

Impacts of Alternative Energy Production on Forests

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Outline of Presentation

- Green technology characteristics
- How forests help us
- Status of forests
- The role of forests in our climate
- Alternative energy technology impacts on forests
 - Bioenergy
 - Hydropower
 - Wind
 - Solar
- Recommendations

Green Technology

- Green technology:
 - Gets the job done
 - Uses resources sustainably
 - Minimizes collateral damage
- Everything is interconnected in a web – need to consider effects on:
 - Environment – air, water, soil, climate, biodiversity, food
 - Human health
 - Economy
 - Society
- Technologies are not intrinsically green
 - They need to be deployed in a green way

What Do Forests Do For Us?

- Carbon uptake and storage:
 - America’s forests sequester and store 12% of total US greenhouse gas (GHG) emissions (*Obama Clean Power Plan*)
 - Few options for carbon storage: plants, soil, water
- Provide oxygen
- Clean air and water
- Prevent soil erosion
- Wildlife habitat
- Flood storage, water conservation, and water cycle moderation
- Shade and temperature moderation
- Wood, food, medicine
- Nature and wilderness for humans
- Many believe living things have an inherent right to exist
 - “Nature’s Rights”
 - Aside from how they benefit humans

What Are Ecosystem Services?

- Benefits people obtain from ecosystems
- United Nations Millennium Ecosystem Assessment categories:
 - Provisioning Services
 - Food, fresh water, fuel, fiber, and other goods
 - Regulating Services
 - Climate, water, and disease regulation, as well as pollination
 - Supporting Services
 - Soil formation and nutrient cycling
 - Cultural Services
 - Educational, aesthetic, and cultural heritage values
 - Recreation and tourism

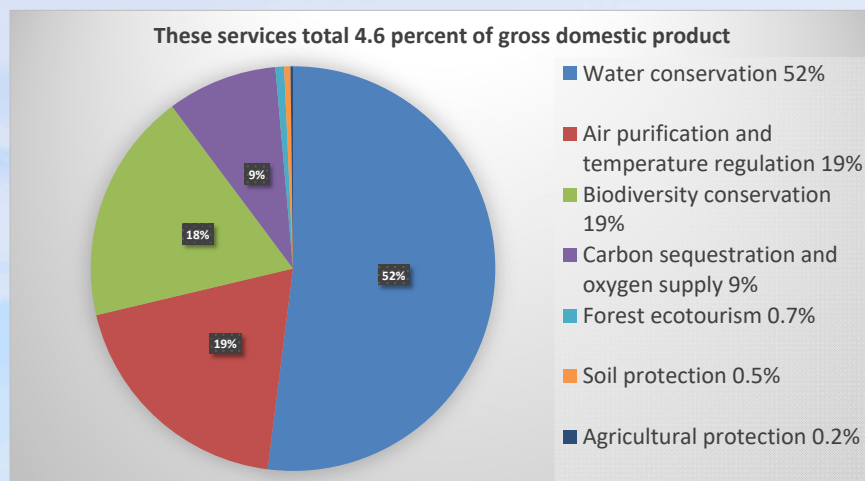
<http://www.millenniumassessment.org/en/Index.aspx>

EU-Commissioned Study of Economic Value of Forest Loss

- Led by a Deutsche Bank economist
- Estimated global financial loss of ecosystem services from forest loss
- Staggering annual cost of forest loss:
 - \$2 trillion to \$5 trillion
- For reference, the total annual U.S. federal budget:
 - \$3.8 trillion

