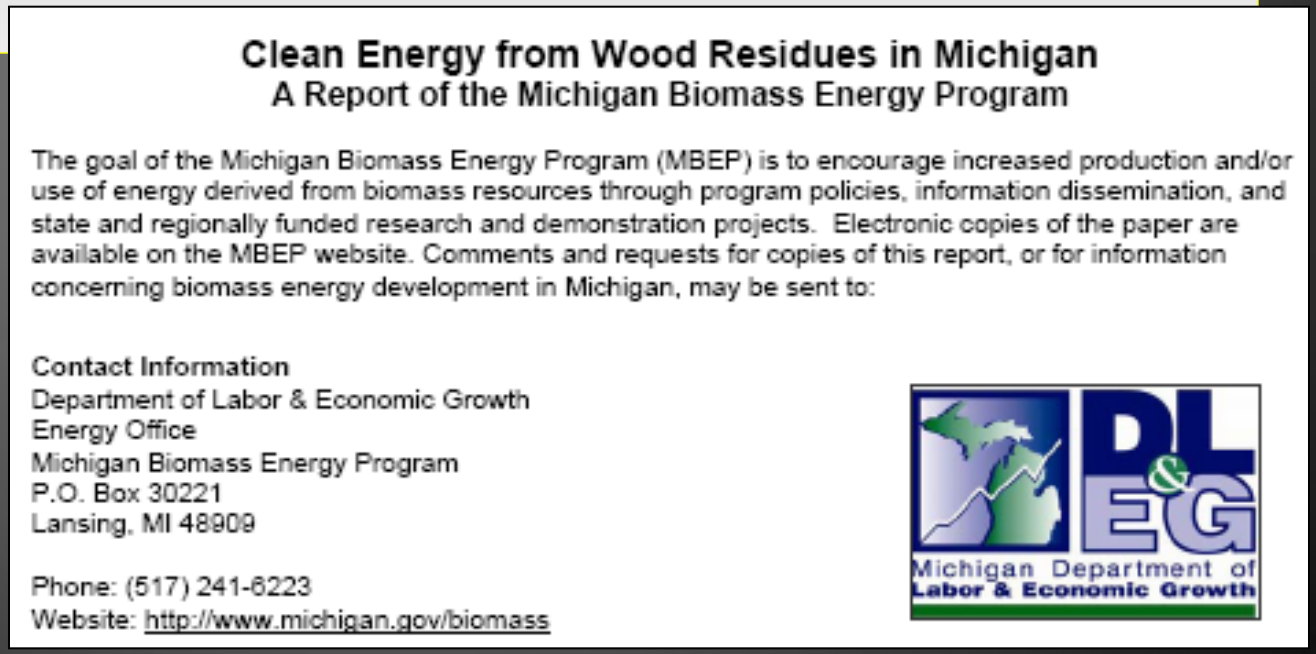


Blackout

Distributed generation is desirable …

The 2003 blackout …demonstrated the extreme vulnerability of our state and region to centralized energy's tenuous infrastructure.

Because wood is locally abundant in outlying areas as well as in cities, **it is a preferred source of energy for distributed generation** utilizing smaller, less centralized energy production facilities.



Clean Energy from Wood Residues in Michigan
A Report of the Michigan Biomass Energy Program

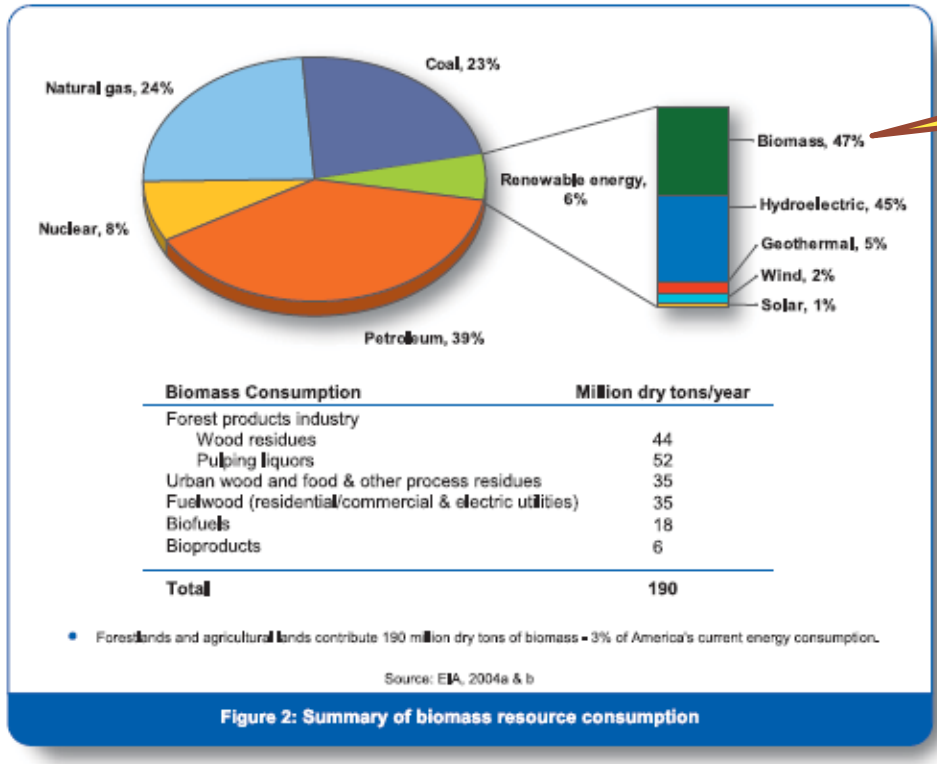
The goal of the Michigan Biomass Energy Program (MBEP) is to encourage increased production and/or use of energy derived from biomass resources through program policies, information dissemination, and state and regionally funded research and demonstration projects. Electronic copies of the paper are available on the MBEP website. Comments and requests for copies of this report, or for information concerning biomass energy development in Michigan, may be sent to:

Contact Information
Department of Labor & Economic Growth
Energy Office
Michigan Biomass Energy Program
P.O. Box 30221
Lansing, MI 48909

Phone: (517) 241-6223
Website: http://www.michigan.gov/biomass

Michigan Department of Labor & Economic Growth

Current Biomass Contribution



Biomass Consumption	Million dry tons/year
Forest products industry	
Wood residues	44
Pulping liquors	52
Urban wood and food & other process residues	35
Fuelwood (residential/commercial & electric utilities)	35
Biofuels	18
Bioproducts	6
Total	**190**

- Forestlands and agricultural lands contribute 190 million dry tons of biomass - 3% of America's current energy consumption.

Source: EIA, 2004a & b

Figure 2: Summary of biomass resource consumption

47% of 6% = 3%

Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply

April 2005

Currently, biomass accounts for approximately:
13% of renewably generated electricity,
97% of the industrial renewable energy use,
84% of renewable energy consumption in the residential sector
90% of renewable energy consumption in the commercial sector
2.5% of transport fuel use.

Upper Peninsula Resource Conservation and Development Council

Energy Cost Calculator

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

ENERGY COST CALCULATOR

Enter the costs in Column E below for the various fuels in your area, or just use the numbers already listed.

FUEL	ENERGY CONTENT	UNIT PRICE	HEAT CONVERSION EFFICIENCY	COST PER MILLION BTU
Kerosene	134,000 BTU/gal	$2.75 /gal	85 %	$24.14
#2 Fuel Oil	138,000 BTU/gal	$3.29 /gal	80	$29.80
Propane	92,000 BTU/gal	$2.24 /gal	85	$28.64
Natural Gas	100,000 BTU/therm	$1.40 /therm*	85	$16.47
Electricity - Resistance	3,412 BTU/kWh	$0.09 /kWh**	100	$26.38
Electricity - Heat Pump	3,412 BTU/kWh	$0.09 /kWh**	200	$13.19
Coal	13,200 BTU/lb	$325.00 /ton	75	$16.41
Firewood-Hardwood	25,000,000 BTU/cord	$200.00 /cord	60	$13.33
Wood Pellets	8,200 BTU/lb	$228.00 /ton	80	$17.38
Shelled Corn	6,800 BTU/lb	$2.50 /bushel	75	$8.75

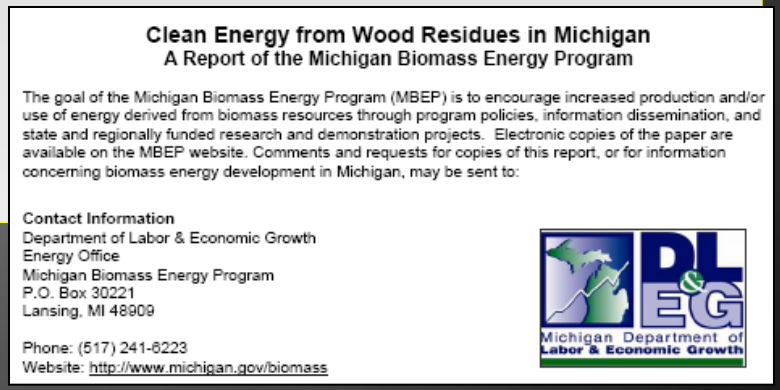
* Enter the price of natural gas as the price per therm. If your price for natural gas is based on $ per 1,000 cubic feet, divide that number by 10 to enter above. For example, if your cost for natural gas is $14.00 per 1,000 cubic feet, then divide by 10 and enter $1.40 as your price per therm.

