

Forest Operations and Sustainable Supply Chains

From Theory to Practice
Challenges for Forest Engineering



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Introduction

- The purpose of this presentation is to place the field of forest operations within sustainability debates.
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Outline

- What does a sustainable supply chain look like?
 - Are forest operations a sustainable practice?
 - Ecological factors
 - Cost factors
 - Social and market factors
 - Operator factors
 - Conclusion
 - Take home message
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What does a sustainable supply chain look like?

It is one that conveys:

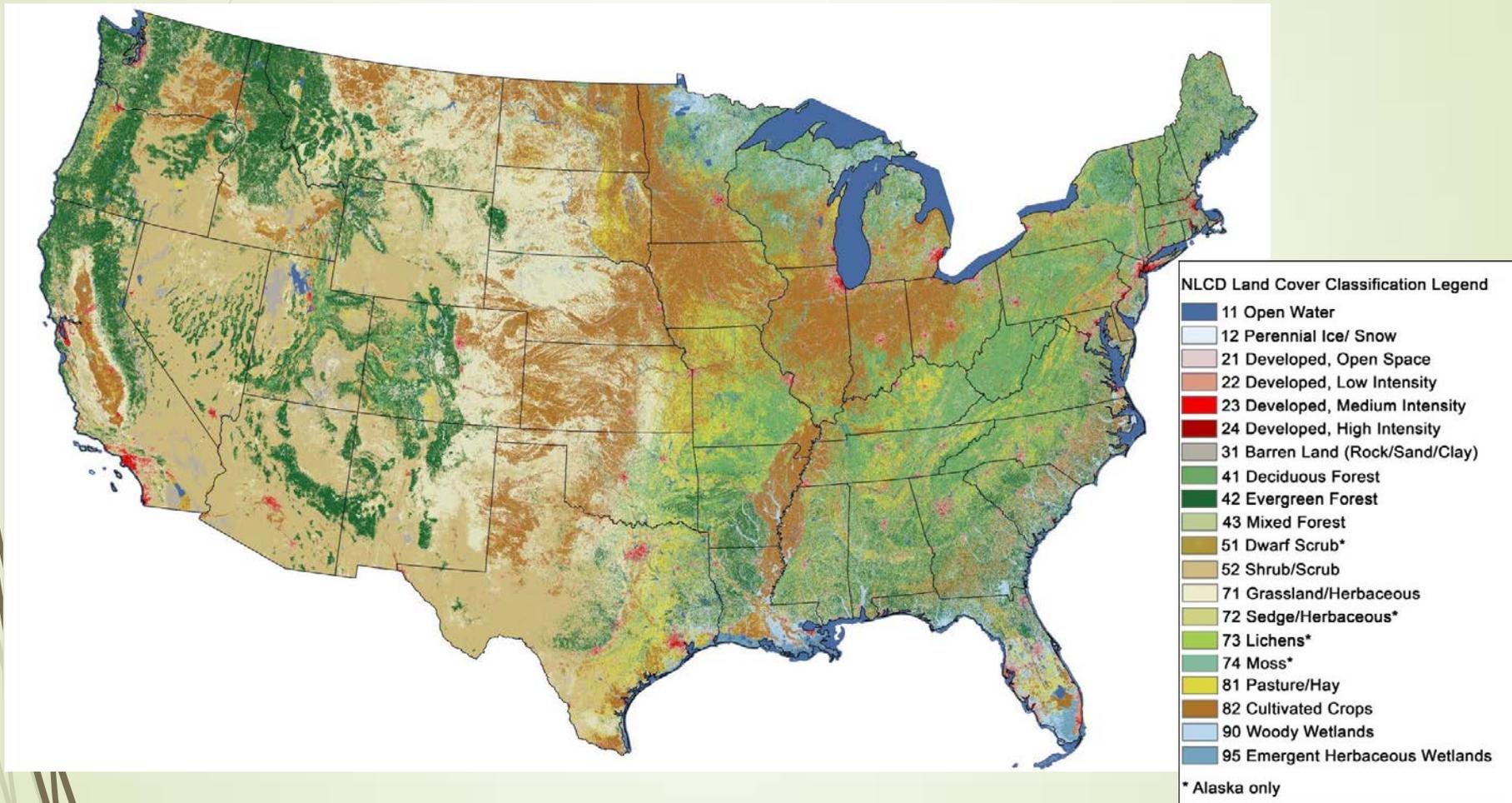
- Environmental soundness
- Cost effectiveness
- Social and market acceptability
- I add to those operator factors



Are Forest Operations a Sustainable Practice?