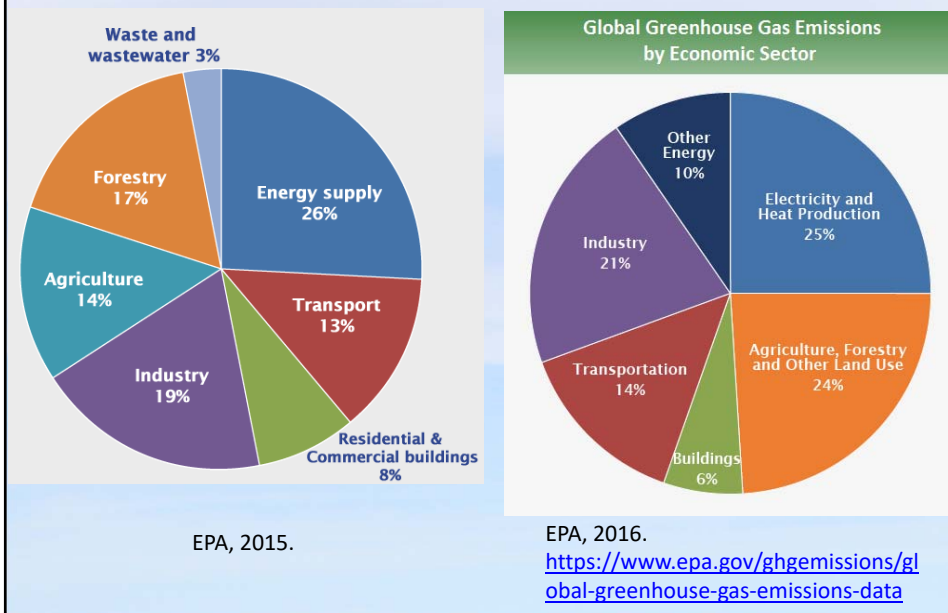
<http://news.bbc.co.uk/2/hi/7662565.stm>

Example: Beijing Municipality – Value of Forest Ecosystem Services and Sociocultural Benefits

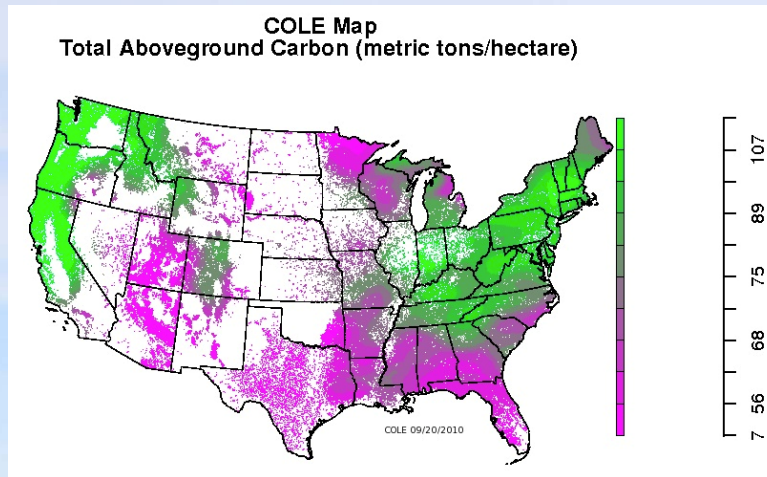


www.fao.org/docrep/012/i1507e/i1507e07.pdf

Sources of Global GHG Emissions



Forest Carbon Storage



<http://www.ncasi2.org/COLE/>

Status of Forests

- There are 3 trillion trees on Earth
- We cut down 15 billion trees each year
- Earth has lost 46% of its trees since the onset of agriculture 12,000 years ago
- Rapid deforestation occurring not just in rainforests
 - Temperate and boreal forests too
- 68% the world's flowering plants (many in forests) are now threatened or endangered – due to
 - Habitat loss and degradation
 - Invasive species

<http://www.nature.com/news/global-count-reaches-3-trillion-trees-1.18287>

https://www.researchgate.net/publication/281532511_Mapping_tree_density_at_a_global_scale

http://www.huffingtonpost.ca/2014/09/05/canada-deforestation-worst-in-world_n_5773142.html