** Enter the price of electricity in dollars. An electricity price of 9 cents per kWh, for example, needs to be entered as $0.09.

Employment Benefits of Biomass Energy

"...the use of biomass energy has some employment benefits over using fossil fuels at a national level if there is a substantial employment generation effect from producing the biomass fuel, especially if it substitutes imported fuels. But, the greatest value of bioelectricity schemes with regard to employment lies in the fact that quality jobs could be generated where there is great need for them, in particular in rural areas where job maintenance and creation and economic growth are of issues of concern."

Recent studies using only data from the United States show that both power plants and fuel production operations provide rural jobs with good comparative wages and benefits. In addition, there are almost twice as many supporting jobs than in the plants themselves, with total employment equal to 4.9 fulltime jobs per each megawatt of net plant generating capacity.



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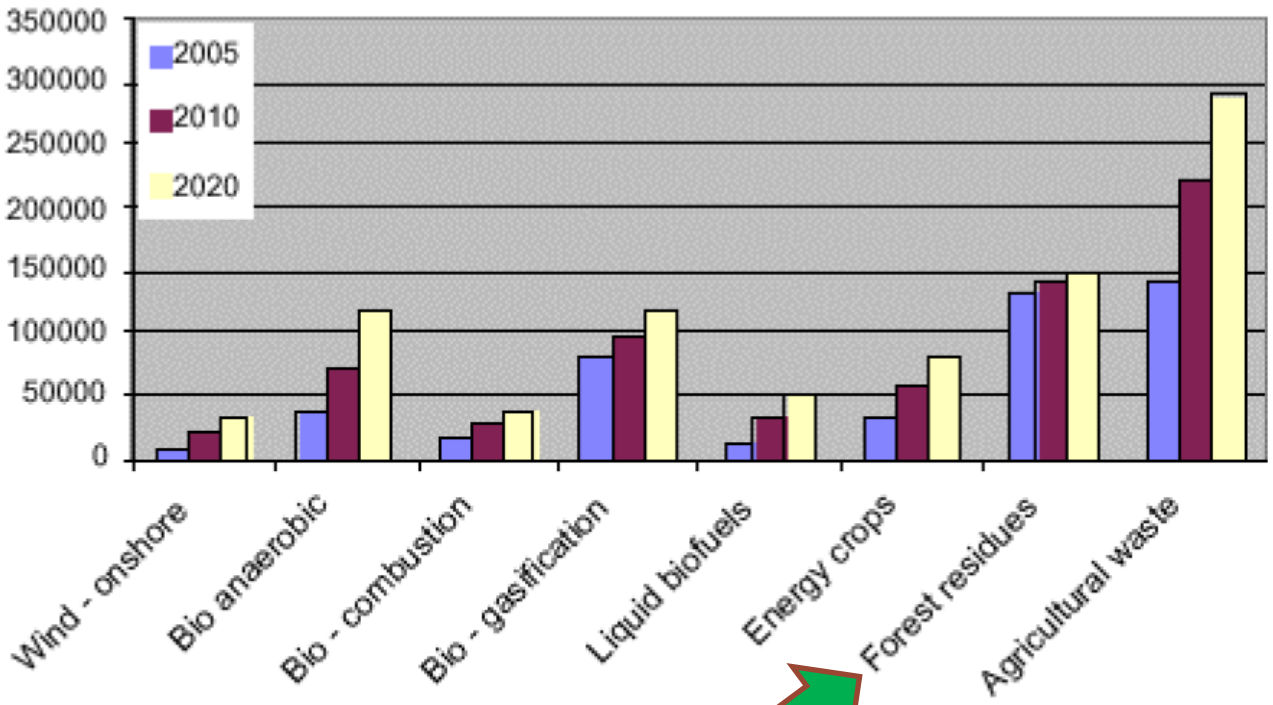
Phone: (517) 241-6223
Website: http://www.michigan.gov/biomass

DL&EG
Michigan Department of Labor & Economic Growth

Projected Employment from Bioenergy

Projected Employment from Bioenergy in the EU



Projected employment in the EU for biomass technolo nd is included for comparison.
Source: EU Altener Report: Impact o on Employment, 2000.

4 Uses of Biomass

Ever since humans started burning wood or other organic matter to keep warm and to cook food, we've been using biomass energy, or bioenergy.

Here you can explore the different ways to use biomass energy:

1. **Biofuels**

   Fuel your vehicle with ethanol or biodiesel.

2. **Biopower**

   Buy clean electricity generated from biomass.

3. **Bioproducts**

   Use products, like plastics, made from biomass.

4. **Space heating**

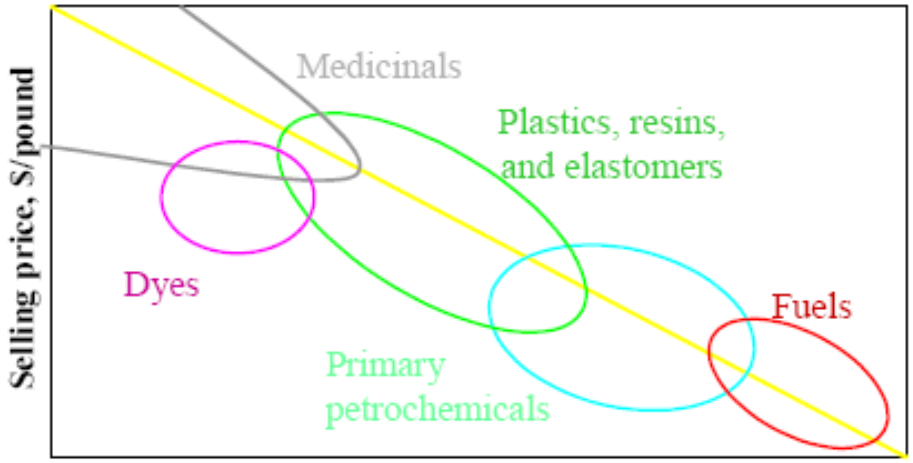
   Heat your home using wood or biobased pellets.

U.S. Department of Energy
Energy Efficiency and Renewable Energy

www.eere.energy.gov/consumer/renewable_energy/biomass

Potential Bio-Products

Selling Price and Market Volume of Potential Bio-Products



Sweden's Remarkable Transition to Renewable Fuels: Can it happen here too?

February 26, 2008

Bay de Noc Community College

Swedish Delegation Presentations
Bay De Noc College, Feb. 2008

ENERGI-
KLUSTER
Småland

Bioenergy Småland

Business development through biomass in the region of Småland

Michigan February 2008
Regional economy, Växjö as an example, district heating

Hans Gulliksson
Energikontor Sydost/Bioenergy Group in Växjö AB

Upper Peninsula Resource Conservation and Development Council

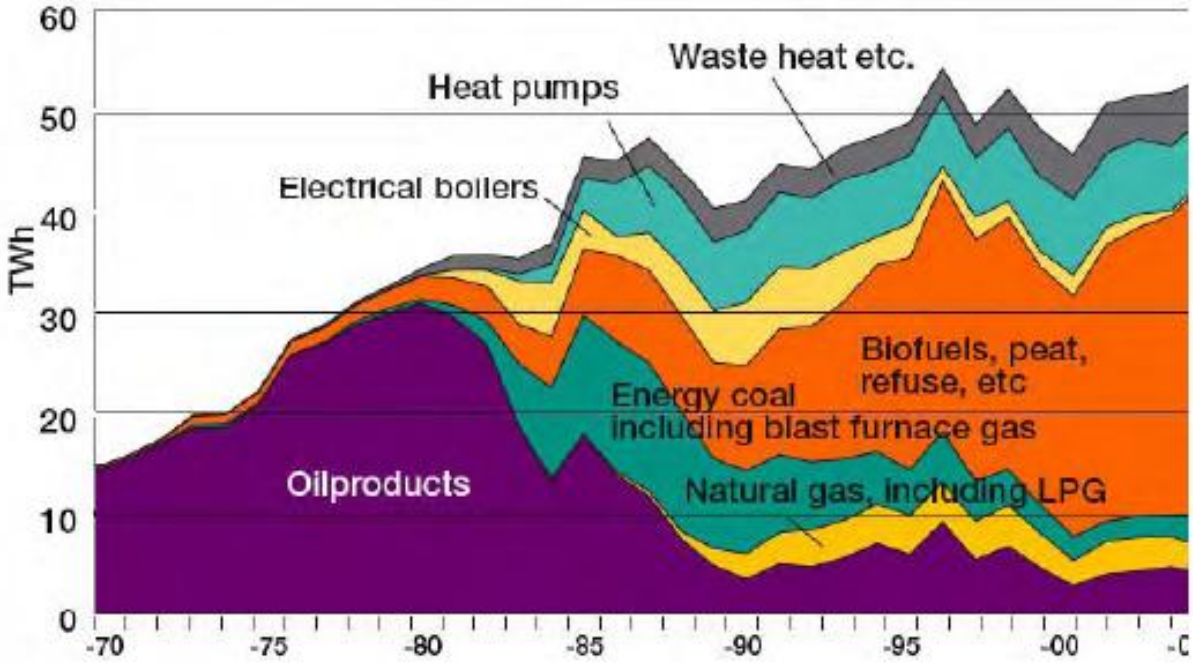
Declining fossil fuels
Increasing biofuels
Sweden: 1970-2004

