



My name is Lloyd Helferty, President of Biochar Ontario.

Welcome to my presentation about Biochar

I am part of an initiative that is attempting to Create a Biochar Industry in Ontario -- and Canada

I helped start the *Canadian Biochar Initiative* and I am the **President** of an organization called “**Biochar Ontario**”.

Biochar Ontario is the “Ontario” chapter of the “CBI” : The **Canadian Biochar Initiative**, that was started back in December 2008.



- So Why am I here at a *Climate Change Summit* Presenting information about Biochar?

- This presentation is intended to introduce everyone to the **Biochar** idea, which is both an Ancient and a Modern concept.

- Biochar is an idea whose knowledge, although it has been around for *thousands of years* had been mostly lost to modern agricultural technological management practices.



First, I should tell you what Biochar is:

- Essentially, Biochar is a term used for **Charcoal**
 - Everyone probably knows what charcoal is – you burn it in your Bar-B-Que, right? --- Not Biochar!
 - Biochar it is much more than that, because Biochar is charcoal that is intended for use in **SOIL**.
 - And What *is* charcoal? Mainly it's just **pure CARBON**.
 - It is the product of Biomass that has been heated in the absence of oxygen, to temperatures of about 500 degrees Celsius.
If you have biomass and you can “burn” it *without oxygen*, it will turn into charcoal.
 - Sometimes this charcoal is good for cooking...
- ... But if we do it **right**, this charcoal can also be **good for the Soil**. We call it “Biochar” when it goes into the soil.



What happens when we make Biochar?

The process of making charcoal is called “Pyrolysis”.

•The process of *Pyrolysis* results in three things:

•**1. bio-gas,** **2. bio-oils** and **3. bio-char**

The process releases a lot of energy [mostly in the form of **heat**] -- so the process of making it is actually an *energy source*.

•But the resulting Charcoal – when placed into the soil as a soil additive is actually **good** for soils that have been *abused by agriculture*

– which means **most** soils found around the world today.



What can Biochar **Do**? And, Why is biochar so special?

It is probably the **ONLY** technology that can do three things at once:

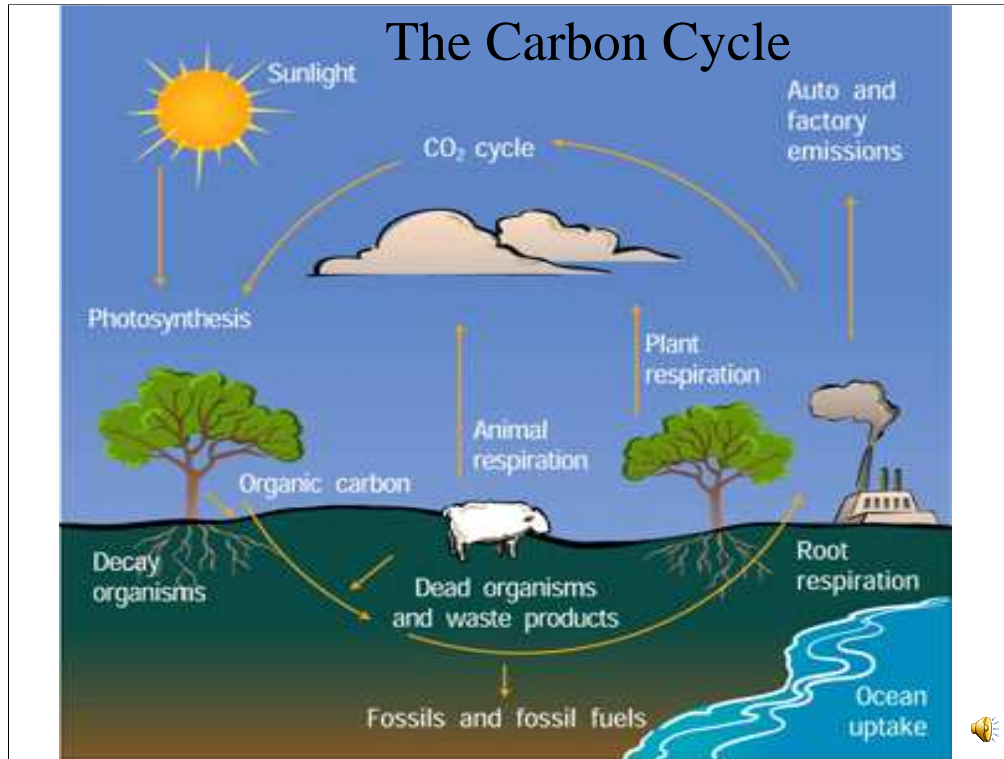
1. The process of making it produces **useful energy**
2. It can **improve agriculture** and help our soils in many ways by making them more **fertile**
3. And, it can **sequester carbon** and help to mitigate climate change