- ▶ Yes, no and maybe.
- ▶ These views are from one book and one region:
 - ▶ “Oliver et al. (1997) argued that **forest harvesting should be increased in many regions**, including the Pacific Northwest, in order to reduce fuel loads and the danger of catastrophic fires.”
 - ▶ “Because most plant species abundances do not vary greatly among younger, mature, and old-growth forests in western Oregon and Washington (Spies 1991), few plant species have been **directly endangered** by the forest harvesting that has occurred.”
- ▶ In our field, we attempt to make sure forest operations and the entire supply chain are a sustainable practice.

US Forest Types Map



What gets *in the way* of biomass harvesting and supply?

- ▶ Guidelines and the effect of harvest operations on:
 - ▶ Nutrient requirements
 - ▶ Water Quality
 - ▶ Biodiversity needs
 - ▶ Carbon footprint
 - ▶ Cultural acceptance of the removal practices
 - ▶ Cost
 - ▶ The full supply chain
 - ▶ The introduction of new pieces of equipment in operations
 - ▶ Market
 - ▶ Alternatives for energy uses
 - ▶ Alternatives material uses
 - ▶ Technology and workforce
- Provisioning
Ecosystem
Services



Ecological Factors

Forest Harvest Guidelines



Sustainability Guidelines

- Guidelines and best management practices (BMPs) are the conventional instruments used to promote environmentally sustainable practices.
- Best management practices are mostly voluntary. If implemented, they offer agreed upon practices to protect soil, water, wildlife and biodiversity values, without impairing the resources' commercial and non commercial resources (MFRC 2005, Abbas et al. 2011)

Key Concerns from Forest Operations



Ecological:

- Soil and nutrients
- Water quality and quantity
- Wildlife and biodiversity
- Site impacts

Other areas:

- Storage and handling of harvested material
- Cultural and aesthetic values

Soils Guidelines

Seek to:

- Protect the physical, chemical and biological properties of soils by **minimizing the effects of soil compaction, rutting, erosion and nutrient removal.**
- Tree removal = Soil nutrients removal



Source: dfr.state.nc.us



Concerns

- **Nutrients:** depletion of soil nutrients from frequent and repeated harvests.
- **Compaction:** Reduced water availability and increased runoff; height reduction of 50% or more, volume reduction up to 75% (Reisinger et al. 1988)
- **Steep and wet terrain:** Steep terrain in riparian areas will increase the potential for erosion, sedimentation, and mass movement of the hillside (Verry et al. 1999).
- **Tree removals:** Loss of organic matter and site disturbance, as up to 50% reduction if site is severely compacted (Amaranthus et al., 1996)

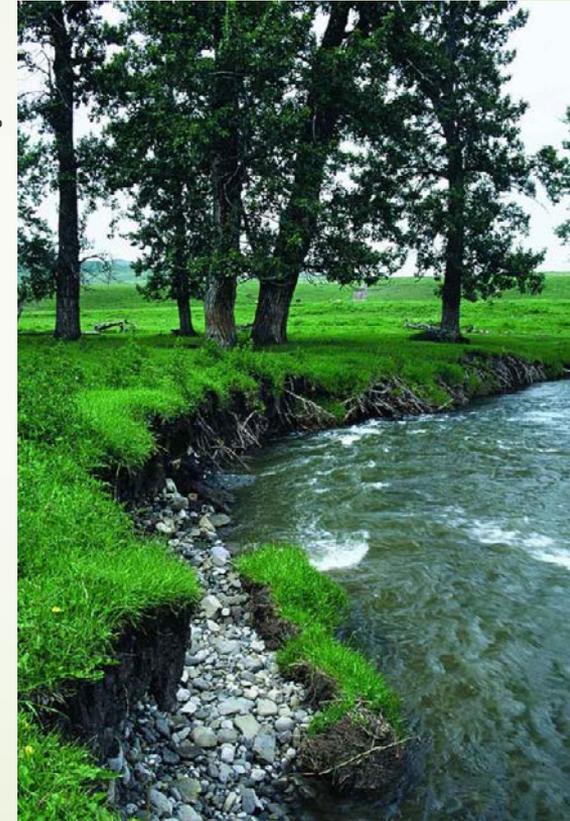


Concerns contd.

