Guidelines and technical concerns of harvesting woody biomass for energy

IEA Bioenergy

Biofuels and bioenergy: Challenges and Opportunities

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Dalia Abbas

Department of Forest Resources

University of Minnesota

sale0056@umn.edu

Purpose of this presentation

Based on field visits, discussions and a literature review, this presentation discusses:

1. Current Minnesota efforts in developing biomass guidelines
2. Biomass guidelines
3. Technical concerns attached to removing woody biomass.
4. Cases from Finnish, Swedish, Canadian and American biomass removal guidelines.
5. Advantages and disadvantages of using woody biomass for energy.

Minnesota initiative

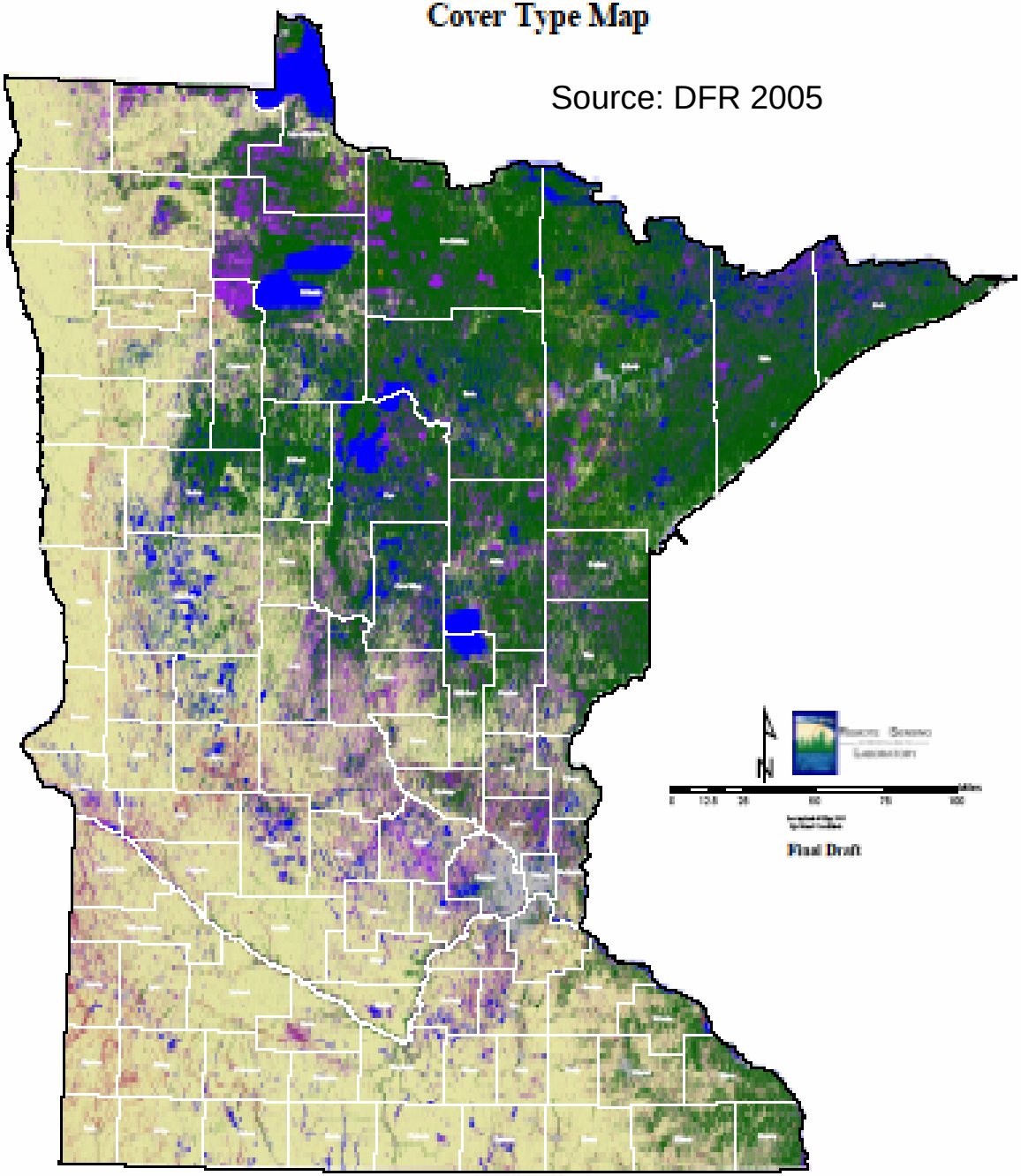
Minnesota Public Utilities Act in 1994 mandated Xcel Energy to produce 110 MW of biomass electricity per year for up to 20 years.

