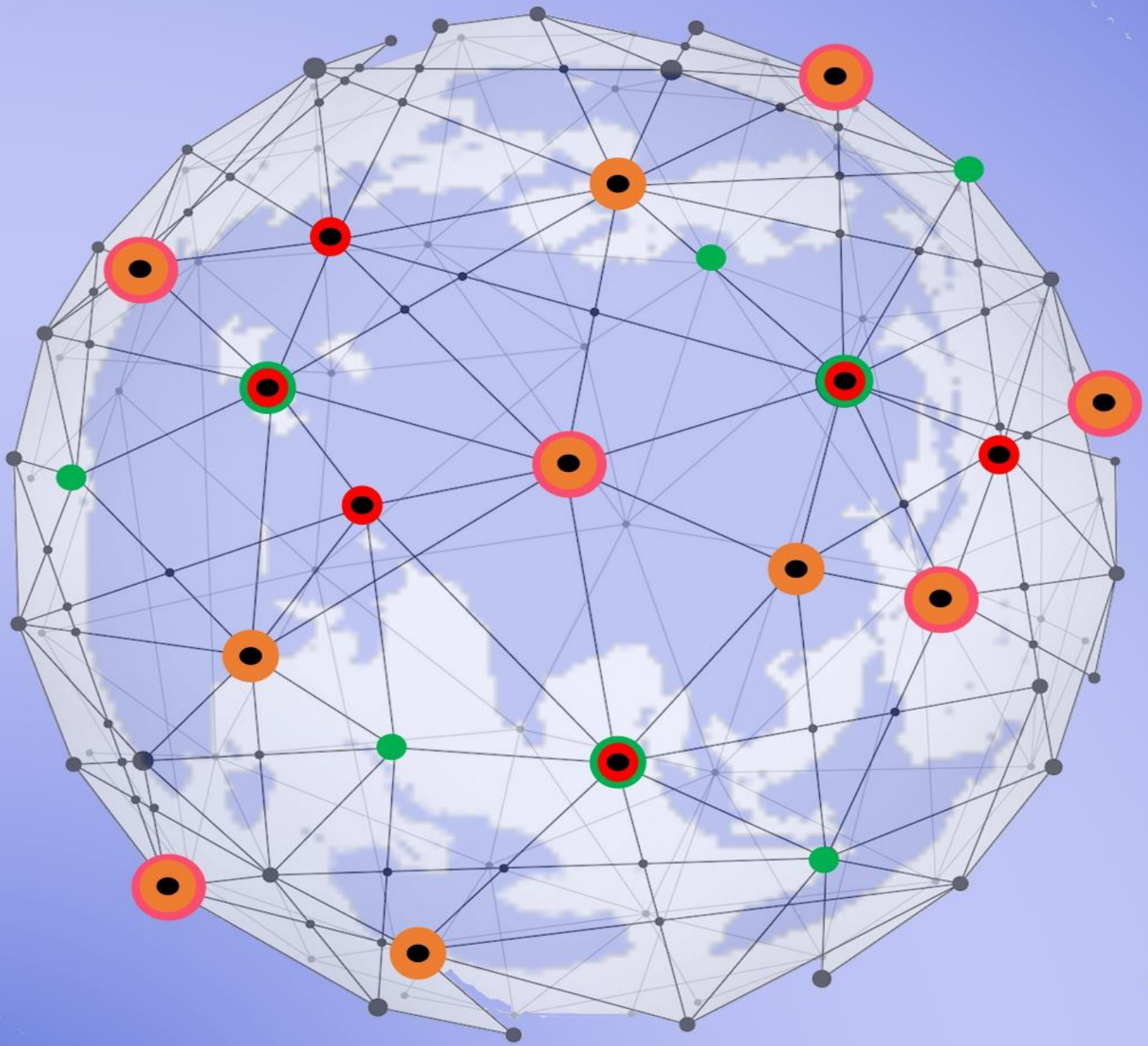
# Ecogas

# Gas On Demand White Paper



ADVANCED RENEWABLE

# Gas On Demand White Paper

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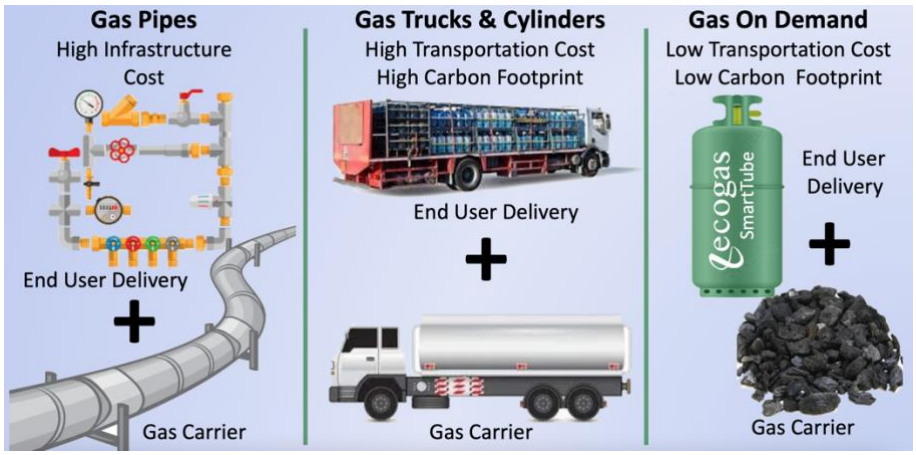
## Problems and Solutions

If you watch how gas gets to you, you'll see why it is expensive and can even be scarce. For those who are lucky, if in their area there is a gas pipeline, this is the cheapest delivery of gas. But because the cost to build this gas pipeline is very expensive, from time to time not many of these gas pipelines are added.

So the next way is to transport gas in large tanks, then transfer it to smaller gas cylinders for delivery to end users. This is a very expensive way of delivering gas because it requires tanks and cylinders that weigh more than the gas itself, and these cylinders go back and forth between filling and emptying. Besides being expensive in terms of transportation costs, gas delivery in this way also has a very heavy carbon footprint.

The era of energy transition opens up opportunities for disruption of the gas delivery system. Not only is the fuel itself carbon neutral, but the carbon footprint can be reduced to a minimum. The impact of reducing costs will be significant because there is no need for any new infrastructure, there is no need for very heavy tanks and pressurized gas cylinders, and there is no need to go back and forth in filled and empty conditions.