<http://www.nytimes.com/2015/10/17/opinion/our-vanishing-flowers.html>

Intact Forests Absorb and Store More Carbon

- Undisturbed, mature forests are carbon “sinks”
 - Continuing to absorb and store carbon from the atmosphere for 400 years or more
- Large, old trees absorb and store more carbon than small trees
 - One big tree can add as much carbon in a year as is contained in an entire mid-sized tree
- Unlogged northern hardwood forests absorb 39% to 118% more carbon than logged forests

https://www.uvm.edu/giee/pubpdfs/Keeton_2011_Forest_Science.pdf

http://web.natur.cuni.cz/fyziol5/kfrserver/gztu/pdf/Luyssaert_et_al_2008.pdf

<http://pubs.acs.org/doi/pdfplus/10.1021/es902647k>

<http://andrewsforest.oregonstate.edu/pubs/pdf/pub4835.pdf>

http://www.uvm.edu/giee/pubpdfs/Nunery_2010_Forest_Ecology_and_Management.pdf

Intact Forests Absorb and Store More Carbon

- At least 50% of total ecosystem carbon is stored in soils
 - In intact northeastern U.S. forests
- Protecting high-biomass forests from logging avoids significant carbon emissions to the atmosphere
- Eliminating logging on U.S. public lands
 - Would increase carbon storage by 43% over current levels

<http://onlinelibrary.wiley.com/doi/10.1111/gcbb.12221/abstract>

<http://www.pnas.org/content/106/28/11635.full.pdf>

<http://naldc.nal.usda.gov/download/21039/PDF>

Logging Reduces Carbon Storage

- Old forests that are logged and converted to young forests
 - Release large amounts of GHGs
 - Can take 200 years or more to recover original carbon storage capacity
- Only ~23% of carbon in logged trees ends up in long-term storage
 - Mostly incorporated into buildings or buried in landfills
- Wood products manufacturing discards 45% to 60% of original carbon in trees as waste
 - Rapidly decomposes or is burned

<http://andrewsforest.oregonstate.edu/pubs/pdf/pub1046.pdf>

<http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.335.6609&rep=rep1&type=pdf>

<http://andrewsforest.oregonstate.edu/pubs/pdf/pub2101.pdf>

Logging Releases Carbon From Soil

- Logging a forest quickly releases ~30% of carbon stored in shallow forest floor soils to the atmosphere
- Deeper mineral soils gradually continue to release carbon after logging
 - May contribute to climate change over decades

<http://soilslab.cfr.washington.edu/publications/Nave-et-al-2010-SoilCarbon.pdf>

http://www.nrs.fs.fed.us/pubs/jrnl/2010/nrs_2010_johnson_001.pdf

http://www.eurekalert.org/pub_releases/2014-12/dc-ldf120214.php

Deforestation



Bioenergy

- Primary technologies:
 - Burning wood for electricity and/or heat (biomass)
 - Biofuels – converting plants to liquid fuels
- Other minor technologies, such as
 - Burning methane from landfills and anaerobic digesters

Biofuels

- Primary biofuels:
 - Corn and cellulosic ethanol
 - Palm oil biodiesel
- Devastate forests and other lands
 - Inefficient process – requires a lot of feedstock
 - *Science*: to replace 10% of US gasoline with ethanol and biodiesel would require 43% of U.S. cropland, plus lead to forest clearing for food corn in developing world
- More energy consumed to produce biofuels than biofuels contain
 - Takes more than a gallon of petroleum to make a gallon of ethanol
 - Ethanol contains less energy than petroleum

http://e360.yale.edu/feature/the_case_against_biofuels_probing_ethanols_hidden_costs/2251/
http://news.minnesota.publicradio.org/features/2005/03/21_steilm_ethanolenergy/
http://www.huffingtonpost.com/ellen-mover-phd/biomass-biofuel-biopower-b_8680774.html

