Before the

COMMITTEE ON ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE

Statement of

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On

Near-Term Deployment of Commercial Scale Clean Coal Technologies

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www.dow.com

About Dow

The Dow Chemical Company (Dow), founded in 1897, is America's largest chemical company. It is a diversified chemical company that harnesses the power of innovation, science and technology to constantly improve what is essential to human progress. The Company offers a broad range of products and services to customers in more than 175 countries, providing solutions for everything from fresh water, food and pharmaceuticals, to paints, packaging and personal care products. Built on its principles of sustainability, Dow has annual sales of $49 billion and employs 43,000 people worldwide, with roughly half of each in the U.S.

Dow has embraced a series of bold Sustainability Goals to address some of the world's most pressing economic, social and environmental concerns by 2015. One of these goals is to provide a sustainable, affordable energy supply worldwide while working to combat climate change.

Dow operates at the nexus between energy and all of the manufacturing that occurs in the world today. More than 96% of all manufactured products have some level of chemistry in them. As the premier chemical producer and one of the world's largest and most efficient industrial energy users, no one has more at stake in the solution — or more of an ability to have an impact on — the overlapping issues of energy supply and climate change than we do.

Dow is uniquely positioned to develop and implement innovative energy and feedstock alternatives, maximize carbon efficiency and invent other products and solutions not yet imagined. This is an imperative for Dow, since our purchase of oil and natural gas accounts for nearly 50% of our costs. Last year, we paid $22 billion for the energy and feedstocks we needed, versus $8 billion in 2002. In the second quarter of this year, these costs escalated by $700 million over the previous quarter.

Dow is working aggressively to solve the problems of volatile, high-priced oil and natural gas by focusing on energy and carbon efficiency, resource conservation and conversion to sensible alternative raw materials. Our options have been described publicly, and include diverse initiatives such as solar power, coal-based chemicals manufacturing in China, oil shale conversion in Canada and innovative materials to reduce the cost of wind power. Most recently, on July 19 we announced a world-scale project in Brazil that will turn sugar cane ethanol into plastic. It's a first-of-a-kind facility; it's renewable; and it's energy efficient, as we will use the leftover bagasse from the sugar

cane to generate electricity. The project demonstrates Dow's role as a technology integrator, as well as the opportunities we have to drive forward our strategic growth in a way that fully supports our sustainability commitments.

In addition, we:

- Pioneered the use of soybeans in the manufacture of high-quality plastic foam used in automobiles, office and home furnishings, and other products;
- Recently announced Dow will make aircraft de-icing fluid from glycerin, a by-product of biodiesel processing.

Other sustainable energy inventions are on the horizon. For example, in our Building Solutions Business, we are developing new roofing materials that convert solar energy to electricity, a project the Department of Energy has chosen to jointly fund because of its promise.

Along with our technology advancements, we are calling for strong government action on climate change, energy efficiency, conservation and security of supply. As a member of the U.S. Climate Action Partnership (USCAP), we are encouraging Congress to promptly enact mandatory, market-based climate legislation.

We have been recognized as leaders in energy efficiency and are believers that improved conservation offers the greatest prospect to reduce carbon dioxide (CO2) and other greenhouse gas emissions.

We have also made real progress inside our company on energy and carbon efficiency.

In 1994, Dow made a public commitment to sustainability. We pledged then to improve our energy efficiency 20% by 2005. It was an ambitious goal — far greater than others in heavy industries — and the fact that we achieved a 22% improvement is a great source of pride to our company and our employees, not only because of the reduction in our energy use, but because we did it profitably. We invested roughly $1 billion dollars and saved nearly $5 billion, which we believe is a very good return on our investment.

During this period we saved 900 trillion Btu, enough energy to power all the homes in California for a year.

Since 1990, we have improved our energy intensity by 38% and reduced our absolute greenhouse gas emissions by more than 20%, a level that exceeds Kyoto Protocol targets. We believe there is more to do, and have set a further goal to reduce our energy intensity by another 25% by 2015.

