MAGNUM GROUP INTERNATIONAL

Technology & Strategic Partner of ATS Technology Holdings Ltd.

Corporate Presentation

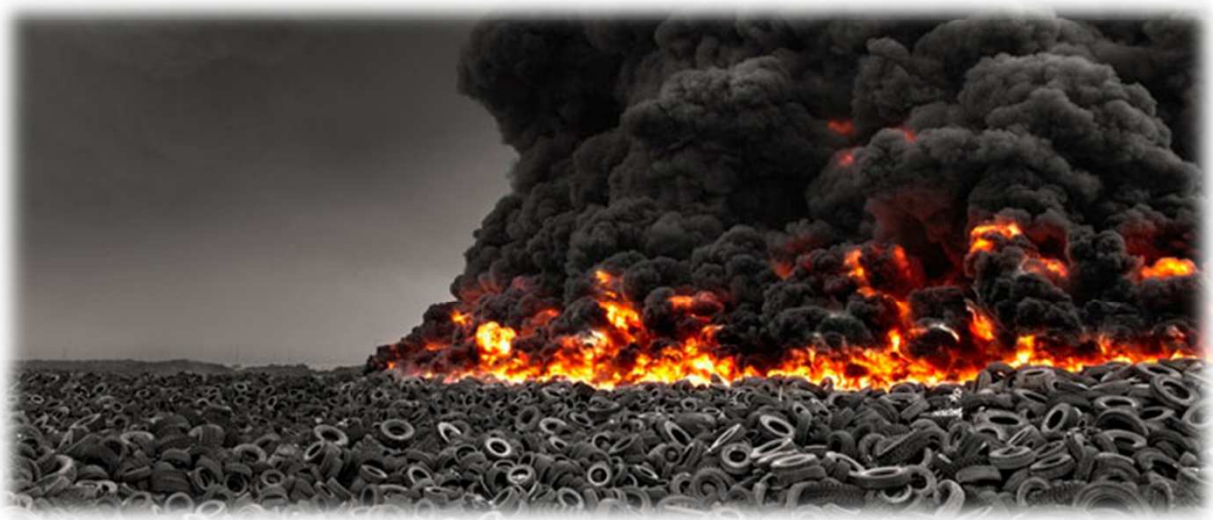
August 2018

Confidential

Introducing Magnum Group International

"... if we're going to make progress with sustainability we'll have to accept the fact that many people are like Faust — they will sell their souls (or at least their planet) to the devil in order to maintain their current standard of living. Until we give them a better choice, and prove that sustainability doesn't require sacrifice, we'll be fighting an uphill battle..." **Sustainability's Faustian Dilemma** April 5, 2011 - Ron Ashkenas.

Waste - the Opportunity & the Solution



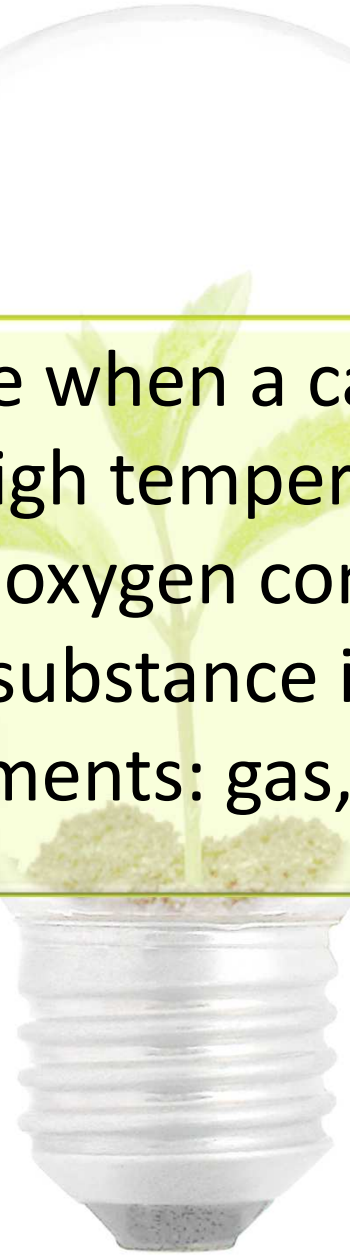
Society is waking to the reality that we cannot continue to treat waste by: burying it, pushing it into huge piles, or incinerating it.

With Global Climate Change threatening us government and industry are being forced to consider the Greenhouse Gasses being released by all this carbon based waste.

Into this environment Magnum Group International brings it's truly disruptive Advanced Activation Thermolysis System (AATS) technology.