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

ENERGI-KLUSTER Småland

Figure 26: Energy input for district heating, 1970–2004

Now > 60% bio fuels

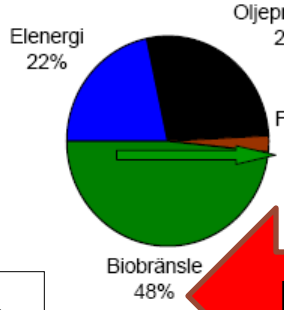


Source: Swedish Energy Agency

Bioenergy Share in Sweden

ENERGI-KLUSTER Småland

Energy as a economic driver in the region



6,8 TWh

2.250 work

13,9 TWh

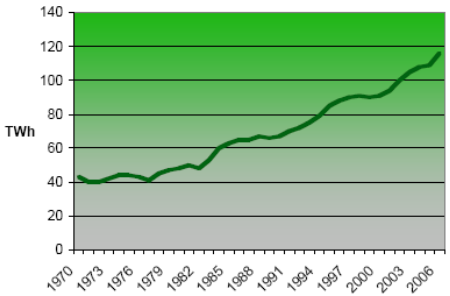
MSEK

"Regional energy economi"

Regional: 48%

Energikontor Sydost
Energy Agency for Southeast Sweden

Bioenergy development in Sweden 1970-2005



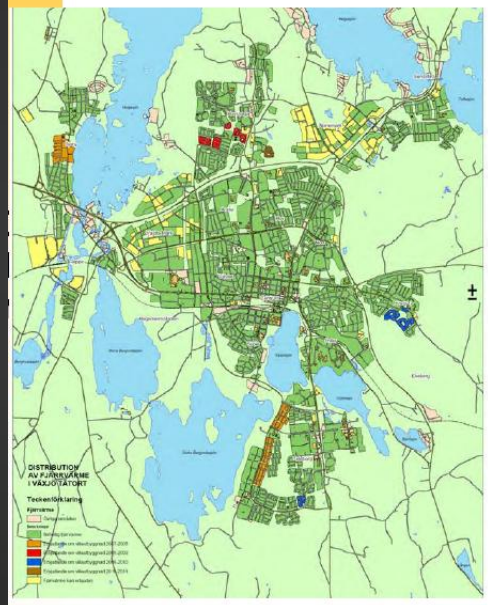
The bioenergy share of the total energy use

