Module 01

Lecture #1

Intro EV Historical Background

Electric Vehicles – Part-1

Hello, everyone. Welcome to the NPTEL online course on Electric Vehicles.

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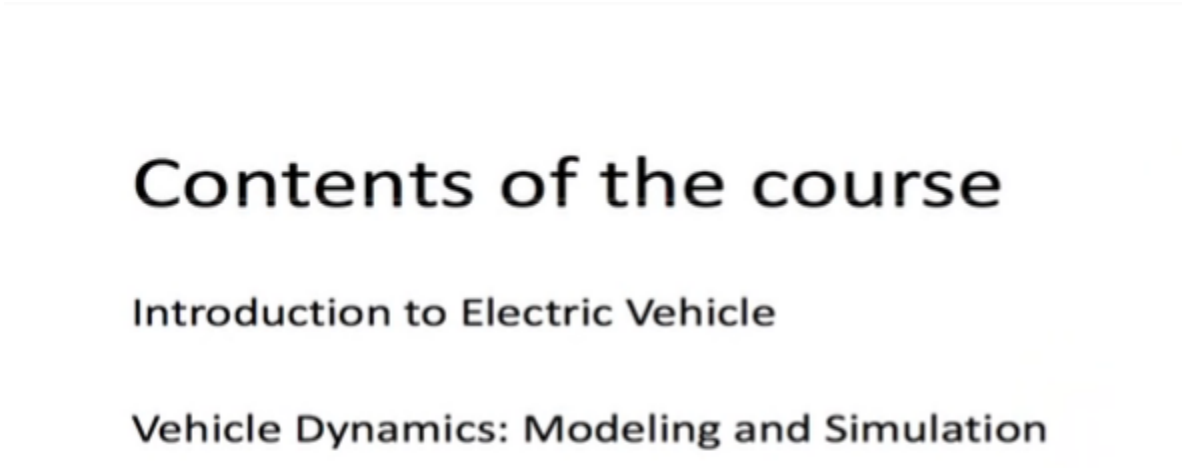

So the contents of this course are;

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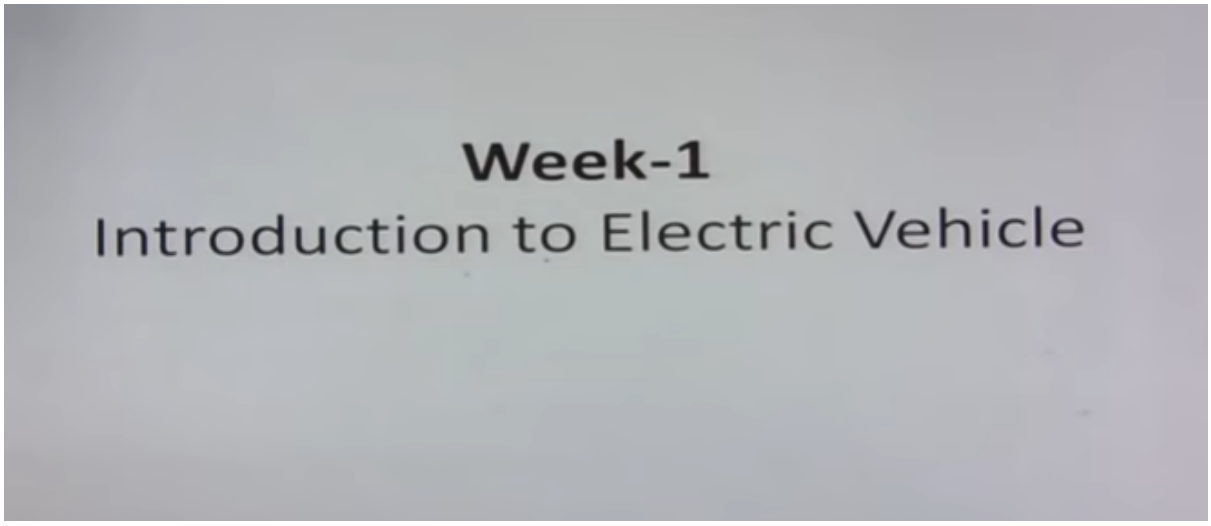

So let us start, the topic of Week-1, which is Introduction to Electric Vehicle.

