



Vary Tech Website



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— Biocarbon-based Material Industry Development —

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**The multiple properties of bio-carbon "enable us to address four major crises simultaneously: the climate change crisis, the energy crisis, the food crisis, and the water crisis."**

**-- Tim Flannery**

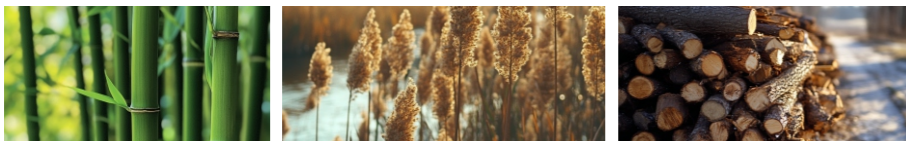
## Biomass Resources

The Earth's terrestrial ecosystems can accommodate a sufficient amount of vegetation to absorb more than 4 billion tons of carbon dioxide from the atmosphere annually, producing 173 billion tons of biomass, which contains energy equivalent to 10-20 times the total global energy consumption, yet the current utilization rate is less than 3%.

China's agricultural and forestry residues output has reached 1.2 billion t/y. With the implementation of sustainable forest resource management, it is anticipated that over 2 billion t/y of agricultural and forestry biomass can be developed and utilized. Energy development will transition from the mining era into the "plantation" era.

The formation of biomass is a process that absorbs the most common natural resources of soil, sunlight, air, water, and microorganisms on the earth and converges them into life energy. It is also a "negative carbon" process of carbon capture through "photosynthesis".

Nevertheless, the application of biomass is constrained by its inherent drawbacks, including low energy density, high costs associated with storage and transportation, as well as its propensity for rapid decay and decomposition.



## Biocarbon-based Material

Biocarbon is a carbon-rich solid product derived from biomass via pyrolysis or thermochemical conversion. It mainly consists of aromatic hydrocarbons and elemental carbon, or carbon possessing a graphite-like structure. Biomass with different textures, at different temperatures and different heating rates, will generate "carbonized" or "semi-carbonized" substances with varying fixed carbon content, that is, biological carbon-based materials. Because bio-carbon has higher energy density, better grilability and hydrophobicity than ordinary biomass raw materials, it has a wider range of applications.

The most basic application field of biocarbon-based materials is "charcoal fuel", also known as "green coal", which is recognized worldwide as a "carbon-neutral energy source". Substituting one ton of standard coal with an equal amount of normal bio-carbon fuel can lead to a reduction in CO<sub>2</sub> emissions by 2.67 tons. The primary methods of application include:

- ① Mixed combustion with powdered coal for electricity generation;
- ② Substitute for coal used in smelting iron, silicon, etc;
- ③ Boiler fuel;
- ④ Application in home heating and food baking.

The application of biocarbon-based materials in rice seedling raising and carbon-based fertilizers can enhance soil fertility and increase crop yields, which is a typical "carbon sequestration" process.

Modern carbon production processes and equipment enable carbon-based materials to have higher and more stable product performance, and their application prospects are also broader:

- ① Manufacture a range of activated carbon products (suitable for food, pharmaceutical, chemical, and water treatment industries) following secondary activation.
- ② Serve as the hard carbon negative electrode material for sodium batteries.
- ③ Produce various carbon-rich materials.

# Traditional Carbon Production

“Charcoal seller” --Earth Kiln



## Traditional Kiln Carbonization Furnace

Charcoal making has a long history. Traditional biomass carbonization mainly uses earth kilns or brick kiln methods. First, the biomass material is filled into the kiln. The fuel combustion in the kiln provides the heat required for the carbonization process. Then the kiln is sealed, with air vents on the top of the kiln. The carbonization material is smoldered in an oxygen-deficient environment and then slowly cooled inside the kiln, ultimately producing charcoal.