We call this disruptive delivery system as gas on demand, which takes advantage of the nature of biomass fuel which in fact can carry fuel in any form, solid, liquid or gas. To become a gas carrier, biomass can be processed into charcoal - so that there is a higher energy concentration while cleaning the biomass from disturbing volatile materials.




Biomass that has been converted into charcoal is also hydrophobic, does not absorb water, does not smell or taste. This makes the biomass charcoal easy to transport and store, even safe in bulk form and stored in an open space.

With this gas-on-demand-style delivery system, there are no areas that cannot be reached by gas on demand. Where humans can live, food can be sent, so is gas on demand. Even the procurement of charcoal itself is a form of democratized energy economy which is an opportunity for the wider community to make it themselves by utilizing local biomass sources.

There is only one small, compact machine needed for this gas on demand presence, namely what we call the Ecogas SmartTube (EST). In essence, this machine decomposes the biomass charcoal into gas

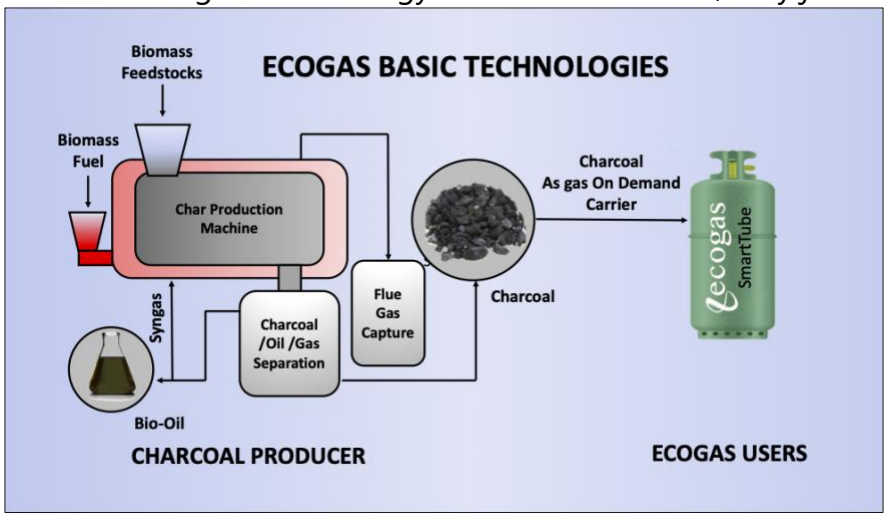
(syngas) while at the same time upgrading its quality by reforming and purification to produce very pure and clean gas. You can see the quality of the gas produced by this EST from the flame it generates as seen in this video link: https://lnkd.in/gwiKVCRe

