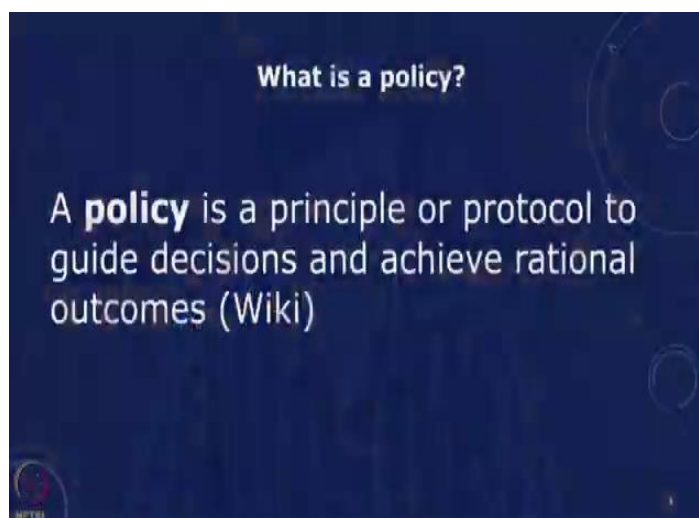
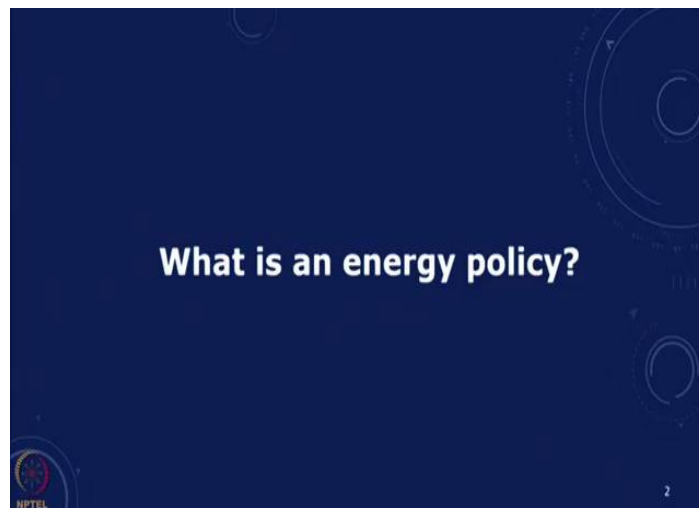


Energy Resources, Economics and Environment
Professor Rangan Banerjee
Department of Energy Science and Engineering
Indian Institute of Technology Bombay
Lecture 23
Energy Policy – Part 1

So, we have seen now all the different modules related to energy resources, economics and environment. Now we put these all together, to look at energy policy. So, in this module and the next one we will be focusing on energy policy.

(Refer Slide Time 0:35)



So, the first question that we should think about is what is an energy policy? The definition of a policy, and we can look at the Wikipedia definition, says that policy is a principle or a protocol to guide decisions and achieve some desired rational outcomes.

So, we can in our daily life we can look at different kinds of policies which have been adopted, policies which have been adopted by the government, policies which have been adopted by institutions, by the state, by the local authority. And let us look at how do we analyze, what is the framework by which we look at different policies.

(Refer Slide Time 1:21)



So, when we talk about policies, we need to understand that what are the decisions involved and what is the policy trying to impact which kind of decisions. Who are the stakeholders that means who are the people who are involved in that, in these decisions and who are affected by the policies. And then based on this what are the discrete policies to impact those decisions and to look at the stakeholders.

We can then see based on the particular policy what will be the impact on individual stakeholders, what will be the stakeholder perceptions? We can set for ourselves some goals related to the policies. And after setting those goals we can have some quantifiable criteria, and that means these will be matrix or numbers that we calculate. We can see they could be quantifiable, they could be qualitative. We can look at that and do an analysis to see whether or not a particular policy is going to be useful, is going to be good.

So, in any policy whenever we talk in terms of policies analysis, and especially when we in our context we are talking of policies related to energy. We can look at list out decisions, the stakeholders, policies, goals, the criteria and then do the analysis. We can also put down what are the institutions and the mechanisms, who is going to implement the policies.

(Refer Slide Time 3:06)



So, with this let us try and see if you look at the global energy assessment, the chapter 22 deals with policies and in that they specify a set of different goals which are usually there for energy policy. The first 1 is the, is that we want to increase energy access and will talk about this a little bit more, we try and see what are the kind of, that means we would like the entire population to have access to energy so that they can have better quality of life. And develop the capacities for the energy transitions.