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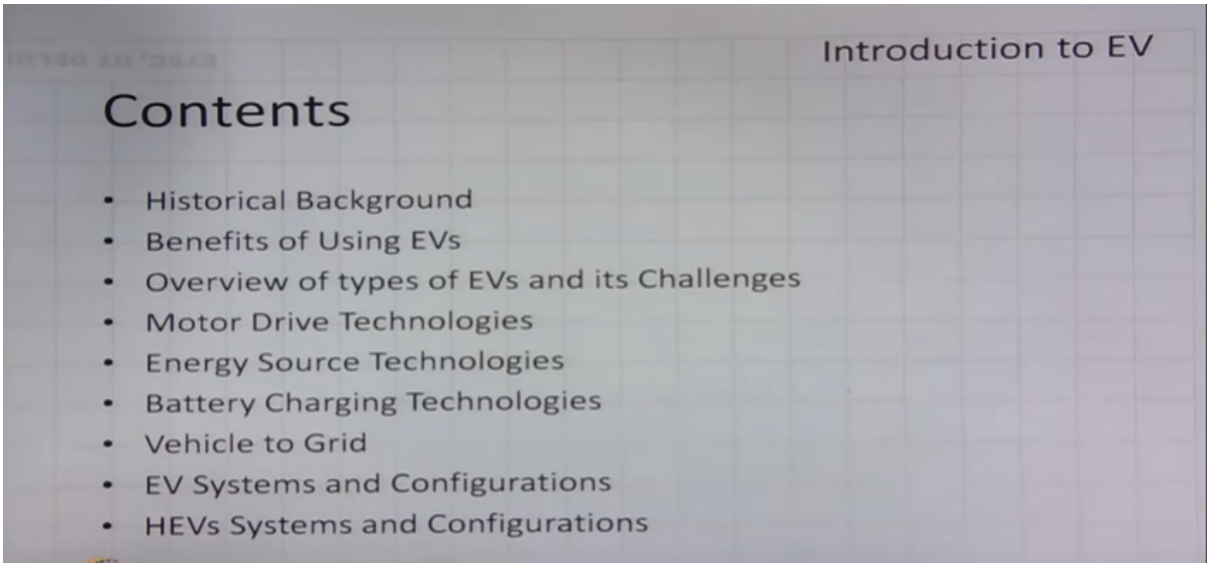

So content of this first topic are the following; we start with historical background. Then we will discuss, the benefits of using EVs, compared to other modes of transport; overview of different types of EVs and their challenges; Motor Drive Technologies; Energy Source Technologies; Battery Charging Technologies; Vehicle to Grid; Different Types of EV Sub systems and their Configurations and Different types of HEVs sub systems and their Configurations.

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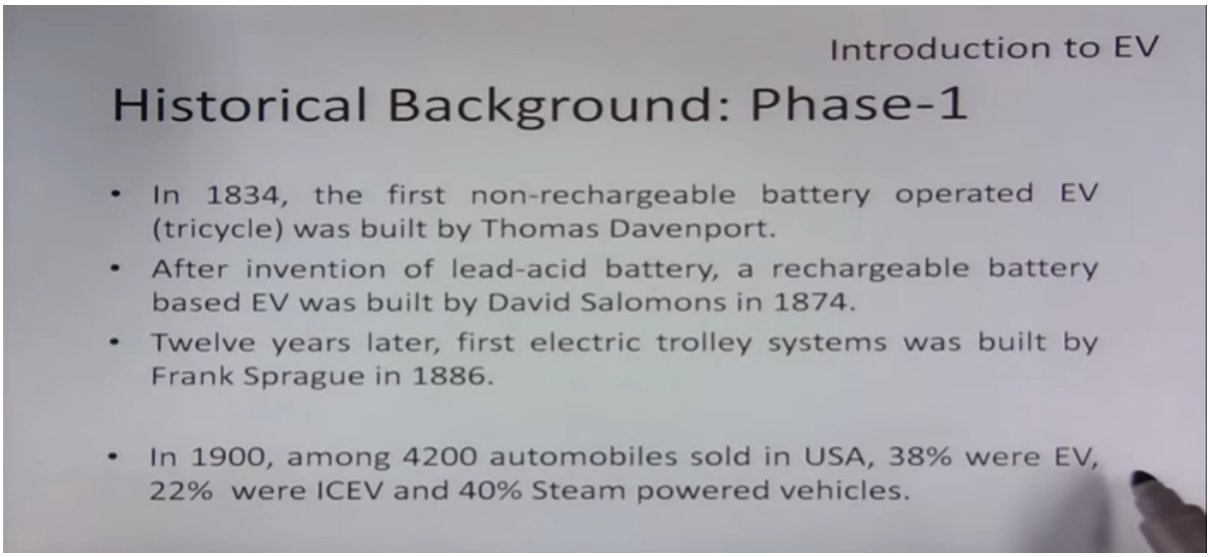

It is very interesting to know that, the first EV was built in 1834, which is about, 150 years back. It was built on a non-rechargeable battery that was available at that time. After the invention of lead-acid battery, recharge, a rechargeable battery based EV was possible and was built in 1874, by, David Salomons. With this development, it was possible to develop commercial products, by 1886. So all this developments, led to, popularisation of EVs, in the manage team automobiles, in a global

scenario. So it can be seen that, in 1900, among 4200 automobiles that were sold in USA, 38% were EVs.