This relentless dedication to energy efficiency and our achievements is evidence that we know how to optimize the footprint of our existing assets and improve the efficiency of succeeding generations of technology.

As we look to the future and contemplate asset investments, we must be able to site our plants in locations that will enable us to have long-term access to low-cost, price-stable feedstocks, while at the same time achieve our aggressive sustainability targets. Looking at the U.S., we see no price relief in sight for oil- or gas-based feedstocks. Quite frankly, we see only limited options for the future prosperity of our U.S. operations. Industrial gasification, where both feedstock and technology availability exist at the scale we need, could be an important solution to help meet this challenge.

Why gasification?

Industrial gasification provides technologically proven, flexible paths to a more carbon-efficient future and greater U.S. energy security. It will help our country diversify with abundant, domestic energy resources while helping address the high cost Dow and other manufacturers pay for raw materials.

About the technology

Industrial gasification refers to the process of producing synthesis gas (syngas), a mixture of hydrogen and carbon monoxide, from a wide variety of raw materials, including coal, petroleum coke, industrial and municipal wastes, and other carbon-containing streams. Syngas is a highly efficient, highly versatile intermediate that can be converted to electricity, transportation fuels,

chemicals or plastics — or a combination of any of these products, in what is known as polygeneration (Figure 1, below).

Gasification technology can also be utilized to convert a wide range of biomass — plant matter, wood waste and crops — to energy and chemicals, replacing hydrocarbon fuels and feedstocks and reducing overall emissions of CO_2. Additionally, it can turn high-volume waste streams (e.g. plastics, municipal solid waste) into strategic fuel and feedstock sources.

By innovatively combining bio-based materials with high-energy materials such as coal, waste streams that are otherwise "non-recyclable" (or only mechanically recyclable) can be converted into useful virgin materials, achieving a closed-loop, "cradle-to-cradle" life cycle for virtually any chemical or plastic.