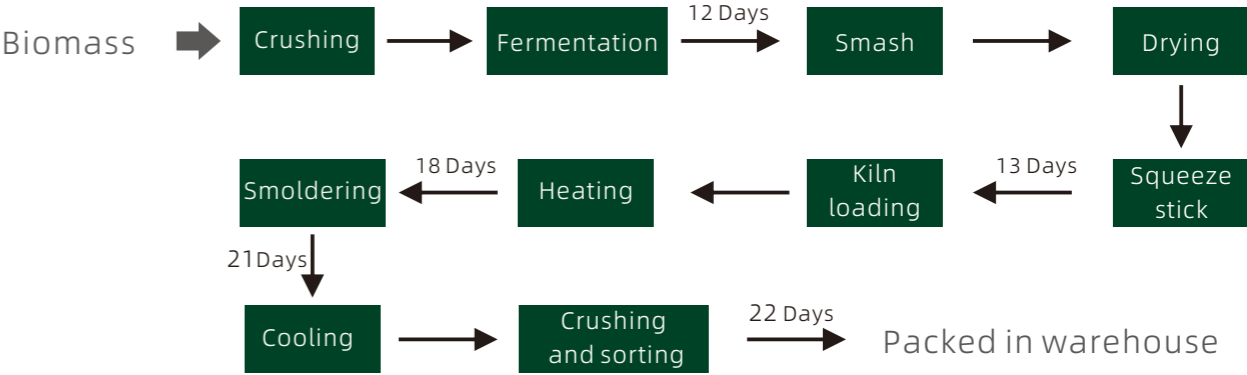
Most kiln-type carbonization furnaces are made of earth bricks, making it very difficult to control the fire during the combustion process. The production process has poor labor conditions, high intensity, long production cycles, and serious pollution. Earth kilns use a large amount of raw wood materials but only obtain less than 20% charcoal, with more than 80% of the gaseous and liquid products being emitted into the environment, posing a considerable pollution problem.



## “Mechanism Carbon” Process Flow of Forming Before Carbonization

To manufacture charcoal from 3 forestry residues (lodging residue, wood residue, processing residue), China has developed the "mechanical carbon" process, which has become the mainstream process for bio-carbon. However, there are many issues as outlined below:

- ① The raw material per-treatment has a long cycle and occupies a large space;
- ② There are many procedures with high consumption of wear parts and electricity, and severe pollution to the working environment due to thick smoke generated during surface carbonization;
- ③ The pyrolysis gas produced by the multi-furnace carbonization consisting of hundreds of well-type furnaces is difficult to collect, poses significant safety hazards, wastes thermal energy, and causes severe pollution from direct emissions;
- ④ The pyrolysis flue gas and waste liquid treatment does not meet discharging standards, leading to serious environmental pollution;
- ⑤ The entire process cycle lasts for over 20 days, involves many procedures, relies entirely on manual operation experience, and results in unstable product quality.