- **Wetlands:** Removal of biomass may be inappropriate from wetlands that support rare communities (Evans et. Al. 2002)
 - **Roads:** Impact the area removed from production, as up to 30% of forest area lost to roads (Megahan and Kidd 1972 cited in Elliott et al.)
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Water Quality Protection

- Reduce nonpoint source **pollution** from forest management activities.
- Maintain water **temperatures**.
- Reduce **erosion** and subsequent sedimentation of water bodies.
- Reduce the movement of pesticides, **fuel, lubricants** and other chemicals to surface water, wetlands and ground water.





Water Quality Guidelines

- Residue **not piled** or stored on ditches.
 - Residue **not removed** from riparian zones and from nearby all small water bodies after harvest.
 - Ditches must remain **functional** after harvest.
 - Avoid placing clearing debris in **filter strips**.
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Wildlife and Biodiversity

Maintain structural components of the site (including live trees, snags, fine and coarse woody debris, shrubs and ground cover) needed for forest wildlife both now and as the forest stand regenerates.



<http://www.bcgrasslands.org>



<http://www.sfgate.com>

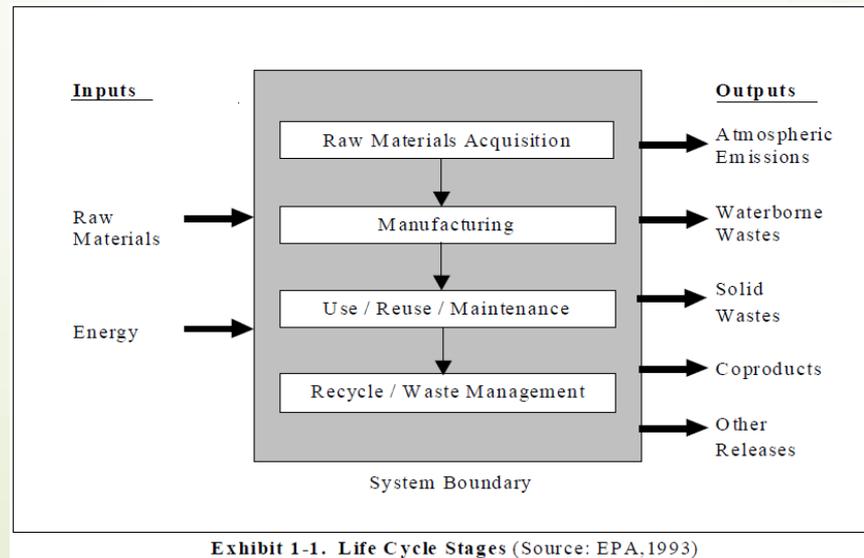


Wildlife and Biomass Harvesting

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

Ensure that the carbon emitted from the manufacture, use, and maintenance of wood products to their final disposal, including the raw material acquisition required to manufacture the product is **not a plus** to the environment through mitigation and accounting methods.





Other Considerations

- Avoid damage of sites of valuable social and cultural significances.
- Integrate biomass harvesting with other commercial operations and goals
- Be efficient and minimize fuel consumption



Cost limitations

The effect of steepness, terrain type, cut type and species on the cost of operations is not insignificant



From a business perspective, why is it important to analyze biomass removal?