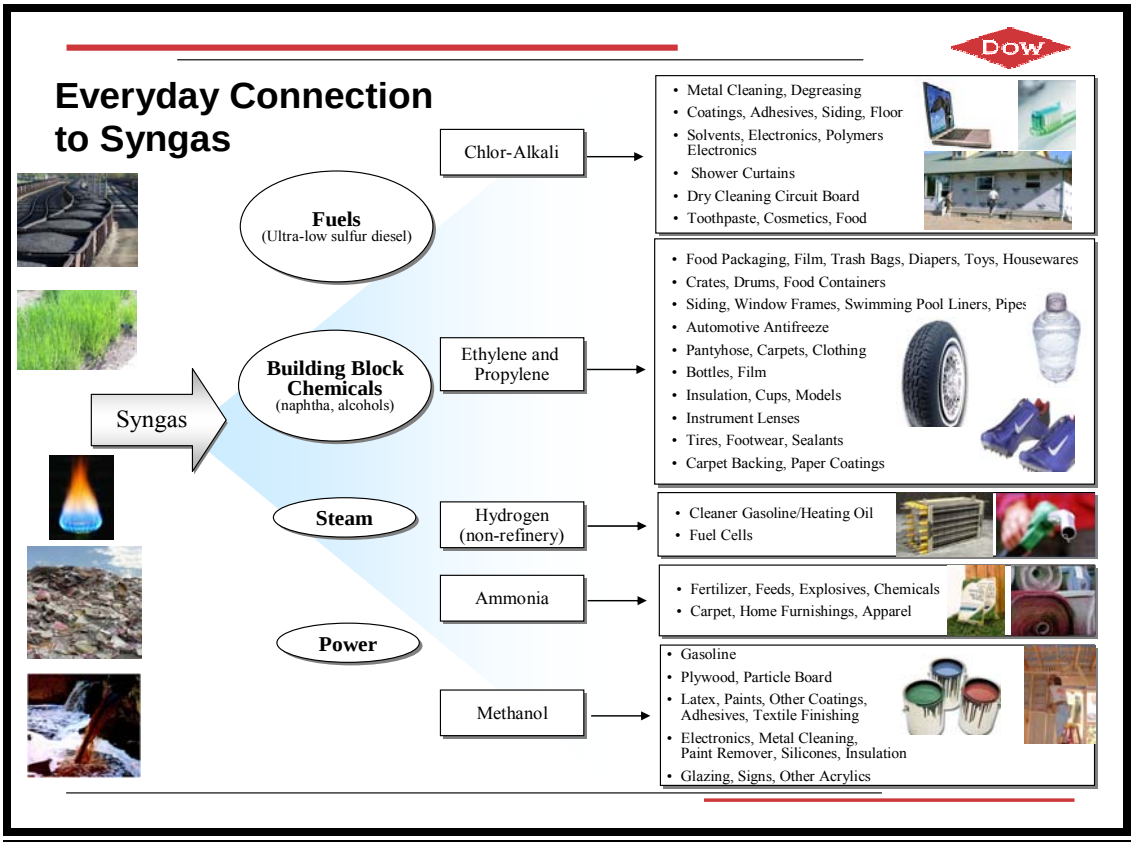

Figure 1. A sampling of the energy and everyday products that can be made with a syngas plant.

Challenges

Capital Costs. Even a "small" gasifier is a complex piece of equipment. Multiple gasifiers and related unit operations (i.e. an oxygen plant) are typically required, resulting in high capital costs relative to other technologies. A coal to liquids (CTL) gasification plant requires some three to four times the capital of a comparable oil refinery.

Lack of Experience. While gasification technologies have been around since the early 20th century, relatively few in the chemical or fuel industries have hands-on experience, contributing to the perception that gasification carries a greater-than-average technology risk. However, the operational experience to date provides evidence that a syngas platform could be a viable way to produce chemicals, plastics and fuels. Eastman Chemical in the U.S. and Sasol in South Africa are currently practicing coal-based chemistry on a commercial scale. This evidence of viability should give us confidence that larger scale deployment is achievable.

CO_2. A globally-consistent carbon regulatory scheme is needed to create a stable long-term investment climate for gasification projects. Carbon capture and sequestration is arguably the most needed and widely acceptable technology solution for CO_2 emissions control. Financing the development of the sequestration technology and infrastructure should be a priority for government investment. Gasification plants using hydrocarbon feedstocks, with their concentrated CO_2 exhaust streams, are well suited to a national sequestration program as it develops. Economically attractive uses of CO_2, such as enhanced oil recovery, should be encouraged.

Co-gasification of biomass and wastes can help to reduce consumption of hydrocarbon feedstocks and overall CO_2 emissions. Some studies have shown that biomass can be co-gasified with coal at a rate up to 30% of total input.

With industrial gasification, a significant portion of the carbon will find its way back into the supply chain as useful product. Carbon-based products such as carpeting, water and sewer pipes,

building insulation, packaging and automotive components can all be derived from either the naphtha co-product of a CTL plant, or directly from the syngas.

Dow's Plan

We congratulate the committee and the Senate for its recent passage of an energy bill to improve U.S. energy security. But we respectfully submit that more needs to be done, particularly on the supply side.

Our search for alternatives to the feedstocks we use currently has led us to believe that industrial gasification technology is mature and scaleable, could greatly improve America's energy security, and building a full-scale plant of this kind in the United States can best be accomplished through a public/private partnership. We have expressed an interest in leading a consortium in the U.S. to demonstrate the technology on a commercial scale (approx. 80,000-100,000 barrels/day).

Raw material feedstocks to produce syngas are abundant, present throughout the United States, and available at low costs. However, the major hurdle for any such plant in the U.S. is the high capital cost and obtaining financing. The promise of syngas plants will matter little without the right policy and incentives. Financiers are hesitant to provide the capital needed for a facility of the size needed to prove its worth.

That is why we believe the federal government must dramatically increase its commitment to the development of a syngas infrastructure. Even with oil prices where they are today, the payback period deters private entities from building these plants (*Chart 1)*.