- 1970: 9%
- 1980: 11%
- 1990: 15%
- 2000: 20%
- 2006: 27%

National:27%

District Heating in Sweden
Established in many towns & cities

District heating In Växjö



Existing

Planning 2007-2008

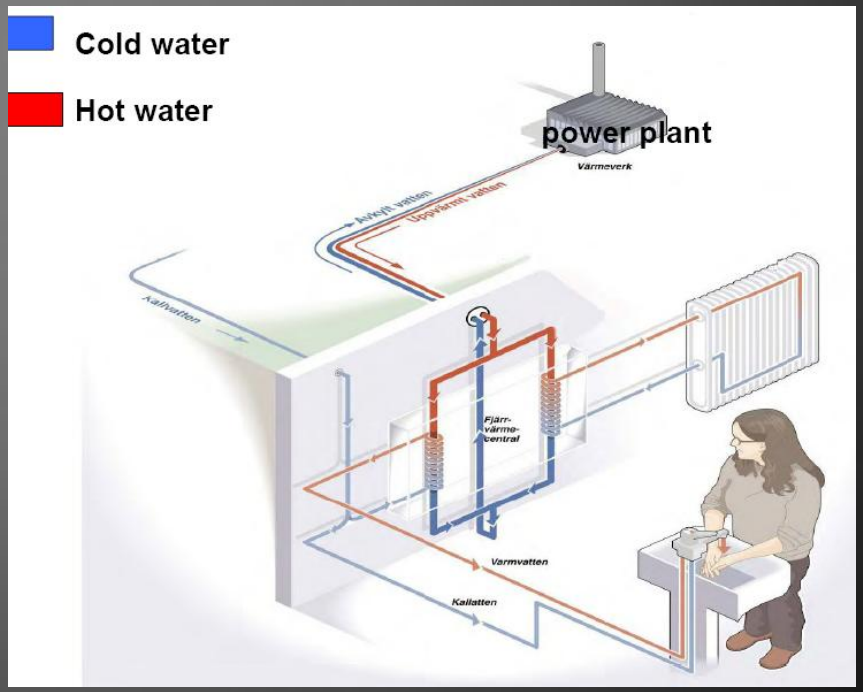
Planning 2008-2009

Planning 2009-2010

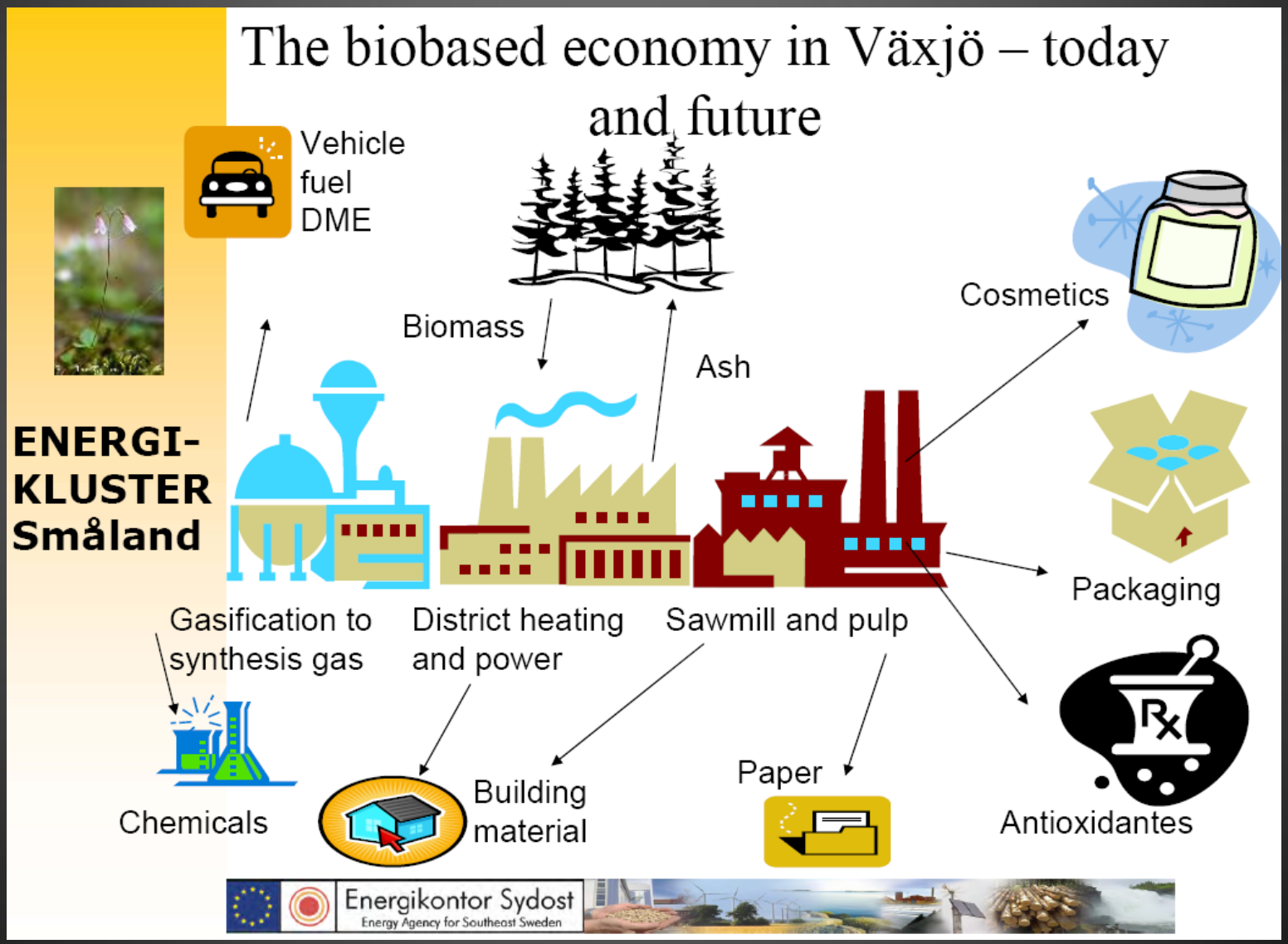
Planning 2010-2011

Available

Energikontor Sydost
Energy Agency for Southeast Sweden



Biobased Economy

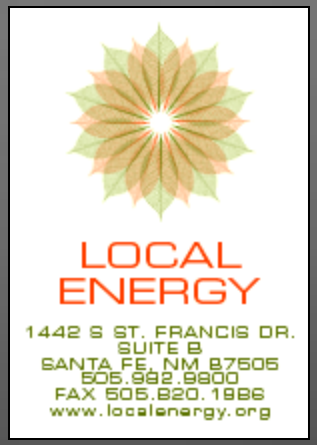


Upper Peninsula Resource Conservation and Development Council

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

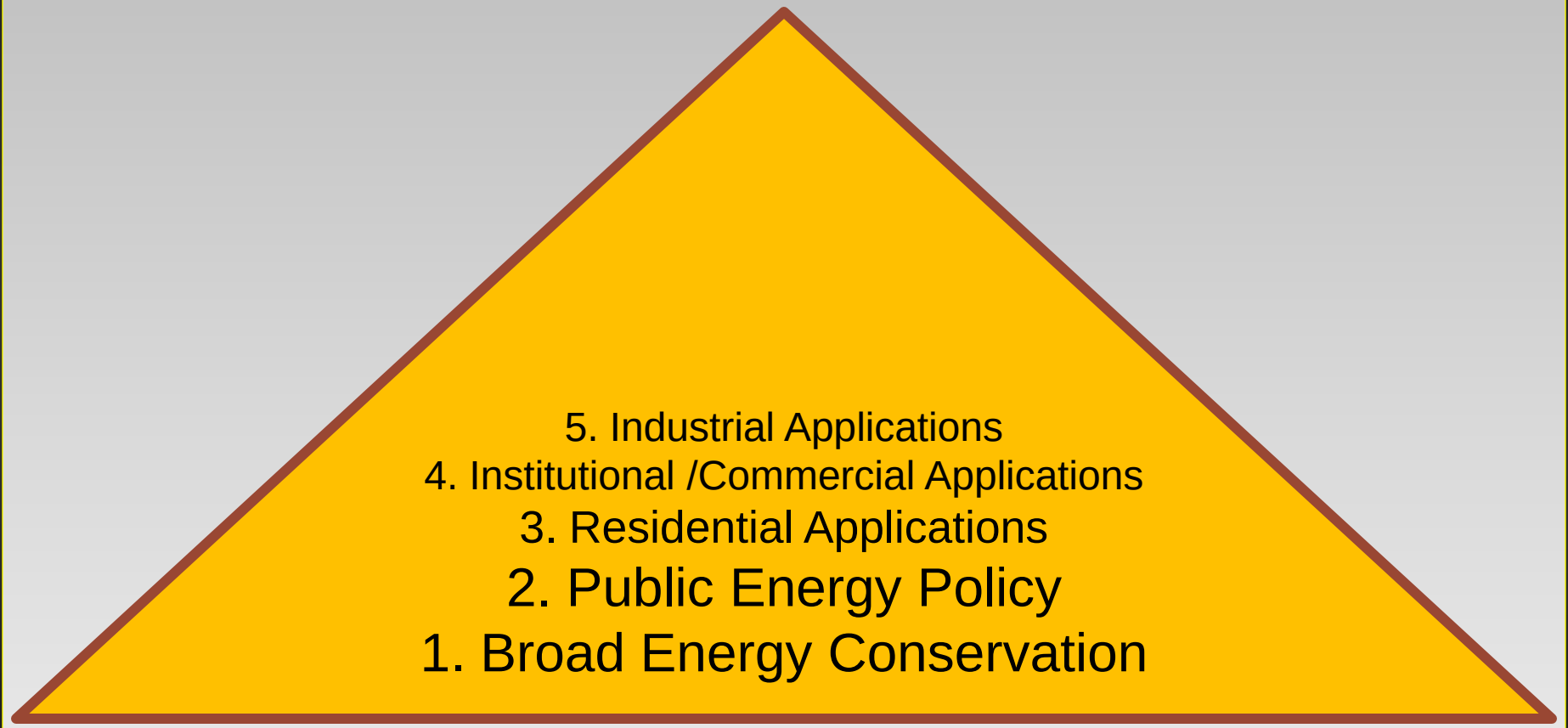
Community Self-Reliance

- PETROLEUM = GLOBAL DEPENDENCY
- BIOMASS = COMMUNITY SELF-RELIANCE

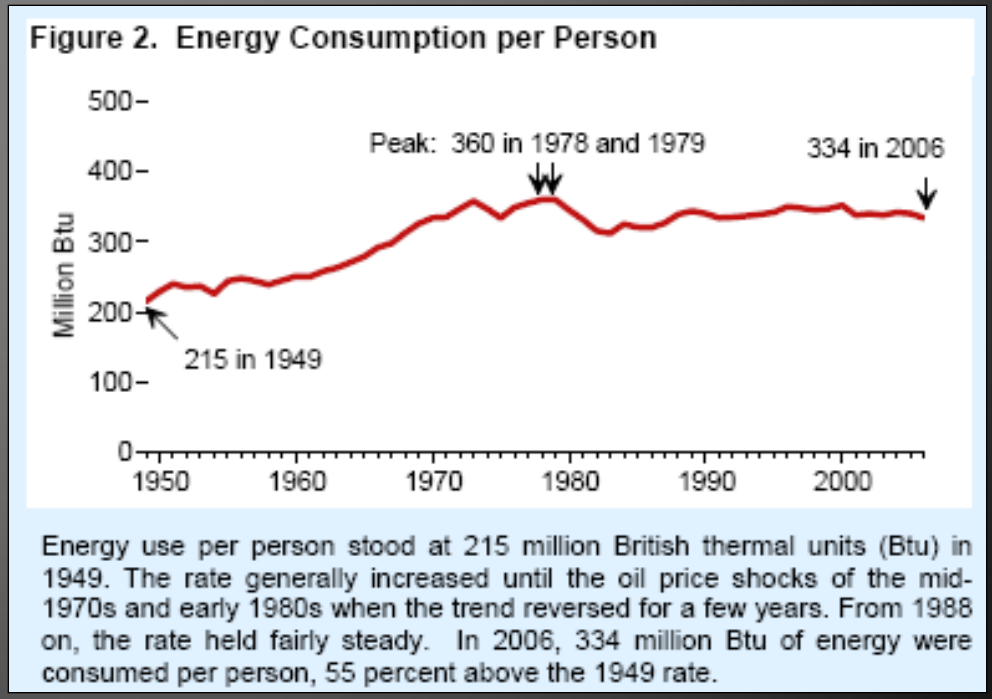


V. Taking Action

Conservation & Development Priorities vis-à-vis Wood Energy (My personal assessment)



1st Priority
Energy Conservation
>Personal Choices



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2nd Priority
Public Energy Policy

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP

Driving forces behind success of bioenergy in Sweden

Driving forces for bioenergy development

- External
  - Climate Change
  - Security of supply (EU)
  - Increased oil- and gas prices
- National
  - Political will in Sweden
  - Industrial traditions and relevant raw material resources

A General Overview of Swedish Bioenergy Industry

Michigan February 2008
Kjell Andersson

Financial incentives for biofuels (Sweden)

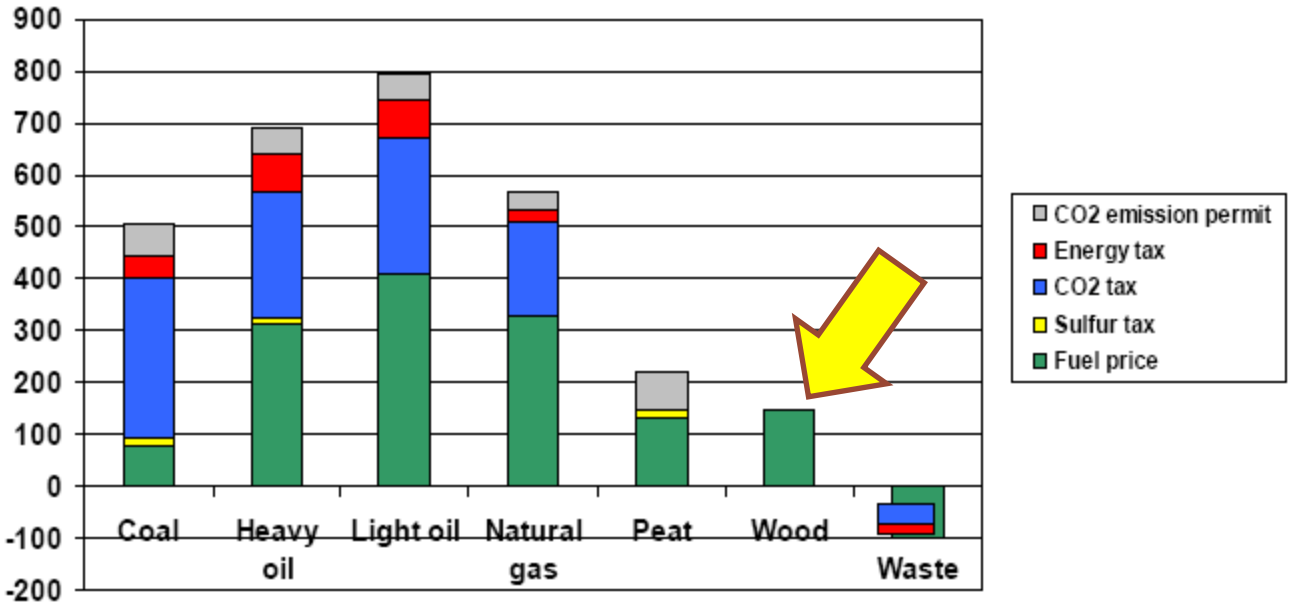
63

ENERGI-
KLUSTER
Småland

21

-21

Approximate costs for fuel and taxes for heatproduction in hotwater boiler – september 2007