This last point is the reason that I am presenting at this Summit.



Biochar for ***Climate Mitigation***? How is that? How does Biochar Address Climate Change?

- When plants **grow** they use a “magical” process called ***Photosynthesis***
- Photosynthesis means converting **Carbon Dioxide** and water in the air into Oxygen and **Glucose** -- one of the fundamental building blocks of life.



This is a simple depiction of **the Global Carbon Cycle**

What does the “Carbon Cycle” have to do with Biochar?

- Almost all the Carbon that is **absorbed by plants** is eventually returned to the atmosphere as carbon dioxide -- or methane.
- Most of this happens when plants **decompose** (rot).
- Once a plant is dead, for most Biomass this happens in a matter of weeks, months or a few short years.
- When we change the Carbon from plants into **Biochar** -- **instead** of leaving it to rot -- we are effectively “**storing**” it for **thousands of years**.
- This is because the Biochar **does not degrade and turn back into CO₂ very quickly...**

The half-life in soils is usually hundreds or thousands of years. We know this, otherwise “Carbon Dating” would not exist!



So effectively,

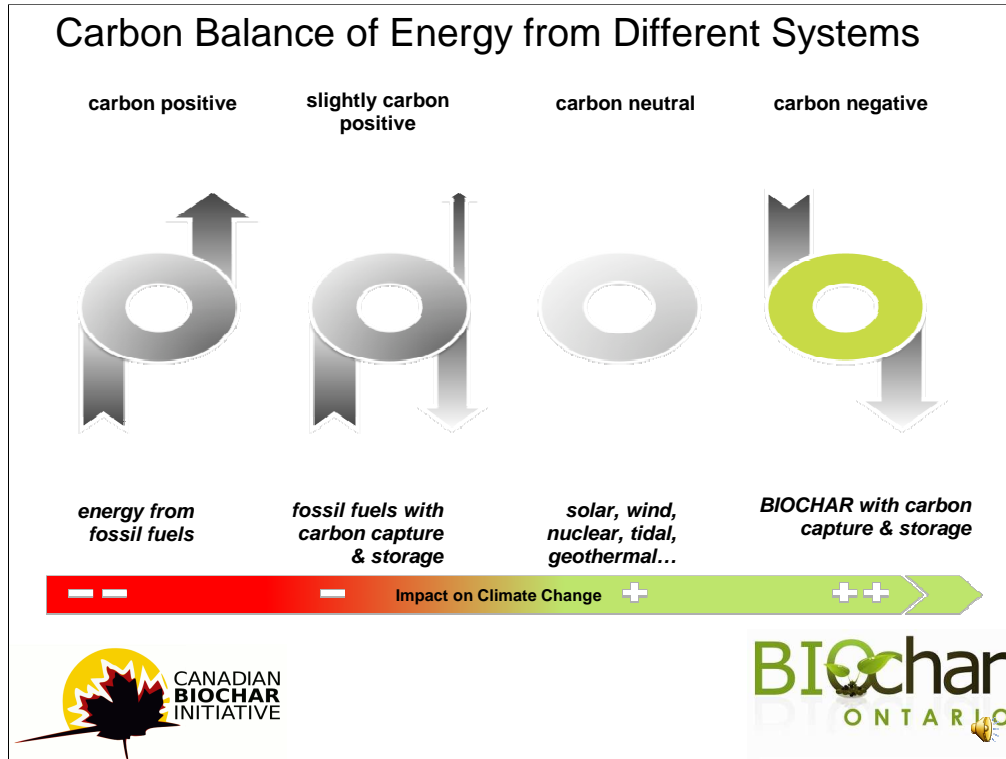
- The **CO₂** that is taken up by plants and it is converted to organic carbon molecules like ***cellulose and lignin***.

