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Fossil fuels as a carbon source are consolidated compared to biomass which is distributed. This needs to be considered in more detail because it directly relates to petroleum refining. Oil is concentrated in select places in huge underground reservoirs and is pump-able. As a result, the United States and North America are covered in biomass, not oil. The vast majority of the oil is only found in a few special areas. Because oil is concentrated in select places in huge underground reservoirs and is pump-able, oil refineries tend to be massive and centralized. There are only ~ 150 refineries spread across the US after 100 years of major oil production – these refineries fit the scale and form of their resource.

Compared to oil, there are over 200 corn ethanol plants after about 40 years of major production and the number keeps growing. Oil refining on the other hand is fairly mature and refineries are closing and consolidating instead of being built. The "newest" simple oil refinery in the United States began operating in 2008 in Wyoming. The "newest" complex refinery with significant downstream unit capacity began operating in 1977 in Louisiana. The newest ethanol plant was built this year.

Another great example of how to use biomass effectively is wood products. There are thousands of wood processors distributed across the US because of the unique aspects of processing biomass. Wood processing has been happening for longer than oil refining and where oil refining has settled on 150 facilities, wood processing has utilized thousands. This comparison makes an important statement about processing biomass for money and what is likely to be the most reasonable scale for biorefining. It does not make sense to try and build massive biorefineries analogous to petroleum refineries because that scale doesn't fit the resource. If it did, wood processing and corn ethanol would not be as small and distributed as they are after decades and centuries of business development. To succeed, biorefiners must fit the size and location of their resource.

Biomass is a distributed resource and therefore it cannot be compared to oil & gas which are consolidated. This fact permeates every aspect of biorefinery planning and development and it is very likely that the industry will eventually contain 9,000 small biorefineries rather than 500 massive ones. This means successfully biorefineries will need to be economic at fairly small scales ... like the town or suburban scale. This also means that the choice of biomass products and markets must reflect the size of the facility. Many commodity chemicals are only commodity chemicals because they are produced at massive scales that take advantage of economy of scale. Most biorefineries will probably not have economy of scale on their side without some form of concentrating or hub-spoke model. This is not to say that biomass couldn't be used economically for commodity chemicals, just that it couldn't be done the same way that petrochem does it.

Lecture 20 Biorefining in North America

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