Laurentian Energy Authority, in Hibbing and Virginia, is contracted to produce 70% of 35 MW from using biomass chips.

25%-50% of this biomass is coming from closed loop.

2000 Minnesota Landsat Cover Type Map

Source: DFR 2005



Urban
An area containing any amount of impervious cover of man-made solid materials or compacted soils including areas with interspersed vegetation. Examples: parking lots, shopping malls, warehouses, industrail parks, highways, sparse development, single family residential developments, single lane roads, and mines.

Agriculture
An area where the primary cover type during the growing season is an agricultural covertype including row crops, forage crops and small grains. Examples: corn, soybeans, alfalfa, oats, wheat and barley.

Forest
An area of land (upland or lowland) covered with woody perennial plants, the tree reaching a mature height of at least 6 feet tall with a definite crown. To be considered a forest cover type the stand must have a combined species minimum of 3 cords/acre or 1, 251 bdft/acre or 251 stems per acre depending on size class. Examples: white pine, red pine, oak, mixed conifer and mixed deciduous.

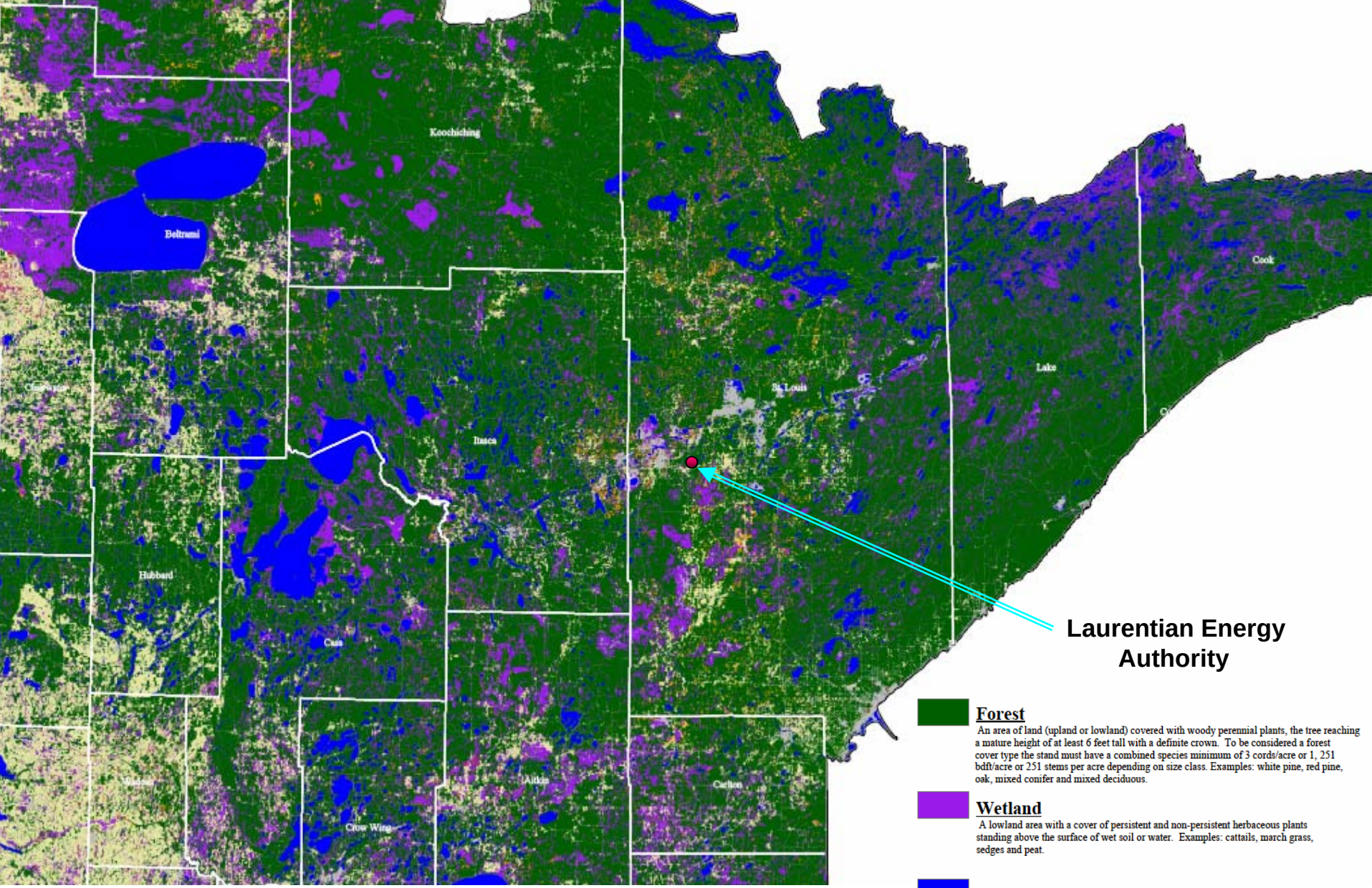
Wetland
A lowland area with a cover of persistent and non-persistent herbaceous plants standing above the surface of wet soil or water. Examples: cattails, march grass, sedges and peat.