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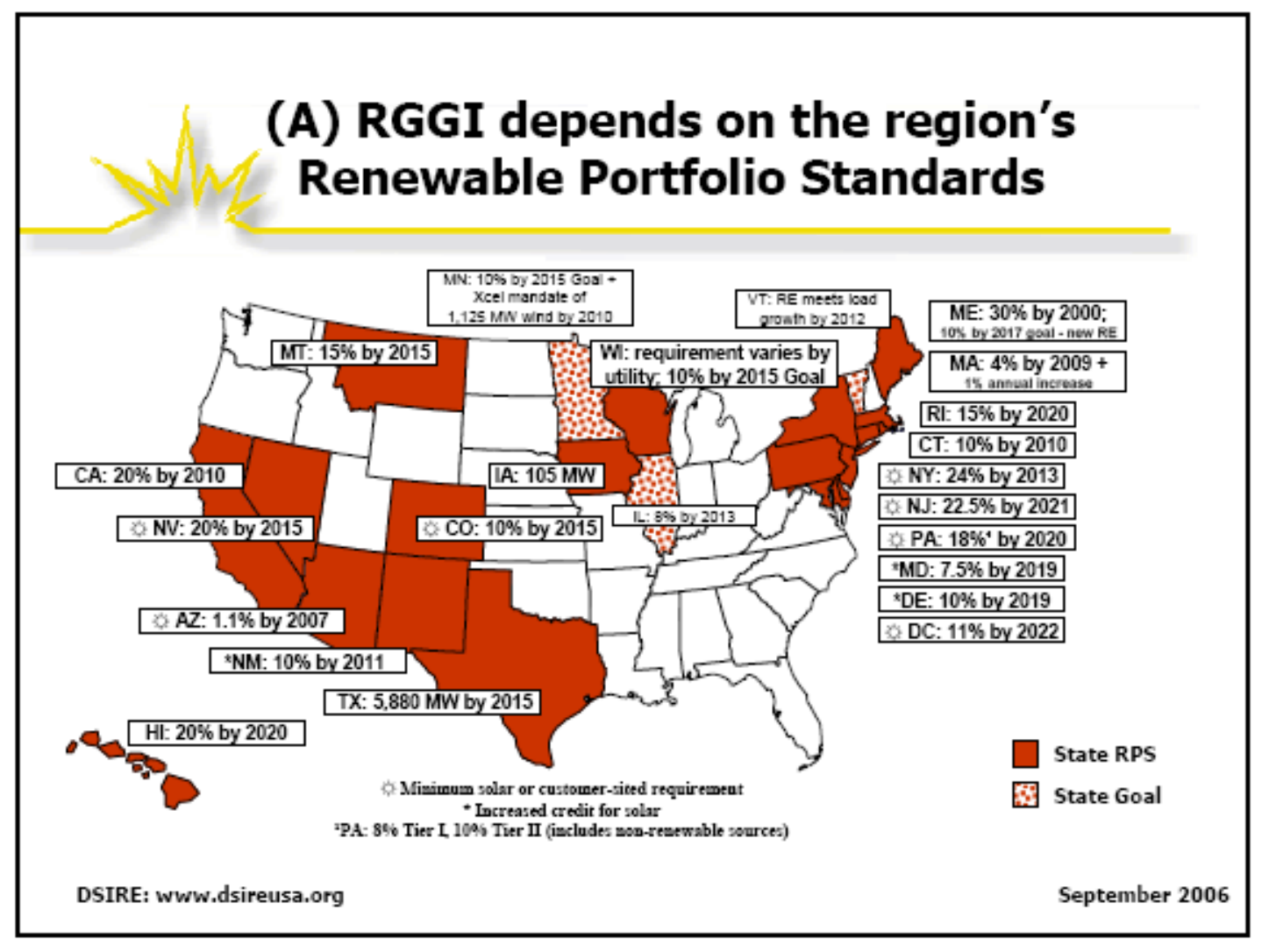
Renewable Portfolio Standards

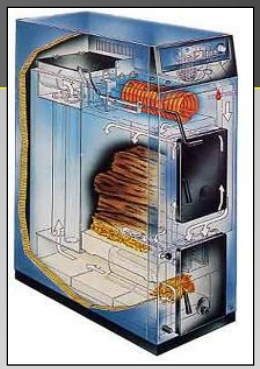
Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

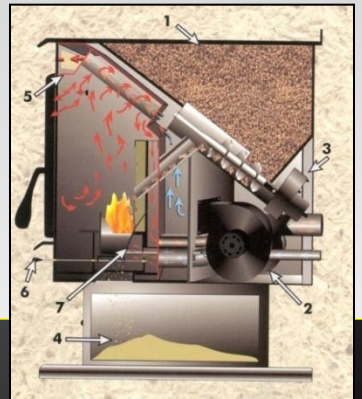


3rd Priority
Residential Wood Energy Applications
Clean Efficient use of Cordwood & Pellets

Production Costs ($ & BTU's): Minimal to Intermediate
Transportation Distances: Minimal to Intermediate
Social Values: Maximum (Origin of Conservation Values, Private Land Tenure)

- Wood stoves
- Wood furnaces
- Outdoor wood boilers (OWB)
- Outdoor gasifiers
- Masonry heaters
- Pellet stoves





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Smoke Gets in Your Lungs: Outdoor Wood Boilers in New York State October 2005

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

Table 4: Fuel Costs for Various Heating Systems

Type of Fuel	Fuel Price [i]	Price per million BTU (Dollars)	Efficiency [ii]	Price per mmBTU adjusted for efficiency (Dollars)	Total Household Energy Cost per year (Dollars) [iii]
Wood (for use in OWB)	$170 per cord	$8.50	43%	$19.77	$1,977 (or less if not all purchased)
Wood (for use in catalytic indoor wood stove)	$170 per cord	$8.50	72%	$11.81	$1,181 (or less if not all purchased)
Wood (for use in non-catalytic indoor wood stove)	$170 per cord	$8.50	68%	$12.50	$1,250 (or less if not all purchased)
Oil	$1.99 per gallon	$14.35	78%	$18.40	$1,840
Gas	$1.13 per therm	$11.30	78%	$14.49	$1,449
Electricity	$0.094 per kilowatt hour	$27.46	97%	$28.31	$2,831

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Smoke Gets in Your Lungs: Outdoor Wood Boilers in New York State October 2005

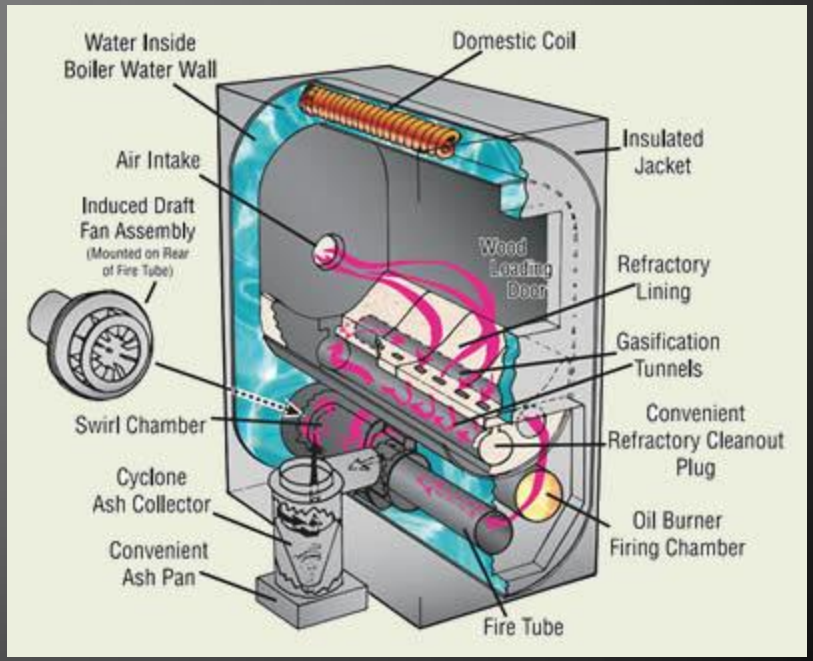
Biomass Utilization & Restoration Network for the Upper Peninsula BURN-UP

Figure 4: Relative Emissions of Fine Particulate Matter From Home Heating Devices

Gasification Wood Boilers

These are NOT OWB's –

very different and very clean wood gasification technology



http://www.alternateheatingsystems.com/index.htm

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1990's: Masonry Heater Revival