## Gas On Demand Basic Technologies

The basic Ecogas gas on demand technologies consists of two main technologies. The first technology is needed at the biomass management community at the central biomass production sites, which processes biomass into charcoal. This charcoal in our system is used as the most economical carrier for gas, easy to transport and store, stable in a very long time.

In these biomass production centres what are installed are units for processing biomass into charcoal, its function is to turn biomass into charcoal which is odorless and hydrophobic so that it is easy to store and is timeless and weatherproof. In these machine everything that has the opportunity to pollute the environment is cleaned, including various toxic gases such as SOx, NOx, VOC, CO2 etc. The result is clean charcoal that is ready to be used as a carrier for gas on demand to various users who need it.

In users site, such as household, restaurants, catering, small and medium industries and even various large industries that need gas as an energy source or feedstock, they just need to convert the charcoal into synthetic gas (syngas). For this, it is necessary to install a gasification tube at the user's premises, which we call Ecogas SmartTube.




Ecogas SmartTube can be made into various sizes and types to meet the users need both in term of gas volume they need as well as the quality of gas they want. Simple gasification can be made for heating only, whilst advanced gasifications

including Ultra High Hydrogen Gasification (UHHG) can also be made for highest quality gas production, such as for bio-hydrogen production.

## Quality of Gases We Can Deliver

So far, we are familiar with the blue flame of gas in our homes. Normally this blue color comes from an LPG flame. When we want to replace LPG gas from fossil with renewable gas, the choices are many. The choice in terms of feedstock and the production process of carbon neutral renewable gas - which we will hereinafter call Ecogas - can even be seen visually with the naked eye from the colors of the flame that it displays like in the photo below.

These are the original colorful flames produced from various types of biomass used as feedstocks from the two types of gasification equipment that we make, namely Ecogas SmartStove and Ecogas SmartTube. Apart from producing beauty, these colors also challenge our science to be able to explore them and use them for the prosperity of mankind.

Our Creator has shown the truth of His verses, among others, through this color code. Colors are not only present in the rainbow on the horizon, but in fruits, in honey, in the color of our skin and now it is also found in the color of the flames. With the colors in fruits and vegetables, for example, we can know the phytonutrients contained in these fruits and vegetables and their properties for our health. So what are the benefits of each color in flame?

This is where our science is challenged to explore it, as simple as for example, the different colors of this fire indicate different levels of heat, the more towards purple (right) the hotter it is. Even from this, we can already use it to easily distinguish which biomass fuel is suitable for our needs, the same as when we choose the color of the fruit to take its health benefits.

What we have also studied - and still needs to be further explored, is the relationship between this color and the hydrogen concentration present in the gas produced from the combination of the process and the feedstock used. The further to the right towards purple, the higher the ratio of hydrogen to carbon monoxide.

In a blue flame, for example, the H2/CO ratio reaches above 2, which is a suitable gas to be used as raw material for the production of Advanced Biofuels such as green diesel, bio-jet, bio-gasoline, bio-LPG etc. through the Fischer Tropsch Synthesis (FTS), or it can also be made into methanol through the Syngas To Methanol (STM) Process, Hydrogen trough gas enrichment and separation, and also Ammonia through Haber-Bosch Synthesis.

What is clear is that with this color code from the Creator, our lives become easier. Imagine if there is only one color of fruit and vegetables, you would need a scientist with complicated tools to be able to understand each fruit and vegetable. Likewise, if there is only one color of gas flame, which is blue, then only the producer knows - and God knows best - exactly what is inside.

The following are colours of flames from our gases on demand which is related to its purity, H/C ratio and also level of heat it can achieve.

## Our Five Years Road Map

After doing deep technology research and development in the last five years, We have four milestones for our next five years.