Introducing Thermolysis

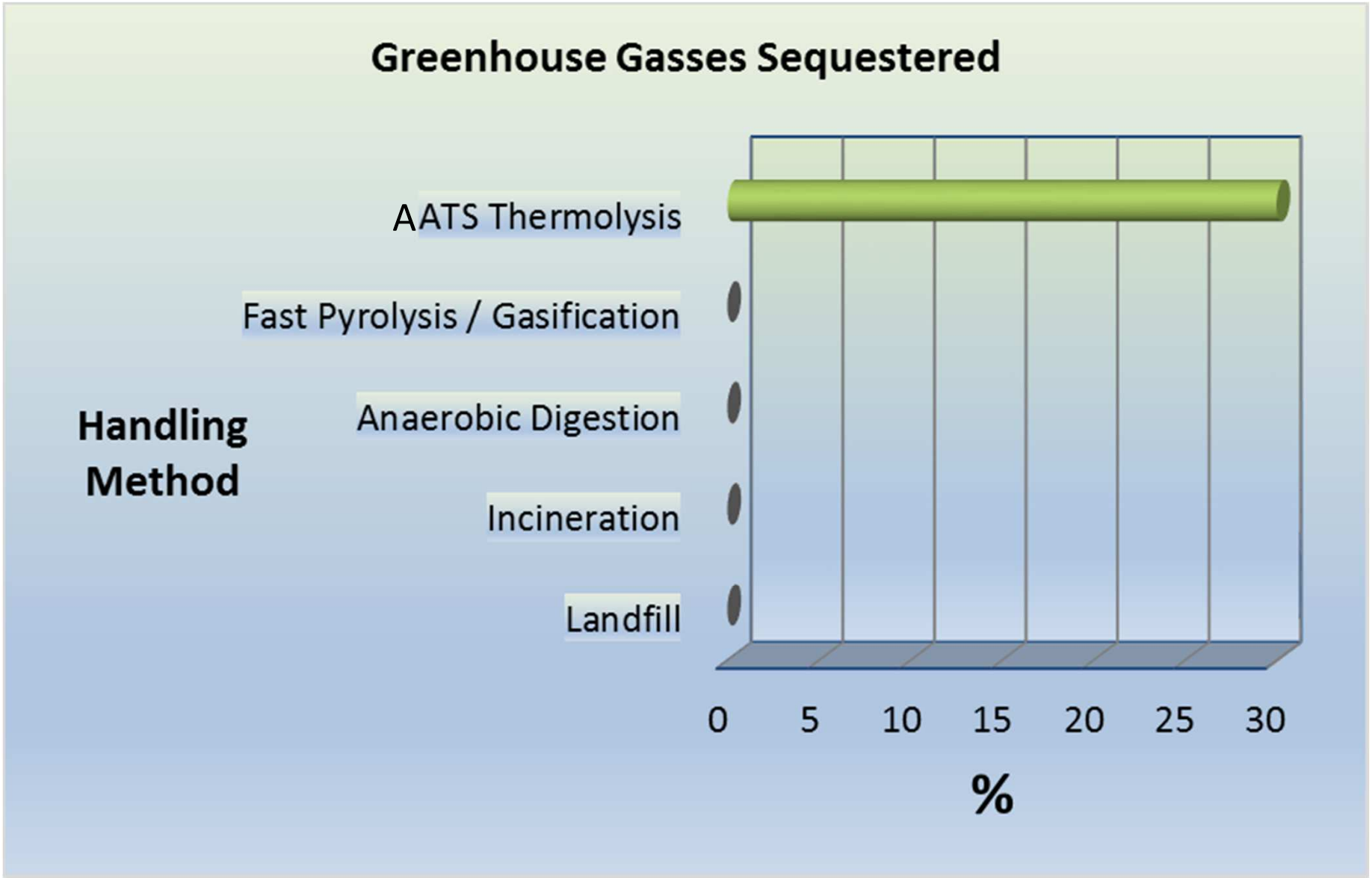
Thermolysis takes place when a carbon based substance is subjected to a very high temperature in the absence of oxygen. Without the oxygen combustion cannot take place and instead the substance is broken down into its constituent elements: gas, oil and carbon.



Waste to Carbon by Thermolysis



Fighting Climate Change



Advanced Activation Thermolysis System (AATS) Proven Technology

The inventor, a Doctor of Chemical Engineering, worked as a consultant to one of the leading European institutions specializing in heat-mass science. He and his team did ground-breaking work in maximizing the efficiency of thermal decomposition of waste rubber, waste plastics and various biomasses.

Over the past 15 years the Doctor collaborated with Magnum Group International, which provided financial and other forms of assistance, in developing the world's leading thermolysis process for all carbon-based waste materials. Through extensive research and testing, the team overcame the difficulties that challenged traditional pyrolysis systems and created a 4th generation thermolysis system that earned an endorsement from ABB Inc, which had themselves sunk millions into pyrolysis research. This 4th generation system is now operational in Vegreville Alberta, Canada.

Now, Magnum and the inventor have developed a 5th generation of thermolysis technology, which further enhances operational efficiency, throughput and carbon creation.



Tom Malcolm, MBA
Graduate Fellow, Clean-Tech Consultant
ISIS Research Center, UBC Sauder School of Business

Re: Magnum Group/Emergent Waste Pyrolosis System

Dear Mr.Tom Malcolm:

Thank you for the opportunity for ABB to assist with the proposed Pyrolosis System Project. We feel we can assist with the following:

1. Add ABB engineering and controls technology to a good continuous process
2. Offer a turnkey package for Process Control, Control Room and Power Systems

ABB has an initiative and segment focus on the next generation OEM and End User Biomass to Fuel Plants. As noted in the enclosed power point, ABB is taking a variety of actions to meet a demand that USDA projects will be 500, 40MGY bio fuel plants to meet 2022 federal mandate.

We certainly can help in a variety of ways to deploy these gasification and pyrolysis systems in North America.

What is unique about the proposed system is three fold:

A. This system is pressure neutral. This lends itself to a much safer operation than high pressure or high vacuum operation
B. The system uses steam injection which more effectively permeates the biomass and helps keep the system from being shut down due to fowling.
C. This operation is not batch but a continuous process. In the gasification world it is always better to be able to continue the process repeatedly to insure or even improve results.

It is also our experience that the business model for these projects is enhanced when the process can be applied to multiple feed stocks. While we have not built or tested this one, the technology lends itself to a variety of carbon materials.

Feel free to call me if you have any more questions.

Best of regards,

Nicholas Masucci
Business Development Manager - Biomass Renewable Energy
Process Automation Division -Control Systems Electrical Integration
ABB Inc
955 Mearns Road
Warminster, PA 18974
315-254-9470