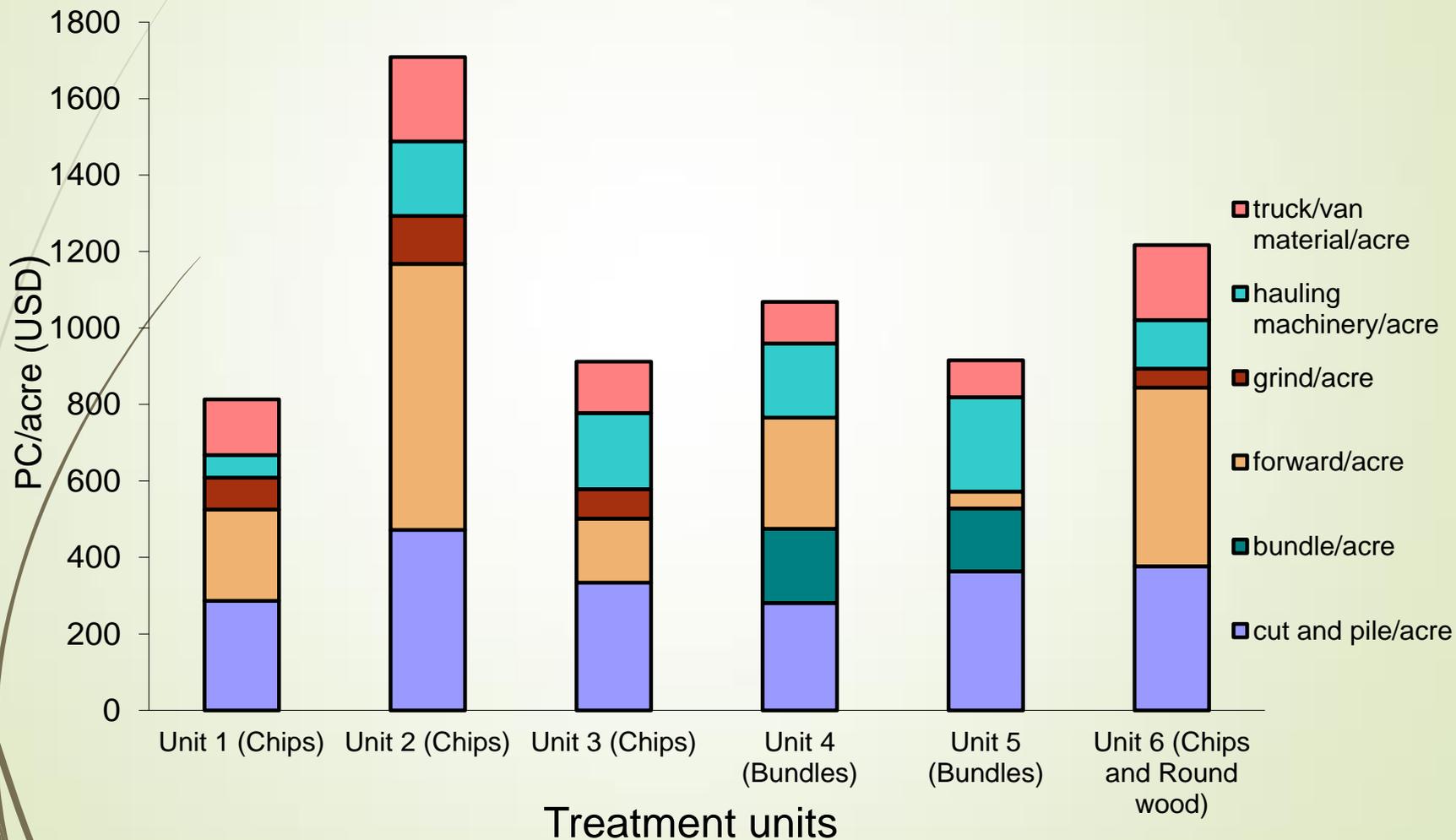
- Optimize production factors
- Compare different harvest systems
- Develop alternative scenarios
- Reduce negative environmental impacts
- Of course, we need to make sure that the system in use is **profitable** not only productive.



