









Northern Ontario Circular Economy Symposium

Water Protection and Sustainability



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SUDBURY INTEGRATED NICKEL OPERATIONS ~GLENCORE COMPANY

Executive Summary

On January 19, 2021 speakers from Canada and abroad came together to speak about current and future opportunities of a circular economy in Northern Ontario. A circular economy refers to a system that reduces waste by reusing material in the creation of new products.

Dr. John Gunn, who works at Laurentian University and is the Canada Research Chair in Stressed Aquatic Systems, discusses the transformation of the City of Greater Sudbury. In his presentation he discusses several possible avenues for a circular economy:

 \rightarrow Using paper sludge and wood ashes and human biosolids can be valuable in restoring vast amounts of damaged industrial land and in time creating biofuels growing on those.

 \rightarrow Converting abandoned mining pits into places where solar farms can be established. The land could also be used for growing biofuel crops.

 \rightarrow Creating a cross-laminated timber facility similar to the one in St. Thomas, Ontario.

 \rightarrow Encourage the growth of an engineered microbial industry that can utilize leftover nickel and the like in tailings. In fact, there are efforts being done that are finding very promising pharmaceuticals in the algae and other life forms that can survive in these extreme environments and that might be very soon released as cancer drugs.

Gunn uses a Northern Ontario example to explain how and why circular economy is effective. This gives readers a unique perspective to see how employing a circular economy is effective in the North. Moreover, it demonstrates to readers that the impossible- the recovery of a toofar-gone environment – is in fact possible. But as Gunn says, operating "business as usual" would get limited, if any, positive environmental impacts. In order for the impossible to be achieved, radical change, like that of biotech solutions, are a necessity.



Living with Lakes, Laurentian University Canada Research Chair

Dr. John Gunn is the Canada Research Chair in Stressed Aquatic Systems at Laurentian University and founding Director of the award winning Vale Living With Lakes Centre (LEED Platinum building), a research centre that specializes in restoration ecology and management of aquatic ecosystems impacted by industrial emissions, climate change and multiple stressors.

Purpose

This commentary was transcribed from a presentation John Gunn gave on January 19, 2021, at the online Northern Ontario Circular Economy Symposium event. The editor has adapted some of the text for the sake of structure and narrative. The presentation is viewable on ParlAmerica's YouTube channel.

The event aimed to explore current and future opportunities of a circular economy in Northern Ontario, which refers to a system that "aims to gradually decouple growth from the consumption of finite resources" (Ellen MacArthur Foundation n.d.) — in other words, reducing waste by reusing material in the creation of new products. By doing so, we can create more self-sustaining communities, produce more jobs, become our own supply chain, and reap benefits across Ontario's northern regions.

" In the end, the term 'circularity' may just be one way to make us aware that we need a more encompassing, integrated and restorative sustainability path that includes people as much as technology and nature."

- Michiel Schwarz, A Sustainist Lexicon



Water Protection and Sustainability

Today I'm going to try to represent our larger research community that's operating — in our case, a history study site — and for this particular presentation we'll be using Sudbury, which is the largest city in Northeastern Ontario as an example. Sudbury is known across the whole world now as one of the great examples of wise investment in environmental improvements, and it's becoming a model for the rest of the world, so I'll take that in perspective. Dr. Nathan Basiliko has helped me with the ideas around land and Dr. Nadia Mykytczuk around microbial solutions. We work in an awardwinning building— the LEED platinum building. It's probably the only LEED platinum building in Northeastern Ontario, and inside of it you can see what the future might be in the use of wood. This building won the design with wood competition for Ontario. It might be the impetus for creating a new type of lumber industry for the future, because, if you look at it, it is not just a building, it is 180 tonnes of stored carbon and probably in many ways a safer place to store carbon than in the trees surrounding the building.

One enormous product that we produce in research centres such as this is people, and young people. We really need to produce the critical thinkers of the future, and they have to have elite science communication skills. The fake news that we hear and the alternate facts — we can't tolerate those in a challenging world, and we need young people to be innovators. I'm proud that we're producing some ourselves at this elite research centre. It has the only graduate program in science communication beyond the undergraduate level in all of Canada.

June 5th this year is the announcement of the UN decade of restoration and the severe crisis the world is facing, and Sudbury has to be brought forth as an example of where transformation was thought impossible but proved to be possible. What we're looking at is a landscape that has changed and at the potential values that have been generated now out of this landscape. Making the transformation affects the costs of water treatment, the importance of carbon sequestration. From an industry perspective, it's reduction of liability insurance and, as Peter [Xavier] mentioned, waste repurposing is very important here. So, let's put our hats on as ecologists and look at this landscape through ecological principles.