The government needs to jump start a public-private partnership to develop a syngas industry by providing a focused capital investment, enacting stable policies and permitting the military to enter into long-term off-take agreements. Loan guarantees and tax credits alone won't make this happen.

Based on our analysis, direct government loans covering up to 50% of the cost of a few early-mover projects seems to be what is needed to demonstrate viability (*Chart 2*). We remain open to comparable alternatives.

Our view is that, absent a scaleable solution like industrial gasification (which brings a range of benefits), the U.S. over time will become a bit player in the petrochemical industry. Without significant U.S. action to reduce demand, increase supply and provide alternatives, the center of gravity of the petrochemical industry, and its downstream production, will shift to the Middle East, Africa and Asia. This movement has already begun. In the last two months alone, Dow by itself has announced joint ventures totaling around $30 billion in these areas. More than 10,000 direct and 60,000 indirect jobs will be created. Many of those could have been created in the United States, but for the high cost of energy, particularly natural gas, a commodity that, unlike oil, is regionally, rather than globally priced.

Global competitors are integrated to low-cost feedstocks and will be able to land competing products in the U.S. at a natural gas-equivalent cost of roughly half the U.S. gas price. The U.S. must continue to drive demand reduction through energy efficiency, increase domestic oil and natural gas production, and promote alternative and renewable forms of energy and feedstock. Syngas from coal, biomass or a combination of the two is a potential low-cost alternative to the high and volatile cost of natural gas, gas liquids and petroleum byproducts that are the basic building blocks of the modern chemical industry.

We expect that with the government's assistance, we — in partnership with others — would prove the worth of a U.S. syngas industry. We elaborate this further in the following paragraphs.

Syngas can be converted to chemicals and plastics, electricity and transportation fuels. Dow can make virtually all of the products we manufacture from syngas. Coal is important to this process because its abundance and established supply chain make it most capable of meeting syngas needs on a scale that will be economically meaningful.

Carbon Benefits

Dow fully understands that we must live in a carbon-constrained world. And we support Congress' desire to improve the carbon efficiency of coal technologies. The CO_2 must be managed. We agree with many members of this committee that in the near term, carbon capture and storage (CCS) should be developed to ease the U.S. transition from a fossil fuel-based energy economy to a low-carbon paradigm and eventually a zero-emissions future.

Industrial gasification plants will help demonstrate options for CCS. Gasification of hydrocarbon feedstocks produces relatively pure CO_2 streams, which can be used for economic purposes such as enhanced oil recovery. These are not the only ways to limit atmospheric CO_2 emissions.

Our involvement in the gasification process (a chemical process) offers another way to maximize the use of CO_2. The chemicals we make bind the carbon into useful products like plastic (Figures 2-4).

Our initial analysis suggests that were a syngas plant to run on 30% biomass, as experts tells us is possible, and were we to make products from the plant's feedstocks, we could bring the CO_2 footprint of a CTL plant down by about half (Figure 4).

Further, we expect that this consortium with other stakeholders, relying on experts such as those here today and our history of optimizing the chemical process, will assure carbon efficiency improvements.

Coal-to-liquids

We've heard on both sides of the Capitol from members of both parties that coal must remain a key part of the U.S. energy mix and that any ultimate climate change policy must require a “Manhattan Project” for coal. The question is how to use coal in a carbon constrained world. In other words, how do you grow coal without breaking the carbon "bank"? We submit that one of the best ways is through coal gasification.

Dow believes we can participate in a coal-to-liquids plant as an integrator, bringing chemicals, plastics, and electricity generation into the fuels production processes. By doing so, we will improve the carbon footprint and maximize the carbon efficiency of the feedstock.

Initially, these plants are likely to run mostly on coal (Figure 3). Over time, their operators will gain experience and the facilities will become more efficient, reducing their greenhouse gas emissions. Biomass will be increasingly used, further reducing greenhouse gases. And by utilizing innovative carbon management techniques in such a setup, there can be a net reduction in greenhouse gases compared to an oil refinery of comparable size (Figure 4).