- This carbon is then **fixed** in the charcoal when it is turned into Biochar.

and

- This carbon is effectively “**stored**” when the Biochar is placed into soils. This storage is, for all intents and purposes, “**permanent**”.

Thus, we can say that Biochar is the ***only*** “carbon ***negative***” energy: The more Biochar you produce, the **less** CO₂ is in the atmosphere!



•This is a chart that lays out side-by-side the different energy technologies we have:

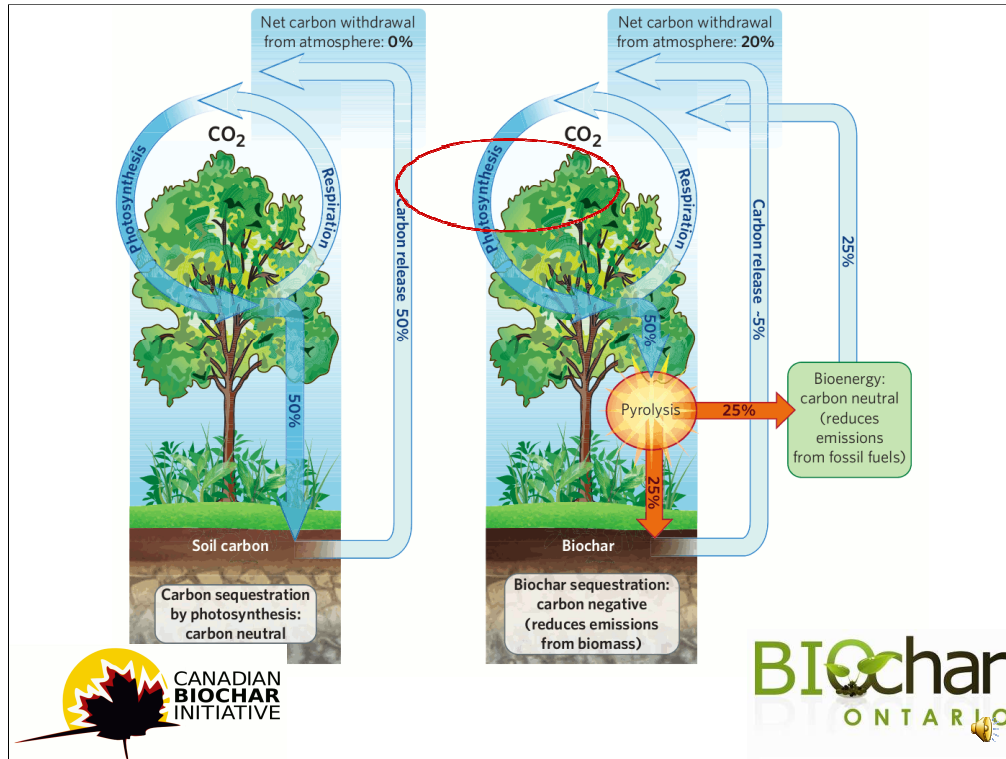
-On the far left is Fossil Fuels, with its net emissions of fossil Carbon.

-Just to the right is the infamous “Carbon Capture and Storage” or *CCS technologies*, which are supposed to capture a small part of the emissions from fossil fuels – like those from Coal plants. They don’t work very well.

-Next we have the truly “renewable” sources of energy – Solar, Wind and Hydroelectricity etc... They have effectively **no** CO2 emissions.

-On the far right is Biochar.

- Biochar production could actually be a “*fast-start*” strategy to help mitigate climate change.
- It is very **simple to do**.
- It would require relatively little research before it could become widespread, and it could have some very important benefits for agriculture.



This is a side-by-side diagram showing a simplified carbon cycle.

When we create Biochar from plant materials we are interrupting this carbon cycle.

This makes more sense than trying to just “store” the carbon in plants and trees...

