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Critical Materials and Economic Independence

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Greg Henthorn is the Vice President of Corporate Development for AmeriCarbon Enterprises, a primary mover in developing a fully domestic supply chain for graphite, carbon pitch, and other carbon materials. Henthorn has been an entrepreneur and business executive for nearly three decades, with business interests in energy, chemical manufacturing, healthcare, and technology. He holds degrees in chemical engineering, business, and law, all from West Virginia University, where he serves as an adjunct faculty member. Henthorn is also a board member of TechConnect West Virginia, dedicated to innovation-based economic growth in the state and region.

I consider myself an optimist, but I have an underlying nervousness. In recent decades, due to a variety of internal and external forces, our great country has an increasing potential to become vulnerable on a global and geopolitical stage. Europe's reliance on Russia for natural gas may have been a contributing factor in Putin's calculation to invade Ukraine, highlighting the perils of a lack of energy independence. Regardless of how the balance of soft power and military strength may evolve in the coming years, in order to maintain our true independence as a nation, we must regain our economic independence.

The world economy may seem different in 2050. Although the future can be difficult to predict, a global shift toward the reduction of greenhouse gas emissions, combined with major advancements in computing and data, will no doubt be part of the story. What will serve as the lifeblood of that world economy? Carbon and other critical materials.

Carbon has special properties and attributes that make it the building block of life – the backbone of DNA – and which also hold the key for driving technological progress in the 21st century, much in the way silicon ushered in technological advancement in the past 50 years.

AmeriCarbon

As one example among several of the importance of carbon and critical materials, there is more carbon in a lithium-ion battery than any other material, including lithium. Ironically, a shift to electric vehicles is reliant upon a source of carbon and graphite, for which coal is the ideal feedstock.

The essence lies in carbon's nature to form covalent bonds (although it also can form ionic bonds). It does so in a way that makes it analogous to Tinker Toy pieces – it can bond to hydrogen, oxygen, nitrogen, and a number of other elements. But its most interesting bonding occurs with other carbon atoms, enabling combinations that can form long chains, rings, buckyballs (imagine a molecular soccer ball), tubes, and other shapes that are generally not possible with other elements. Further, the nature of carbon's bonding orientation also leads to shapes that are not

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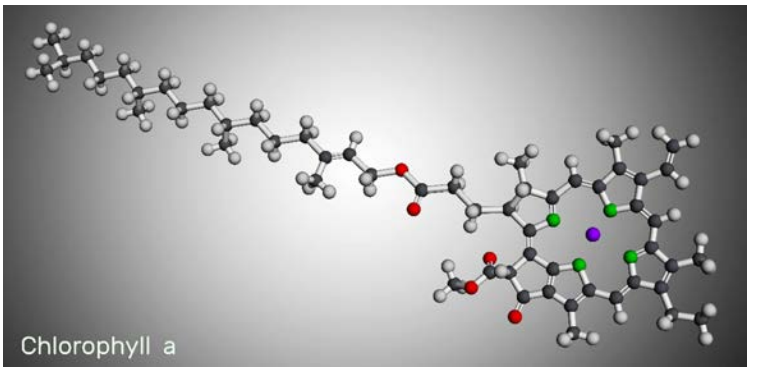
only linear but also can provide unique functionality based on molecular structure, as illustrated in complex biochemicals such as DNA, RNA, proteins, and other cellular components.



Chlorophyll A is an example of a carbon chain with spatial configuration.

The carbon chains in coal vary in length and composition, not only from coal seam to coal seam, but also within an individual coal seam. Carbon chains in coal typically contain more than 100 carbon atoms, and the diverse and complex structures give coal an advantage for forming carbon products.

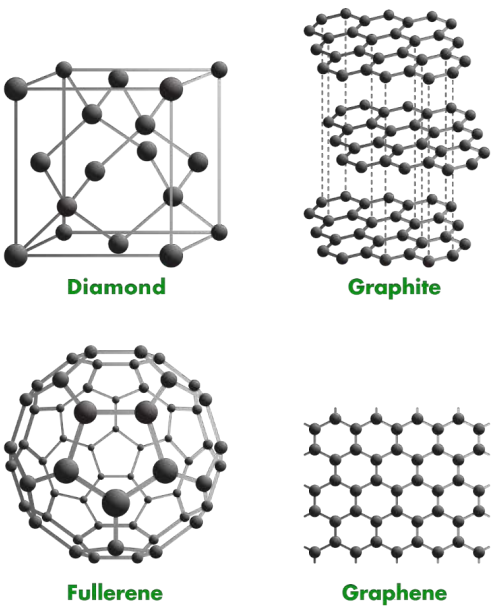
Examples of configurations of carbon that illustrate carbon's special bonding properties include diamond, graphite, fullerene, and graphene, as shown in the accompanying image. These special properties unique to carbon can be harnessed to manufacture materials with high strength-to-weight ratio, directional conductivity of electricity and heat, radar absorption, and a number of other specialized properties.

Carbon Ore – the Step Change Material of the 21st Century

Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Initiative for U.S. Basins is a federal effort, focused on the onshoring of production capacity for materials that are critical to the United States' manufacturing supply chains. Harnessing the properties of carbon ore will provide the basis for the advancement of technological progress in the remainder of the 21st century, similar to the prominence held by silicon, gold, and other materials in prior time periods. Fortunately, the United States holds more than one-fifth of the world's coal supply, including diversity among lignite, sub-bituminous, and bituminous coals, each of which have unique properties that can be optimized for different applications.

Although the United States has an abundance of carbon, it is not found in the form needed. Instead, it must be processed in order to convert carbon to a form that can harness these unique material properties. Currently, industry relies on the production of coal tar pitch, which is a three to eight percent by-product of coking ovens in the steelmaking process, which is an energy-intensive process that is predominantly based overseas. This reliance on foreign material supplies for strategic industries places the United States in a precarious position, lessening our economic independence.

Our company, AmeriCarbon, has developed an alternative chemical process to produce a liquid carbon pitch called Eco-Pitch™, which is considerably more efficient and less energy intensive as compared to current industry supplies, resulting in a dramatic reduction in greenhouse gas emissions. It uses coal as a feedstock and produces Eco-Pitch™ as the primary product. We are developing our initial manufacturing plants in Wyoming County, West Virginia and North Dakota.



Examples of carbon configurations that are enabled by its unique bonding properties.

AmeriCarbon is riding a new wave of innovation that has the potential to position the Appalachian Basin and other coal communities for significant economic growth, driven by manufactured products that harness materials such as carbon, rare earth elements, and other innovative materials. These innovations can lead to a much higher economic value for coal, on a per-ton basis, as compared to heating, power generation, or steel manufacturing.

By focusing our collective energies on using coal as a chemical feedstock for graphite and other carbon products, continuing investment in research and development that will further unlock special properties of carbon and rare earth elements, and building a domestic manufacturing supply chain for critical materials that will underpin economic growth in strategic industries, our country can further strengthen our economic independence.