ATS500 in Vegreville Alberta, Canada

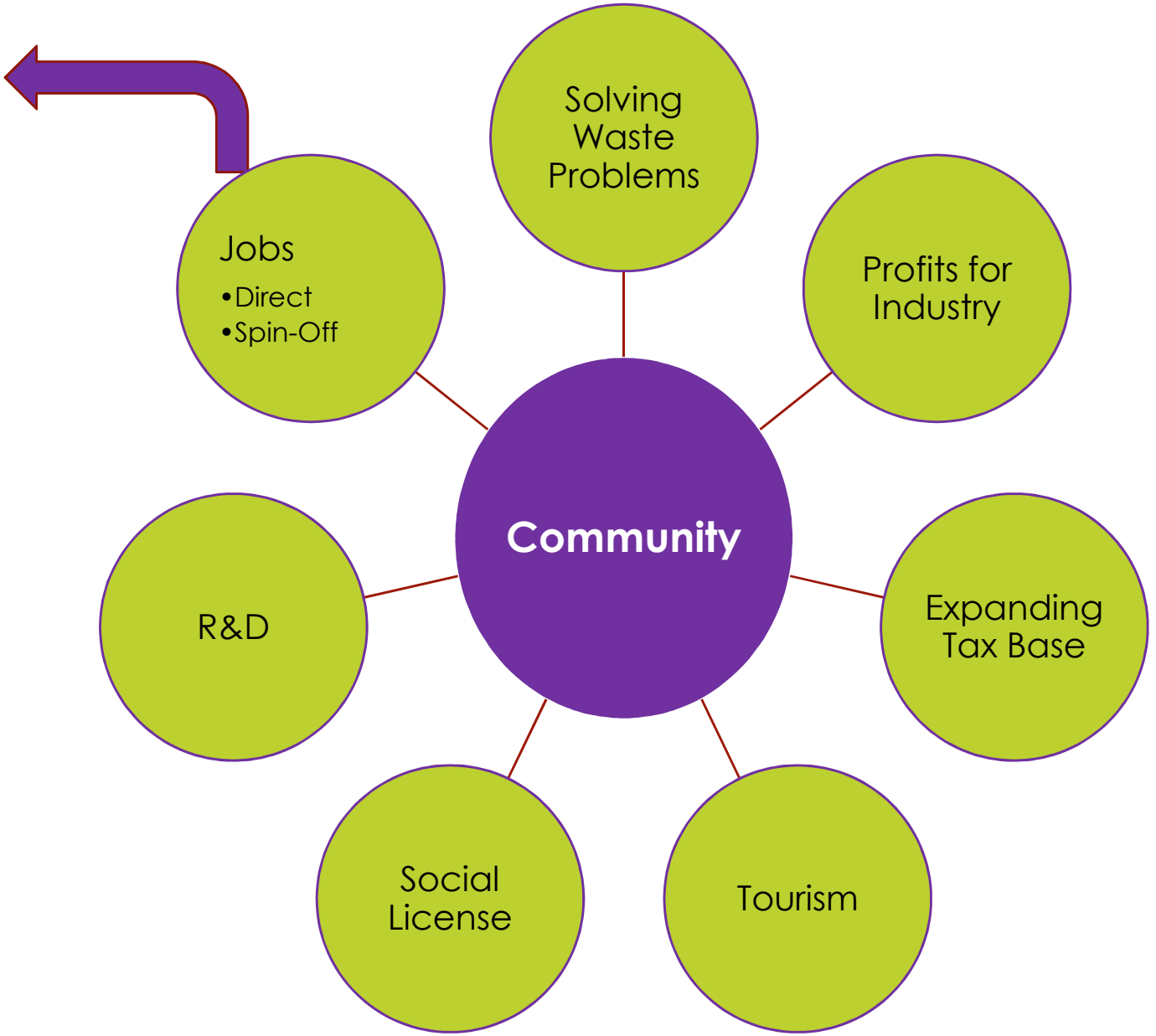


Benefiting Communities

~10 full-time workers for ATS500

~20 full-time workers for AATS2000

Employment during assembly & site prep:
- Electricians
- Welders
- Pipe-fitters
- Carpenters
- Machinery operators
- Technicians etc.



Canadian Market & Carbon Savings Potential

Waste Stream	Plants Required to Process Waste Stream	Tonnes of CO2 Potentially Saved *
Livestock Manure	644	6,694,380
Municipal Sewage Sludge	143	1,486,485
Used Rubber Tires	23	358,628
Recycled Plastic	110	1,588,125
Municipal Solid Waste	784	4,980,360
Pulp Mills	114	1,580,040
Waste Wood Biomass	1,734	24,033,240
Total	**3,552**	**40,721,258**

* Source: http://www.engineeringtoolbox.com/co2-emission-fuels-d_1085.html | http://www.jeabioenergy.com

When it Comes to Garbage, Municipalities find themselves between a …



The Rock



Incineration



Cities

The Hard Place



Composting



Environmentally and Economically Sustainable



Home-owners remove only metal & glass



All other waste is taken to a central processing center



Non-Carbon material is removed & Refuse Derived Fuel (RDF) pellets are created



Pellets are fed into AATS Plant



Valuable Biochar is created



Waste is 100% Recycled

Refuse Derived Fuel (RDF) pellets are supplied to the AATS Plant



Biochar is produced and may optionally be refined to an Activated Carbon





Synthetic Gas is created and used as a fuel source for the Plant





Pyrolysis Oil is extracted and can be further refined to add value

Profit Potential for AATS5000 - MSW

Municipal Solid Waste (MSW) - AATS5000				
Manufactured Product	**% of Output**	**Annual Output**	**Price Per Tonne**	**Revenue**
Light Fuel Oil	40%	15,840	$400	$3,960,000
Biochar	34%	13,464	$1,500	$43,956,000
Recovered Steel	11%	4,158	$300	$1,247,400
Glass	6%	2,297	$100	$229,700
Tipping Fee			$100	$5,800,000
Total Revenue	90%			**$55,193,100**
Approx. Operational Expenses				$9,743,252
Royalty				$2,759,655
Net Income (before taxes)				**$42,690,193**

Notes:

- Based on 120 Tonnes Per Day for 330 Operating Days Per Year
- All figures are shown in US Dollars
- Chart assumes a Canadian setting
- Additional by-products may be produced that would both generate power and heat for the plant, and potentially produce additional revenue.

