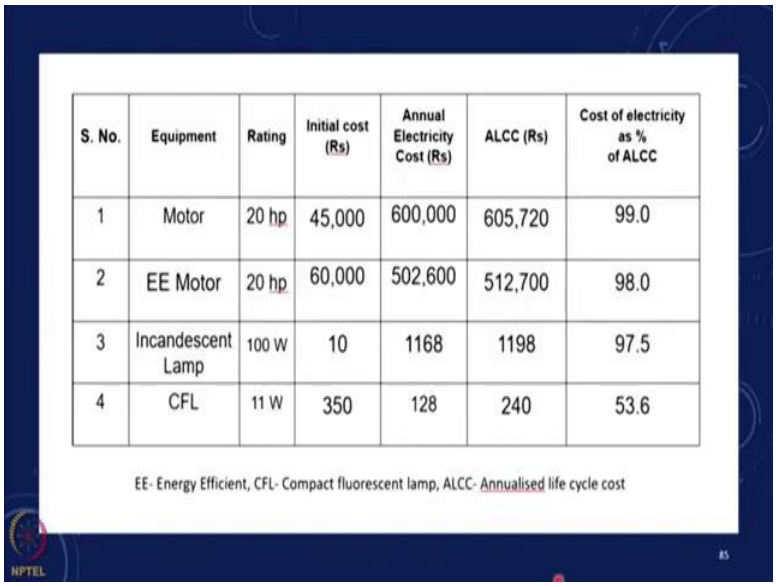
Energy Resources, Economics and Environment
Professor Rangan Banerjee
Department of Energy Science and Engineering
Indian Institute of Technology Bombay
Lecture 24
Energy Policy examples – Part 2

(Refer Slide Time: 0:21)



Now I would like to talk to you a little bit about energy efficiency, and if you look at energy efficiency, many of the devices that we talk of for energy efficiency for instance, an energy efficient motor as compared to the standard motor, you would find that the initial cost of the energy efficient device is slightly higher. But most of these energy intensive devices, the operating costs is far exceeds the cost of the initial purchase.

For instance, if you look at a 20 horsepower motor, and the initial cost of a 20 horsepower motor is just Rs. 45000 and energy efficient motor may be slightly costly to let us say at 60000. However, the annual cost of electricity to run that motor continuously is about 6 lakhs. And in the case of the energy efficient motor, this turns out to be 5 lakhs and so, we get much more than this benefit in terms of doing this.

The problem often is that when you implement a motor, it is one of the loads of the total. So, we never track what is happening in terms of the benefit that we are getting. And this is one of the difficulties which happens when this. So many of these whether you look at incandescent lamps, boilers, the energy, the operating cost far outweighs the cost and that is why we would like to look at it from a lifecycle point of view.

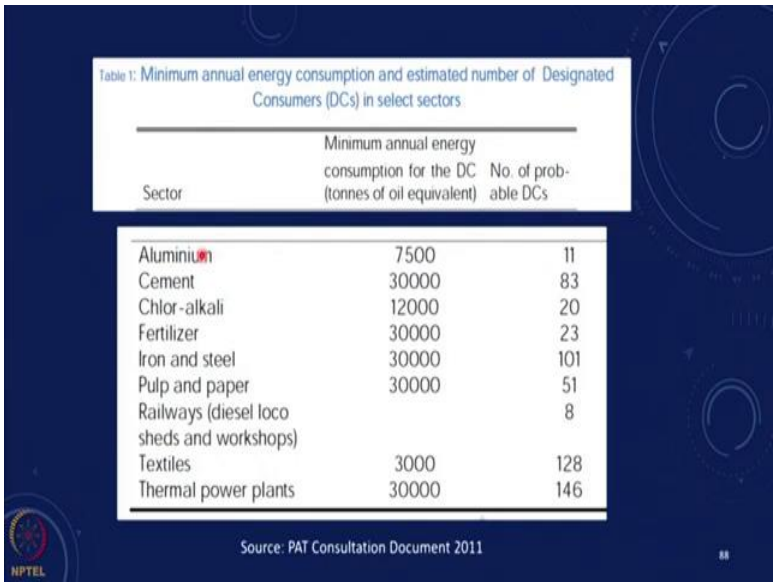
(Refer Slide Time: 01:47)

So, this is from a German study which shows that how do we remove the obstacles for energy efficient motors and there are a whole set of different policies which can be done. So, there are in the case of motors, there are these original equipment manufacturers, for instance, in textiles and many of these industries, they buy the process equipment where the electric motors are part of the equipment.

So, in this if we can have voluntary agreement, standards and labelling, then in the case of the buying by the large industry, there are consultants and then there again labelling, information, subsidies and duties, campaigns for replacing inefficient equipment.

Again, the information, auditing, environmental taxes, create incentives for new product development, marketing by motor manufacturers so that you can have the energy efficient motor being the major stream where people rework their entire manufacturing and then the cost differential will also come down. So, there are a whole host of things and these kinds of analysis can be done for almost all the energy efficiency options.

(Refer Slide Time 3:03)



Now let us look at the last another example, before we do that, let me look at the another energy efficiency example. I talked to you about the perform, achieve and trade and this was a scheme which was launched by the Bureau of energy efficiency and the idea was the large energy intensive industries were targeted as designated consumers.

There were discussions with each of these stakeholders and for all of them, the total amount of energy which is being used was calculated, the specific energy consumption that means the energy consumed per unit of product was calculated, and there were set targets in terms of how much they should reduce the specific energy consumption.

