HOW RE-PURPOSING CONTAMINATED LANDS CAN FULFILL INCREASING ENERGY DEMANDS WITH CLEAN ENERGY

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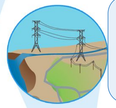
Abstract

In the United States alone, marginal and contaminated lands such as brownfields, closed landfills, and abandoned mine lands (AML) cover a total of 121,000,000 hectares (ha) of space.[1] These lands cannot be used for any purpose until properly assessed for environmental and social impacts. As remediation processes often require an incredible amount of time and resources, much of this land is considered purposeless and left derelict. This poster aims to highlight economically viable and environmentally friendly strategies to re-purpose these lands as seen in the U.S. EPA's Re-Purposing initiative and explore similar possibilities in Canada.

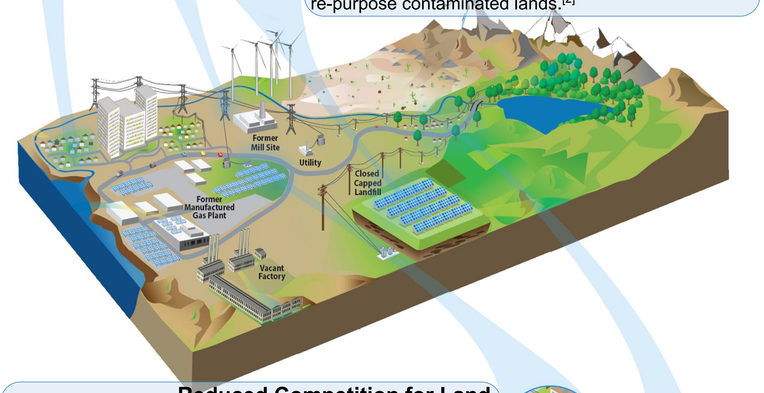
Advantages of Re-purposing

Community Support
Local communities can suffer from both environmental impacts and lowered land value due to contaminated sites. Repurposing these sites can provide lower cost energy while increasing surrounding property values.[2]



Availability of Existing Infrastructures
Project development costs and time investments can be reduced by taking advantage of pre-existing transmission lines, roads, water supply, and buildings found on marginal lands.[2]

Reduced Land Costs
Marginal lands can often be acquired or leased at lower rates than similar undeveloped sites. Federal tax incentives can also help finance projects aimed to re-purpose contaminated lands.[2]



Reduced Competition for Land
With a growing population and food demand more agricultural space is required thereby increasing competition for land resources.[2] Utilizing marginal land for energy production can reduce competition for more productive land sites.[2]

Expedited Re-zoning Applications
Zoning designations are often compatible with pre-existing designations thereby reducing costs.[2] Application process can also be streamlined by the city as many communities support redevelopment of contaminated land.[2]

Figure 1: Benefits of U.S. EPA's "RE-Powering America's Lands" initiative of encouraging the development of clean, renewable energy projects on currently and formerly contaminated lands.[2]

Re-purposing American Lands

As of 2015, the United States has 25,114 AML sites, 15,808 Brownfields sites, and 588 landfills.[1] Many of these sites overlay areas with high Photovoltaic potential, large microalgae growth rates, and top tier wind power classes, making them ideal locations for clean energy production.

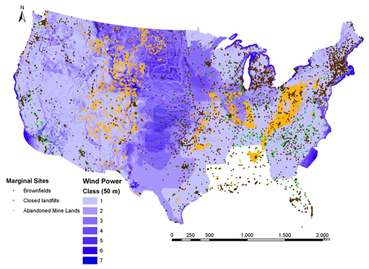


Figure 2: Mapped brownfield, closed landfill, and AML sites overlaid on regional wind power classes across the United States. Wind power classes 1 to 7 correspond to 0, 200, 300, 400, 500, 600 and 800 W/m^2, respectively. States with missing data were excluded.[1]