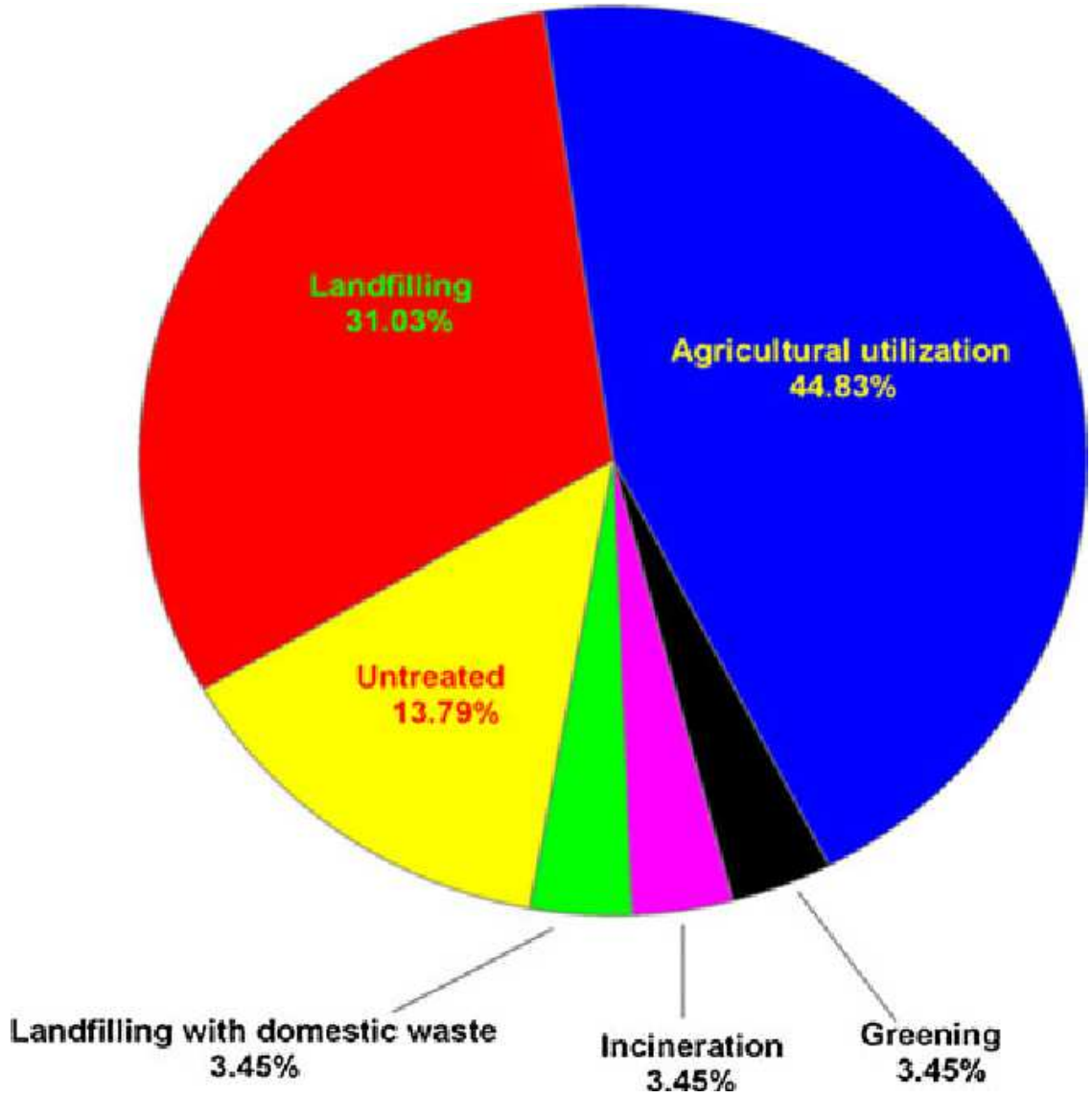
Sewage Biosolids



https://biosciencеresource.org/sewage-sludge-biosolids-land-application-health-risks-and-regulation-2/

Data from China – Disposing of Biosolids

Sewage sludge (biosolids) refers to the residual, semi-solid material that is produced as a by-product during sewage treatment of industrial or municipal wastewater.



@article{Chen2012UtilizationOU, title={Utilization of urban sewage sludge: Chinese perspectives.}, author={Hong Chen and S-H Yan and Z-L Ye and H-J Meng and Y Zhu}, journal={Environmental science and pollution research international}, year={2012}, volume={19 5}, pages={1454-63} }

The Biosolids Solution

Biochar production by sewage sludge pyrolysis - Chania, Greece - Evita Agrafiotia, George Bourasa, Dimitrios Kalderisb, Evan Diamadopoulosa

there is no environmental risk using sludge-derived biochars as soil amendments

Nutrients and Heavy Metals in Biochar Produced by Sewage Sludge Pyrolysis: It's Application in Soil Amendment – Guiyang, China - Taoze Liu, Bangyu Liu, Wei Zhang

Heavy metals were not prone to bioaccumulation in the plant

Application of biochar from sewage sludge to plant cultivation: Influence of pyrolysis temperature and biochar-to-soil ratio on yield and heavy metal accumulation – Shanghai, China - X.D. Song, X.Y. Xue, D.Z. Chen, P.J. He, X.H. Dai

Biochars were rich in nutrient contents and they improved garlic yields

Influence of pyrolysis temperature on production and nutrient properties of wastewater sludge biochar – NSW, Australia - Mustafa K. Hossain, Vladimir Strezov, K. Yin Chan, Artur Ziolkowski, Peter F. Nelson

there is a great potential to convert wastewater sludge to biochar

The Changes of Heavy Metals in Sewage Sludge Following Pyrolysis Treatment - China - Ma T; Song Y; Zhao X; Li G; Lin Q

Heavy metals…mainly existed in inertial form in biochar

The Biosolids Solution

Nutrients and Heavy Metals in Biochar Produced by Sewage Sludge Pyrolysis: Its Application in Soil Amendment - China - Taoze Liu, Bangyu Liu, Wei Zhang

remediated contaminated soil by reducing the plant availability of heavy metals

Flash pyrolysis of heavy metal contaminated biomass from phytoremediation: Influence of temperature, entrained flow and wood/leaves blended pyrolysis on the behaviour of heavy metals - Belgium - M. Stalsa, E. Thijssena, J. Vangronsveldb, R. Carleera, S. Schreursc, J. Ypermana

…offer a valuable processing method for heavy metal contaminated biomass

Masters student Zoe Williamson carried out the survey under the supervision of Professor Alistair Boxall at the University of York in the UK.