Water
An area of open water with none or very little above surface vegetaton. Example: lakes, streams, rivers and open wetlands.

Grassland
An upland area covered by cultivated or non-cultivated herbaceous vegetation predominated by grasses, grass-like plants and forbs. Includes non-agricultural upland vegetation dominated by short manicured grasses and forbs as well as non-cultivated herbaceous upland vegetation dominated by native grasses and forbs. Examples: golf courses, lawns, athletic fields, dry priaries and pastures.

Shrubland
An upland or lowland area with vegetation that has a persistent woody stem, generally with several basal shoots, low growth of less than 20 feet in height. Area has less than 251 stems per acre of commercial tree species, the shrub species are fairly uniformly distributed throughout and the density of the coverage is moderate to high. Examples: alder, willow, buckthorn, hazel, and sumac.

65% of entire state harvest (8.32 million green tons per year) is within 100 miles radii around Virginia and Hibbing (Berguson et al. 2005).



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Woody biomass sources include:

- Fuel load reduction treatments
- Timber stand improvement practices
- Forest residue
- Brushlands
- Short rotation woody crops

Minnesota mandate-related studies include:

Project name	***BUG***	***Brushland harvest/IREE***	***Bottleneck***
Timeline	2005-2007	2005-2006	2005-2008
Woody resource used/harvested	National forests Fuel reduction	Forest residue and brushlands	Logging/slash from forest harvest
Activities	Test harvest Inventory Preharvest Post harvest **Economic assessment**	**Literature review of biomass guidelines** Environmental impacts **Economic assessment** Transportation study	Assessing slash amount Training and curriculum development •Loggers •Nat. Res. professionals •Landowners

What are biomass guidelines?

Practices and activities established by **consensus**, and approved by a recognized **body**, to provide for common and **repeated** use, rules, and characteristics for activities or their results, aimed at addressing **potentials** for woody biomass uses in forested areas (adapted from ISO definition of standards 2006).

No one guideline fits all

Different sources have different management goals.

Each biomass source seems biomass potentials **differently.**

However, biomass material is there, and needs to be dealt with.

Research into existing guidelines has identified **four** different types of biomass harvesting guidelines.

Types of biomass guidelines

1. Biomass-specific guidelines (Sweden and Finland)
2. Timber harvesting guidelines that make reference to slash removal only (most timber harvesting guidelines)
3. Biomass case-specific guidelines (Canada and USA)
4. Guidelines specific to growing short rotation woody crops and energy plantations (Scotland)

1. Biomass-specific guidelines

Guidelines that show a direct tie between removing specific forest residue and energy.

Biomass for energy is a management priority.

For Example, soil fertilization may be prescribed, to compensate for nutrients removed for energy.

No wood = no energy

Biomass energy is quantified and calculated in terms of energy contents per operation.

Examples in Finland and Sweden.

2. Timber harvesting guidelines with reference to slash removal (most common).

Forest and timber best management practices.

Reference to biomass is restricted to cases when slash is either left or removed from a site.

For example, if biomass is not removed, it needs to be returned to the forest floor.

Slash removed is not quantified.

3. Handling biomass material within forest management practices

Based on guidelines type two.

Biomass is managed to achieve forest wide objectives, rather than energy goals.