The first milestone is commercial production of our Ecogas SmartStove. Essentially this is a gasification stove with unique features, among other can detect quality of biomass fuel you are using. Colour of flame that come out of this SmartStove will be representing quality of the biomass fuel.

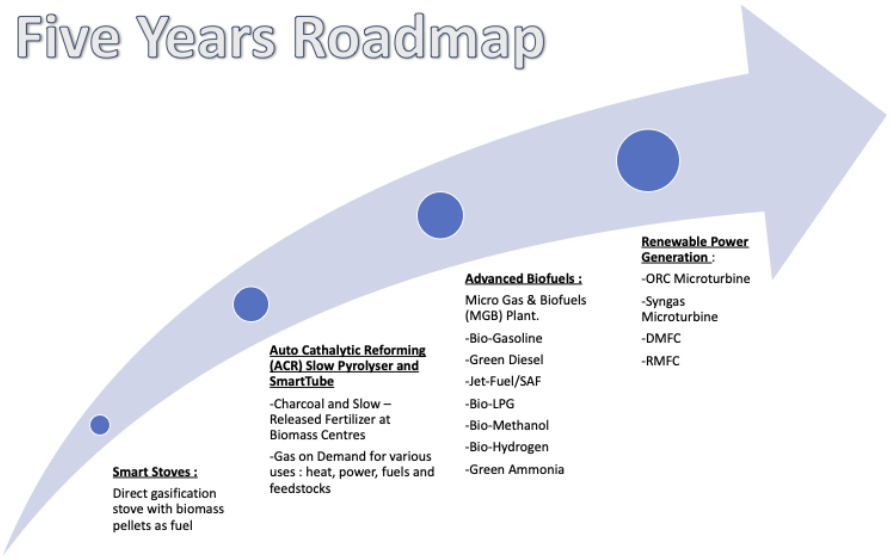
This might be the first in the world that simple equipment like this SmartStove can produce green color. We have achieved this first milestone, with commercialization of our SmartStove. It is already in the market and ready stock for those who need it.

The second milestove have also bee achived by production of our ACR Pyrolysers for biomass to charcoal production, as well as Ecogas SmartTube for gas production at users premises. We can also add option in the ACR Pyrolyser with flue gas processing into slow-released fertilizer. This feature add two benefits in charcoal production process, first is that charcoal production become smoke-free, and the second is valuable byproduct in the form of sustainable fertilizer.

You can see the demonstration of the first and second milestones in this youtube videos : https://www.youtube.com/watch?v=UGOhE-kaBlY for SmartStove and SmartTube, and this one for ACR Pyrolyser. https://www.youtube.com/watch?v=vs_xP_S7s8E&t=12s

For the third milestone, we have finished with our modelling to produce various types of Advanced Biofuels as per European Union Renewable Energy Directive 2 (EU RED2) like green diesel, bio-jet, bio-gasoline, bio-LPG, bio-methanol, bio-hydrogen and green merhanol. In addition to gasification technologies, in third milestone we will also use Fischer-Topsch Synthesis, Syngas to Methanol, Steam Methane Reforming and various other technologies that will be needed for the Advanced Biofuels production.

As with final milestone we will produce renewable electricity from our waste heat of pyrolysers and gasifiers, as well as renewable electricity from our gasification main product which is syngas. For waste heat we can use Organic Rankine Cycle (ORC) microturbine, stirling engine or Thermo Electric Generator (TEG), while from syngas main product we can also generate electricity with Internal Combustion Generator Engine, Gas Engine and even with the most efficient fuels cells technologies. For this fuels cells we have two approaches, i.e. Direct Methanol Fuel Cells (DMFC) , Reformed Methanol Fuel Cells (RMFC) and also Solid Oxide Fuel Cells (SOFC) technology.




For the third and fourth milestone will be carried out within the next three years once capital investment required for these two steps is secured.

## The First Milestone Technology

The price of LPG may never go down, its availability may even be disrupted at any time by changes in global geopolitics, natural disasters, etc. But people can always provide an umbrella before it rains. People in any part of the world can now easily make their own gas.

In addition to being cheap and easy, this gas, which we call Ecogas, is carbon neutral because it is made from local biomass. The simple stove that we used for this example is also smart, it can tell you to instantly know the quality of your biomass or pellets based on the color of the fire they cause.