17 of the most thermally stable pharmaceuticals were tested in the trial, which revealed that thermolysis technology destroys over 99% of 10 of the pharmaceuticals and an average of 94% of the remaining 7.

Profit Potential for AATS2000 - Biosolids

Sewage Bio-Solids (Canadian Setting) - AATS2000				
Manufactured Product	**% of Output**	**Annual Output**	**Price Per Tonne**	**Revenue**
Biochar	30%	4,752	$1,500	$7,128,000
Tipping Fees		3,500	$400	$1,400,000
Total Revenue				**$8,528,000**
Cost of Goods Sold				$456,192
Royalty	5			$356,400
Approx. Operational Expenses				$866,075
Net Income (before taxes)				**$6,849,333**

Notes:

- Based on 24 Tonnes Per Day for 330 Operating Days Per Year
- All figures are shown in Canadian Dollars
- Chart assumes a Canadian setting
- Additional by-products may be produced that would both generate power and heat for the plant, and potentially produce additional revenue.

Wood Waste

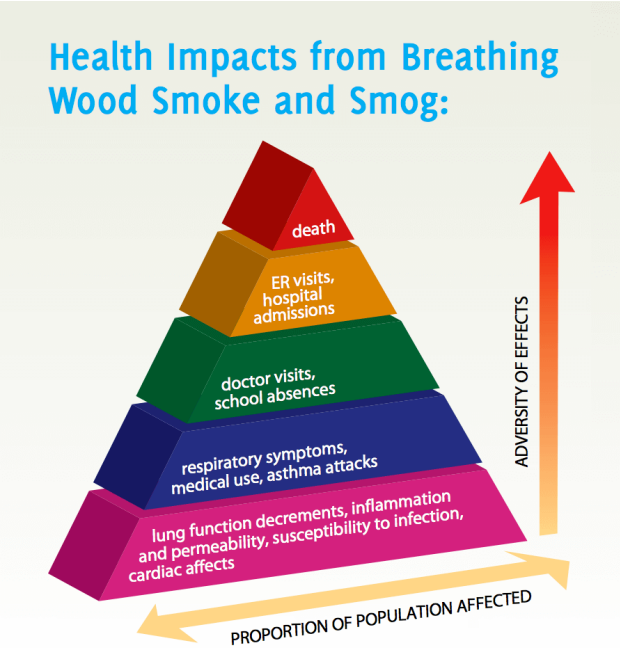


Incineration - Facts



Main wood smoke contaminants include CO, NOx, and VOCs

Also contains toxins: benzene, acrolein, PAHs, formaldehyde, dioxins & furans



*Open burning includes pile burning of forestry, agricultural, and land-clearing debris and controlled burns for ecosystem restoration, fuel reduction, and ecosystem health.

* From: A Smoke Management Framework for British Columbia, a BC Government Publication