– This is because the plants and trees we grow will eventually die and decompose ~ back into CO_2 . [This is the Natural *Carbon Cycle*!]

But the CO_2 would not be generated if we converted *a small portion* of that Biomass into Biochar! That carbon would stay in the **soil**!



But Biochar does **more** for the atmosphere than just Carbon Sequestration.

There have been other benefits found from Biochar as well:

- Biochar has been shown to be able to reduce **methane emissions** from soils – especially Anaerobic soils (wet soils).

Methane is about **21 X more powerful** than CO₂ as a greenhouse gas.

- Some other studies have found decreased emissions of **“Nitrous oxide”** from soils.

Nitrous oxide is a **major** greenhouse gas that is **310 X more powerful** than carbon dioxide.



AND, the Biochar that is deliberately placed into our soils as a ***soil amendment can*** have many other benefits as well.

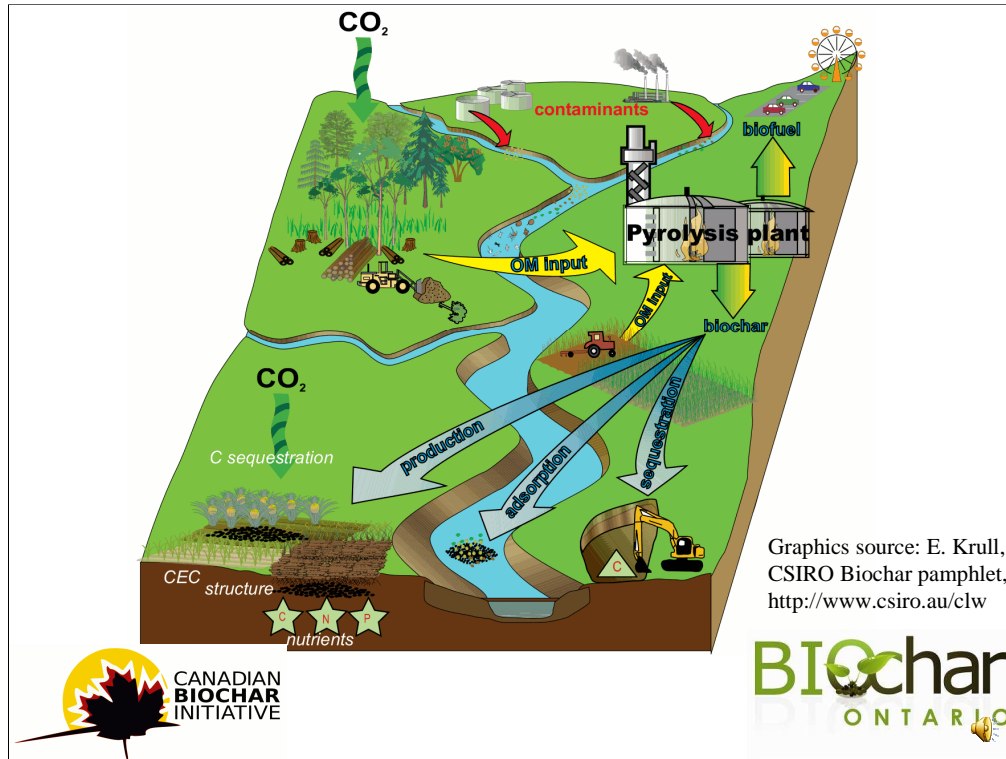
- Biochar placed into soil will **stay in the soil**. This will help the climate by keeping CO₂ from **re-entering** the atmosphere.
- You only need to apply it once – or a few times over a few years.
- It will also **grab on to Soil Nutrients** and keep them in place longer, which might help to **prevent contamination of our freshwater resources**. Agricultural runoff is one of the main sources of water pollution around the World.
- And this might also mean that **less fertilizers** will need to be **applied to farms**, which translates to Less Cost to Farmers – and **less cost** to us.
 - This is especially good for **small Canadian farmers** – because they don't need multimillion dollar equipment to make Biochar – they can buy one system as part of a Co-operative, and share it between them -- so every one of them can all **affordably** apply Biochar to their fields.