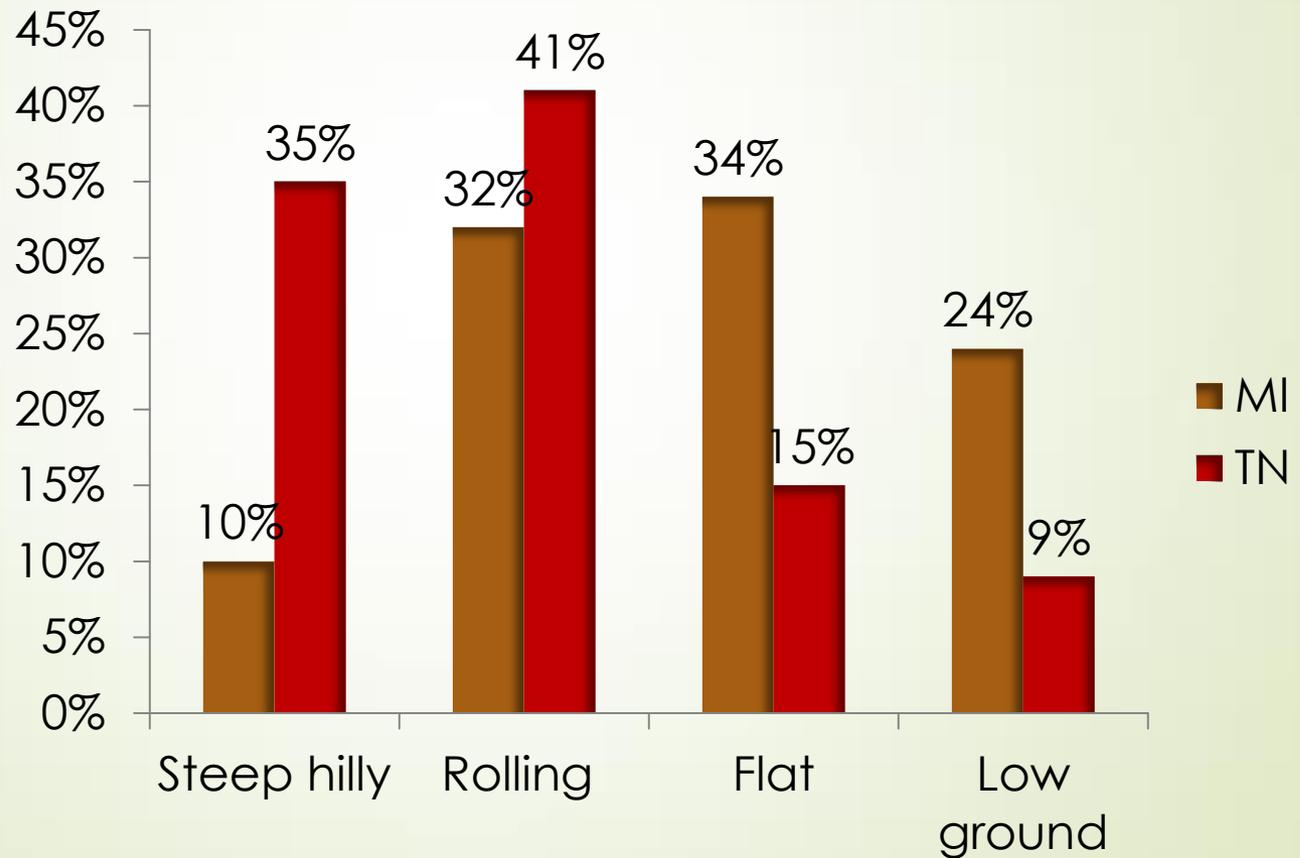
Equipment and Supply Chain Cost factors

- Equipment purchase price
- Machine life
- Salvage value after machine life
- Time involved in the operation (SMH and PMH)
- Repair and maintenance
- Insurance, interest and tax rates
- What is the price of fuel? How much is used?
- how much lube and oil is used? What is the price?
- How much are the operators paid? fringe and benefits?