4





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First, the importance of this site. In 1960, Sudbury was the world's largest point source of sulphur dioxide on earth, at two and a half million tonnes (total for the year). To put that in perspective, all of China today produces about ten million tonnes per day. This was a bigger source than much of Europe is today. As Peter mentioned, emissions reduced by 99 per cent is a fabulous accomplishment for Sudbury that we now need to turn to greenhouse gas and other environmental issues. With clean air, there's been a whole timeline — maybe it's correlation rather than causation, but I don't think we would have created a film festival, we wouldn't have built science centres, we wouldn't have won the Nobel prize in physics or created Canada's happiest city in 1960. As emissions declined, communities evolved to invest in other things, and this is what's going to be the future. As we invest in pollution controls, we open up opportunities for investment in social and other community benefits.

Peter already showed this tremendous accomplishment at one of the smelting companies, Glencore. To me, this is really proof of the Michael Porter hypothesis that good government and wellcrafted regulations can spur innovation and create the opportunity for industries to deal with the pollution problem and also become profitable and modernize. Indeed, a clean company doesn't mean we lose an industry.

So, let's take a naturalist point of view and an ecology point of view, and look at what is our best example of an ultimate zero-waste circular economy: nature. There's no waste in nature, it's completely reused, and to the betterment of all of us, as Dr. Bota mentioned. What is it in nature that we should highlight? Well, there's the rejuvenation issue, there's connectivity, and there's continuous nutrient and elemental cycling.

How would we see those principles expressed in the human system? Well, let's take the example of Sudbury and ask the question: can disturbance rejuvenate a city? How do we respond to catastrophe? I think we've got to respond guickly. Let's look at Sudbury's catastrophes of the past. We were hit by a meteorite, we were ground down by glaciers, we produced a very polluting industry, and now we're impacted by mining. What did the meteorite impact produce? One of the greatest ore bodies on earth, where most of the metals that we're discussing now for the e-economy exist. What did the glaciers produce? They produced the city of lakes that create the opportunities that natural systems provide, and now we have to rethink our forest industry. Ikea or Sweden doesn't send out raw fibre and wood, it sends out Ikea furniture. We've got to start manufacturing in Northern Ontario and send high-quality products out of our industry in the same way that the mining industry is now ready not only to recycle but also to produce the essential metals for the economy going forward.

"We've got to start manufacturing in Northern Ontario and send high-quality products out of our industry in the same way that the mining industry is now ready not only to recycle but also to produce the essential metals for the economy going forward. " Just to show, if we start to think about the connectivity of systems, improving the land has so many downstream benefits. Examples include the United Nations award-winning regreening program in Sudbury, where four thousand volunteer kids and others have regreened the land or industries have jumped in and developed technologies for remote treatment of land. What we see downstream is enormous improvements in the water quality in lakes and streams and the return of sensitive species now responding to the upstream benefits of land reclamation. Just a surprising one as we face climate change — it won't solve all the problems, mind you — but there's always a battle over whether trees are enough to do the work of the climate challenge. I'll give you a couple examples in Sudbury where trees are doing phenomenal things that we didn't think they could do.

As Dr. Bota mentioned, the climate is warming in Sudbury. But as the community invested in growing trees and regreening those barren landscapes, we've reduced the surface winds on Sudbury lakes by 35 per cent, caused by the drag on the land of forests. The export from the forests of organic matter has changed the colour and composition of the lakes to the point that the warming effect of winds doesn't penetrate to the bottom of the lakes, and the shading effects of the organic matter, which I call forest tea, protect the bottom waters. As a result, 40 years after I started working in Sudbury, in spite of the climate warming, the average overall temperature of the lakes is less, and cold-water species like the lake trout are now able to return to downtown Sudbury, where they've been missing for fifty years.

We can't sustain this if we allowed that temperature to continue to rise, but, for a time, investing in nature is showing some immediate benefits. The argument in Canada and around the world is should we plant a billion trees or a trillion trees? Just a reminder where carbon is actually stored in trees. Only 20 per cent of it is stored in the living tree, and only stored there for the life of that tree. About 20 percent in a typical forest is in dry, dead wood, and I would argue that this would be used best in the construction industry, rather than laying on the ground. The vast majority of the carbon is stored in the soil beneath the forest, and the trees are constantly enriching the soil with carbon. We're facing globally a tremendous soil crisis, where soil is being degraded, so if we have to invest, we have to invest first in soil.