In addition to Agriculture, Biochar can also be used for ***Environmental Restoration and Remediation.***

For example, it can be used to help restore **degraded or contaminated** land.

It has uses on farms in other ways, like in **Wastewater filtering** because it **Absorbs** contaminants like Heavy metals and PAH's.



This is a depiction of an **Integrated Biochar system**

Various carbon pathways can be integrated into a sustainable system with net **atmospheric capturing, safe use and storage**.

Organic matter supplies for Biochar can include such things as:

- **The residuals produced from Short rotation crops like wheat straw and corn stover**
- **Forestry slash, manure, and almost any other “green waste”**



Why Canada?

Well... for one, we live here.

Also, Biochar technologies are:

- Local, clean, secure and environmentally friendly
- They are Flexible and can be implemented at both **a small scale [farm scale]** and at a large scale
- They are Relatively inexpensive to establish and
- They utilize **resources that are close at hand**

- It Increases **food security**
- It Increases **energy security**
- It can be used in **urban agriculture systems**



The capacity of the soil to store carbon is HUGE:

Soils contain more carbon than all terrestrial vegetation *and* the atmosphere combined.

Because **Biochar** is **very stable**, it is expected that the ***Long Term Stability*** of **most** biochars will be in the **hundreds or thousands** of years.

There is **HUGE Carbon** sequestration potential for Biochar in Canada – because **we are a HUGE Country**.

Biochar has **Very good Long-term stability** in the **cold soils of Canada**.

This provides Canada with an excellent Opportunity to trade Carbon Credits and become ***Carbon Neutral***...

...Perhaps even “***Carbon Negative***” – We could lower our net emissions of CO2 ***dramatically***.

There is literally **Decades** of CO2 Sequestration value in the soils of Canada.



Pyrolysis plants can be built that Integrate biochar, biofuels and energy.

The Conversion of organic matter to biochar and other products can be done sustainably using **local resources**.

- It is a **Distributed energy** solution
- It could be also be a **Combination** pyrolysis and gasification plant producing **syngas** that can be used for **additional energy production** in the form of **fuels** or Electricity.



So converting **our Residual Biomass resources** from Farms and forests into Biochar makes sense for the Climate and makes sense for Canada.

- It produces energy, which can displace Fossil Fuels as an energy source.
- It can help agriculture in many ways by trapping nutrients and holding water in the soil and preventing other Green House Gasses from escaping.

And it's **very easy to do**: Making charcoal is one of the oldest technologies known to man.

But **modern technologies** for making Biochar are much different than the ancient ways of making Charoal – they are actually **cleaner** than most Biomass **Combustion** technologies! And they can be made at a small scale, **right on farms** and close to cities.



So, now that I have told you what Biochar **is** and what Canada can **do**, I am going to talk about two issues:

Deforestation and Health.



Based on, for instance, the **5 Step program** developed by a *Next Generation* Biochar Stove maker called *Worldstove*, wherever **micro-gasification** Stoves are being widely distributed among third world inhabitants -- who continue to **cut down tropical forests** to make **charcoal and fuelwood** to *cook and feed their families* -- we have estimated that if the pilot programs that were recently undertaken in *Haiti and Africa* were *drastically expanded* to every developing country around the world that we could not only make **considerable quantities of Biochar** to help with *soils and agriculture* in these developing countries, we could also **prevent a significant number of trees from being cut down**.



We *can* create large quantities of biochar **without cutting down a single tree!**

>> Biochar is **not** the same as *biofuels* and *geoengineering* as most people understand it.

- A typical family in Africa burns **about 7.5kg of wood** [or the charcoal equivalent] **every day**, just for *cooking*.

- If **biomass/Biochar stove programs** were implemented *around the world* -- programs where each *family* that takes part could receive "carbon credits" for the "**offset**" they generate by **not** cutting down the forests -- then these stove projects could have a major impact.

- Even though they only produce about 100 kg of Biochar per **year** -- which is equivalent to about 300 kg of CO₂ per year -- the amount of carbon that is actually 'sequestered' by **avoided tree cutting** by a *single family* would be about **3500kg every year** – **this is more than 3 metric tonnes of wood** that would **not** need to be taken from the forests! For **every family**.