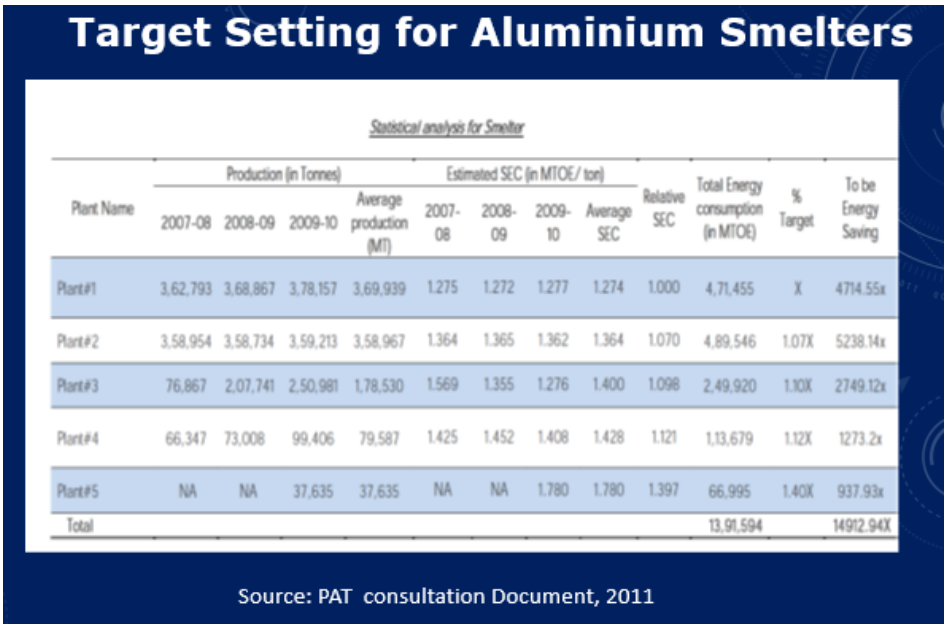
Now in this, the problem which was there is the whole industry has a set of different kinds or there are small players, there are large players, there are efficient players, there are inefficient

players, there are older companies and plants and there are the new and efficient plants. And so, the idea was that the target was distributed amongst the whole segment in a certain way and this was done through a set of so for each of these, there was a consultation document and a process.

(Refer Slide Time: 04:25)

So, in the case of cement, we are looking at each of these the output was put in terms of tons of cement, fertilizer, it was developed in terms of tons of urea. So, the energy use per ton of urea, energy use per ton of cement, energy use per ton of crude steel, sponge iron, aluminium, molten aluminium, pulp paper, fabric, yarn, caustics soda, electricity.

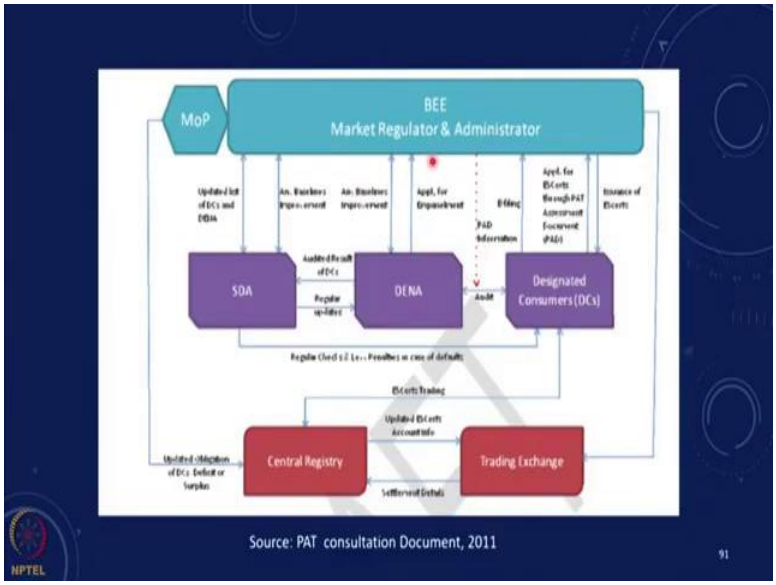
(Refer Slide Time: 04:58)



You can look at the document for further details. So, for instance, if there are a number of clients and the last 3 years of data was collected with their average production and their energy consumption and then amongst these plants, the total consumption was taken. And the best plant was taken as the relative SEC; Specific Energy Consumption, which is the lowest was taken as 1. And correspondingly, the others were divided in terms of the ratio of the specific energy consumption.

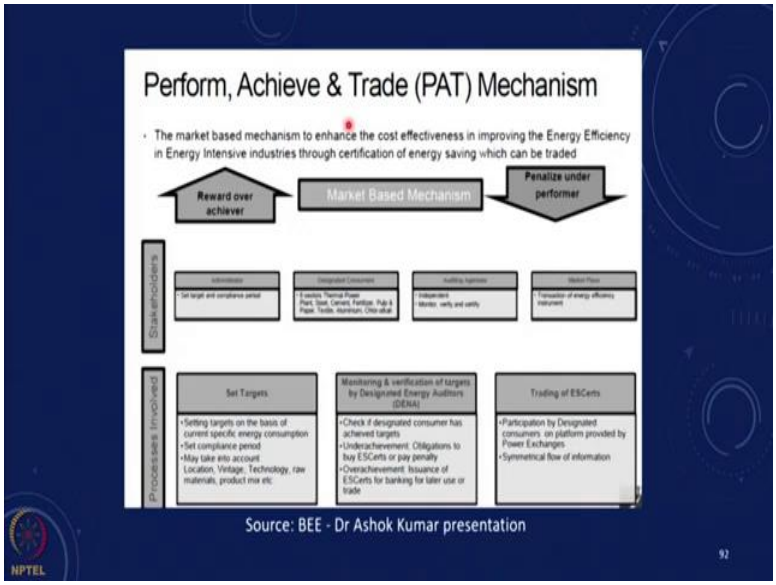
So, the plant which had the highest and if this had, let us say, 40 %, higher specific energy consumption, whatever target was set overall, this would have a higher target of 1.4x, while the plant which had 1 would have only x. We add this up and then the total target was put in terms of a percentage and then attributed divided against amongst the each of these plans, so that there was a differential target with the ones which were more inefficient having to set a higher target compared to those which are already more efficient.

