



JUST THE FACTS



Fossil Fuels Essential to Four Essential Materials that Support Civilization

Time Magazine published an analysis recently by Vaclav Smil, a scientist, policy analyst and Distinguished Professor Emeritus at the University of Manitoba, that demands amplification by Pennsylvania's oil and gas industry and other people interested in facts about the importance of fossil fuels in a modern society. Smil identifies four materials as the pillars of our current civilization - cement, steel, plastics and ammonia - and notes that they are needed in larger quantities than are other essential inputs, and will remain in high demand in the future.

Here are the facts about the importance and value of each of those manufactured items and the reality: there is no substitute for the fossil fuels needed to produce them.

Steel, Cement, Plastic, Ammonia

The world currently produces 4.5 billion tons of cement, 1.8 billion tons of steel, nearly 400 million tons of plastics, and 180 million tons of ammonia every year.

Let's start in reverse order with ammonia, because it is probably the most important one, as it allows us to efficiently meet the basic human need of nutrition. Ammonia is synthesized into all nitrogen fertilizers, and its current production levels are essential to grow the food that meets the needs of about half of the world's population of 8 billion people. Ammonia's importance to feeding people in China is even greater, with three out of five people in that country depending on the synthesis of this compound for fertilizers - with no current substitutes to meet future needs.

The oil and natural gas industry has been pointing to the essential role plastics play in every aspect of our lives for many years, and their uses in important health care, safety and manufacturing applications are only growing. As Smil points out in his essay, life now begins (in maternity wards) and often ends (in intensive care units) surrounded by plastics.



In February 2020, PIOGA published this photo, along with a list of almost 100 devices and equipment derived from oil and natural gas that are found in a typical emergency room. Two months later, emergency departments in hospitals in many parts of the country were relying on this type of equipment - and far more petroleum-based materials - to treat COVID patients.

This and other helpful fact sheets can be found at pioga.org/education/pa-oil-and-gas/fact-sheets-and-additional-resources.

The third product, steel, is our civilization's most widely used metal, and is valued for its strength, durability and versatility. Steel is also used in the tools and machines that extract, process, shape, finish and distribute just about all other metallic and non-metallic products we use.

We would not have mass transportation vehicles or systems without steel, and steel makes up about 1,900 pounds of the average car.

Without cement, our society would have no concrete, which is the world's largest-deployed material and essential to most construction projects. Its use is increasing, not the opposite, with the world now consuming more cement in a single year than it did during the entire first half of the 20th century.

No Substitutes, Any Time Soon

A theme that equals the huge global demand for these four materials is the fact that they cannot be replaced any time in the near future, particularly on a world-wide scale. Any objective analysis also points to the undeniable fact that we will need more of them in the future, and their production on a large scale requires the use of fossil fuels. To quote Smil's *Time Magazine* analysis: "organic fertilizers cannot replace synthetic ammonia: their low nitrogen content and worldwide mass are not enough even if all manures and crop residues were recycled. No other materials offer such advantages for many lightweight yet durable uses as plastics. No other metal is as affordably strong as steel. No other mass-produced material is as suitable for building strong infrastructure as concrete, which is often reinforced with steel."

Smil also notes that even if some countries were able to reduce demand for these materials, a continent like Africa, with the world's fastest-growing population, will need to do the opposite with ammonia to increase its food supply and reduce imports. The demand for steel and cement – to fix outdated infrastructure in affluent countries and build new infrastructure in low-income and developing countries – will also remain strong. Plastics technology, to advance lighter, stronger and more durable products, will also drive demand.

These materials are also essential to the manufacture of renewable energy systems, whether to build and supporting steel towers for wind turbines or mine the rare earths needed to construct solar panels, to name just a few steps involved in the process of sourcing, producing, transporting and installing those energy sources.



Wind turbines provide an iconic representation of renewable energy, but bringing one online is a fossil-fuel intensive process. Foundations are made of reinforced concrete, and towers, rotors and other supporting equipment are made of steel. Massive blades are made of energy-intensive plastic resins, and specialty oils are needed to keep gearboxes running. Every part of a wind turbine has to be transported by large trucks or even ships, and then assembled at the location using large steel cranes.

The Facts

Vaclav Smil deserves the credit for pointing out the hard, cold fact that fossil fuels remain indispensable to manufacturing these four materials, now and in the future. It is also a fact that oil, natural gas and coal from Pennsylvania will continue to support their production.



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