- In fact, the amount of carbon credits received by the "*Avoided Deforestation*", under this scenario, **far exceeds** the amount of carbon credits received from the burial of Biochar into the soils by at least **an order of magnitude**.

- And Experts estimate that around **600–800 million** families worldwide **need** improved **cook** stoves – multiply that by **3 metric tonnes per family** and you will realize **that will allow a lot of forest to remain standing**.



Already, for instance, it is estimated that **500 million metric tonnes** of *sugarcane bagasse* are being **disposed of every year** around the world as a result of the existing sugarcane *Ethanol industry* -- in places like Brazil -- and **hundreds of millions of tonnes** of Forestry Residue are left behind every year as a result of existing forest cutting for "roundwood" -- and pulp and paper operations.

This "waste" -- along with the *hundreds of millions of tons* of **agricultural residues** generated around the world by **every rural family and farm** -- could be utilized to **heat and cook** - by turning the biomass into pellets that could be used for such things as improved **cookstoves** that make Biochar -- thus **avoiding substantial amounts of forest cutting**.

Note that the main source of *Carbon Credits* for Biochar **Stove and Heating** programs is not just the Carbon Credit derived from sequestering the Biochar, but from the **Avoided deforestation**, so it *is* possible to sequester significant amounts of CO₂ by **placing a price on biochar carbon** that makes sense to support *the appropriate use of biomass*. It just has to be done *right*.



So, we *don't* need to cut down forests to make significant quantities of Biochar...

But what about *Health*?

The World Health Organization [WHO] estimates that there are "1.6 Million attributable deaths a year to smoke".

More than half of the world's population rely on **dung, wood, crop waste or coal** to meet their most basic energy needs.

Cooking and heating with such solid fuels on **open fires** or *simple stoves without chimneys* leads to terrible **indoor air pollution**.

This indoor smoke contains a range of health-damaging pollutants including soot particles that are able to penetrate deep into the lungs, causing **pneumonia, chronic respiratory disease and lung cancer** along with adverse pregnancy outcomes, in particular *low birth weight, heart disease* and **cancers** as well as inflammation of the airways and lungs and impaired immune response.

Carbon monoxide also results in systemic effects leading to lower *immune response* and higher incidence of **disease**.



Exposure to smoke is particularly high among **women and children**, who spend the most time near the domestic hearth.

Every year, indoor air pollution is directly attributable to about **one death every 20 seconds**.

The dependence on such fuels is both a **cause** and a **result** of poverty since poor households often do not have the resources to obtain cleaner, more efficient fuels and modern appliances.

According to the W.H.O., Indoor air pollution is considered the **“8th most important risk factor”** in “the global burden of disease“.



In most societies, **women** are in charge of cooking might spend up to **seven hours of every day** near the stove, preparing food.

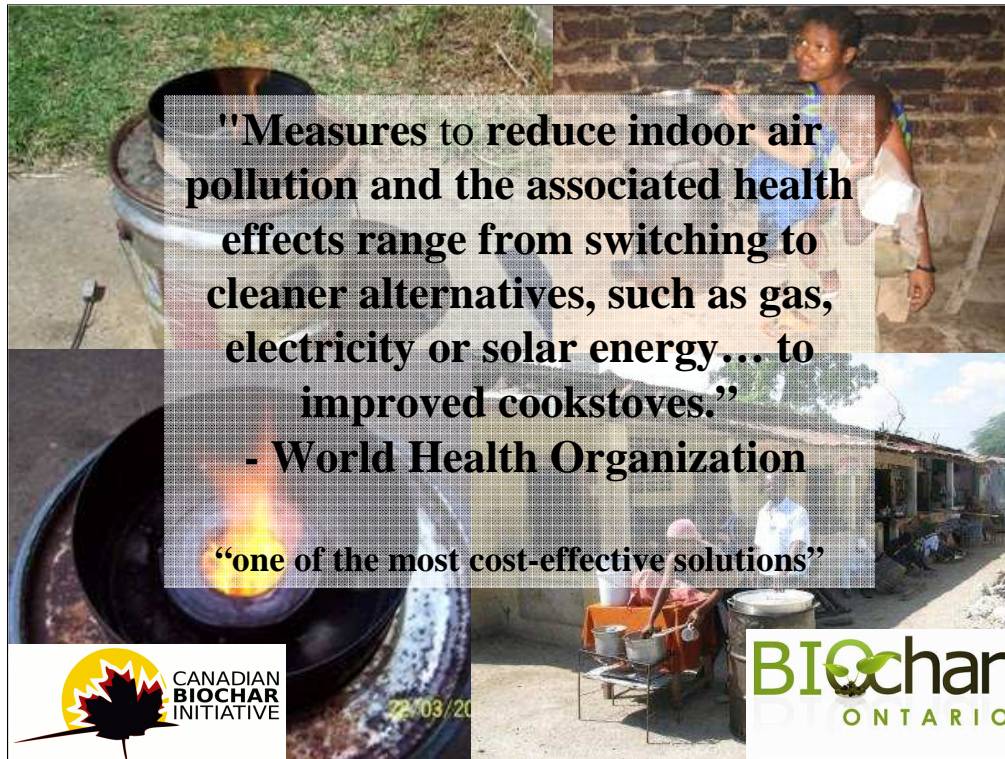
Almost **60% of all indoor air pollution-attributable deaths** thus falls on **women**.