Biomass Power Impacts

- Requires massive amounts of wood
 - Inefficient technology (~20-25% efficient)
 - Fueling 5 biomass plants considered in MA
 - Would have logged all western and central MA forests in 9-16 years
- Cutting and burning a forest for bioenergy creates a carbon “debt”
 - Debt is not offset by regrowth for 20 to 90 years or more
- Releases more carbon dioxide than coal
- Double-whammy damage to the climate
 - Logging and burning release carbon dioxide from forest soils and trees (and equipment)
 - Logging destroys trees that otherwise could have removed CO₂ from the atmosphere

<http://www.maforests.org/Impacts.htm>
<http://www.mass.gov/eea/docs/doer/renewables/biomass/manomet-biomass-report-full-lorenz.pdf>
<http://www.usnews.com/science/articles/2010/06/11/wood-power-worse-polluter-than-coal>
<http://www.mass.gov/eea/docs/doer/renewables/biomass/manomet-biomass-report-full-lorenz.pdf>
<http://energy.gov/energysaver/articles/wood-and-pellet-heating>
http://www.huffingtonpost.com/ellen-mover-phd/burning-trees-to-make-ela_b_1601275.html

Biomass Power Plant - Burlington VT



Hydropower Examples

- Three Gorges Dam, China
 - Flooded 244 square miles
- Southeastern Anatolia Project, Turkey
 - Will flood 121 square miles
- Balbina Dam, Brazil
 - Flooded 1,208 square miles
- Many others...

Lester Brown et al. 2015. The Great Transition: Shifting from Fossil Fuels to Solar and Wind Energy
<http://news.nationalgeographic.com/energy/2015/07/150701-hydropower-dam-threatens-amazon-wildlife/>

Plymouth, MA Solar Farms

- 15 solar farms approved or built since ~2010
- 225 acres (total) of forested land cleared
- Rare Coastal Pine Barrens forests - only found in southeastern MA, Long Island NY, and NJ
- Some sites - developers mined and sold the sand and gravel first
- More lucrative to site solar on forest land

http://www.slate.com/articles/technology/future_tense/2016/06/going_solar_isn_t_green_if_you_cut_down_tons_of_trees.html