In conclusion, development of both syngas production and utilization offers the U.S. economy a flexible path to energy security — a source of power, a feedstock for a variety of chemicals, and a source of diesel fuel. Raw materials to produce syngas are abundant, present in every part of the country and available at low costs. However, the capital costs for building a gasification facility are significantly higher than technologies based on imported oil and natural gas. Coupled with uncertainties about future price, volatility and public policy with respect to traditional oil- and gas-based feedstocks, the current system of loans and tax credits is insufficient to promote industrial gasification development.

A multi-phase government/corporate program is necessary, including the following major categories:

- Significant (up to 50%) capital incentives are needed in the U.S. to catalyze the development of industrial gasification projects, a technology that can result in sustainable energy security for the U.S. and other countries.
- An aggressive investment of public funds is required to speed technology demonstration, optimization and development of gasification and CO_2 sequestration infrastructure projects. Current economic studies indicate that gasification can compete when imported oil is priced at $75 - $85 per barrel. To achieve greater energy security using gasification technology and currently available, low-cost domestic feedstocks, the federal government must dramatically increase its commitment to the development of a syngas infrastructure.

Tens of billions of dollars must be invested, but such investment will be slow to occur unless the government moves decisively to lower the risk. Congress needs to think in terms of a Marshall Plan, a race to the Moon, the Interstate Highways System, or a Manhattan Project-type effort versus the tax credits and loan guarantees that are in place today.

- The significant military and government appetite for consumption of fuels, power, and other hydrocarbon resources offers an opportunity to reduce commercial risk of industrial gasification. Guaranteed off-take agreements, whereby the government would contractually utilize products from industrial gasification plants in military and other government applications, with appropriate pricing formulas to ensure fairness for both sides, would further catalyze development of industrial gasification. Industry participation in similar arrangements should also be explored.

There are significant challenges ahead to create a competitive, energy-secure, syngas-based power, fuel and chemical industry in the U.S. Bold legislative action and substantial investments in public/private partnerships by the U.S. Government can greatly accelerate this opportunity. The Dow Chemical Company stands ready to assist in leading this transformation.