(Refer Slide Time: 06:22)



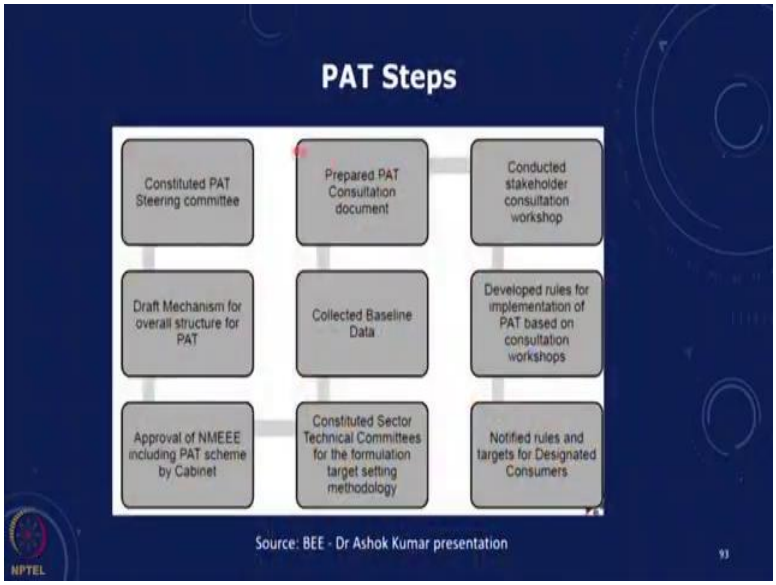
And in this, the idea is that there would be designated consumers, there would be a nodal agency, which would audit and specify what is the consumption and monitor this. And then there would be an exchange and the registry and the market regulator would be the bureau of energy efficiency.

(Refer Slide Time: 06:37)



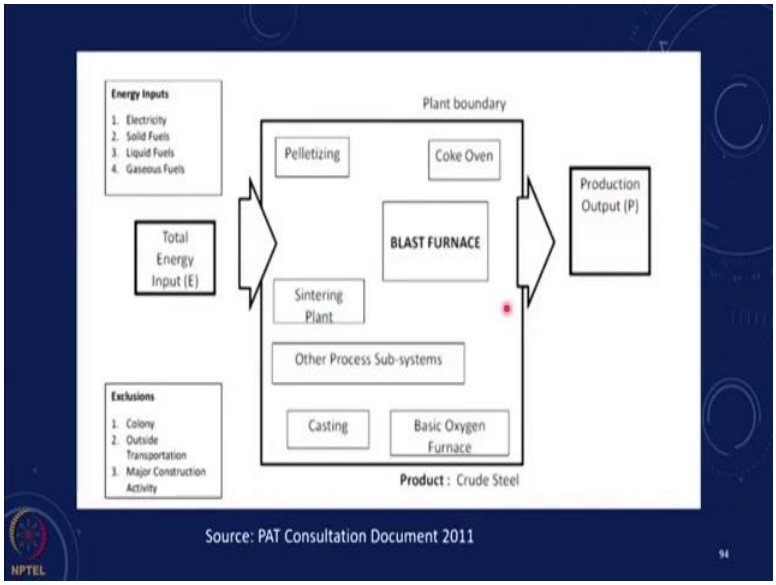
So, the idea was that everyone would have over 3 years cycle a target. If you achieve your target, that is fine if you overachieve, you get a certificate which you can trade and sell. If you under achieve, you either buy the certificate or you pay a penalty and this is how this was sort of propose.

(Refer Slide Time: 07:00)



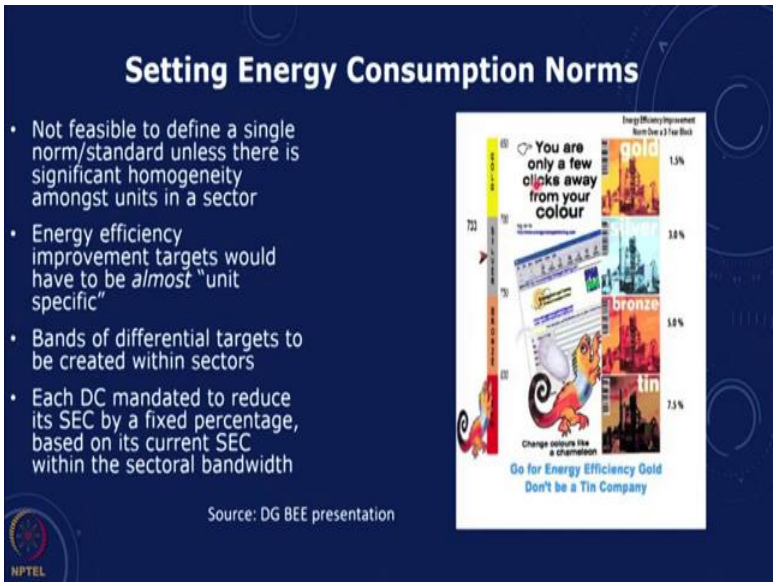
The steps were that steering committees were created and structure this was approved, it was approved by the cabinet and sectoral committees were appointed, baseline data was collected, and then rules and notified and designated consumers.

(Refer Slide Time: 07:17)



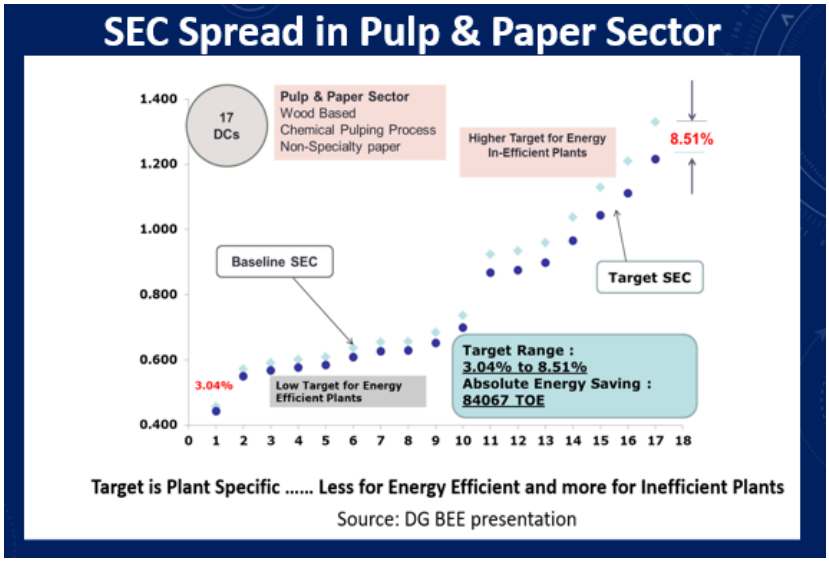
So, for instance, if you look at an iron and steel plant, you can look at the different kinds of processes, the total energy input, electricity, solid fields, all of them put into an equivalent term and then divided by the production output to get the specific energy.