Also, **Young children** are often carried on their mother's back or kept close to the warm hearth as they cook. -- Consequently, **infants** spend many hours breathing indoor smoke **during their first years of life** – which makes them particularly vulnerable to these hazardous pollutants.

As a result, **more than half** of all indoor air pollution-attributable deaths occur in **children under five years old**.

And in addition to the health burden, **fuel collection** can be a serious **time burden** - - on both women **and** children.

Alleviating this work will **free women's time** for other things, and can **increase children's school attendance** -- and their chances of getting a better **education**.



One of the **Millennium Development Goals** is to "*Tackle indoor air pollution*" in the context of *household energy*.

This can be Using **Biochar-producing Cooking Stoves!**

Again, according to the W.H.O.:

"Measures to **reduce indoor air pollution** and the associated health effects range from switching to cleaner alternatives, such as **gas, electricity or solar energy...**" – **all of them very expensive** technologies, especially for the poorest people on Earth – "to **improved cookstoves**".

The WHO has said that "In terms of health, a recent *cost-effectiveness analysis* of different interventions suggests that **improved stoves** ... represent (**one of the most**) **cost-effective solutions**."



Advanced **gasifier stoves** that make **Biochar** will substantially **reduce indoor air pollution**, which could *suignificantly* reduce these illnesses and deaths.

And with **Carbon offsets for Biochar**, it would be possible to create "**Stove**" **programs** that can actually generate **income** for people and communities in developing countries -- at the lowest level: right down to the **household-level**.

– By monetizing both the Carbon sequestered by the Biochar placed into soils, but also the **Avoided Deforestation** that results **from *not* having to cut trees down** to cook their meals!

And because Biochar that is placed into degraded soils helps to *increase Soil productivity*, if Biochar is made right at home where it can easily be placed *directly into the farm or garden* , it could help to **improve nutrition and food security!**



So Who is Biochar Ontario and the Canadian Biochar Initiative?

- We are a not for Profit
- **The Canadian Biochar Initiative (CBI) was Conceived in November 2008**
 - We had our First meeting in December 2008 and Biochar Ontario was Incorporated in June 2009
- **We are the Lead promoter and facilitator of the new Biochar industry in Canada and we Advocate for research, development and commercialization of Biochar and the associated systems -- in Canada and beyond...**

Thank you very much! ☺ ☺

More Information

- **Biochar Ontario**
 - www.biocharontario.ca [under development]
 - <http://groups.google.com/group/biochar-ontario>
- **Canadian Biochar Initiative**
 - www.biochar.ca
- **International Biochar Initiative**
 - www.biochar-international.org



More information can be obtained about **Biochar** – and **Biochar Stove Programs** -- by going to one of these sources of information.

Welcome to the world of Biochar!

I would be happy to take any questions. There is *much more to the world of Biochar* than you have seen here.