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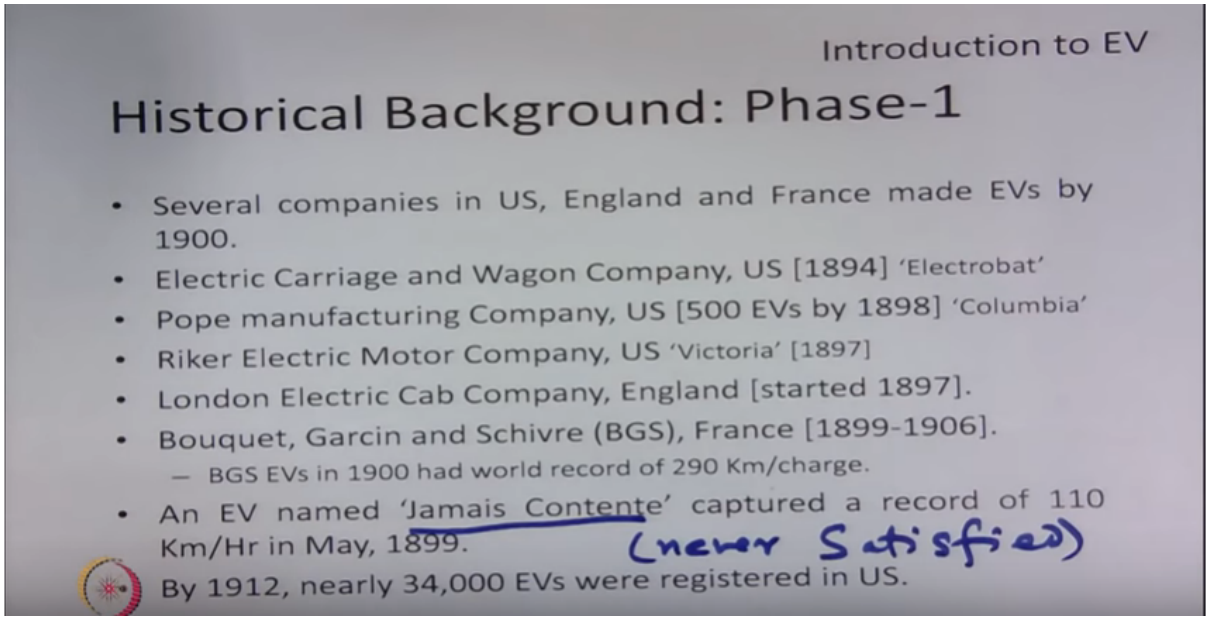

So several companies in US, England and France, made EVs by 1900. And some of the popular companies are, Electric Carriage and Wagon Company, which came up with its model called, 'Electrobat', in 1894. Similarly, there was a model called, 'Victoria', in 1897, which, has become a hosul name, in 1900. Since it had a very good design. This company called, 'BGS', in France, which has developed, many types of EVs, in all skills. Right from cars', buses' and limousines' of all varieties. So one of its products, had world record of, 290 kilometres, per charge. There was another EV, named, 'Jamais Contente', which has captured a record of, 110 kilometres, per hour in, 1899. Apparently, the meaning of this word is, never satisfied. So we can see that, by 1912, around 34,000 EVs, were registered in US. So it was one of the bainstream modes of transport, during that time.

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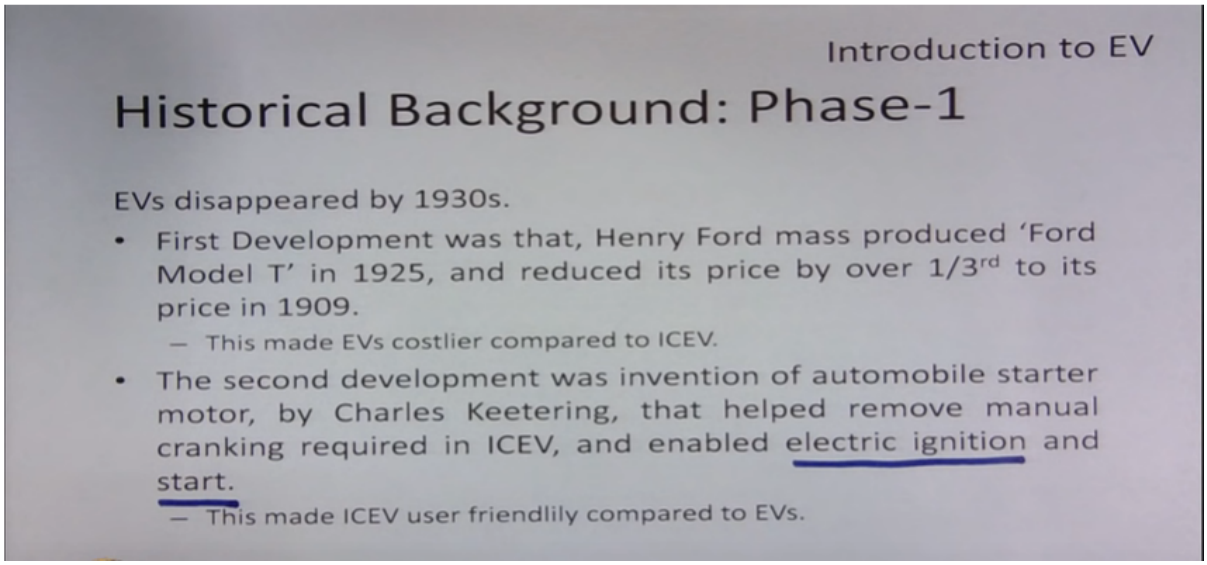