(Refer Slide Time: 7:30)



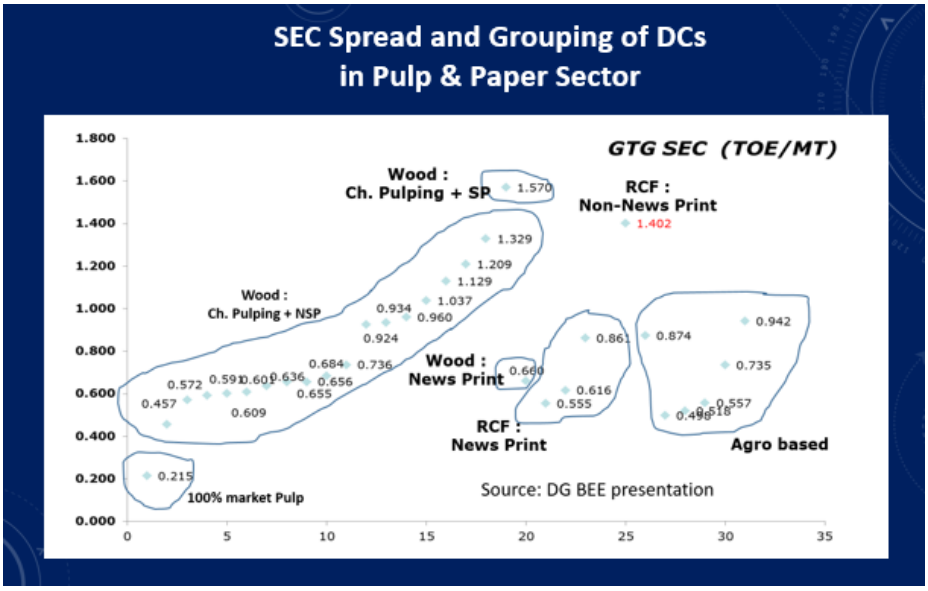
So, the idea was that it was not feasible to do define a single norm. And each unit would have would be targeted based on its past performance and its specific energy consumption within the band of all the units in that sector. And so then, if you see this, the ones which are gold will only have to save 1.5 % on a three year basis, the ones which were inefficient will have to go as high as 7.5 % and so, this is the way in which this happens.

(Refer Slide Time: 08:09)



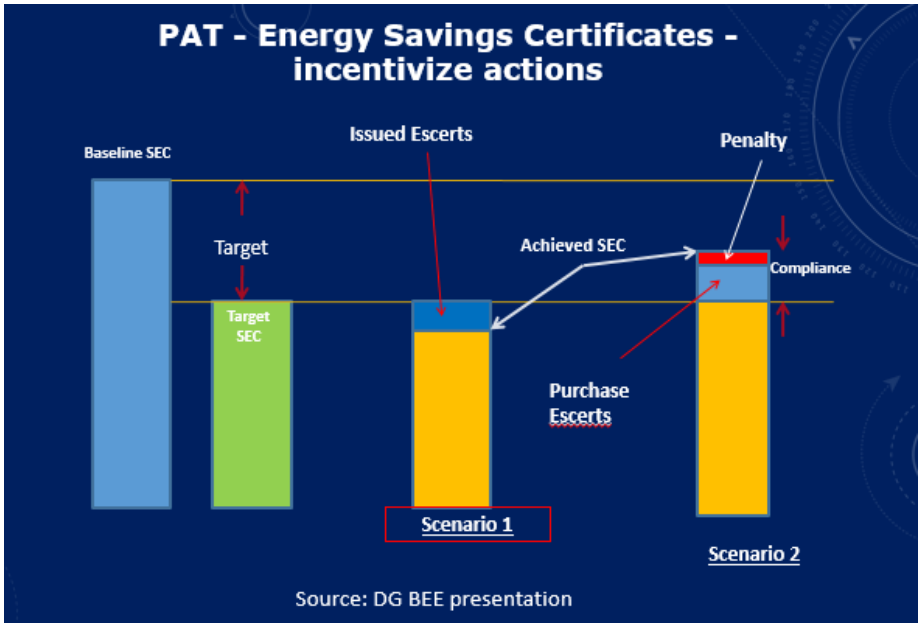
Just to give you an idea the specific energy spread for instance, in the pulp and paper sector, you can see there is a wide range of specific energy consumption of these in 17 units. And you can see then the targets have been set accordingly.

(Refer Slide Time: 8:30)



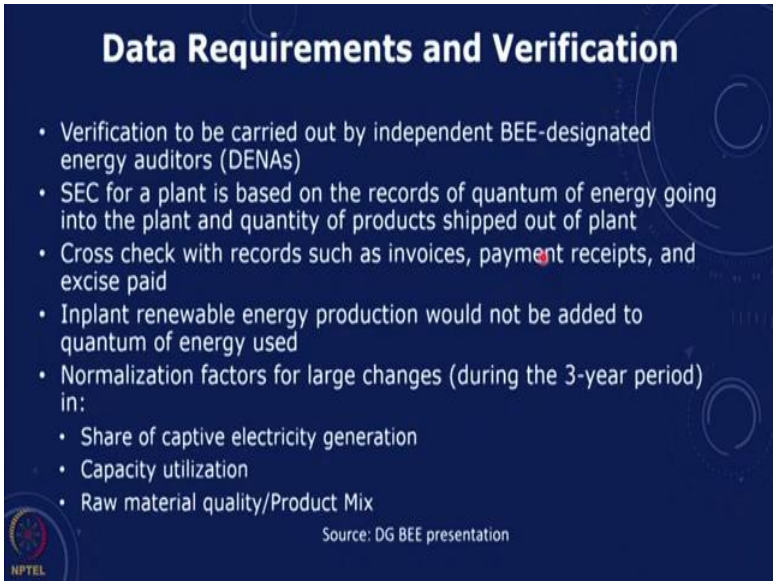
These have been clustered based on the type of feedstock or the type of product and then targets have been set.