This stove is part of the WISE (Waqf, Infaq and Sadaqah for Energy) project, you don't have to buy it for yourself - but it can be donated to thousands of orphanages and Al-Qur'an Islamic boarding schools that are ready to use it all over Indonesia, also in the another world that needs it.

The demonstration on how to use this stove can be seen it here :
https://www.youtube.com/watch?v=iNApTxVtmlo&t=50s

## The Second Milestone

The philosophy in machine design that we learned decades ago from my professor at the university at that time, is still very much ingrained to this day. The philosophy goes something like 'success of machine design is when you can design a simple machine to solve complex problems, not the other way around a complex machine to solve simple problems'.

When we apply this philosophy to energy conversion from biomass into various complex products, the result is a simple machine or reactor that we call Ecogas SmartTube (EST). Although simple, this small reactor can overcome the complex problems of a very diverse biomass gasification process, into high quality syngas.

The ghost of any biomass gasification process is generally tar, which is a collection of various long-chain hydrocarbons which greatly interfere with the quality of syngas. At EST, this tar is removed by a process we call Auto Catalytic Reforming (ACR), which is reforming using a catalyst present in the biomass feedstock that we use to produce this gas itself.

The existence of this catalyst can naturally already exist in a certain biomass, or if it isn't there it can be added but also still from other biomass sources - just take the catalyst only. I have previously shared the details of the catalyst that we use here: https://lnkd.in/gcaRdANX

With the ACR function in this reactor, the gas produced can be managed flexibly. For example, if you only need gas for commercial or industrial heating, the standard syngas is very sufficient already, you don't need syngas with certain characteristics except for those that contain high calories.

Conversely, if syngas is to be used as a feedstock for further processes such as to produce methanol through the syngas to methanol (STM) process, to produce green diesel, bio-jet, bio-gasoline, bio-LPG etc. through Fischer-Tropsch Synthesis (FTS), what is needed then is high quality syngas with a minimum H2/CO ratio of 2. All types of syngas can be produced by this compact reactor.

This Gas On Demand technology is now ready to be implemented on a commercial or industrial scale, the most ready at the moment is for the production of syngas (CO and H2) on demand, but if anyone needs derivative products such as the various types of advanced biofuels mentioned above, or even hydrogen and ammonia, we can already discuss the production route starting from this syngas on demand. The demonstration video for this milestone is here : https://www.youtube.com/watch?v=UGd6O_1_Nw8&t=6s

## The Third Milestone : Opportunity When ' The Winter' Is Coming

Winter is literally the winter experienced by countries with four seasons in the northern and southern hemispheres. Figuratively speaking it means famine because in winter the average tree or plant does not bear fruit, if this occurs in an isolated area due to war etc. then it could be a big disaster like in the Netherlands towards the end of World War II which claimed 22,000 lives.

However, both literal and figurative winter open up great opportunities, among others, for those who can provide solutions. One of them is the increased energy requirements for heating etc. In a figurative sense, winter in the form of an energy shortage is also right before our eyes. A number of areas are starting to experience difficulties with LPG, for example, or having to buy it at a high price.

Even when fossil energy in the form of Diesel, Jet-Fuel, Gasoline and LPG are still available and affordable, their use must be suppressed because the emission impacts are getting more serious. The air temperature has risen sharply in Asia in the past two months, and for countries that will experience winter in the next six months, they are worried that extreme cold temperatures will also occur.

So this is a great opportunity that you can also be involved in, both commercially and socially and environmentally impact. Ecogas SmartTube (EST), which can provide gas-on demand based on local biomass or nearby sources, can be a complete energy solution - regardless of energy needs and anywhere. The video from our workshop that produced it here: https://lnkd.in/gJhehrt6


This EST could be at the heart of any form of energy we need, not just for Combined Heat and Power (CHP), but Combined Heat, Power, Feedstocks and Fuels (CHPFF), because it produces the gas where the direct user is - all elements of the CHPFF can be utilized by users.

Waste heat from the process of decomposing biomass into gas can be recovered for space heating, water heating, and even to produce renewable electricity. There are at least two technologies ready for this, namely the Organic Rankine Cycle (ORC) Microturbine and the Thermo Electric Generator (TEG).

While the main product of EST is syngas which is also very flexible in its use. It can be used as fuel for power plants directly with gas generators, can be used as feedstocks for various industries including producers of green diesel fuel, bio-jet, bio-gasoline, bio-LPG, methanol, ammonia, hydrogen, etc. And the most efficient is when used for power generation with Solid Oxide Fuel Cells (SOFC) technology.