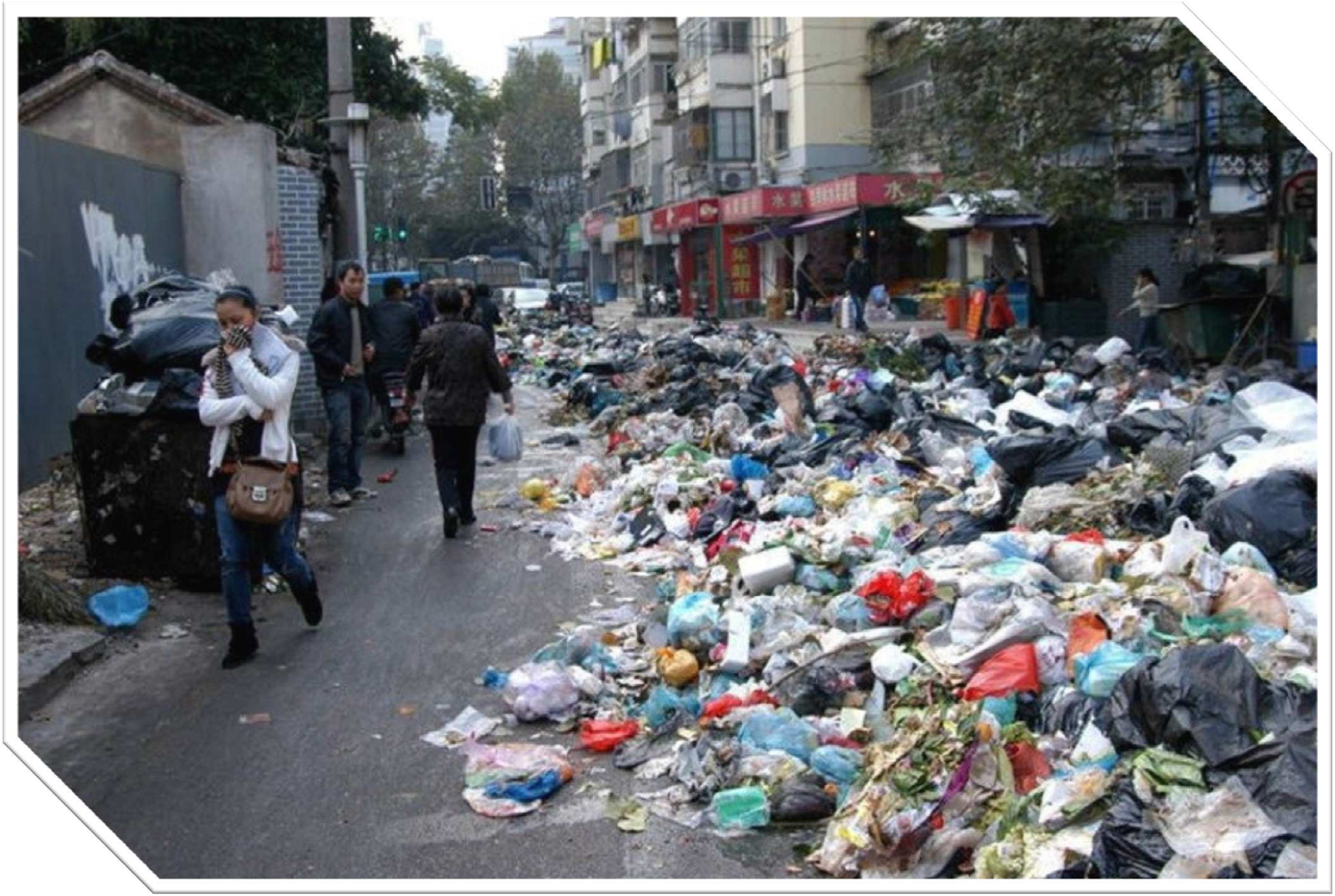
Profit Potential for AATS2000 - Wood

Wood - AATS2000				
Manufactured Product	**% of Output**	**Annual Output**	**Price Per Tonne**	**Revenue**
Biochar	34%	9,425	$2,099	$19,783,692
Total Revenue				**$19,783,692**
Cost of Goods Sold				$3,482,846
Approx. Operational Expenses				$999,527
Depreciation				$385,800
Net Income (before taxes)				**$14,915,519**

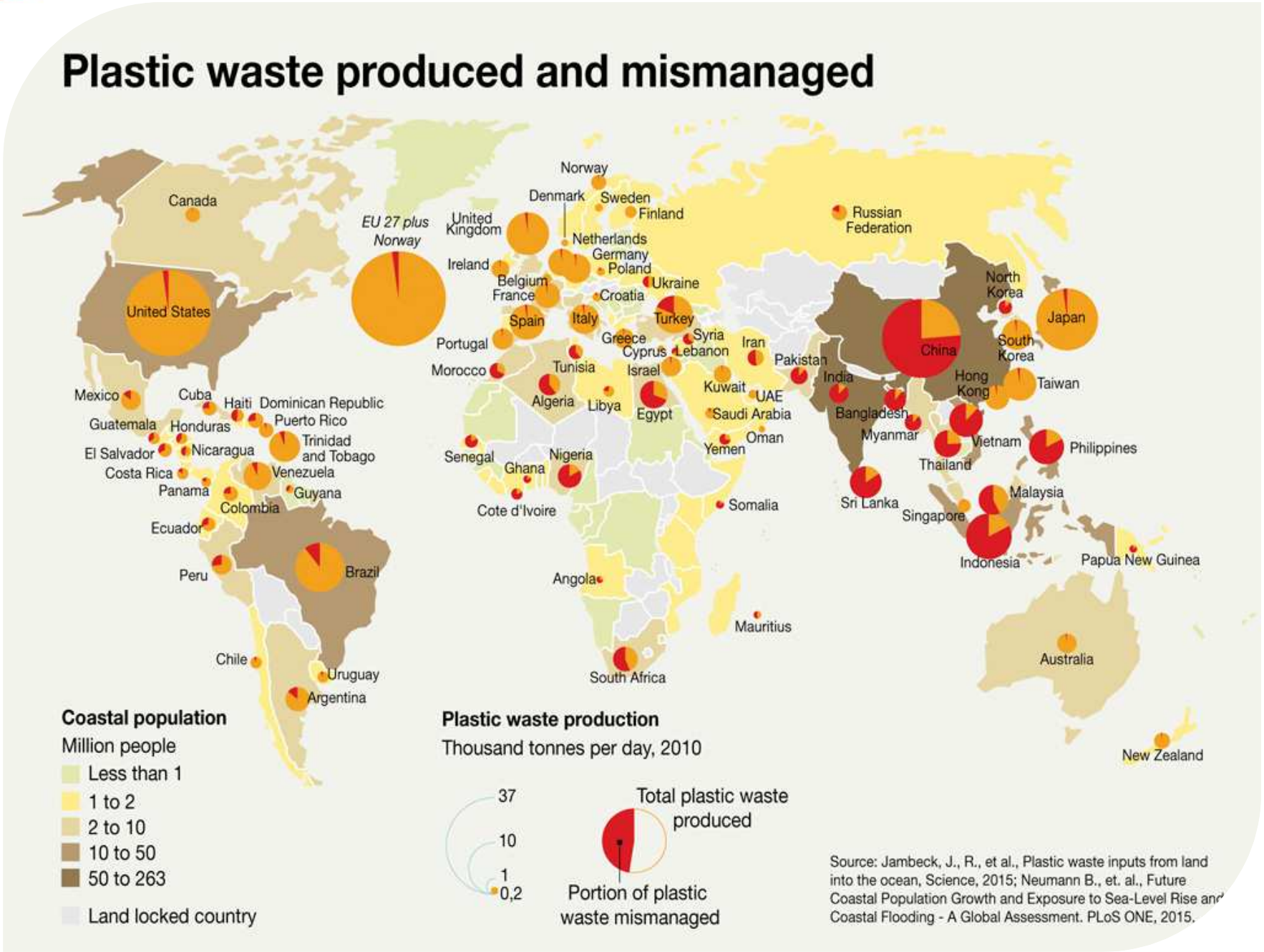
Notes:

- Based on 24 Tonnes Per Day for 330 Operating Days Per Year
- All figures are shown in Canadian Dollars
- Chart assumes a Canadian setting
- Additional by-products may be produced that would both generate power and heat for the plant, and potentially produce additional revenue.