(Refer Slide Time: 08:41)



So, as I told you earlier, we have this possibility of if we meet the target is fine. This is the baseline, this is the target. If we are below the target means that means we overachieved, we get certificates for this amount. If we under achieve we can either purchase the certificates or pay the penalty and the penalty was twice the amount of cost that would have been incurred if you had done that saving.

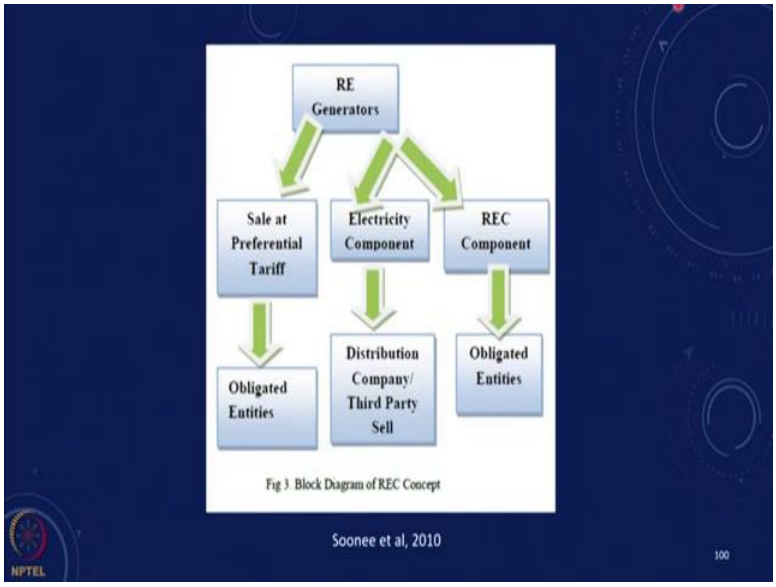
(Refer Slide Time: 09:15)



And then this the many issues verification by energy auditors, specific energy consumption and the normalization factors, so this has been implemented in a certain way. The next phase is happening where this is being broadened and deepened and the question the market is also

market has not yet developed, but the first stage of doing this has happened and this has increased at least the awareness in terms of the energy consumption in the industrial sector.

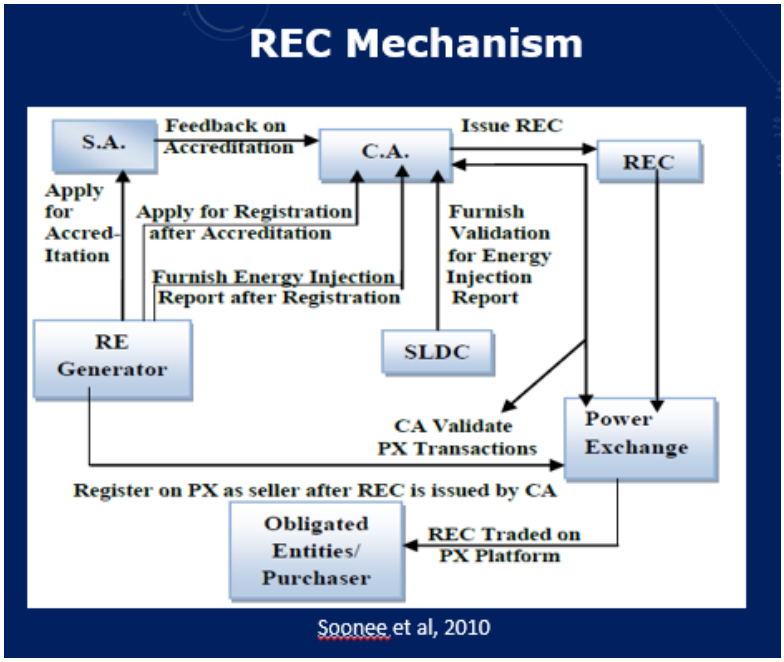
(Refer Slide Time: 09:46)



Another set of we talked about the renewable energy certificates very similar to the PAT. Here what has happened is earlier, we used to have this preferential tariffs where we got for renewable energy, we would give preference in terms of a higher feed in tariff. Now, instead of this, now the idea is that the electricity is sold at the distribution company as the price at which it would normally be bought and you get a certificate saying that we have generated x megawatt hours of renewable energy, renewable electricity.

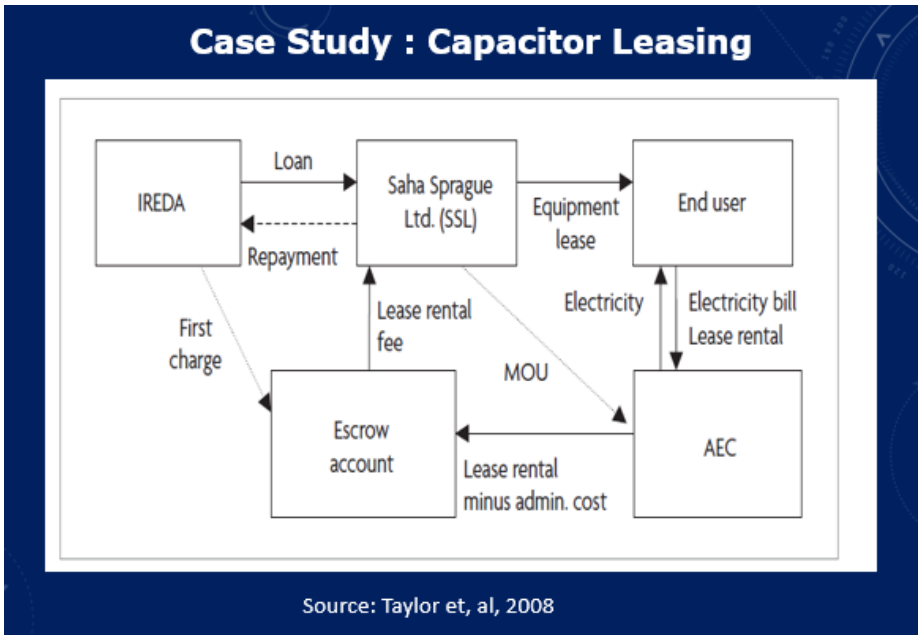
And that renewable electricity can be sold to obligated entities which will meet the renewable purchase obligations. And this has sort of there was the idea was that this these certificates will be traded, but unfortunately, the supply and demand matching of this was not there so it was actually just hovering around the floor and there was not much movement on this. But this is as things progress, the renewable energy certificate mechanism may work.