But unfortunately, EVs started disappearing by 1930's. There were two developments, which led to this happening. First development was, that, Henry Ford, has gone for mass production of, 'Ford, Model T', in 1925. And was able to reduce the price of it, by over one third of its, conventional price, at 1909. So due to this, the EV become much costlier, compared to ICEV engine based cars. Another development, which supported the first development, was the invention of Automobile Starter motor. Incidentally, the IC engines that time were unable to start on its own and need manual cranking. So this automobile starter motor, were able to start and provide electrical ignition to the IC engines. Which is a big milestone, in the development of, IC engine based, vehicles. So due to this two developments, not only the cost of IC engines, based cars were less, also it is very user friendly, compared to, compared to EVs and Customer satisfaction. Because IC engine can be used now in Urban areas and Remote areas. And it doesn't require electricity, to charge the batteries, required in a, conventional EV.

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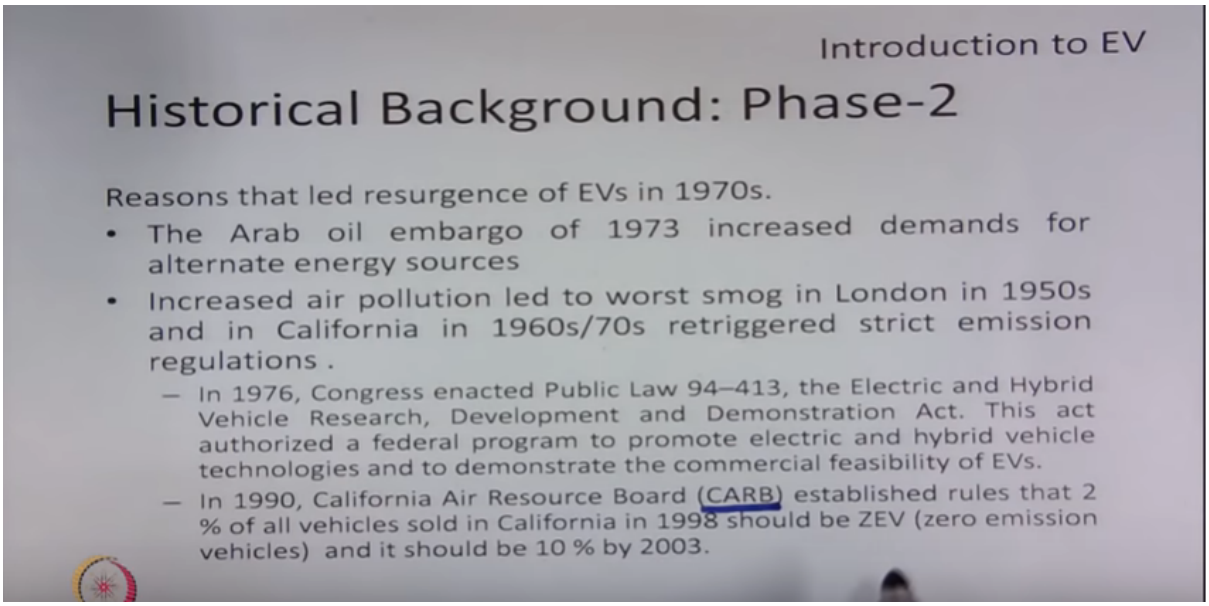

So after a gap of around 40 years', again there was a, resurgence, in the evolution of EVs. There were few developments at that time, which led to this. First was, there was a oil shortage in Arabian countries and Global countries were looking at possibility of alternate, energy resources. Secondly, by 1950s onwards, lot of cities like, London and California, have seen worst kind of smog. And this has pushed the governments, to bring strict, rules and regulations, which can enable governments to take decision, in development of EV technologies and make it feasible for commercial deployment. There is a famous regulation, which is known as, 'CARB', which is, 'California Air Resources Board'. So the regulation is very famous in EV domain. Because, this was the regulation, which has led a serious rethink, in the development of EV. So the rule says that, 2% of all vehicles to be sold in California, in, by 1998, should be, Zero Emission Type and it should be 10% by 2003.