Coastal Pine Barrens – Plymouth, MA



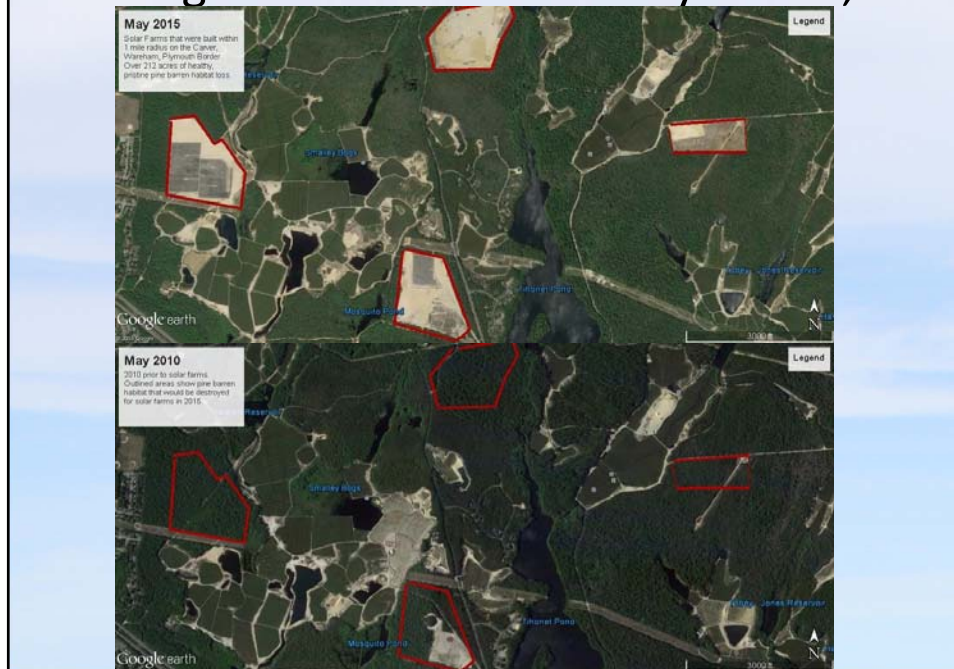
Solar Farms in Plymouth, MA



Plymouth – Solar Farm on County Land



Clearing Forests for Solar in Plymouth, MA



Solar in Shirley, MA



- Clear cut 100 acres
- Clear cut 15-20 acres in Zone II of a public water supply – chemicals?
- Public land taken for industrial use
- Many other examples of forests destroyed for solar
 - Google “solar destroys forests”

Lowell Mountain, VT Ridgeline Wind



Lowell Mtn. Example Areas Destroyed

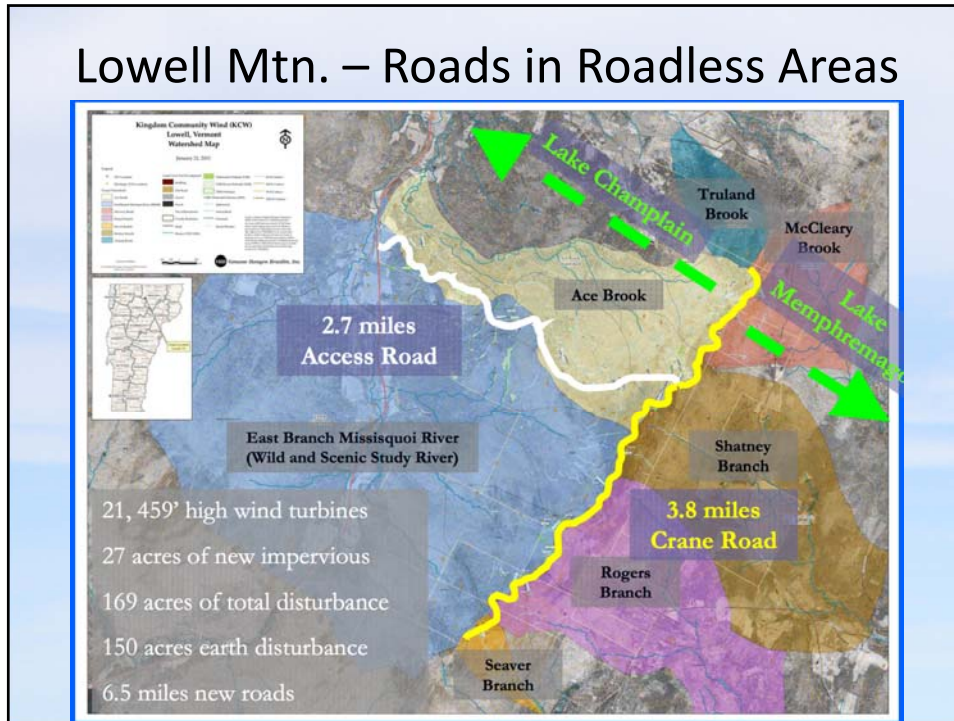
Montane Yellow Birch forest is now turbine 13