Plastics



AATS - a Game Changer for Plastics



Profit Potential for AATS2000 - Plastics

Plastics - AATS2000				
Manufactured Product	**% of Output**	**Annual Output**	**Price Per Tonne**	**Revenue**
Light Fuel Oil	75%	17,820	$500	$8,910,000
Carbon Black N330 Standard	2%	475	$500	$237,600
Total Revenue				**$9,147,600**
Approx. Operational Expenses				$3,381,494
Royalty				$457,380
Net Income (before taxes)				**$5,308,726**

Notes:

- Based on 24 Tonnes Per Day for 330 Operating Days Per Year
- All figures are shown in US Dollars
- Additional by-products may be produced that would both generate power and heat for the plant, and potentially produce additional revenue.

Tires



Tires

Worldwide

1.2 Billion tires disposed of annually – 7 Billion tires sit in existing landfills

ever increasing demand for automobiles, the disposal of used tires becomes an ever increasing environmental problem. This is particularly evident in some of the poorest countries of the world where piles of used tires have been dumped and remain a major hazard at risk of igniting and burning for years.

USA

Waste tires are an ideal host environment for insects that carry viruses such as West Nile

Canada

Canada under strong onus to address the annual 33 Million discarded tires

AATS creates high value products without polluting

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http://www.businesswire.com/news/home/20090331006457/en/Timberland-Teams-Green-Rubber%E2%84%A2-Reduce-Global-Tire

http://www.newswire.ca/en/releases/archive/August2010/12/c2170.html

Profit Potential for AATS2000 - Tires

Tires - AATS2000				
Manufactured Product	**% of Output**	**Annual Output**	**Price Per Tonne**	**Revenue**
Light Fuel Oil	40%	6,336	$400	$2,534,400
Carbon Black N330 Standard	38%	6,019	$2,000	$12,038,400
Recovered Steel	7%	1,109	$300	$332,640
Tipping Fee		15,840	$300	$4,752,000
Total Revenue				**$19,657,440**
Approx. Operational Expenses				$3,571,690
Royalty				$982,872
Depreciation				$525,000
Net Income (before taxes)				**$14,577,878**

Notes:

- Based on 24 Tonnes Per Day for 330 Operating Days Per Year
- All figures are shown in Canadian Dollars
- Chart assumes a Canadian setting
- Additional by-products may be produced that would both generate power and heat for the plant, and potentially produce additional revenue.

AATS – Clearly the World's Best

The most advanced physical activation system

- Eliminates incomplete feedstock penetration
- Eliminates tar build-up in the system
- Employs a triple reactor system, each with its own motor
- Allows heat to be independently controlled in each reactor

Incorporation of super-heated steam

- Penetration of feedstock for better breakdown
- Removal of volatiles from the reactors to prevent recontamination
- Eliminates the problem of organic soot and tar building up in the circulatory systems
- Creates a purer carbon that more easily transitions to activated carbon
- Created from waste heat from the reactors for greater system efficiency

Venturi Condenser Employed

- Increases flash point temperature of the fuel oil from 40^{o} to ~75^{o}
- Separates steam from fuel oil and synthesized gas
- Keeps the base elements from cross-contaminating
- Maintains a high enough temperature to prevent the chemical reaction that creates dioxins and furans during the condensing process in other systems

AATS – Clearly the World's Best

Additional Points of Superiority of the AATS

- Does not use a vacuum pump to create the oxygen-free environment
- Utilizes an auger to move feedstock in the reactors, thereby mixing the feedstock as it moves through the system and allowing more uniform penetration
- Employs a method of dispersing explosive synthesized gas in the event of a shutdown due to power failure
- A nitrogen fire suppression system is connected to the reactors in order to extinguish any fires in the reactors or thermal chamber
- The BTU value of the synthesized gas is increased with a vortex pre-mixing chamber
- The system design allows access to the piping system for cleaning and maintenance
- Dual flap air lock gates are used instead of dual blade gates, thereby eliminating a problem other systems have with particulate build-up on the sliding blades, which may eventually allow ambient air to enter the reactors
- Energy efficiency is superior as the methodologies employed to capture, purify, enhance and ignite the synthesized gas allow the system to operate using virtually all of its own created fuel

AATS – Endorsements

“The ATS technology is years ahead of any solution I have seen”

Manager Business Development Biomass Renewable Energy, ABB Inc. New York (2013)

" Among the biochar material that I have investigated so far, EWS' biochar showed the most promising characteristics and performance in electrochemical adsorption applications."

Amir M. Dehkhoda, *PhD in Chemical & Biological Engineering – University of British Columbia Study*

“Every week I see more and more out there that supports the particular way that Emergent goes about producing BioFuel. The existing problems, process and technology being considered all point in your direction.”

Nick J Masucci, Business Development Manager – Biomass Renewable Energy ABB Inc. – New York

"In our current greenhouse trail, EWS Biochar has outperformed traditional soil amendments increasing crops productivity by enhancing germination and improving the physical and chemical profile of the substrate."

Dr. Anayansi Cohen-Fernandez, Senior Land Reclamation Specialist, Coastal Raintree Consulting – Gibsons, British Columbia

Biochar

Biochar is a carbon-rich product produced when biomass, such as wood, manure or leaves, is heated with little or no available oxygen. Sustainable biochar is a powerful simple tool that can: fight climate change, make soil more fertile and drought resistant, reduce agricultural waste, produce clean renewable energy and serve a multitude of other functions



Our biochar is of such a high quality that we significantly exceed the guidelines created by the European Union to govern the production and characteristics of biochar.