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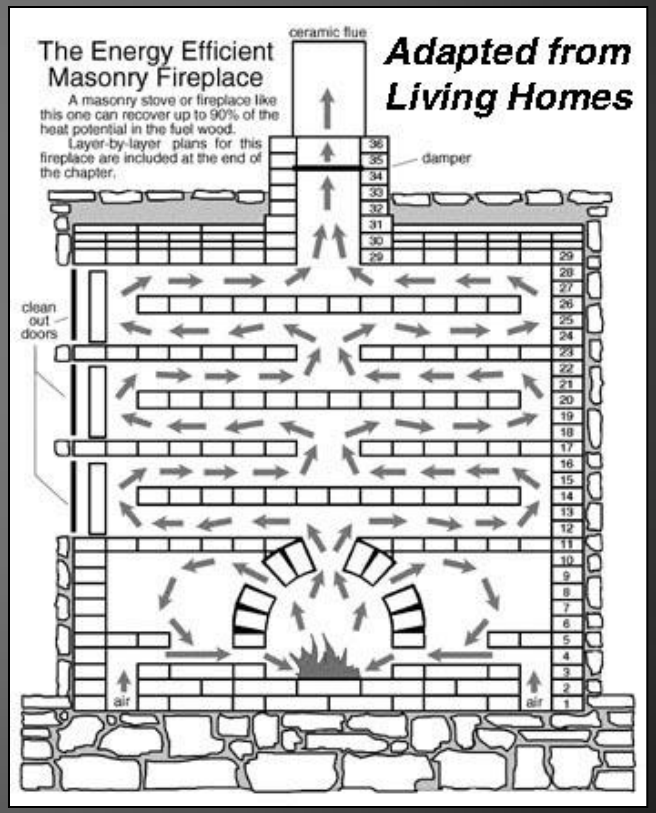
BURN-UP

Russian/Finnish Contraflow "Fireplace"



4th Priority
Commercial/Institutional Applications
Major Expansion of Chips & Pellets

Production Costs ($ & BTU's): Intermediate
Transportation Distances: Intermediate
Social Value: High (especially in schools)

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Wood-Chip Heating Systems

Biomass Energy Resource Center (BERC)

Biomass Utilization & Restoration Network for the Upper Peninsula — BURN-UP

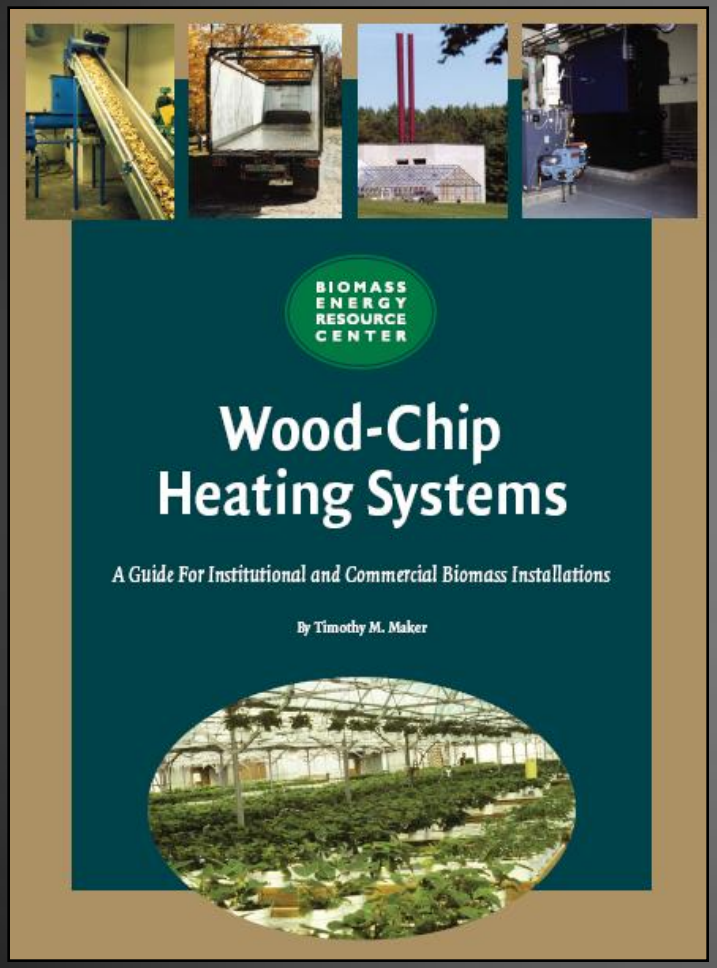


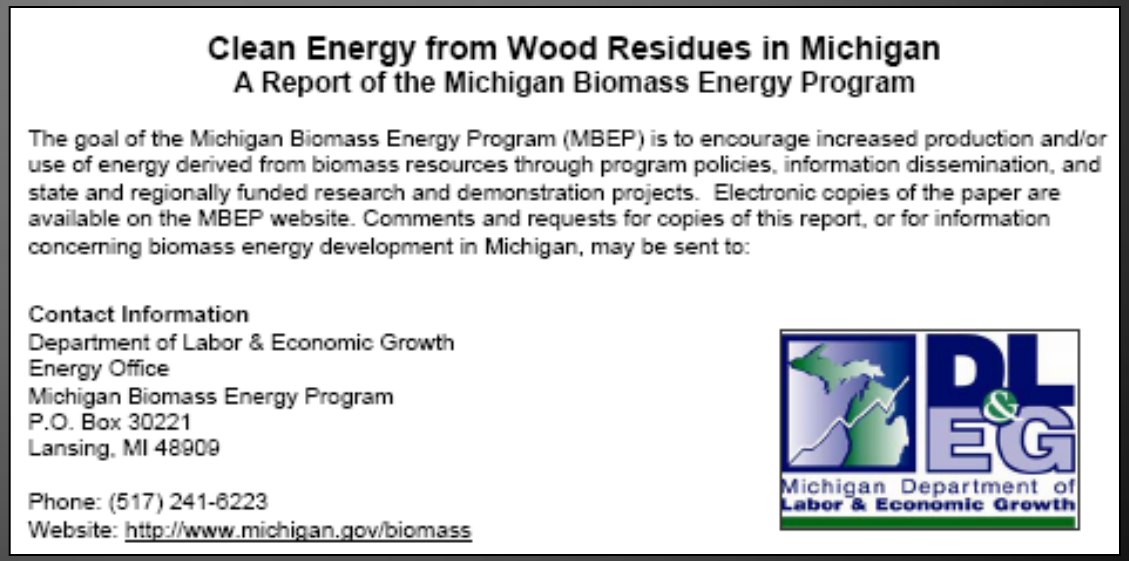
TABLE OF CONTENTS

Densification (Pellets)

Wood residue densification into pellets or briquettes is energy intensive.

However, densification creates wood-based fuel with approximately 20% more energy output per unit volume than logs or wood chips themselves.

In addition, regularly-shaped densified fuels are much easier to transport and store, which helps overcome the energy costs of creating the denser fuel.



Clean Energy from Wood Residues in Michigan
A Report of the Michigan Biomass Energy Program

The goal of the Michigan Biomass Energy Program (MBEP) is to encourage increased production and/or use of energy derived from biomass resources through program policies, information dissemination, and state and regionally funded research and demonstration projects. Electronic copies of the paper are available on the MBEP website. Comments and requests for copies of this report, or for information concerning biomass energy development in Michigan, may be sent to:

Contact Information
Department of Labor & Economic Growth
Energy Office
Michigan Biomass Energy Program
P.O. Box 30221
Lansing, MI 48909

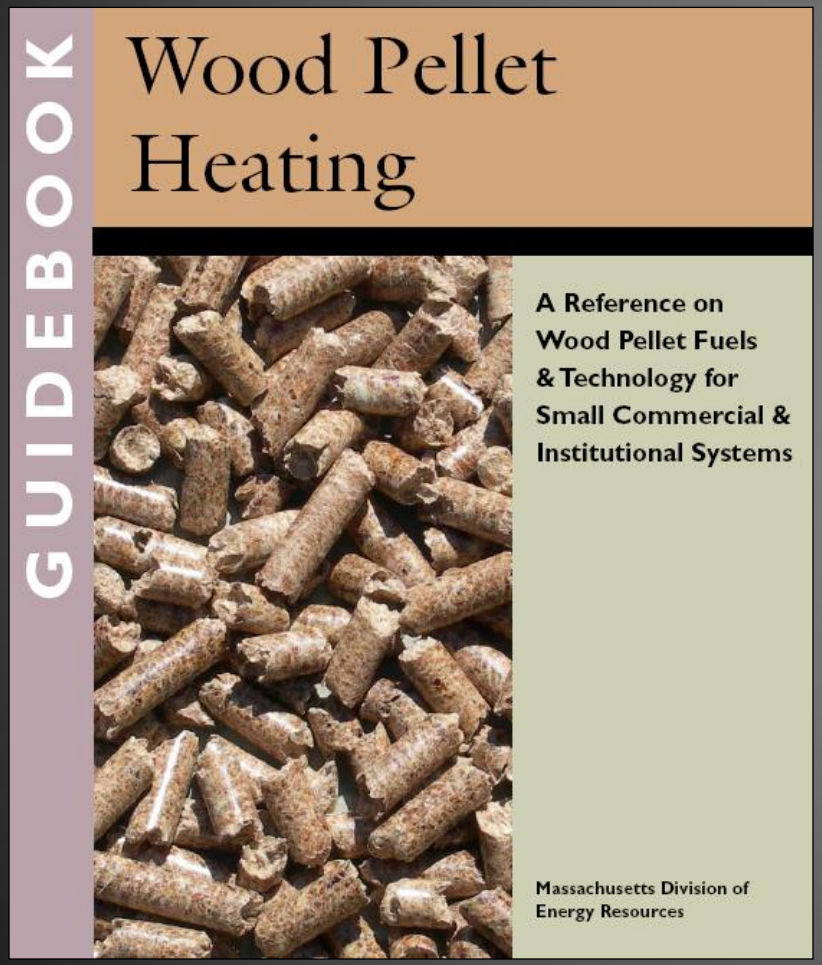
Phone: (517) 241-6223
Website: http://www.michigan.gov/biomass