(Refer Slide Time: 10:56)



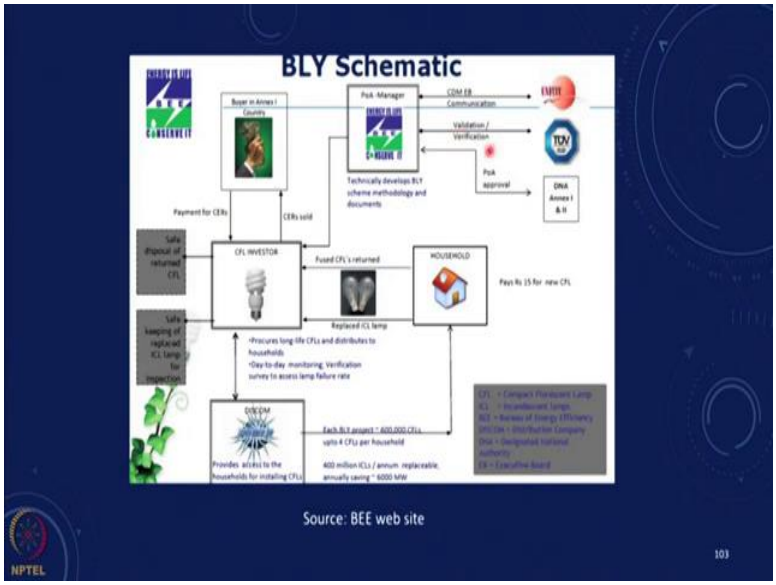
So, the idea in this is that these RECs will be going to the power exchange and the second load is to SLDCs, the renewable energy generators and obligated entities can work on it.

(Refer Slide Time: 11:09)



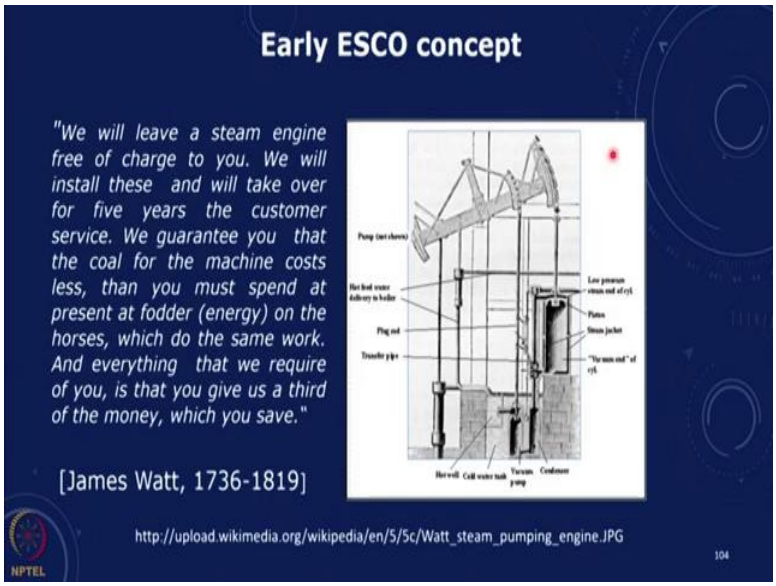
We talked to you when we discuss financing, we looked at this mechanism where we were talking in terms of leasing and I talked to you about this example of Ahmedabad Electricity Company where you had the manufacturer actually leasing the capacitors and getting paid from the electricity bill.

(Refer Slide Time: 11:34)



And similar kind of concept was adopted in the scheme for the compact fluorescent lamp, Bachat Lamp Yojana and the idea in this was that lamps would the prices of lamps will be brought down, and it was of course based on the fact that the CRs would be sold at a price.

(Refer Slide Time: 11:55)



The earliest concept of the energy service called company actually dates back to James Watt and his steam engine at that time. So, this was the idea is that we have this concept, where an energy service company comes in and says that you continue to you are now paying a certain amount for your energy, we will come in and we will you continue to pay you, pay a little less.

So, you save let us say 10 %, we will implement energy efficiency as a service and we will charge you for that and so percentage of the savings will come to us, you benefit because you are getting a lower bill, we benefit because we are getting a profit out of it. So, this kind of concept has been tried and this was earliest was in James Watts, where he says we will leave a steam engine free of charge to you.

We will install these and take over for 5 years the customer service. So, the whole operating risk is with this is especially true for a new industries and it is steam engine, we guarantee you that the coal for the machine costs less than you spend at fodder on the horses which do the same work. So earlier it used to be horse driven mechanical work and everything we require is that you give us a third of the money that you save.

So, one third and two third, one third coming to James Watts Company and two thirds going to the company. So, this is the concept of the energy service company. Somewhat successful in the Indian context, not that successful because many of the industry the energy service company has to get the financing and do a lot of these risks.