Currently, what is ready and can be ordered is EST for on-demand replacement fuel for LPG and LNG, the rest is up to you to explore. Winter is coming, and so are the opportunities.

## The Forth Milestone

This clean, carbon neutral and renewable fuel in the form of biomass has not yet been utilized optimally, while the price of fossil fuels is no longer cheap apart from continuing to pollute the earth's atmosphere massively.

The results of our survey found a crucial problem in empowering this biomass. It is not attractive for farmers and other parties to collect biomass and process it because the selling price is very low. Meanwhile for the user, it is not economical to buy at a better price because of its low energy density making it expensive in transportation costs.

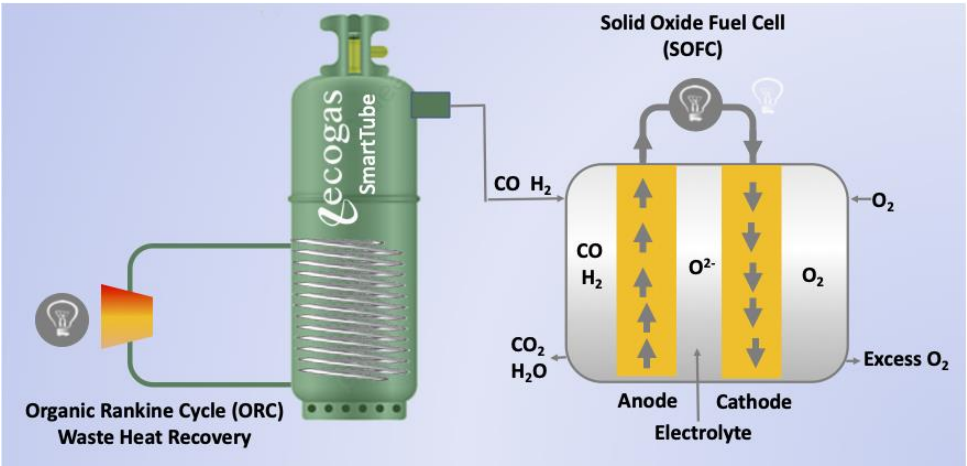
The biggest potential for using biomass for power generation is also not attractive until now because of its low-efficiency energy conversion. Per kilogram of biomass, which on average carries more than 4 kWh of energy, when it is converted into electricity, in averages only produce 1 kWh or an energy conversion efficiency of not more than 25%.

These problems in the energy transition era must be solved so that this clean energy source can be optimally utilized. So what we stretch for the utilization of this biomass is for raw materials for local fuels - namely fuel that is produced and used in the same area by the local community.

If it is turned into electricity, the concept is distributed power generation, namely a very small scale power plant that can be integrated on-grid or used directly by users off-grid. But even with this, the problem of energy conversion efficiency must be improved so that this biomass can become the prima donna of the energy transition.

So what we are stretching further is to change the energy conversion machine with new types of machines that are much more efficient than the existing power generation machines. For this, two technologies can be used, the first is Organic Rankine Cycle (ORC) Microturbine and the second is

Solid Oxide Fuel Cell (SOFC) technology.




Both of them are very well fit to be combined with the micro-scale gasification machine that we made and I shared the video yesterday. The ORC Microturbine can be used to recover the waste heat generated by the Ecogas SmartTube - which emits a lot of waste heat, especially in the reduction zone - namely the space at the bottom of the Ecogas SmartTube. My calculation is around 15% of electrical energy can be generated from this waste heat recovery.

Then the main products from gasification in the form of Co and H2 or syngas, can be directly used to generate electricity using SOFC technology. From here my calculation is 55% to 60% of the energy contained in the biomass can be converted into electricity. With this concept as a whole we can produce between 70% to 75% energy conversion from biomass to electricity, or nearly 3 times the technology that has been used so far.

We have created the Ecogas SmartTube, an opportunity for those of you who have passion in the ORC microturbine and SOFC fields to complete this high efficient biomass-based energy system.