# Vary Tech Biocarbon Development -Oxygen-free Pyrolysis Technology



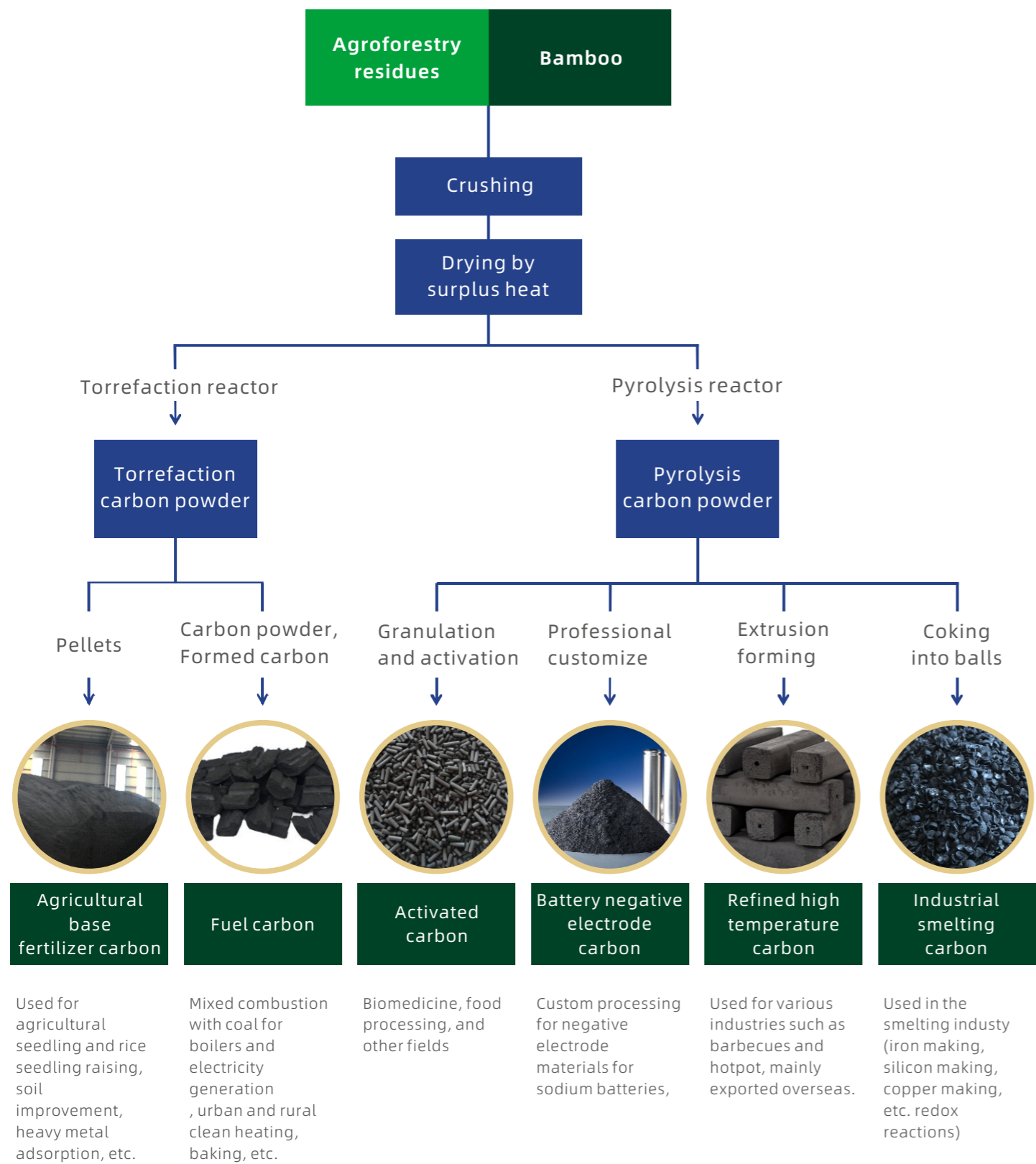
Vary Tech, based on its independently developed "oxygen-free pyrolysis" technology and equipment for organic solid waste, has developed the "continuous rotary kiln type drying and carbonization equipment," which has completely revolutionized traditional carbon production processes, leading in all indicators far beyond existing traditional techniques. The biomass processing capacity of a single line reaches up to 100 tons/day. It operates fully automatically, boasting energy-saving and carbon-reducing features, thereby solving the long-term bottleneck issues that have constrained the development of bio-carbon.

## New Carbon Production Process:



- Take carbon powder as an example:
- The processing cycle has been optimized from 10 steps to 4, reducing the time from 22 days to 1 day. Efficiency has increased by tens of times;
  - Completely sealed, oxygen-free rapid carbonization, recyclable use of combustible gases, saving 30% energy and 20% raw materials compared to traditional processes;
  - Intelligent control system achieves data collection, calculation, correction, mechanical temperature control and product standardization;
  - The production environment is optimal, with complete combustion of gas ensuring that heat is efficiently distributed to each process. Exhaust gases are released in compliance with environmental protection standards, following eco-friendly treatment procedures.