With the energy sectors are in transition we are make, having changes and we need to be able to have the capacity to not get disrupted by these transitions and to be able to cope with these transitions. And hence energy security we have already seen what is the implication in terms of security where we want to have reliable energy supplies, so the goal of our energy policy will be trying to increase the security.

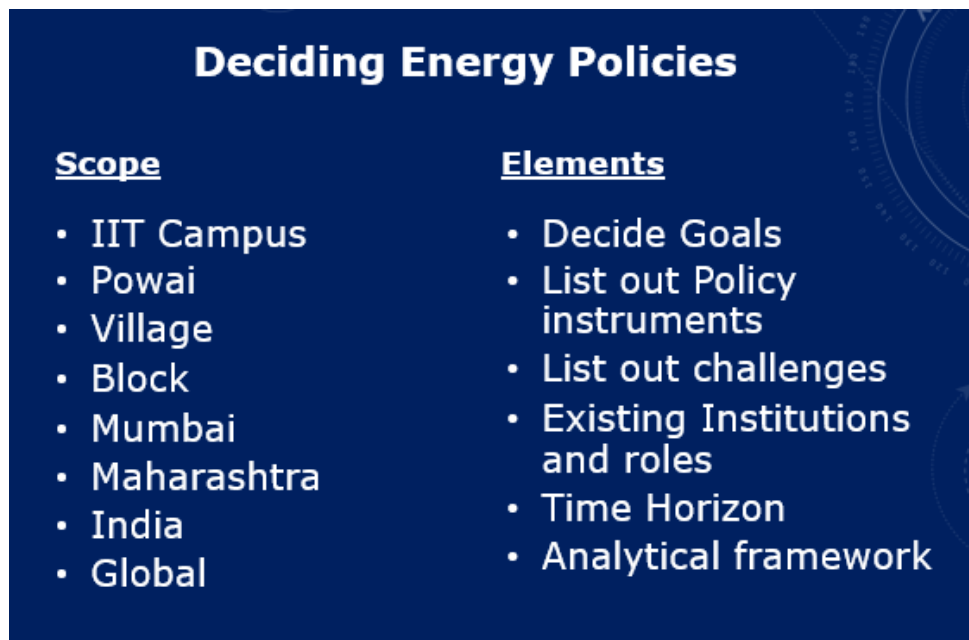
Manage the energy related market powers, so for instance they could be monopolies or oligopolies and a policy would try to see that you balanced it out. So, that everyone has a fair chance and then smaller players can also have an ability to compete in the market. Manage the energy resource endowment, so the resources may be distributed and we want to make sure that these distributions

are such that over different generations through the intergenerational equity or we want to look at how these resources can be managed in an appropriate fashion.

In most of the energy sectors specially when we are looking at the fossil fuels there are adverse environmental impacts, there are adverse human health impacts and one of the goals of the, of, when we analyze energy policies is to reduce the environment and human health impacts. We want to also look at new technologies and accelerate their energy related technological change.

And in some cases for instance when we are talking of maintaining CO₂ emissions less than 1.5 degrees, we want to, we have an international agreement, the Paris agreement, we want to coordinate and implement some of the international energy related policies. So, these are some sort of listing of possible listing kind of energy goals and one will have some aspects of these or some combination of these in most of this.

(Refer Slide Time: 06:07)



<u>Scope</u>	<u>Elements</u>
• IIT Campus	• Decide Goals
• Powai	• List out Policy instruments
• Village	• List out challenges
• Block	• Existing Institutions and roles
• Mumbai	• Time Horizon
• Maharashtra	• Analytical framework
• India	
• Global	

When we think in terms of energy policies you may want to look at the scope and the elements of the policy. So, for instance, if you look at your own institution for instance we are thinking in terms of the IIT Campus. In the case of the IIT Campus we would like to see what are the policies related to energy.

If we think about it, it is about how we are distributing the electricity within the campus, how we charging based on the fixed rate is there, do we have renewable sources of energy on the campus

and are we having incentives and penalties for energy efficiency and the usage of energy. We can look at again in the hostels there is LPG being used for cooking, we are looking at the waste, can we use the waste to generate some of the energy, can we have a sustainable way of doing the cooking energy?

We can look at what are the elements of transport. For instance, several campuses in our campus we do not permit students to have motorized transport within the campus. And there could be we could also have, we have a, we can have an electric vehicle going around the campus, fleet of electric vehicles. We can look at again in within transport some portion of the area where there is no vehicles allowed. There are new campuses being built which are completely vehicle free and these are like walk-able campuses.