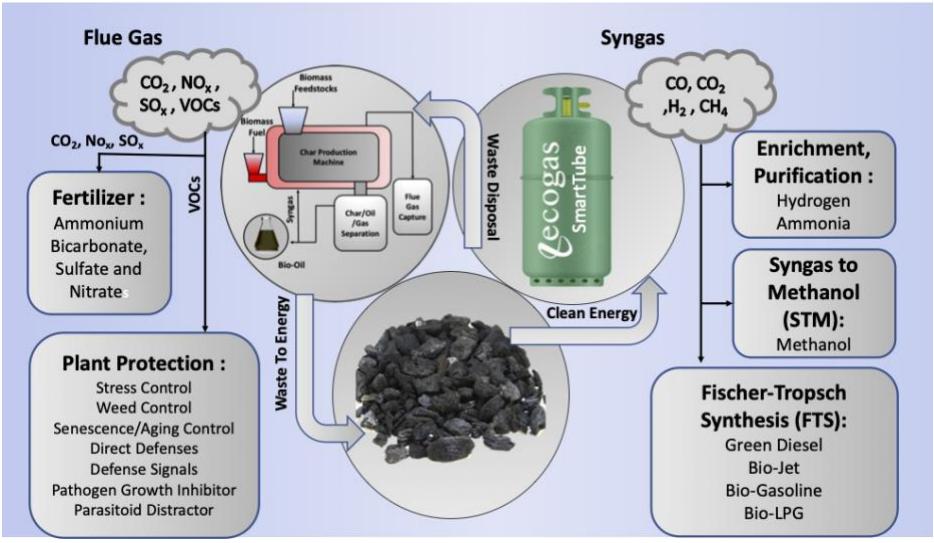
## Our Contribution To Sustainable World : The 3rd Green Revolution and Net Zero Emissions

The first green revolution started at the end of World War II, when chemicals originally used for weapons were turned into fertilizers - to increase world food production. The second green revolution when humans began to use genetically modified plants, such as those used for world soybean production which is currently very massive.

Regardless of the pros and cons of the 1st and 2nd Green Revolutions, both were needed in their respective times, because if there were no chemical fertilizers - how could Indonesia be self-sufficient in rice in the 80s? how can our people still buy cheap tofu and tempeh as our popular side dishes?

But now the world really needs the next green revolution, call it the Green Revolution 3. Why is that? In the next 27 years, by 2050, the world's population will reach around 9.7 billion, up 20% from now. Agricultural land does not increase instead tends to decrease. if the yield per unit area of land remains the same then the world will be permanently famine. Then there must be extraordinary

breakthroughs in the world of agriculture.




It should also be remembered that in the next 27 years the world has targeted Net Zero Emissions of 2050, one of the main candidates for fuel to be used at that time from agricultural biomass. If efforts to provide enough food are not synergized with efforts to obtain green energy which is Net-Zero Emission, then the two can compete for resources and both can fail miserably.

So this is what we are promoting for Green Revolution 3 as well as Net Zero Emission. The point is to use waste biomass from agriculture, plantations, forests and agricultural organic waste for the production of clean fuels, while also producing natural fertilizers, insecticides, pesticides and plant protection. The outline of the process can be seen in the illustration below.

In the biomass centers, the biomass is carbonized into charcoal. In this carbonization process, a lot of smoke will come out or it is called flue gas. The content of this flue gas when released into the air is dangerous for human health, but if we catch it - it becomes very useful for plants. We can capture the flue gas contents in the form of CO2, NOx, and SOx and make them into slow release fertilizers, while we capture Volatile Organic Compounds (VOCs) and return them to their original function, namely various forms of plant protection.

Charcoal, which is the main product of this carbonization process, is used as feedstock for the production of syngas - the most flexible building block for various needs for clean fuels that are carbon neutral and renewable. The slow release fertilizer and various plant protections will be the tool to fertilize and make productive arid lands and even deserts or dead earth, at the same time that the need for clean energy that is Net-Zero Emission is also fulfilled.

## Opportunities For You

Toward SDGs 2030 and even further Net Zero 2050, the most lucrative business in the world will be on those that are related to the two issues. Fortunately that these opportunities are for everybody as this energy transition era is featured by it's 3D characters, Distributed, Democratized and Disruptive.

So what are the opportunities for you?, you can pick any role or combination of roles you want.

## Gas On Demand Users

By taking this simplest role you can already enjoy benefit of energy independent, reducing CO2 emission up to 3 kg CO2 for every LPG you replace with this gas on demand. Once the fuel available in your neighbourhood, you will also enjoy a very low cost clean, carbon neutral and renewable gas.