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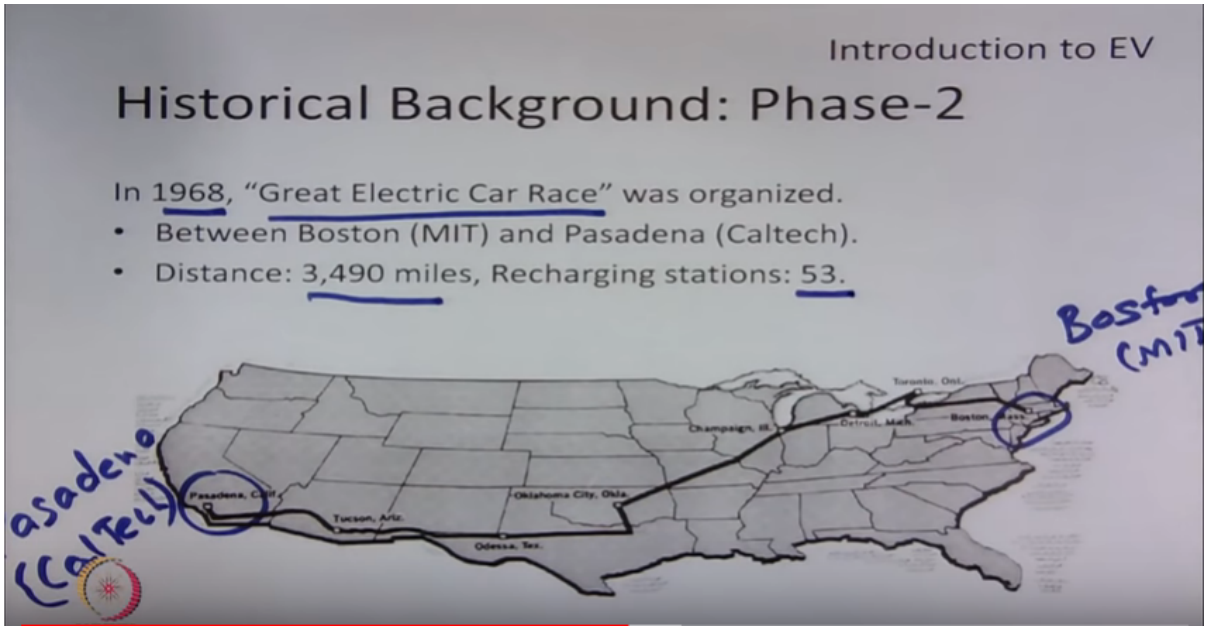

There was also a great push, in academic circles, to promote the research and development, in EV area. One of them was the organisation of, 'Great Electrical Car Race'. That was organised in 1968. So this race is between, Boston near MIT, to Pasadena, near California Institute of Technology, which is known as, 'Caltech'. So the challenge was this, though the universities, will develop their own EVs and the EVs developed by this universities, will travel from, MIT to Pasadena and Pasadena to MIT, covering a distance of, around 3400 miles. And they were able to recharge their EVs, by 53 intermediate, recharging stations. So this was one of the important event, which led to development EVs, in many universities in US. And it helped the industry in US, to come up with commercial EVs.

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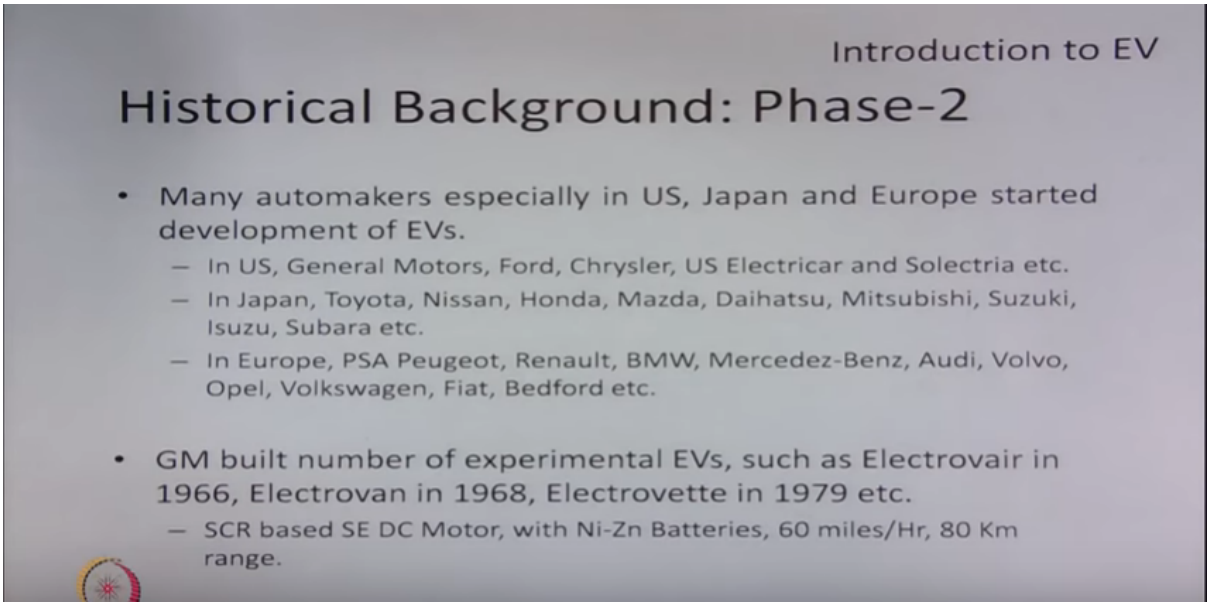

