Hydrogen Energy: Production, Storage, Transportation and Safety

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Lecture - 02
Status of Hydrogen Supply and Demand

Welcome to the 2nd lecture of the course on Hydrogen Energy. Today we will look at the global as well as Indian Status of Hydrogen Supply and Demand. Before going to the numbers let us first see, where is hydrogen being used.

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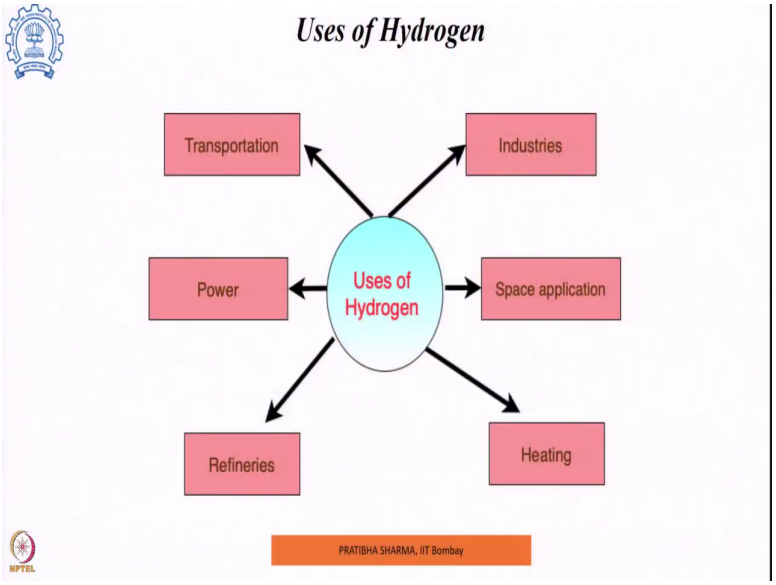

So, the majority of hydrogen is being used in the industries and oil refineries. Oil refineries which were once upon a time being considered as a producer of hydrogen are now major consumers of hydrogen.

Hydrogen was being produced earlier as the byproduct in the refineries, but because of the strict emission norms as such hydrogen is being consumed in the periphery of the refineries for various processes. These are hydro treatment processes like hydro desulfurization, hydro de nitrogen, hydro cracking, reduction in the aromatic content of the crude, hydrogenation of the heavier as well as dirtier feedstock to get refined reformulated gasoline and diesel.

It is being also used in industries primarily in the chemical industry for production of ammonia and methanol, in the fertilizer industry, in the semiconductor industry for

electronics for silicon passivation, it is being used in the food industry for various hydrogenation processes of edible oils of fats.

It is also being used in other sectors like transportation sector, but currently use in the transportation sector is very nominal. However, with the various OEMs coming up with various fuels and electric vehicles, the demand is expected to increase in the transportation sector.

And more promising demand will be in the long-haul transport like freight vehicles: it will come from the shipping and aviation sector. Hydrogen is also being used in the space applications wherein because of the high energy content per unit mass, this is of preferred fuel.

Hydrogen is also finding its way for use for power generation, whether it is used in gas turbines or for stationary fuel cells. Because of the intermittency of the renewable, in order to curtail the output variable to match the supply and demand. Hydrogen can be used for long term large scale storage. It can also be used for various other applications like domestic applications, heating and cooling.