(Refer Slide Time: 13:52)

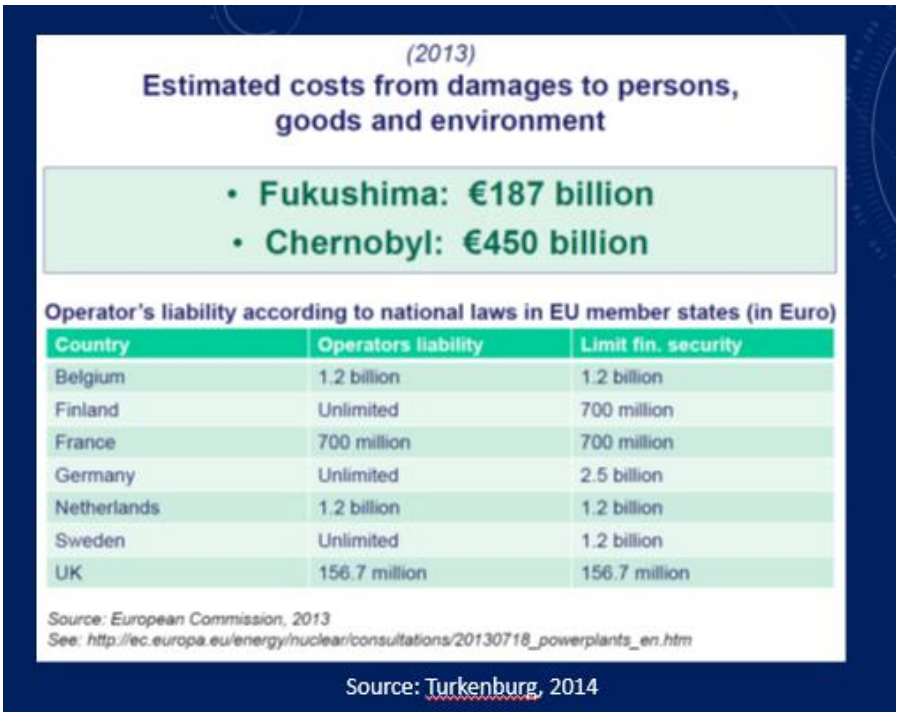
Now, let us talk about the last example and that is about nuclear. We will talk about nuclear, as you may know, everyone usually has a view on nuclear, some many people are positive in terms of Nuclear, some people feel that there are problems with nuclear. In the case of nuclear, from a carbon point of view, it is a low carbon option and it does not have any emissions in terms of CO_2 or local emissions.

However, the problem is with radiation and these are usually large plants and there is a containment areas and the problems are with public acceptance, problem in the case of accidents. And in the case of accidents, there is a very low probability of an accident, but if the accident occurs, there is a very high probability of damage. So, the question is from a societal viewpoint, how do you analyse that and how do you compare this.

There are safety risks both in terms of the fuel cycle and the power plant. There are also problems in terms of nuclear waste disposal of high level waste and problems in terms of proliferation, weapons and missiles materials, the advantages in terms of climate change, and there are some issues related to cost, costs are quite high in the case of nuclear.

So, let us just look at some of the things and there are some estimates of the costs of damages to persons goods and environment.

(Refer Slide Time: 15:25)



And these are in the two accidents, the Fukushima and the Chernobyl accident, these were the kind of damages 187 billion euros and 450 billion for Chernobyl. Now, one of the issues which has been there in terms of policy has been the liability laws, we had this agreement, which was the called the 123 agreements.

So that we can actually be part of the nuclear suppliers group and so that foreign companies can supply. And the question was, should we be limiting the liability, so these are the kind of operator's liabilities and the limiting.

(Refer Slide Time: 16:10)

And in the case of in the case of India, we signed an agreement where the operator liability limit is to 1500 crores. Operator shall have a right to recourse the nuclear incident, so the supplier liability is limited and only the operator will have a right to recourse whether nuclear incident has resulted is a consequence of an act of the supplier or his employee, which includes supply of equipment or materials with patent or latent defects or substandard services. So, only if this is proved then only there will be a liability and this liability was limited.

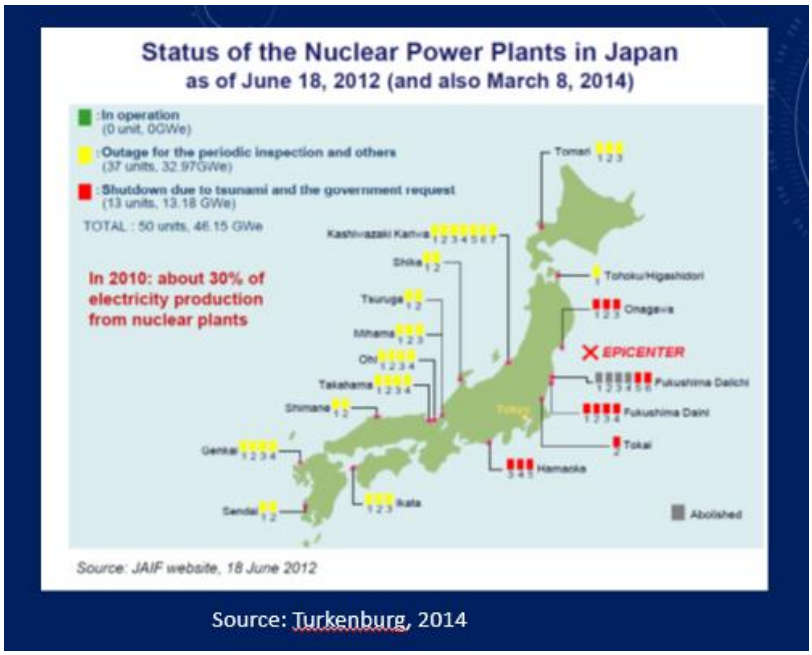
(Refer Slide Time: 16:44)

And so, the idea was in the Indo-US deal was that there is a nuclear liability fund with an insurance cover. And the idea was this insurance premium will come from the electricity supply price, which means of course that it will cost it will result in an increase in the electricity use increase in the electricity costs.

(Refer Slide Time 17:03)

We have had in recent times, which have been there Kudankulam, Tamilnadu, you can see 2000 megawatts at about 17,000 crores. Jaitapur in Ratnagiri district, French about 9.3 billion US dollars, fairly high in terms of the cost.