Due to strict regulations and the opportunity of getting subsidies, many auto makers in US, Japan and Europe, started development of EVs. So we have listed out some of the main companies like, General Motors, Ford and Chrysler in US. In Japan, almost all the companies like, Toyota, Nissan, Honda, Mitsubishi, Suzuki, led the way for the development of EVs. In Europe, Peugeot, Renault, BMW,

Mercedes, Audi, Volvo, Volkswagen, most of this companies have launched their own EVs in the, near future. So General Motors were able to launch, few of their experimental EVs, such as, Elecrovair in 1966, Elecrovan in 1968, Electrovette in 1979. So these technologies were based on conventional separately as a DC motor, with a SCR based invertors. Since the conventional, IGBT based, VSIs were not available at that time.

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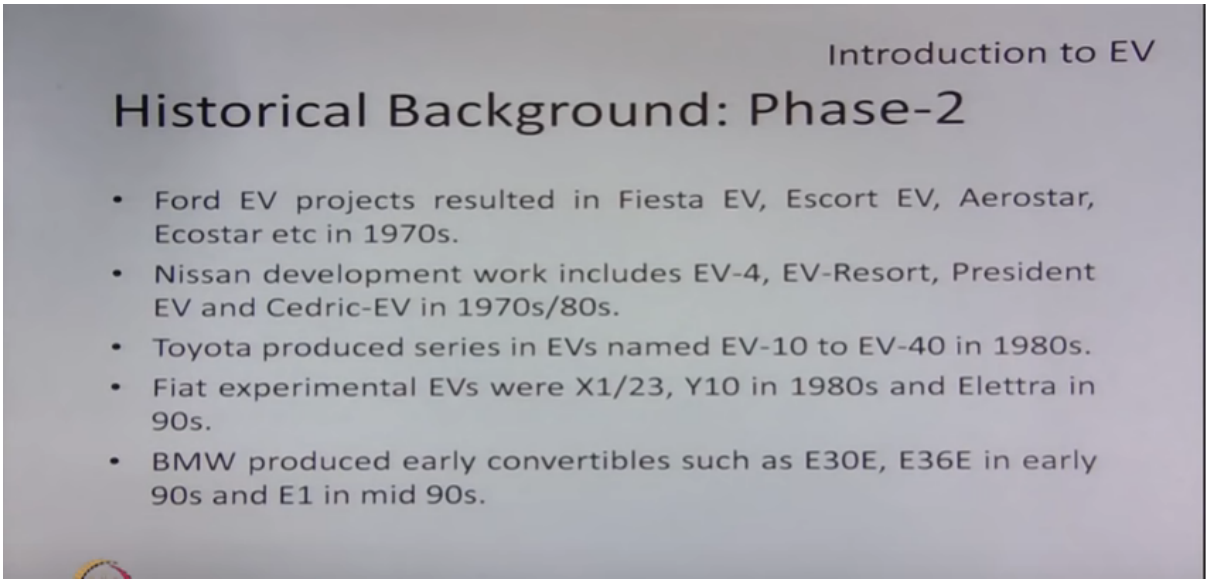

The other companies, like, Ford has launched some of its EVs, like, Fiesta EV, Escort EV, and etc. Nissan, Toyota, Fiat and BMW have launched their own EVs, by late, 1980s and 90s.