Priority is given to:

- Type of reforestation **method** used in this site.
- Slash loading impacts on **regeneration**.
- Site **sensitivity** to nutrient loss.
- **Wildlife** habitat and travel.
- Potential for escaped fire or **fire** spread.

Examples, Manitoba and Minnesota slash removal guidelines.

Biomass energy is not quantified.

4. Guidelines specific to energy plantations from Short Rotation Woody Crops

Like type one guidelines, biomass for energy is a priority.

Priority is to clearcut managed plantations for energy.

Harvesting occurs every three to five years from the same site.

Biomass plantations are seen as a **source** for **:**

- sustainable development in rural communities.
- fuel that can be stored till needed, and used to generate heat and electricity.

Example, Scottish Agricultural College guidelines (2001), for intensive fuel wood systems in Europe.

Biomass energy is quantified.

Key concerns

All types of biomass guidelines have addressed the following concerns with regards to:

- Soils
- Nutrients
- Wildlife
- Water quality
- Storage and handling of biomass material
- Other areas

Next sections address these concerns and guidelines recommendations.

Soils

Concerns: soil **compaction** and **erosion** from improper harvesting operations (ESF 2005)

Guidelines recommend:

- do not remove residue **completely** from a site (Richardson 2005)
- **sensitive** sites must be avoided (Richardson 2005)
- soil compaction can be minimized by operating on dry or frozen **soil conditions** (MN guidelines 2005).
- **avoiding** repeated passes by **heavy** equipment (MN guidelines 2005).
- minimize excessive **exposure** of mineral soil, compaction or rutting of soil (MN guidelines 2005).
- Enter a site as few numbers as possible (MN guidelines 2005)

Nutrients

Concerns: **depletion** of soil nutrients from frequent and repeated harvesting (ESF 2005)

Guidelines recommend:

- **Recycling** ash after combustion (Richardson 2005),
- Spreading ash from co-firing practices must be **avoided** (Richardson 2005).
- Residue can be left to **dry** on site (Finnish guidelines 2005).
- Fertilize with nutrients (mainly using pure wood) (Swedish guidelines 2005)
- Remaining residue is distributed more evenly than conventional forestry practices (Finnish guidelines 2005).

Water quality

Concerns: protect water quality in streams, rivers, and lakes **from** timber **harvesting**, **site** preparation, **roads** and skid **trails** operations, and **fertilization**, and **herbicide** applications (Sheppard 2006).

Guidelines recommend:

- residue must **not** be **piled** or stored on ditches (Finnish guidelines 2005).
- residue and stump pieces must be **removed** from riparian zones and from nearby all small water bodies after harvest (Finnish guidelines 2005).
- ditches must remain **functional** after energy wood harvest (Finnish guidelines 2005).
- avoid placing clearing debris in **filter strips** (Finnish guidelines 2005).

Wildlife

Concern: woody debris is important to maintain biodiversity.

Guidelines recommend:

- Maintain **ground** covers, shrubs, snags, naturally regenerating tree seedlings and other live trees **important** for wildlife and stand regeneration (MN guidelines 2005).
- Reduce potentials for timber harvesting activities which **disturb** sensitive sites, rare species, water features and unique habitats (MN guidelines 2005).
- Damaging of **nests** of all animals is avoided (Finnish guidelines 2005).

Storage and harvesting systems

- Do not store residue close to **other stems** to avoid scaring during removal (Finnish guidelines 2005).
- Store material as loose sticks or bundles, to avoid **combustion** of chips.
- Do **not drive over** biomass, it become more difficult to handle (bundler operator 2006)
- Residue storage site must be **free of rocks, dirt, metal object** and other hard objects can damage a chipper or grinder (Finnish guidelines 2005).
- Make **piles stable** to avoid their collapse
- A high and narrow heap is recommended.

Other areas

- Avoid damage of sites of valuable social and cultural **significances** (MN guidelines 2005 and Finnish guidelines 2005).
- **Integrate** biomass harvesting with other commercial operations and goals (Canadian guidelines 2006)
- Be **efficient** and minimize fuel consumption (Canadian guidelines 2006)

Why are guidelines significant?

There are advantages and disadvantages for using woody biomass.

Guidelines are necessary to help **avoid** many **complications**, and reduce environmental **impacts** of biomass harvesting.

Next section looks at some of these advantages and disadvantages of biomass harvesting.