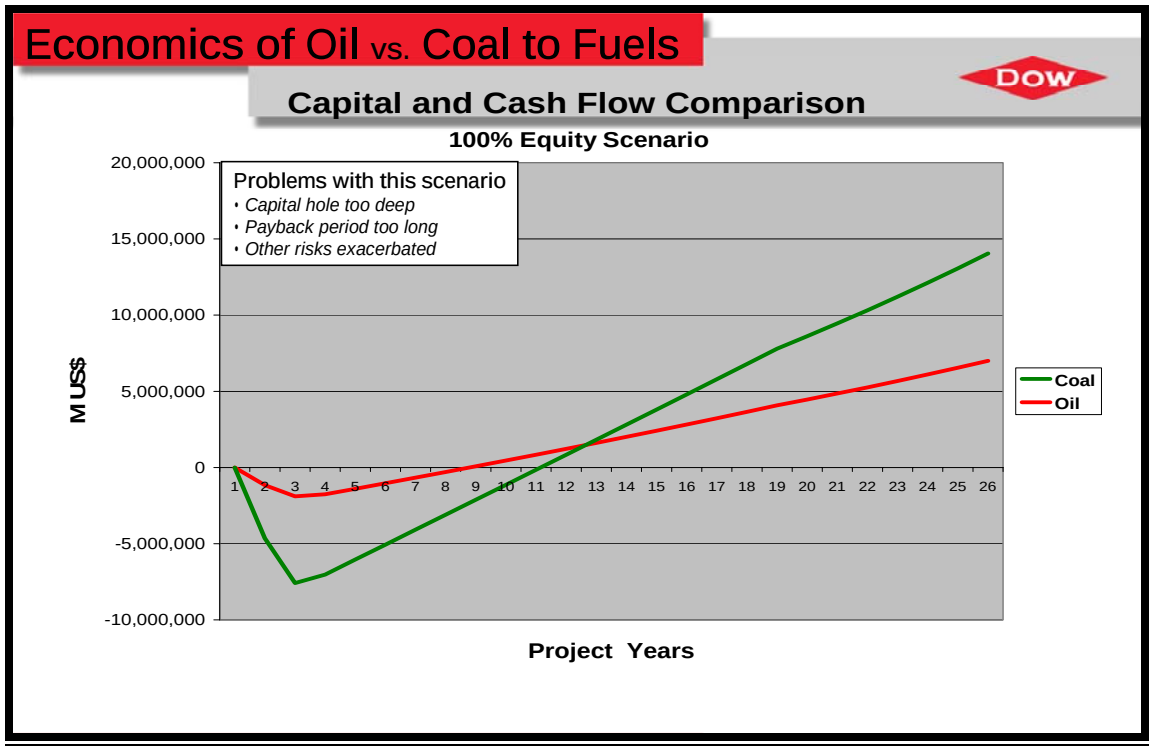

Chart 1. Model of capital and cash flow for 100% privately financed coal-to-fuels plant.

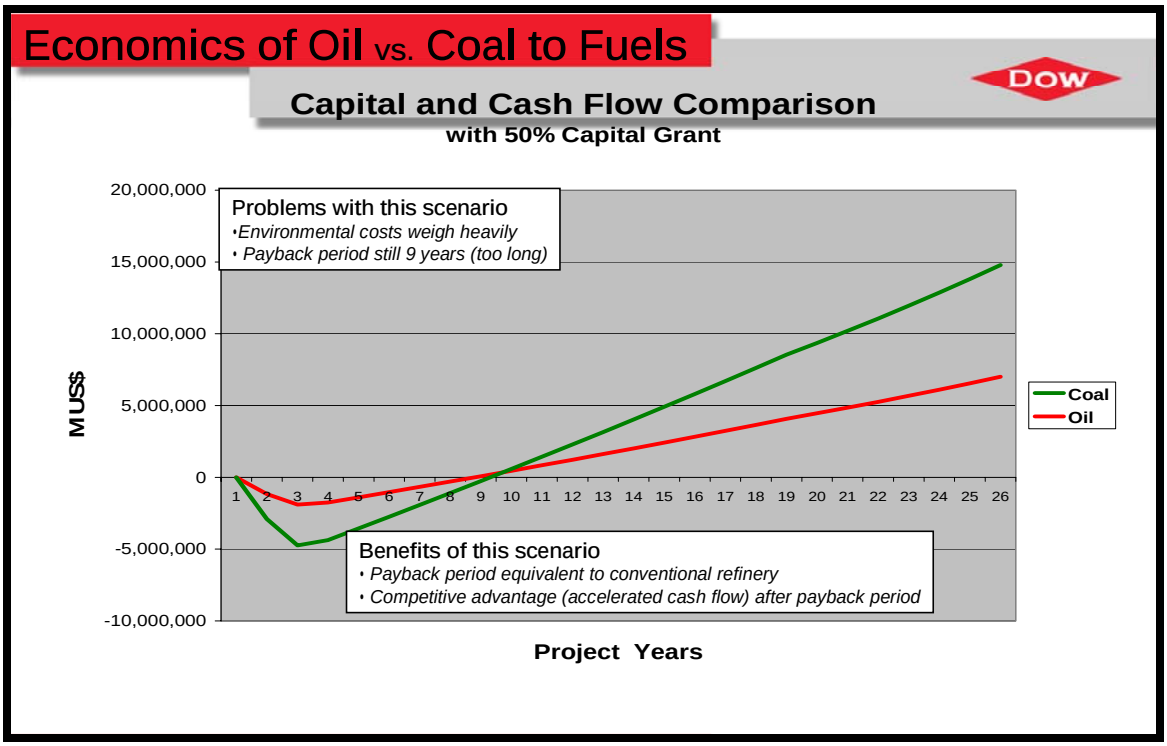

Chart 2. Model of capital and cash flow for coal-to-fuels plant receiving 50% grant.