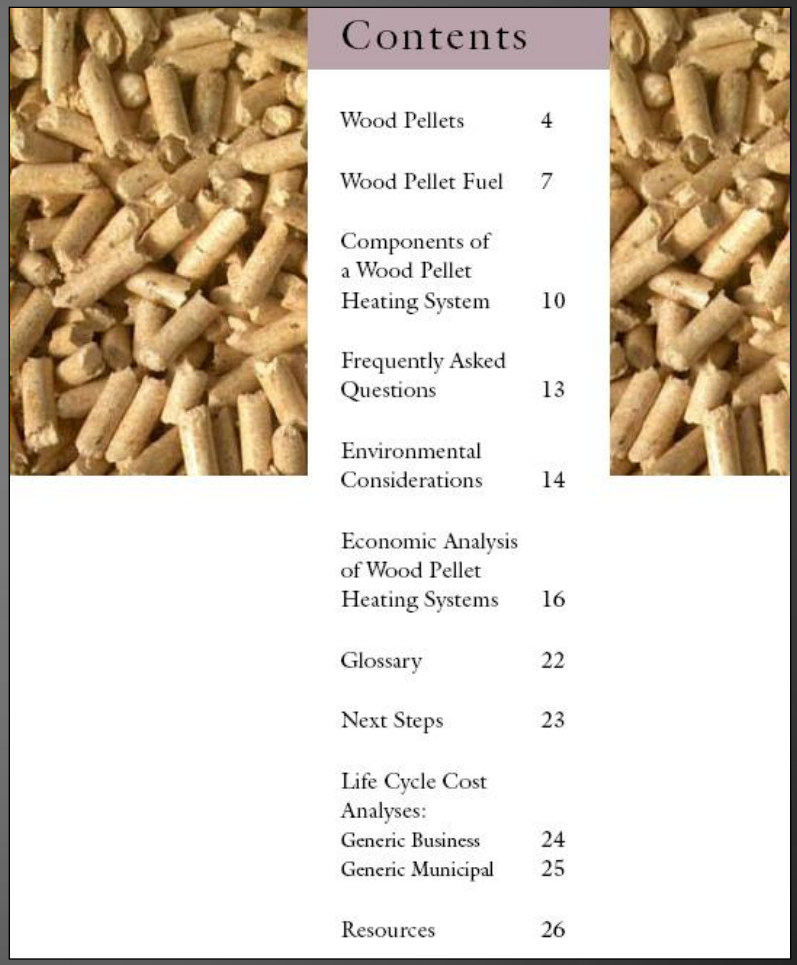
Michigan Department of Labor & Economic Growth

Upper Peninsula Resource Conservation and Development Council

Pellet Guidebook

Biomass Utilization & Restoration Network for the Upper Peninsula
BURN-UP





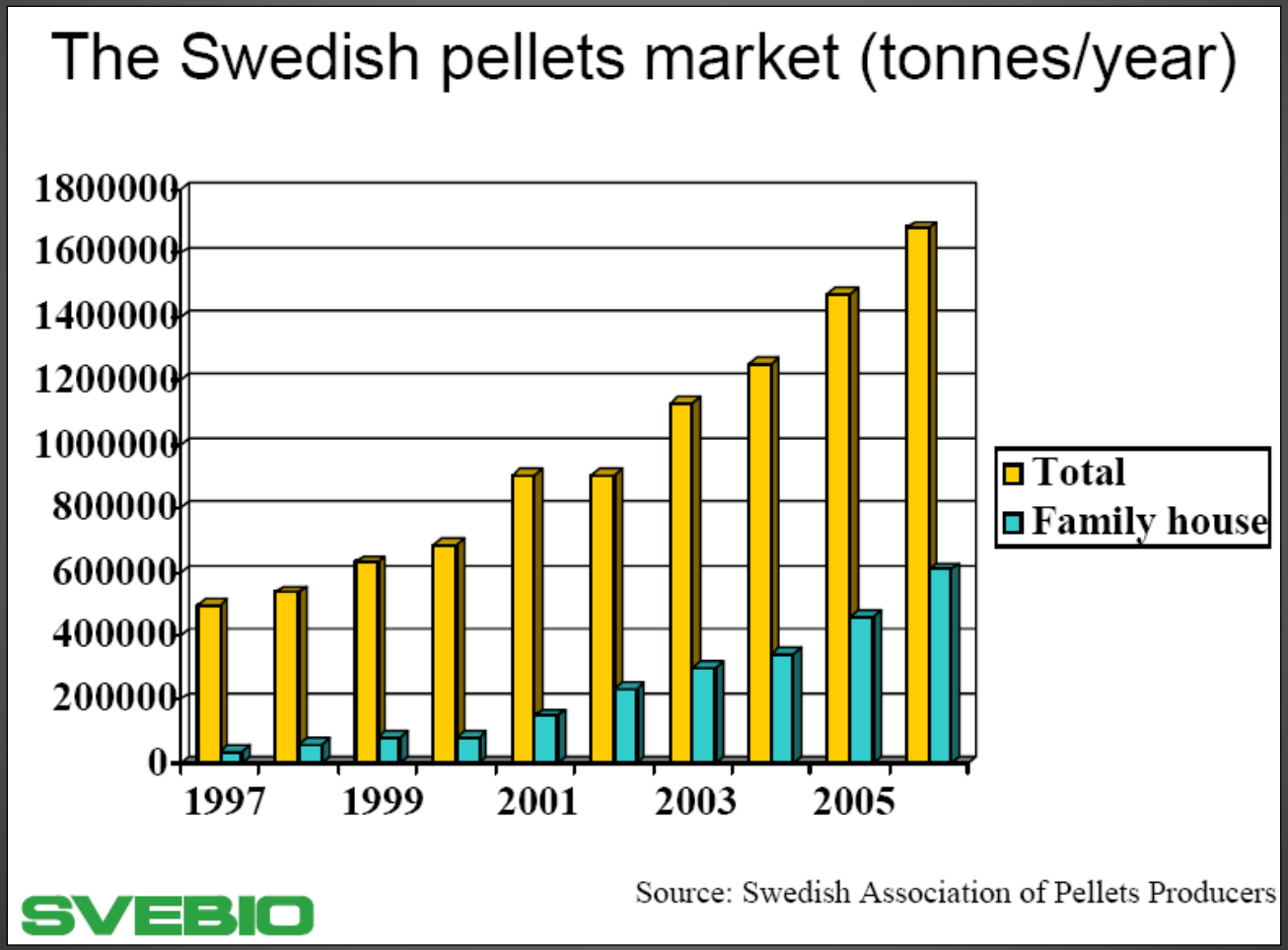
Commercial-Scale Pellet Systems

In addition, wood pellets:

- are convenient and easy to use, and can be bulk stored in less space than other biomass fuels
- have a high energy content, and the technology is highly efficient compared to other biomass fuels
- are a clean-burning renewable fuel source
- are produced from such waste materials as forestry residues and sawdust
- are price stable compared to fossil fuels

Generally better than chips for <1.5 million BTU's or 30,000 sq. ft.

Swedish Pellet Market



5th Priority
Industrial Applications

Production Costs ($ & BTU's): High

Transportation Distances: High

Social Value: Relatively low (debatable) – fewer people involved

Risk to Forest Health: Relatively high in short term

Wood-Fueled Power Plants in Michigan

L'Anse Warden 20 MW conversion 2008?

WE Energies Presque Isle Plant ?

NMU 10 MW CHP 2012?