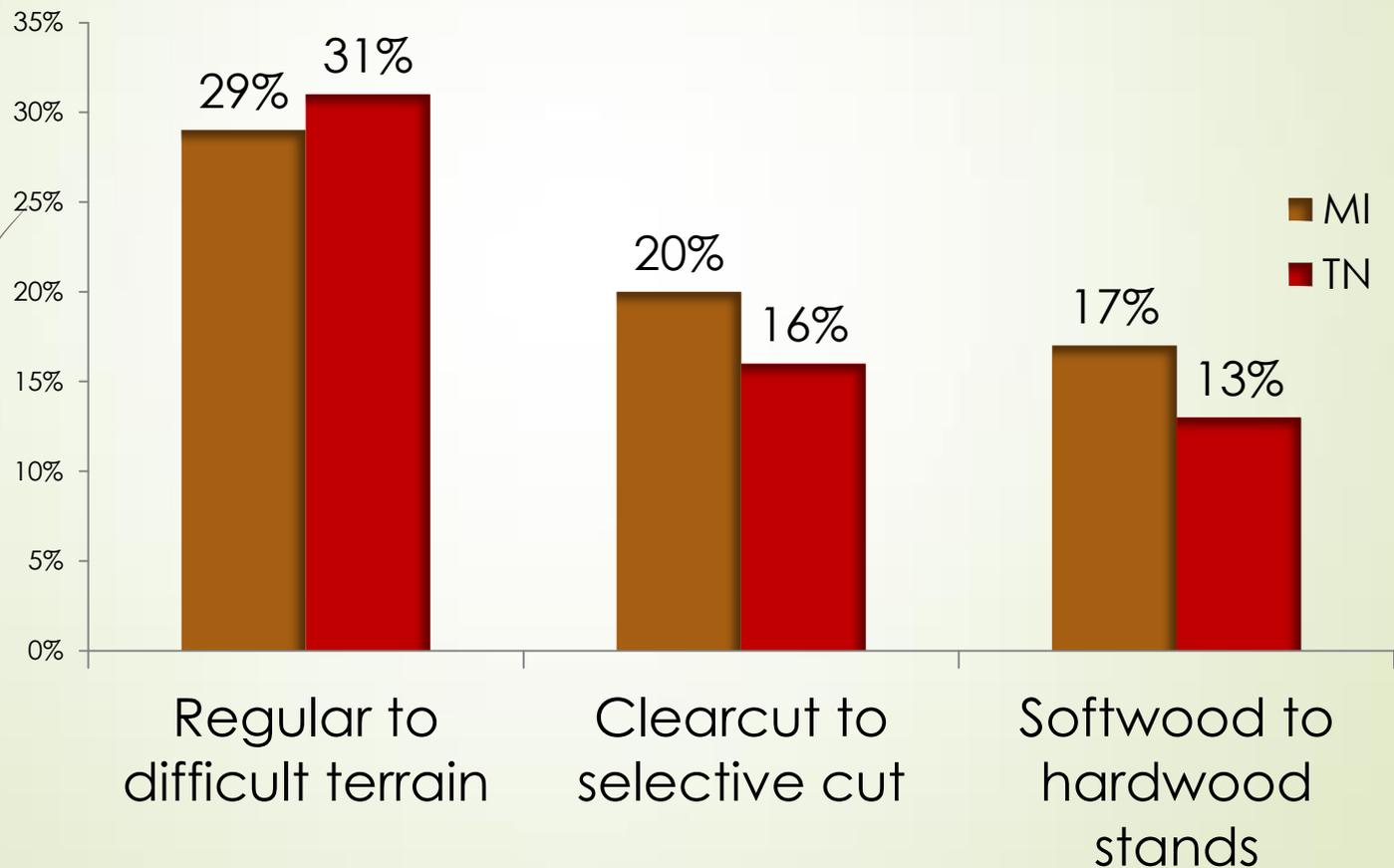
Per acre biomass supply and production costs vary, especially in natural stands.



Cost Increases from Operations on different Terrain Types



Cost Increases from Operations in different Conditions





Social acceptability

What do people think about biomass harvesting for energy?



Social acceptability factors

- Guaranteed supply of woody biomass
- Long-term contracting
- Utilization effect on acres treated
- Lack of industry
- Environmental concerns (NEPA)
- Logistics and transportation costs
- Budgets and staffing

Market Factors

The 800 pound gorilla ...