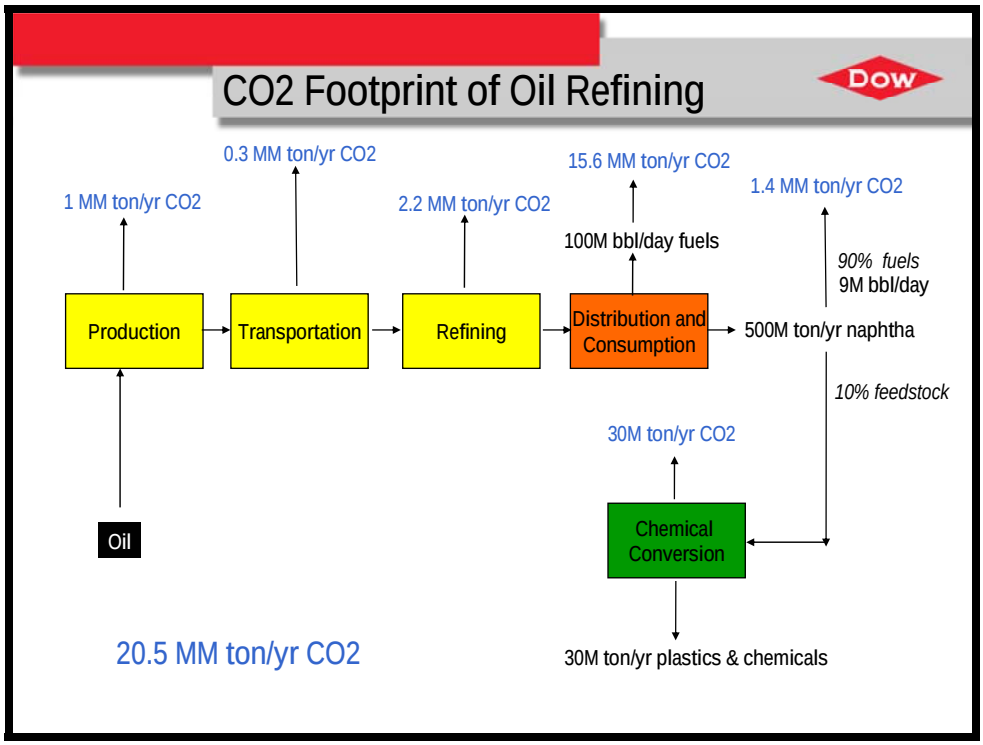

Figure 2: Estimated well-to-wheels CO2 footprint of a 100,000 bbl/day oil refinery.