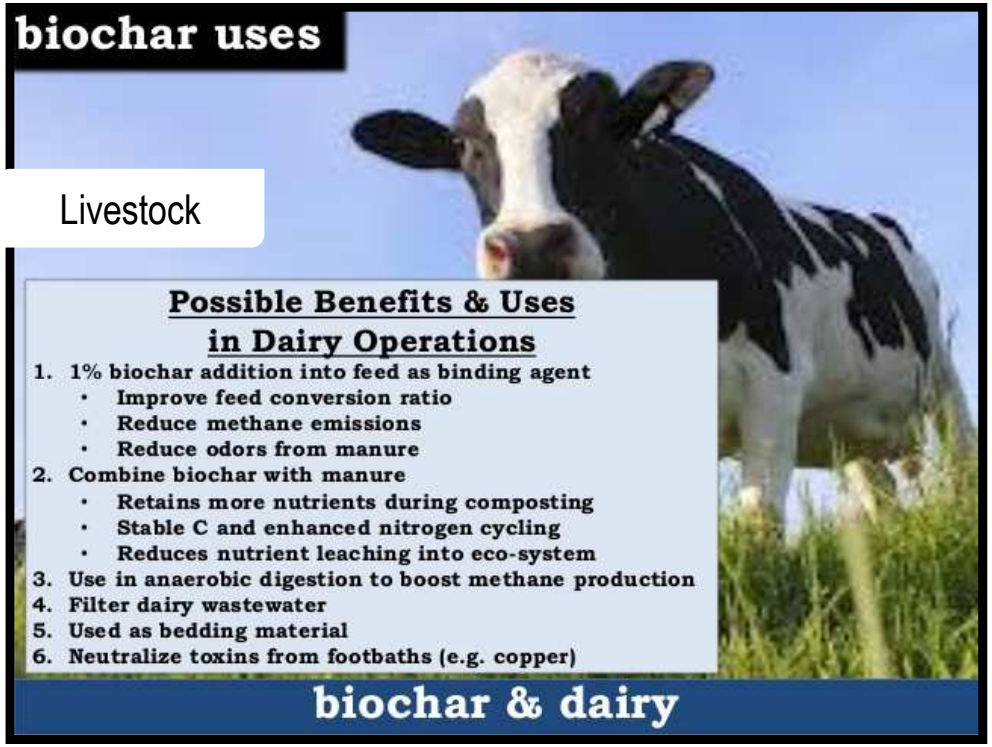
Producing Superior Biochar



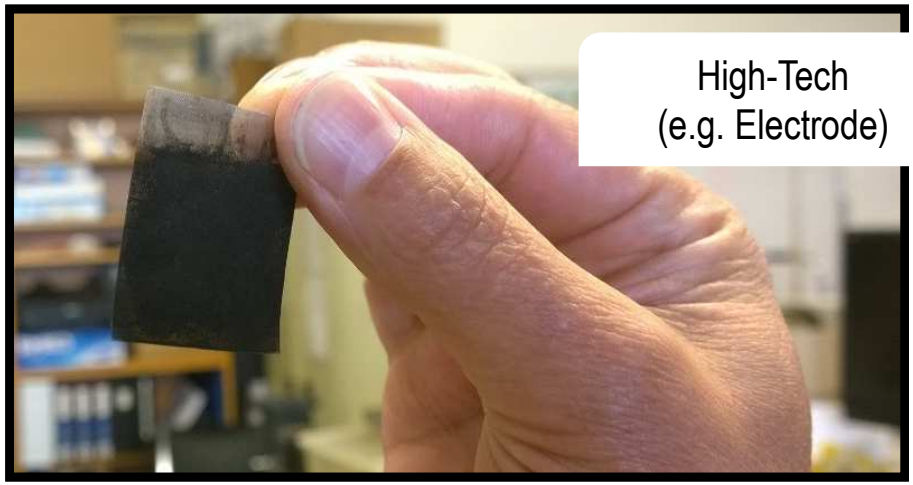
Soil Amendment



Filtration



Livestock



High-Tech
(e.g. Electrode)

Producing Superior Biochar

Contrasting Emergent Biochar with European Guidelines

Criteria	Comments
Feedstock	Our biochar is from only organic, sustainably sourced, wood fibre that is free of contaminants.
	Our feedstock is waste material that would otherwise have been burned, releasing all the greenhouse gasses in that material.
	It is free from all non-organic material and free of paint, solvents and other organic, or non-organic, contaminants.
	Our feedstock is 100 km from our biochar plant. In Europe, it may be practical to enforce an 80-km rule, however in Canada, with our sparse population and vast areas, it is not always reasonable.
Manufacturing Specifications	Our thermolysis temperature does not fluctuate more than 20%. In fact, our temperature remains constant to within 1%.
	The composition of the biomasses does not fluctuate more than 15%.
	Complete production data, including temperature settings, are kept
Sampling Methodology	We are able to adhere to the sampling guidelines as presented in the source document.

Producing Superior Biochar

Biochar Properties	The guidelines call for a carbon content greater than 50%: our Emergent Biochar is greater than 80% carbon.
	H/C ratio is mandated to be less than 0.7, whereas Emergent Biochar is less than .04.
	O/C ratio must be less than 0.4, whereas our Biochar is less than 0.15.
	A list of Volatile Organic Compounds can be made available. The high temperature steam component of our process captures the VOC's and drives them into the synthesized gas outlet, where they are filtered from the gas, which is used as a fuel source for reactor heating. Residual VOC are ≤ 0.5%
	Nitrogen, phosphorus, potassium, magnesium and calcium are not present in our biochar.
	Emergent Biochar stays below published thresholds for heavy metals as the feedstock contains only what is naturally found in wood fibre.
	pH value is 8.55, which is in the recommended range stated in the guidelines
	Ash content is 2.70% ± 0.756%
	Surface area is ≥ 413 m^2/g, significantly above the recommended minimum of 150 m^2/g.
	Water content is for safety reasons and can be dictated by the buyer if this is a concern Normal practice for the Company is for 5% moisture content
	Emergent biochar is well below the 4 mg/kg DM PAH content for premium grade biochar as specified in the guidelines
	PCB, dioxins and furans are not present in Emergent Biochar
Production Technology	The heat source for the reactors is the reclaimed and scrubbed synthesized gas produced by the system.
	The surplus synthesized gas is scrubbed and burned, not released to the atmosphere.
	We comply with emission thresholds for Canada.
	Surplus heat from the reactors is used as fuel for the boiler system.
Shipping & Handling	All safety regulations are followed.
	As noted, moisture is added to the biochar to ensure against dust generation or dust explosions.

Let's work together to make a Greener and Better World by Collaboration and Partnership!



For further information

Please contact Dr SW Lui

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Drsunwinglui@gmail.com