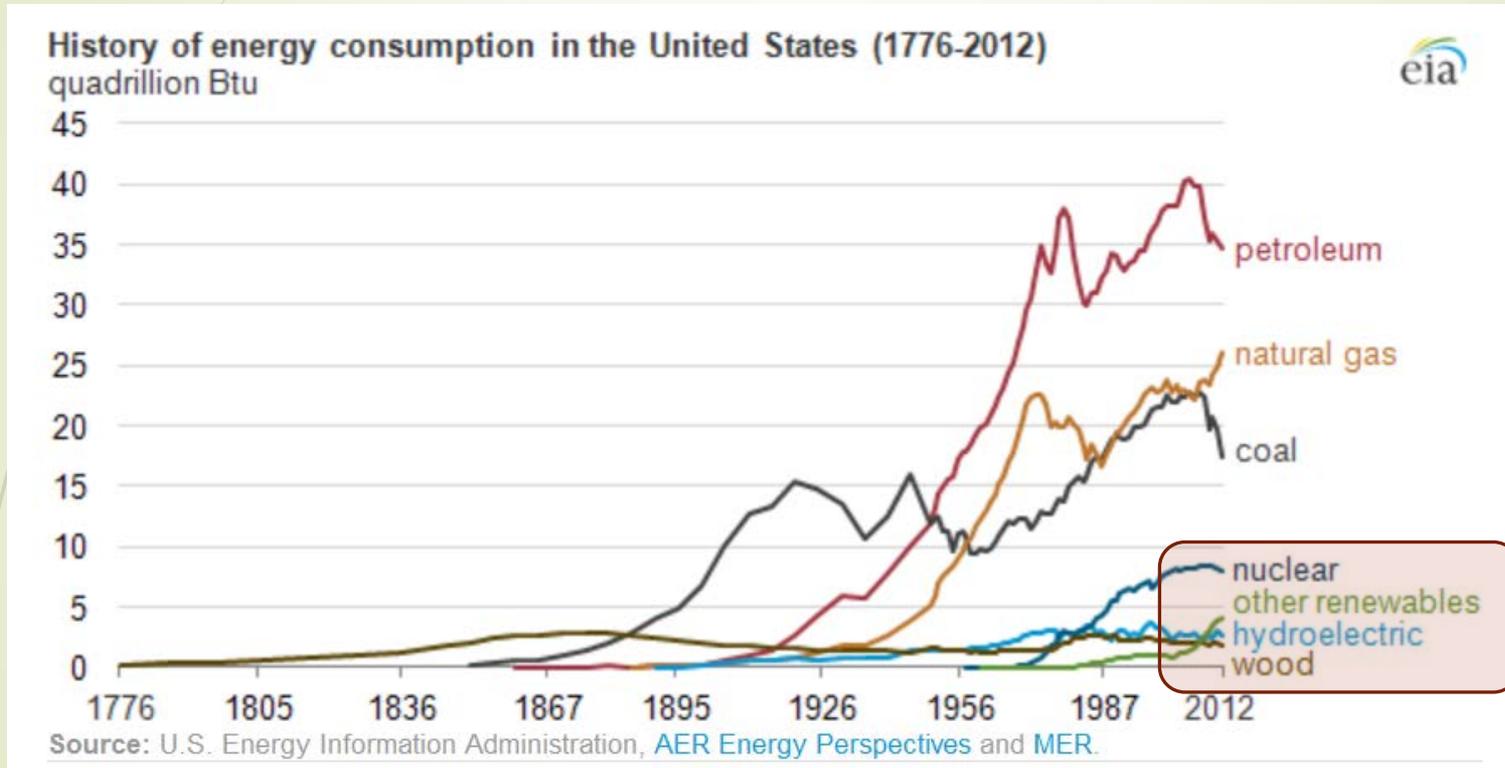


Market factors

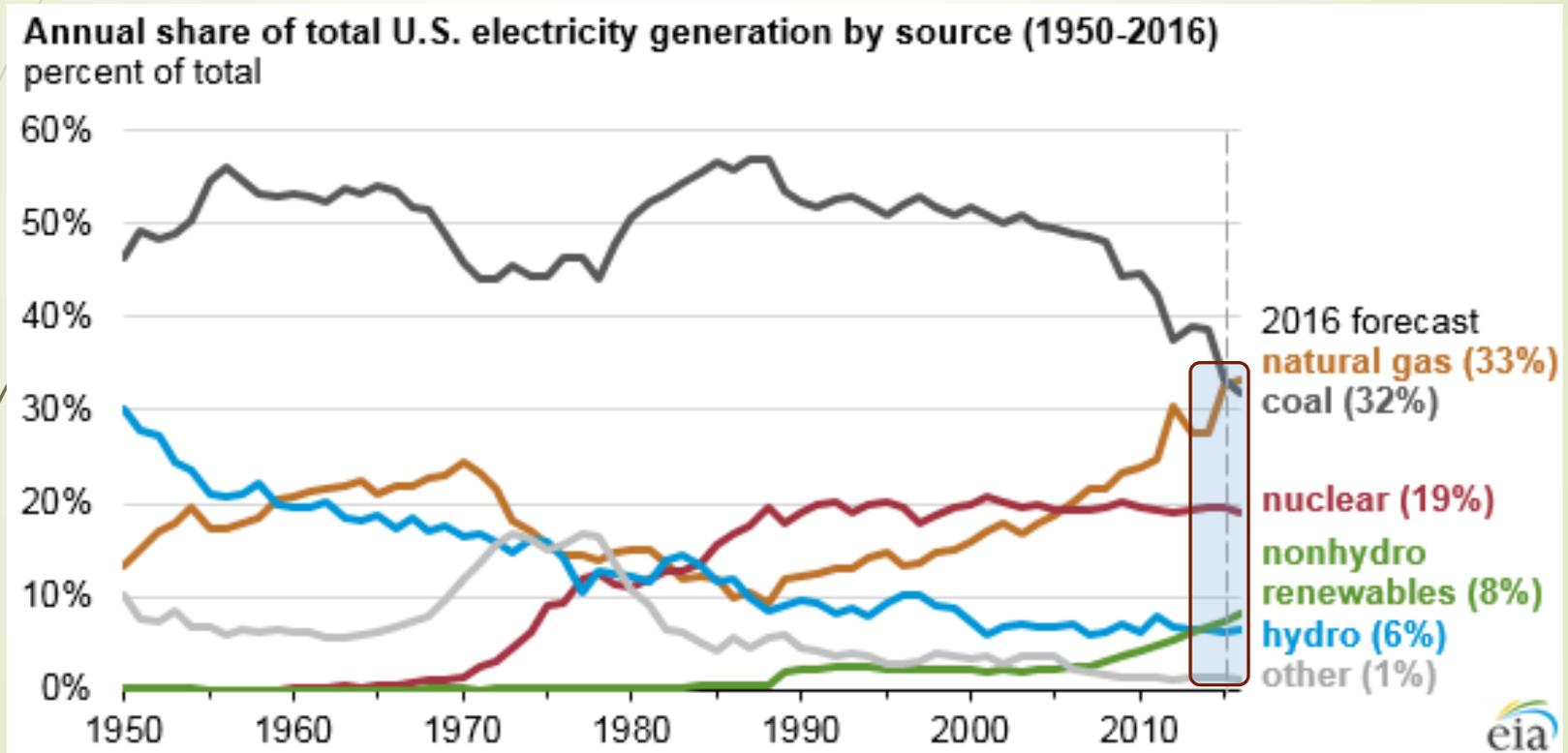


- ▶ Think about it, what is the price of a ton of wood chips vs. ton of pulpwood? [more, less or equal?]
- ▶ Very often it is less, even though woodchips require an additional unit in the product supply chain.
- ▶ The market does not always account for the operational cost of commercially low valued material.
- ▶ There has been a long standing call for the need to develop new biomass-based products that would justify the investment in biomass harvesting.

Market historical trends



Market current trends: “Natural gas expected to surpass coal in mix of fuel used for U.S. power generation in 2016”





Operators and sustainable operations

What are they expected to do?



Harvesting and Operators

- Follow all BMPs for the state or region
- Avoid repeated passes by heavy equipment.
- Enter a site as few numbers as possible.
- Integrate biomass harvesting with other forest operations.
- Use appropriate equipment matched to site and operations.
- Use low-impact logging techniques or use of **slash to protect soil from rutting and compaction from harvest machines.**
- Select equipment



Select Equipment

- Equipment owners need to be aware of the conditions of their operations to operate with, and invest in the **better positioned equipment for their geographical reasons**. However, the skill of the operator to function under different conditions using different technological adaptations must not be underestimated (FAO Forestry Paper 14, 1983)
- However, the selection of equipment among operators depends on the **available equipment and profit compared with affordability**. Several operators rebuild their equipment and/or buy used equipment.



Wrap up



Conclusion

- ▶ Sustainability in forest operations supply chains is a humbug of different considerations
- ▶ They include
 - ▶ Forest best management practices and their environmental considerations
 - ▶ Efficient forest products supply chains
 - ▶ An informed understanding of the market dynamics as they relate to forest products, but also alternative markets that forest products are supplied for.
 - ▶ A deliberate effort to focus on the role of operators along the supply chain and their interactions with the landowners, foresters and most importantly the industry.
- ▶ With all of these considerations, we start to talk about sustainable supply chains, because every piece of the sustainability jigsaw helps build the sustainability picture.



Take home message

- ▶ In order to link forest operations, the supply chain sustainability factors, we need to:
 - A. Bridge the gaps, and investigate further the linkages, between operational guidelines, cost and acceptability and the operator's role to build an effective supply chain.
 - B. Keen in mind the full picture of sustainability



Thank you for your attention!

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