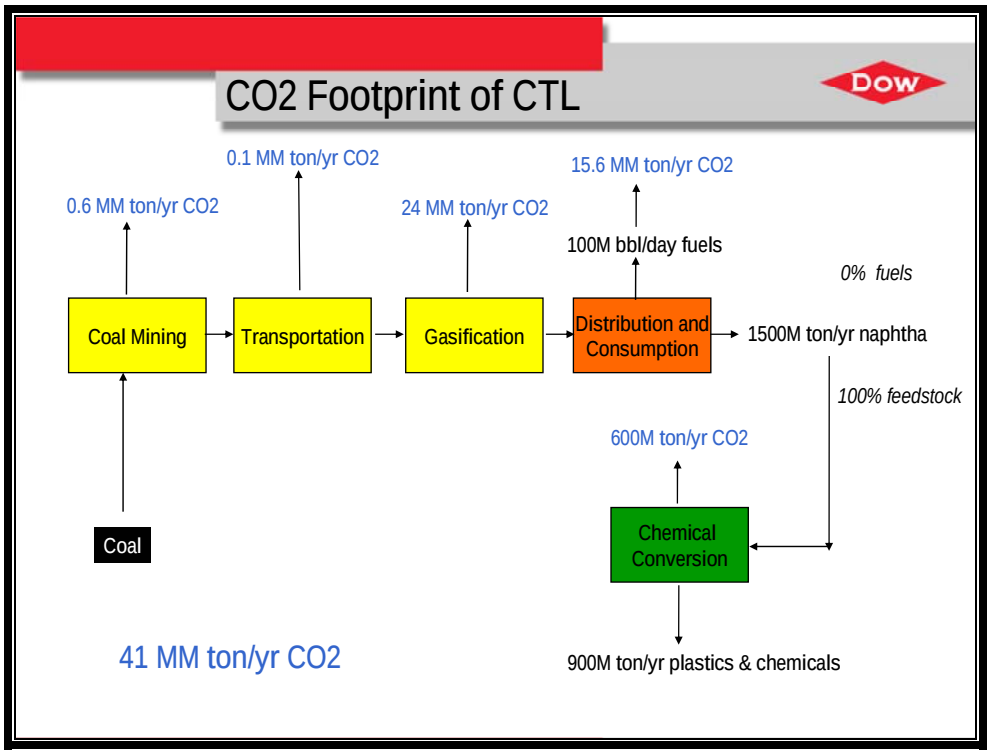

Figure 3: A comparably sized CTL plant without CCS emits 41 million tons of CO2.

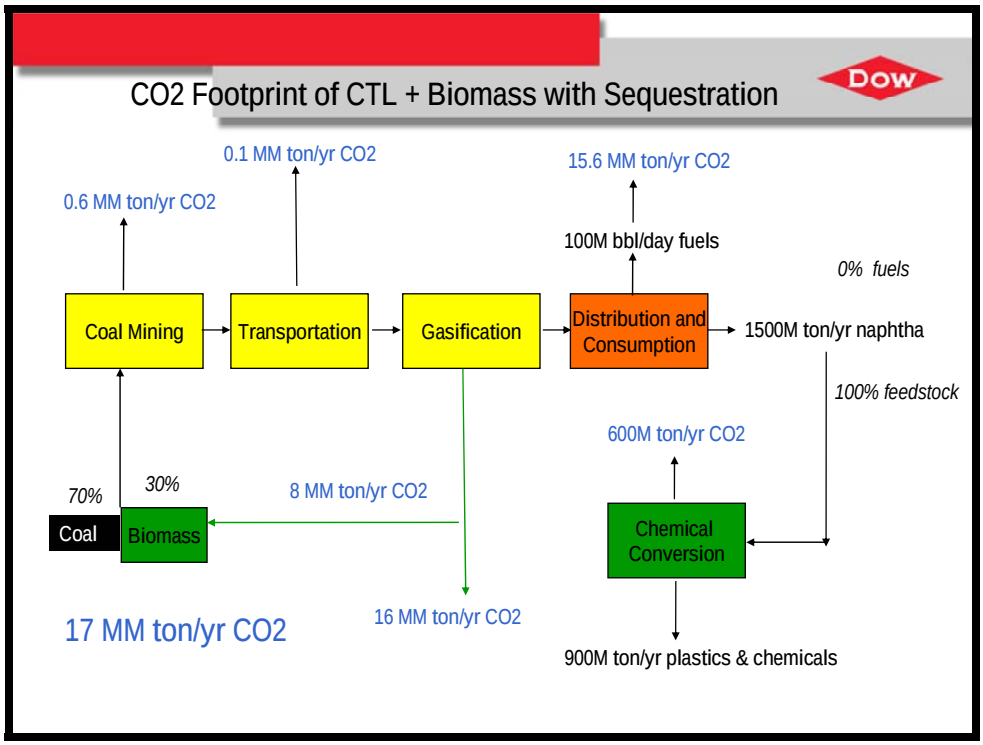

Figure 4: Introducing 30% biomass and CCS along with chemical conversion reduces the CO2 footprint to 17 million tons.