" If we start to think about the connectivity of systems, improving the land has so many downstream benefits. "



In an industrial landscape, if soil is the foundation for a healthy ecosystem, can we repair the broken foundation that we've created here? Yes, there are technologies being developed. More is needed in treating soil with various industrial waste materials that are a waste to one company but essential to other companies. For instance, paper sludge and wood ashes and human biosolids are of huge value in the restoring of vast amounts of damaged industrial land and in time creating biofuels growing on those. Another example is an initiative that focused on the understory of trees where individuals carried plants to recycle the ground cover near a bypass. Instead of just bulldozing that material, the understory plants that are so difficult to establish in mining areas are hand transported into damaged areas and allowed to inoculate that site.

Lichens are the beginning of forest soil, and they can't grow in polluted air, so, as Sudbury has cleaned up its air, the natural soilbuilding process of lichens is now returning to the area, showing how nature can help if you first deal with the pollution source. There's no sense doing any of this work if you first don't reduce the pollution. The old idea of diluting pollution makes no sense anymore. We just have to stop pollution.

We have left the world with critical needs. There isn't enough land to support the human population, so it's a terrible crisis to leave land in a degraded state. In Northeastern Ontario, we have about 20,000 hectares of land in the form of abandoned and active aggregate pits. As another speaker mentioned, this is an enormous problem where it's on the public purse to deal with. These can be converted into products like solar farms or used for growing biofuel crops better than wasteland. In terms of forest products, we've mentioned cellulose, carbon credits, fibre lumber, biomass energy, and plywood, but permission is now being granted to build taller and taller buildings that are fireproof — six storeys, thirteen storeys — but they need a massive timber produced by cross-laminated timber. The first cross-laminate timber plant in Ontario was developed in St. Thomas last year. Quebec has opened theirs. We need this type of modern manufacturing capability in Northeastern Ontario.

I'll just wrap up with some estimates. The City of Sudbury is doing a great job trying to get to its ultimate goal, after declaring a climate emergency, of being net zero in 2050. However, with every business-as-usual modernization effort they make, we can only make modest changes. Under the most strenuous efforts of the climate emergency, we might get to 30 or so per cent reduction. Trees are a solution, but there's no solution without the full elimination of fossil fuel use in a city like Sudbury by 2050. We have to aggressively become fossil free in these next 30 years.



"With every businessas-usual modernization effort [made], we can only make modest changes." The final one is acid mine drainage. There is a famous picture by Ed Brutinski that shows tailings from a mine. You may look at it as industrial waste and acid mine drainage. Another way to look at it is the fantastic opportunity that Aaron [Henry] mentioned. These are ancient life forms, the sulphate-reducing bacteria, looking for alternate energy sources in the form of iron and liberating copper, nickel, and a multitude of other metals as a by-product of their energy metabolism. If we stand on top of the copper cliff tailings, a massive tailing, one of the largest in North America, and now analyse it, there are \$7.8 billion approximately of nickel left in those tailings. We could build an engineered microbial industry that could harvest this and recycle this back into the economy.

There are other fantastic things that the new biotech industries can also look for, and that is to go into the extreme environments of metal sites and look for hearty organisms like the algae that are best at producing biofuels. A researcher is also finding very promising pharmaceuticals in the algae and other life forms that can survive in these extreme environments and that might be very soon released as cancer drugs.

Finally, ideas are amalgamating in Northeastern Ontario around the idea of building a new industry related to these biotech solutions to the to the mine waste. Dr. Nadia Mykytczuk is currently working on a large proposal to build a centre for mine waste biotechnology in Northeastern Ontario that can generate some of these products and some of these solutions in the mining area and create incubators of education, training, and profitable industries. They're at the early feasibility study now, and you can follow up with Nadia and where this industry is going to grow.

The great global thinker and designer Bruce Mau, who is a product of Sudbury, works for all the big advertising companies of the world, and he looks at Sudbury as the future — as a resource management city within a park, that we build the park and live within a park and live with clean industries all at the same time. We see that mining, if done properly, can have footprints the size of a Walmart parking lot. We have to start producing our own food within this landscape. There's no reason that we can't do a sustainable forestry within a city and similarly running biomining and using biological reactors to separate waste. We lost the rights to carbon storage credits, but this area could be where other countries and other industries will want to invest in carbon credits. But carbon storage itself is a real important purpose for industrially damaged lands.

I thank you for the opportunity to speak to you and to bring some of these ideas of what an industrial city could look like in 2050.

"There's no reason that we can't do a sustainable forestry within a city and similarly running biomining and using biological reactors to separate waste. "



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