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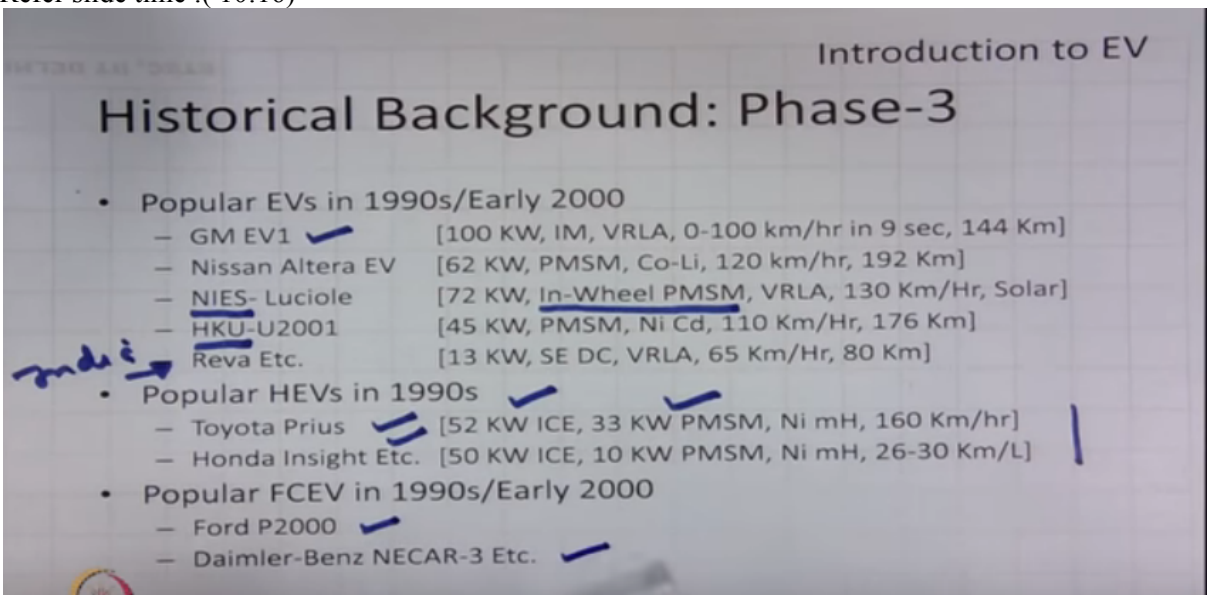

So by late 90s, many companies were able to launch their EVs. And which were, you can say, a very good vehicles, in terms of performance and efficiency. There is a vehicle names, named as, 'GM EV1'. So, it used 100 Kilo watt, induction machine, with lead acid battery and it is able to achieve, 100 kms/hr, within 9 seconds. And it has a range of, 144 kilometres. This vehicle has got a very good

name, in terms of design and it was almost certain that, EV will pick up from there. Nissan has launched its EV, named as, 'Altera EV', which is based on 62 kilo watt, PMSM drive and it was to go up to 120 kilometre, per hour, with 192 kilometre range. This institute in Japan, which is known as, 'National Institute of Environmental Studies', short form NIES, which went ahead with very high performance, EVs. Which are very complex to build and operate. So this works on a principle of, In-Wheel drives. Which means, separate motors are used to control, separate wheels of the vehicle. Is very complex, but it has taken the EVs to a next level. The performance, better than IC engine based vehicles, in terms of, operation. Another university, known as, 'Hong Kong University', has launched a similar vehicle, named as, 'U2001', this similar performance. In India, electric car, called, 'Reva', was launched in 2002, which was a low power urban car, based on separately SE DC machine. With a top speed of 65 km/hour, with a range of, 80 kms. The hybrid electric vehicles, also became popular in 1990s. Some of them were, Toyota Prius, all of us know and Honda Insight. So they were launched within a span of 2, 3 years. So both were based on, high engine capacity and low power electric motor. So you can say, it is a engine heavy, hybrid electric vehicle. There were some popular, fuel cell electric vehicles also launched at that time. So one was from Ford and another from, Daimler-Benz. So this vehicle used, hydrogen as fuel.

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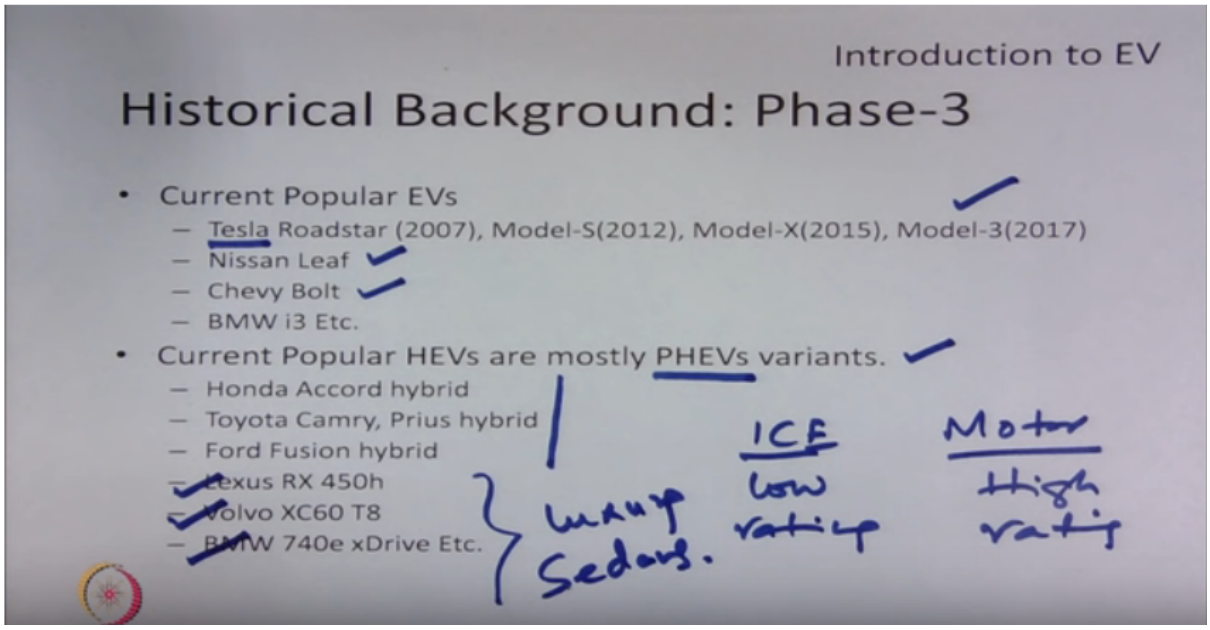