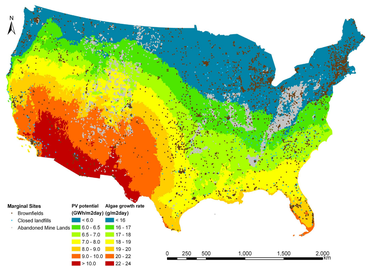


Figure 3: PV potential and microbial growth rate across the U.S. overlaid on individual brownfield, closed landfill, and AML sites.[1]

In 2012, 1.20 x 10^5 TJ of biodiesel was consumed and 28.4 x 10^6 GWh of electricity was used in the U.S.[1] While individual energy outputs potentials of marginal land sites will vary dependent on location, strategic deployment of clean energy sources can produce a sizable amount of energy.

Table 1: Range of annual single-source energy production potentials on U.S. brownfields, closed landfills and abandoned mine lands. Minimums and maximums were based on ranges of technological and environmental efficiencies. Each estimate of energy production assumes the use of all mapped marginal lands.[1]

Source	Biodiesel (min) (TJ)	Biodiesel (max) (TJ)	Electricity (min) (GWh)	Electricity (max) (GWh)
Sunflower	5,219	10,439	N/A	N/A
Soybean	10,028	13,305	N/A	N/A
Algae	**33,663**	**53,216**	N/A	N/A
Solar	N/A	N/A	**96,778**	**225,815**
Wind	N/A	N/A	18,139	27,571

Energy generated upon marginal land sites can satisfy up to 39% of the total U.S. energy demand for biodiesel and electricity.[1]

Opportunities in Canada

- Marginal lands defined as areas with poor agricultural productivity, cover between 9.49 - 18.27 million ha of Canadian land.[3]
- Conversion of these marginal lands to plantations for hybrid poplar can generate on average 40 tons of biomass per ha.
- In areas like alberta, these plantations can produce economic returns reaching $316 per ha.
- Strategic conversion of agriculturally marginal lands can supplement energy production while also being economically viable.

10% of active contaminated sites are Federally owned, which costs $4.3 billion to remediate or otherwise manage.[5]

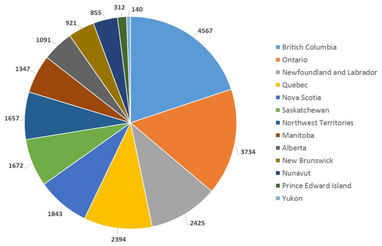


Figure 4: Provincial and territorial active contaminated sites across Canada.[4]

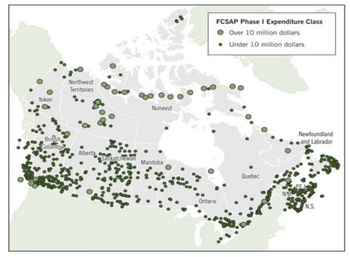


Figure 5: Federally owned contaminated sites across Canada in 2011.[5]

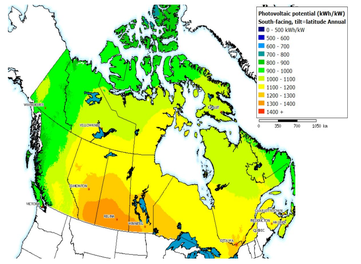


Figure 6: PV potential across Canada with the largest potential located in Southern Saskatchewan.[6]

As seen in Figure 5 and 6, many of these sites are located in relatively high PV potential areas such as southern Saskatchewan. While not every site may be suitable for solar PV development, integrating renewable energy sources and employing sustainable strategies may restore value to marginal and contaminated lands.

Conclusion

- Developing renewable energy technologies on contaminated lands can be highly beneficial to project timeline and economics.
- Utilizing contaminated sites for energy generation can significantly contribute to the rising energy demand.
- Around 10% of active contaminated sites in Canada are federally owned and would cost $4.3 billion to remediate or manage. Avoiding this cost with economically viable clean energy production can provide a major driving force for future investment in contaminated sites.

References

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