Advantages of using woody biomass energy

a) Forest biomass is a **renewable** resource that can displace fossil fuels (Canadian guidelines 2006)
b) Forest biomass is a **carbon-neutral** energy source (Canadian guidelines 2006)
c) Recovery of debris within a stand or at roadside can **facilitate** stand renewal treatments and **reduce** fire hazards (Canadian guidelines 2006)
d) Forestry related **jobs** (Canadian guidelines 2006)
e) Provide new **opportunities** for smaller rural communities (Canadian guidelines 2006)

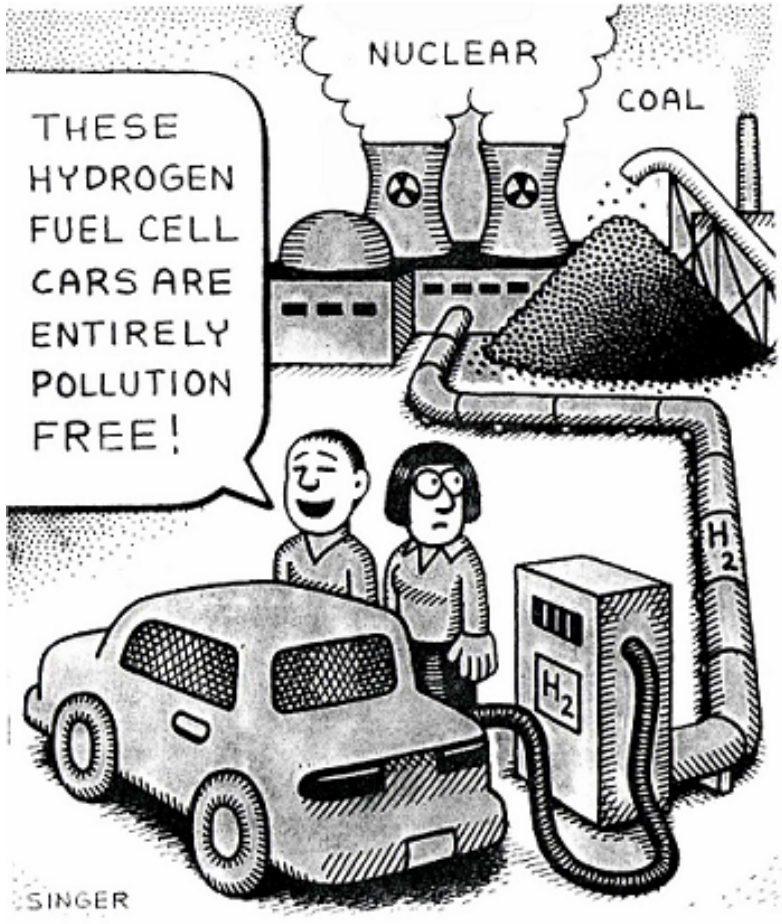
Advantages contd.

f) **Improves** conditions for **soil** preparation (Finnish guidelines 2005).

g) Planting become easier and faster to carry out, and the **results** of regeneration are better (Finnish guidelines 2005).

h) Renewable energy has not experienced the same **price** volatility of other energy resources (NEP 2001)

I) Biomass is a **good** energy source.



Disadvantages of using woody biomass energy

a) Leaving large scale unutilized woody debris on road side **decreases** land productivity (Manitoba Guidelines 2005).
b) Piling debris can **increase** fire risks (Manitoba Guidelines 2005).
c) Removing debris may affect soil **fertility** (Manitoba Guidelines 2005).
d) Woody debris is important to **maintain** biodiversity (Manitoba Guidelines 2005).
e) Cone bearing slash promotes natural regeneration (Manitoba Guidelines 2005).
f) **Leaving** slash on shallow soils or coarse textured dry sites promotes natural regeneration (Manitoba Guidelines 2005).

Disadvantages contd.

g) Overloading **negatively** impacts forest road conditions (Hamelinck et. al. 2005).

h) Burning woody debris **releases** greenhouse gases.

i) Need for more forest residue harvesting **technology** and **research** to make this energy project more environmentally sensitive and economically viable.

Conclusion

Biomass removal guidelines are important in **determining** and **identifying** biomass energy potentials.

Biomass harvesting for energy can create economic **opportunities** for the communities whose livelihoods depend on its production.

Biomass for energy is a **renewable** and a **cleaner** source than other non renewable fossil fuel sources.

However, care needs to be considered, lest biomass harvesting causes a **decline** in the natural resources regeneration and **depletes** natural resources in the future.

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