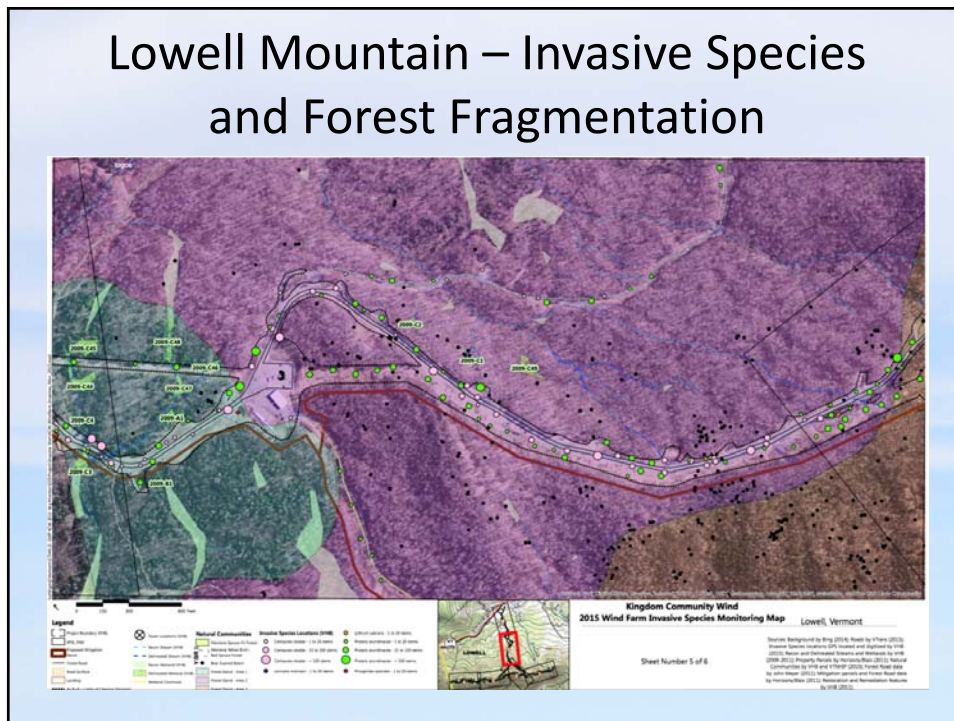
Serpentine boulder is now turbine 18



Lowell Mtn. – Roads in Roadless Areas



Lowell Mountain – Invasive Species and Forest Fragmentation



Recommendations

- Preserving trees is a major answer to climate change (+ more)
- Conservation and efficiency – top priority
 - Minimize the need for new energy generation
- Start valuing forests' many ecosystem services
- Crucial to preserve our trees for carbon removal and storage and other services
 - No commercial logging on public land
- Remaining old growth forest especially crucial to protect
- Switch to carbon-free energy quickly but carefully
 - Consider all the ramifications
- Carbon-free energy sited recklessly is not green energy
- Start using a green approach
 - We need to do more than one thing at a time – energy *and* climate *and* land *and* forests *and* water *and* air *and* economy *and* ...

Recommendations

- Climate change says: stop burning things, tearing up the land, and destroying carbon sinks
 - Logging
 - Burning trees for energy
- Avoid massive hydropower projects
- Stop siting wind and solar projects on forest land
 - Forests as last resort, not first choice
- Site wind and solar on suitable sites

Energy Conservation and Efficiency First

- USDOE: “Energy efficiency is one of the easiest and most cost-effective ways to combat climate change.”
- Efficiency is the cheapest electricity resource:
 - ~1/3 the cost of new electricity generation
- Huge opportunity
 - North Americans use twice as much energy as Europeans
- Other benefits besides climate:
 - Cleaner air
 - Improved competitiveness of businesses
 - Reduced energy costs

<http://energy.gov/science-innovation/energy-efficiency>

http://ma-eeac.org/wordpress/wp-content/uploads/1_Saving-Electricity

[_A-Summary-of-the-Performance-of-Electric-Efficiency-Programs-Funded-by-RatePayers.pdf](#)

Plenty of Suitable Sites for Potential Wind and Solar

- Rooftops
- Highway rights-of-way
- Closed landfills, hazardous waste sites, and brownfield sites
- Closed coal plants
 - Example: Mount Tom, Holyoke, MA solar
- Farmland – wind
- Offshore – wind
- Challenge: suitable sites may be less profitable and more difficult for developers
 - As long as ecosystem services are not valued
 - As long as energy technology is not deployed in a green way

Thank You

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