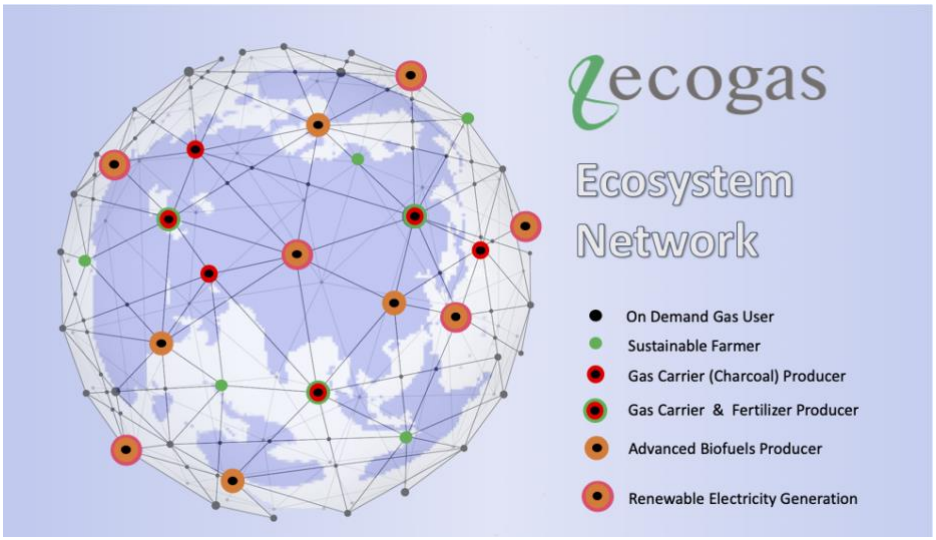
## Sustainable Farmers

On the way we produce on demand gas for energy, we will also produce a lot of slow release fertilizer. And also all kind of plant protection. Not only organic and green, it will also be low cost way to grow crops and plant in the sustainable future. How can it be low cost? Because it is a byproduct of energy production, so most of the costs already absorbed by the energy users.

## Charcoal Producers

For those of you living in the central of biomass production, it might be the best opportunity for you to convert those cheap or even free in some cases, biomass from agricultural waste, plantation, forestry and biomass of municipal solid waste into valuable products with simple process, i.e. convert it into charcoal.

You can do it manually as making charcoal is one of the oldest civilization, but if you want to do it effectively and cleanly, then you only need our ACR Pyrolyser. Then our ecosystem will take as off-taker of your charcoal, that why we must develop the ecosystem together for area or region.




## Charcoal and Fertilizer Produzer

In this role you upgrade further your ACR Pyrolyser with flue gas capture and unit to convert flue gas into various types of slow release fertilizer and plant protection.

Two additional benefit you will get from this role is that your charcoal production process will become smoke-free, and you will also have additional income, not only selling charcoal but also selling fertilizers and plant protections.

## Advanced Biofuels Production

Depend on type of gasifier you will use, the Ultra High Hydrogen Gasifiers can produce syngas with very high H/C ratio. This kind of syngas can be use as feedstocks to produce any Advanced Biofuels you need.

With Syngas To Methanol (STM) you can produce bio-methanol right away from syngas. With Fischer-Tropsch Synthesis (FTS) you can produce green diesel, bio-jet, bio-gasoline, and bio-LPG. Anda even you can produce bio-hydrogen with enrichment and purification of syngas, and last bot not least is that you can produce ammonia by adding Air Separation Unit (ASU) to capture nitrogen from air, and then use it to proce ammonia via Haber-Bosch Synthesis.

## Renewable Electricity Generation

As people moving toward heavily rely-on electricity for transportation and other modern machines, demand for clean and renewable electricity will only going up from now on up to 2050 or even further.

Various ways to generate clean and renewable electricity with syngas. You can capture the waste heat with ORC Microturbine, Stirling engine or thermoelectric generator for low cost electricity generation. Or you can produce electricity on purpose with the syngas produced by your gasifier.

Numbers of technologies are available for the latest, including Internal Combustion Engine (ICE), gas engine, and the most efficient energy conversion with fuel cell technologies, like RMFC, DMFC and SOFC.

## Contact

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