In the current scenario, the EVs are extremely popular and they are able to compete with conventional IC engines, in terms of performance. The famous models of Tesla, is known to everyone. So they have launched 4 vehicles, till now, starting with, Roadstar. And now, recently they have launched, Model 3, which is extremely, high performance, EV. Product by Nissan, which is called, 'Nissan Leaf', is also extremely popular, globally. Similarly, the name of Chevy Bolt, is a household name, Europe. The other products, such as, BMW i3, which is also popular. Chevy's are also popular, but now, all are PHEV type. Means, pluggin, electric, vehicles. Which means, it is electric motor heavy, HEV. So IC engine is, low power device, primarily used to recharge the battery for long range requirements. So some of the popular products are, Honda Accord hybrid, Toyota, Toyota Camry, Toyota Prius hybrid, Ford Fusion hybrid. There are also luxury version of them, which are costly and meant for high segment, like, Lexus RX, Volvo T8 and BMW xDrive. So these are called, 'Luxury

Sedans'. So the internal parameters of this vehicles, will be discussed, as we go along in the presentation. And we will see, how this EVs and HEVs are configured, internally. So this is the end of our, first topic, introduction to EV, which is historical background.

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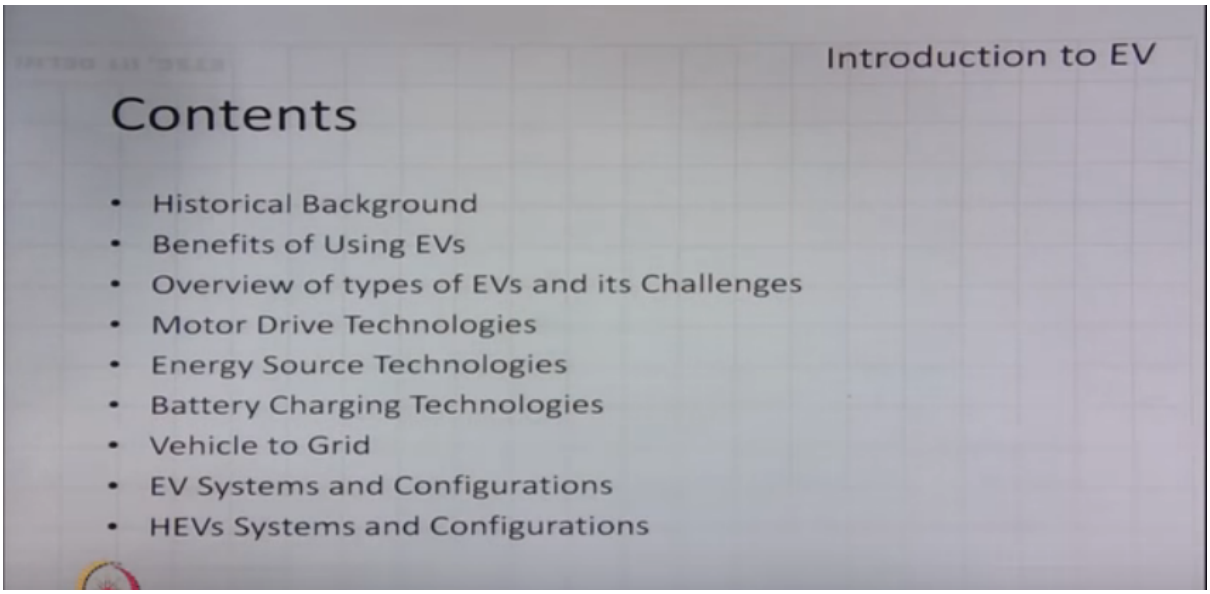

And we will go to, next topic of this sub-session, which is, benefits of using EVs, compared to, other modes of transport. And, thank you.