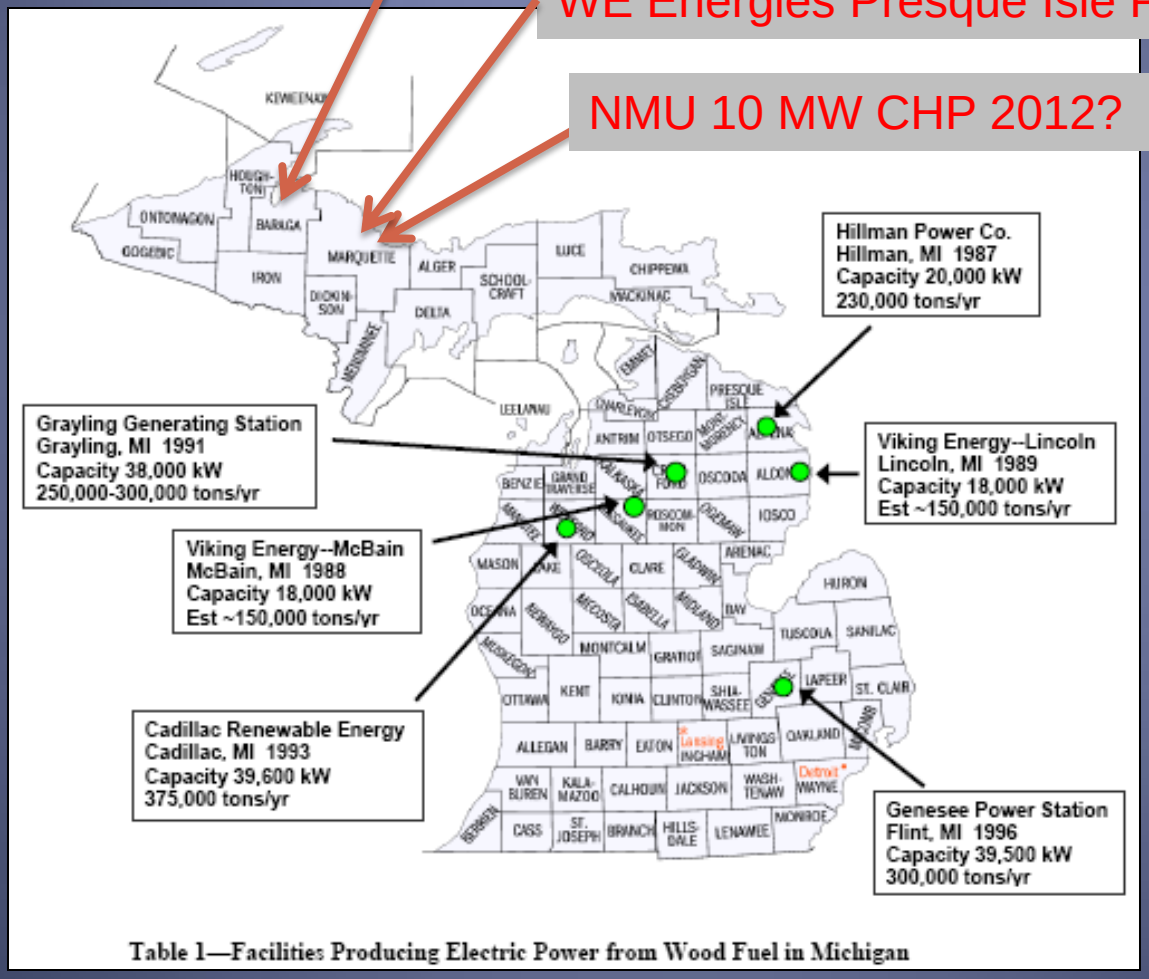
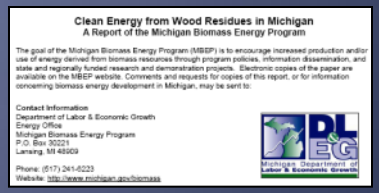


Table 1—Facilities Producing Electric Power from Wood Fuel in Michigan



Woody Biomass Energy: Key Points

1. There is no such thing as "waste" wood or woody "debris."
2. All forests are not created equal – some can be harvested at will, some shouldn't be harvested at all, most are somewhere between – simple rules simply won't work.
3. Environmental impacts of biomass harvesting are site specific & global.
4. There is no single best approach to growing, harvesting, processing, transporting, or utilizing woody biomass for the UP as a whole. The solutions are multi-faceted, multi-scaled & site-specific (context is key).
5. It's not all about economics – sense of place, lifestyle & culture matter!
6. Integration & cooperation are key – residential to industrial scales.
7. "RC & D" – Resource Conservation before & during Development

   Let's get the harvesting right before "bad habits" develop.

No Technical Barriers...

There are no technical reasons to prevent a major increase in utilisation of bioenergy from forests or agricultural land, and there are clear environmental benefits if this were to occur.

Given a supportive policy environment, bioenergy can provide a sustainable solution to future energy demands.

International Energy Agency

Issues to Overcome

The keys to the successful implementation of energy technologies, and in particular, biopower technologies, are overcoming issues that can be categorized as —regulatory, financial, infrastructural, and perceptual.

- National Renewable Energy Lab

Highlights of Biopower Technical Assessment:
State of the Industry and the Technology
April 2003 • NREL/TP-510-33502
R.L. Bain and W.A. Amos
National Renewable Energy Laboratory Golden, Colorado
M. Downing and R.L. Perlack
Oak Ridge National Laboratory Oak Ridge, Tennessee
National Renewable Energy Laboratory

Risk Management
A Perceptual Barrier

- Schools (& others) are very risk averse, which is good, but…
- There is a misperception that the future supply & cost of wood fuels is a high risk.
- The supply is not going away - it is growing.
- The price is historically more stable than any other fuel.
- What fossil fuel company will guarantee supply & price for 5 years?
- For many situations, the real risk is <u>not</u> converting to wood fuel!

Successful Projects Almost Always Have…

1. A Good Local Wood Source
2. The Right Team – The Right Technology – tap experience.
3. Political Will & Long-Term Commitment – exercise your Yooper sense of place.
4. A Champion - Don't have a champion? Don't expect success.
5. A High Energy Bill – focus on "clusters" of users

"The Dog Ate My Homework"

Will this Be Your Answer on Forest Biofuels ?

Upper Peninsula Resource Conservation and Development Council

Or Will This ?

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP

VERMONT

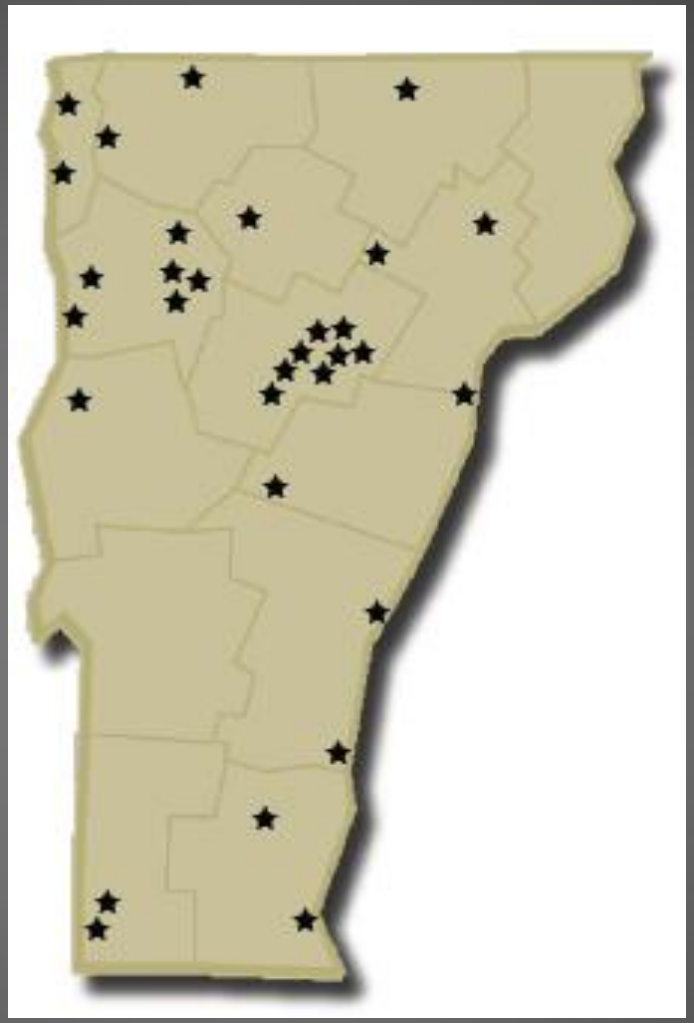
Fuels for Schools

Biomass Utilization & Restoration Network for the Upper Peninsula

BURN-UP

Over the last 15 years, 31 schools have installed woodchip systems.

Currently, 20 percent of all public school students in Vermont attend wood-heated schools.



"The Department of Education and the State Board of Education encourage school districts to invest in cost-effective, energy-efficient facility improvements. Woodchip heating systems have proven to be both; they are a tremendous success story in Vermont schools…"

http://www.biomasscenter.org/services/school-wood-heat.html

Concerns Associated with Biomass Fuels

- Burning biomass usually takes more operator attention then burning conventional fuels.
- In contrast to other fuels, biomass fuel is variable in quality. It may require more vigilance and effort from the owner to ensure the desired fuel quality.
- It may require time and effort to set up a stable biomass fuel supply network in a region where one is not in place.
- Biomass does not burn as cleanly as natural gas. The public may be worried about a new biomass installation because of the reputation of wood burning as being "dirty".
- Some biomass systems require more maintenance than systems using conventional fuels.