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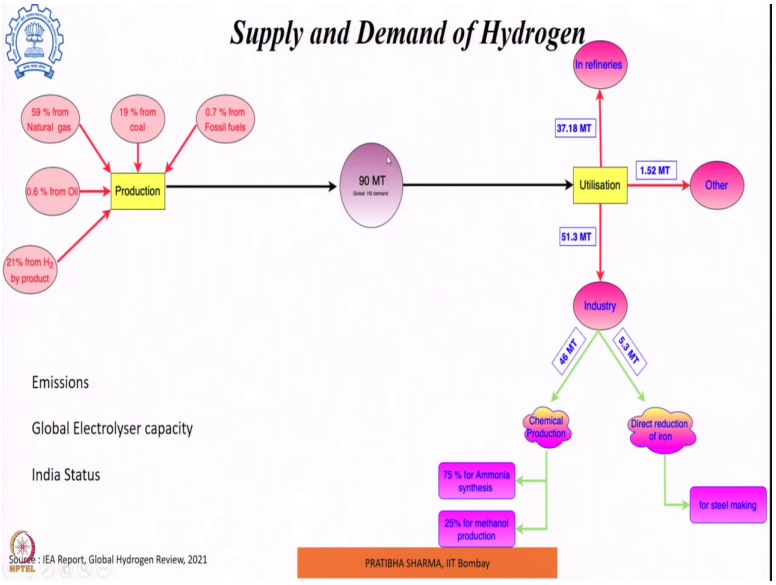

Now, if we look at the current status, about 90 million metric tons of hydrogen is produced globally. Out of this 80 percent is being used as pure hydrogen and 20 percent is being used as a mixture of other gases for various applications. If we look from the production side then

59 percent of this is being produced from natural gas, 19 percent from coal, 0.6 percent is coming from oil.

Another 21 percent of hydrogen is a byproduct wherein it is coming as a secondary product. Only 0.7 percent of it is being produced from fossil fuels with carbon capture use and sequestration. So, we can see that majority of it is being produced from fossil fuels, if we look at the demand side, 37.18 million tons of it is being used in refineries for the various hydro treatment processes, 51.3 million tons is being used in industrial sector.

Out of this 51 million tons, 46 million tons is being used for production of various chemicals including ammonia synthesis which is 75 percent of it and 25 percent of it is being used for methanol production. 5.3 million tons is used in the steel industry for direct reduction of iron.

Now, since most of it is being produced from fossil fuel it results into emissions and except for 0.7 percent which is where in carbon capture use and sequestration is being integrated all that emissions is released into the environment. So, hydrogen when we say is a clean carrier or it has potential for decarbonization, in order to have entire value chain to be decarbonize, the production of hydrogen also need to be green.

Now, what this green hydrogen means what do we mean by the color, that we will see in the next slide. All these emissions contribute about 900 million tons of CO 2, whether it is from natural gas and depending on the compositions the numbers may vary. From natural gas it is roughly about 10 tons of CO 2 released per ton of hydrogen being produced.

From oil or oil products again heavier oil or middle distillate or lighter distillate it is roughly about 12 tons of carbon dioxide being released per ton of hydrogen being produced. And if it is from coal then around 19 tons of carbon dioxide is released per ton of hydrogen being produced.

The positive sign is that the contribution from green hydrogen is also increasing, the global electrolyzer capacity is growing in the 2021and it is around 350 megawatt and the projection says that it is expected to become 52 giga watt by 2030.

Now, if we look at the India country status, then about 6 million tons of hydrogen is being produced per annum. Out of this 2.6 million tons per annum is used in refineries, 3.2 million

tons is being used for chemical industry specially in the fertilizer industry and the remaining is obtained as a byproduct hydrogen.

There is a different coding which is given to hydrogen as we have seen in the first lecture, hydrogen is a colorless, odorless and tasteless gas. So, hydrogen itself do not have a color; however, there is a color coding given to identify from which source that hydrogen is being produced.

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So, the color coding given for hydrogen being produced from bituminous coal is black, if it is being produced from lignite then it is brown, hydrogen being produced from natural gas without carbon capture use and sequestration then it is gray. However, if it is being produced from fossil fuels, but with integrated with carbon capture use and sequestration it is blue hydrogen.

There are few more colors which are being assigned. If the hydrogen is being produced by methane pyrolysis i.e, decomposition of methane giving carbon and hydrogen, then it is turquoise hydrogen. And if it is being produced from renewables then it is called green hydrogen.

Now what are the different methods of production, what are the different conversion technologies from these feedstock's we will see in the next class.

Thank you.