(Refer Slide Time: 17:26)



Now what has been happening is over a period of time because of these perceptions and this the Japan for instance had a significant amount of nuclear generation and based on the problem and the Fukushima accident there has been a setback in terms of nuclear generation in Japan.

In most of the countries the regulation has mandated more controls, and also many of the power plant nuclear generators are not functioning, are not increasing the number of equipment.

(Refer Slide Time: 18:22)

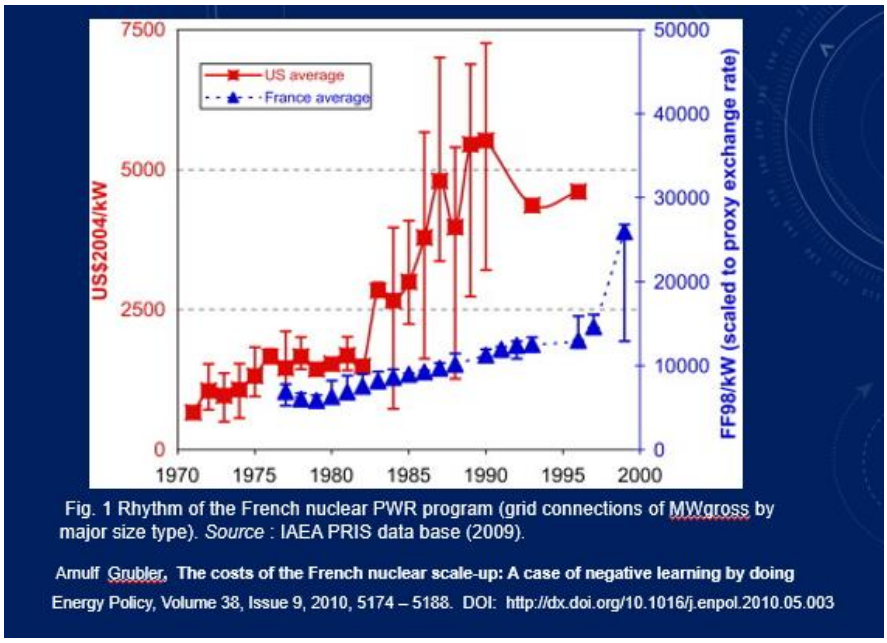


Fig. 1 Rhythm of the French nuclear PWR program (grid connections of MWgross by major size type). *Source* : IAEA PRIS data base (2009).

Amulf Grubler, **The costs of the French nuclear scale-up: A case of negative learning by doing**
Energy Policy, Volume 38, Issue 9, 2010, 5174 – 5188. DOI: http://dx.doi.org/10.1016/j.enpol.2010.05.003

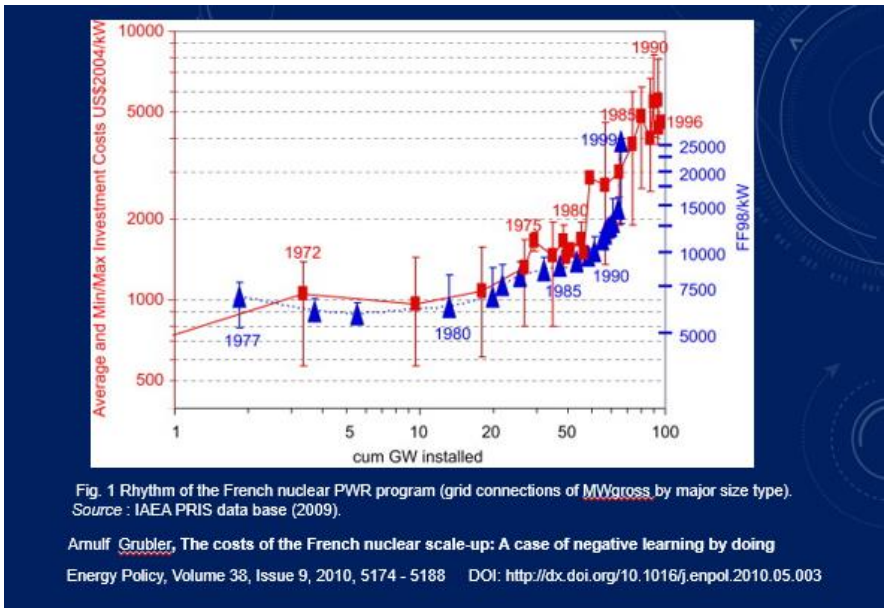


Fig. 1 Rhythm of the French nuclear PWR program (grid connections of MWgross by major size type).
Source : IAEA PRIS data base (2009).

Amulf Grubler, **The costs of the French nuclear scale-up: A case of negative learning by doing**
Energy Policy, Volume 38, Issue 9, 2010, 5174 - 5188 DOI: http://dx.doi.org/10.1016/j.enpol.2010.05.003

So, the costs unlike in the case of solar and wind, where you see a learning curve and the costs have been declining, you can actually see in many of these cases, the US average and the French

average that the capital cost has been increasing and this is because of more regulations, more stringent mechanisms and control mechanisms.

And you can see that this is the range minimum to maximum and this is the kind of thing. Of course, people are talking in terms of more inherently safe nuclear reactors. And there are people are also talking in terms of breakthroughs in nuclear, both in terms of smaller reactors and there is also research going on nuclear fusion. In our context we have been looking at now thorium as a feed stock.

But the whole issue in the case of nuclear is a question of addressing the perception and the reality of risks and putting seeing whether this is societally acceptable, or whether there are options. But this could be one of the cases where we can look at nuclear to meet some of the base loads. With this, we conclude this section on energy policy. We have looked at different examples.

We have talked about the framework for policies, we have looked at different kinds of policy instruments and different metrics. We have looked at air pollution, we have looked at our Paris commitments, we have looked at access cooking, energy efficiency, PAT and the nuclear agreements. So, you can look at many other different policies which are being launched by the government and also at the international level.

And you can try and put all the components that we have learned in this course to analyse these policies, and then also you can propose what would be the appropriate policies for different contexts.