# Vary Bio-carbon Industrialization Path

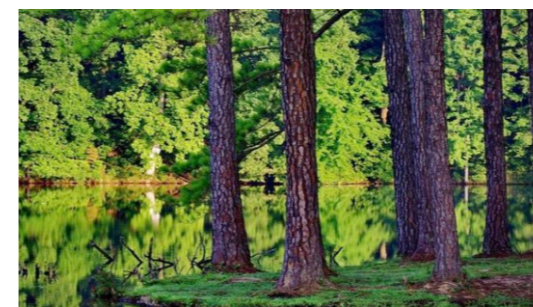


# Vary Bio-carbon Investment Project Phase 1



## Xinmi Vary Bio-carbon Demonstration Base

Utilizing the existing factory infrastructure and two Pr18 oxygen-free pyrolysis lines and local biomass materials with northern characteristics (such as fruit branches, cotton stalks, corn cobs, and peanut shells) to produce a scale of 30,000 tons of "Bio-carbon Fuel" and "Civilian Charcoal (for heating and barbecuing)"



## Pine Bio-carbon Production Base

Relying on the abundant biomass resources of the southern forest regions of Hunan, Vary has leased a 20,000m<sup>2</sup> area, invests 600 million RMB to built a plant with 4 sets of Pr18 production lines. The plant is designed to consume 200,000t /y of biomass raw material, yielding 65,000 t/y of biocarbonbased materials and forest products, as well as 30,000 t/y of chemical raw materials.



## Reed Bio-carbon Production Base

Utilizing the abundant reed resources of Dongting Lake, Vary has leased an existing area of 10,000m<sup>2</sup>, transferring 100,000 t/y of reeds to 30,000t/y of bio-carbon fuel and 10,000t/y of seedling matrix bio-carbon.

## Carbon Emission Reduction Effect



### Reduce dependence on fossil energy and promote carbon neutrality

Bio-carbon is recognized worldwide as a "carbon-neutral energy source" , and is hailed as "green coal" . China's coal consumption reaches 4.2 billion tons per year. With an estimated 10% replacement rate, the usage of "green coal" could reach 400 million tons per year. The reduction in carbon dioxide emissions could exceed 1.48 billion tons. Among these, the steel industry alone could achieve a reduction of 156 million tons.

The application of bio-carbon in rice seedling raising and carbon-based fertilizers is a typical example of "carbon sequestration". Its "negative carbon" contribution will play a crucial role in the "carbon neutrality" of the agricultural and rural sectors.

## Effectively Promotion of “Agricultural and Rural Revitalization”

At a critical time when the per capita income in the current agricultural and forestry industries is low and the revitalization of agriculture and rural areas urgently needs to seek new breakthroughs, biocarbon, as a trillion-level market (400 million tons × 2500 yuan/ton), plays a significant role in achieving the "carbon neutrality" goal. It can also drive economic growth in vast agricultural and forestry areas.

After carbonization, biomass straw and rice husks can be used as carbon-based fertilizers for rice seedling raising and economic crops, which will have a lasting improvement effect on the control of soil heavy metal pollution, water and fertilizer retention, and agricultural income.

Low-cost heating charcoal produced mainly from straw and forestry residues can solve the problem of clean heating in rural areas during winter, significantly reducing pollutant emissions caused by coal burning. At the same time, it fundamentally addresses the long-standing issue of "straw burning".

The by-product of bio-carbon , pyroligneous acid (various natural bioactive substances extracted during the process of pyrolysis carbonization) can be widely applied in agriculture and forestry industries as foliar fertilizers to promote crop growth; as disinfectant and bactericidal solutions for livestock feed; as deodorants or biopesticides, etc. It plays a positive role in promoting the development of modern agricultural industries.