So, in each of these when you decide the policies related to a campus, you can decide what are the goals, the goals to ensure that there is very little environmental impact. Goals are to also provide the cost effective transportation. We can list out what are all the policy instruments, list out the challenges, existing institution and the roles, the time horizon and create a framework by which we are analyze the policy.

So, this is in terms of campus we can go beyond the campus to the region in our case that is that becomes Powai and we can look at in Powai what kind of policies are there, who is deciding what are the things? If you are in a rural area we can look at a village and we can see whether that village has connection to the grid, whether it has a micro grid, whether it has some common areas for electricity. We can go to the next level where we look at a number of villages in a block and we can look at a set of policies for the block.

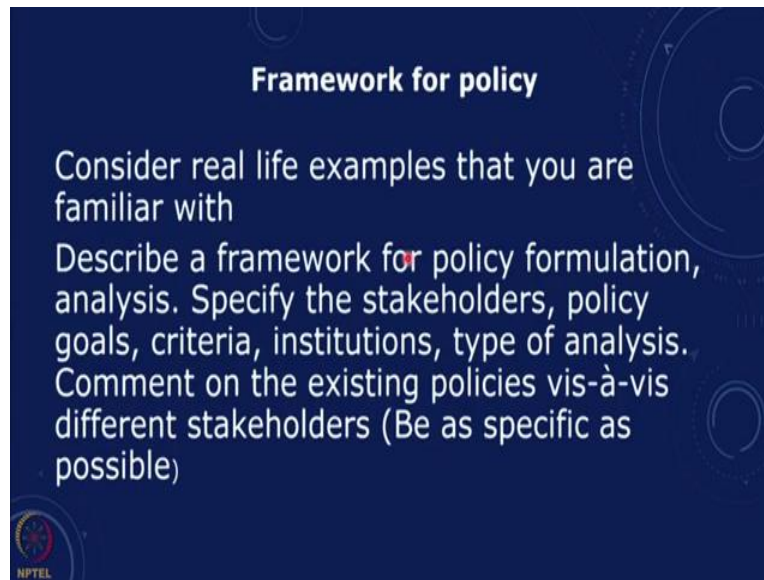
We can look at a city or a region so in the case of Mumbai we can see which are the agencies, what are the kind of things, should Mumbai have a policy where it is going to have electric charging stations for instance. What about the air quality in Mumbai and things like that and we can go from the city to a region to the state Maharashtra, and we can make an energy policy and the plan for the state.

What is Maharashtra's policy in terms of net metering? Do we have, if people are connecting photo voltages to the roof tops, what kind of incentive will be given and we go one step of aggregation further we can go to the country level at India and we can see a large number of centrally decided

policies related to the energy sector. And then ofcourse we can go to the world as a whole where we can have we are thinking in terms of the IPCC.

We are thinking of the Paris agreements, we have agreements on trade and a whole host of thing. So we can decide what is the scope, which is the focus look at the different elements and then analyze the policies.

(Refer Slide Time 9:52)



And I will urge you to think in terms of some real life examples that you are familiar with, list out some policies and describe the framework for the policy formulation. Who is going to formulate the policy, how we are going to analyze it, who are the stakeholders, what are the policy goals, what are the criteria by which you are going to assess the policy, which institutions will implement it, what is the type of analysis that we should be focusing on and comment on existing policies, vis-a-vis some new policies with respect to different stakeholders.

You should do this with a specific example then you will get an idea of how this framework works. Now I will do is I will take you through a few policy examples to illustrate how we can analyze this framework. But you should try and do this yourself so that you can get an idea of this is logical, common sense kind of framework but if you list out in the same fashion you will get an idea of how we can do policy analysis.

(Refer Slide Time 11:05)

Classification of policy Instruments

- Regulating instruments
 - Rationing – emission quotas, mandatory technology
 - Performance standards, benchmarks
- Implied Deregulation-
 - Emission Permit Trading, Green Certificates
 - Voluntary Agreements
- Fiscal and Financial Instruments- Taxes, subsidies or grants
- Supportive Actions
 - Improvement knowledge, market transparency
 - Dissemination
 - Reduce Transaction costs

Perrels, IPCC, 2001

So, in the case of one of the things that we talked of when we talk of policies is how, what are the instruments? Or what is the way in which we are going to implement policies. So, there are number of different instruments, so for instance there are regulating instruments for instance where we can ration, we can provide an emission quota or we can mandate a technology.

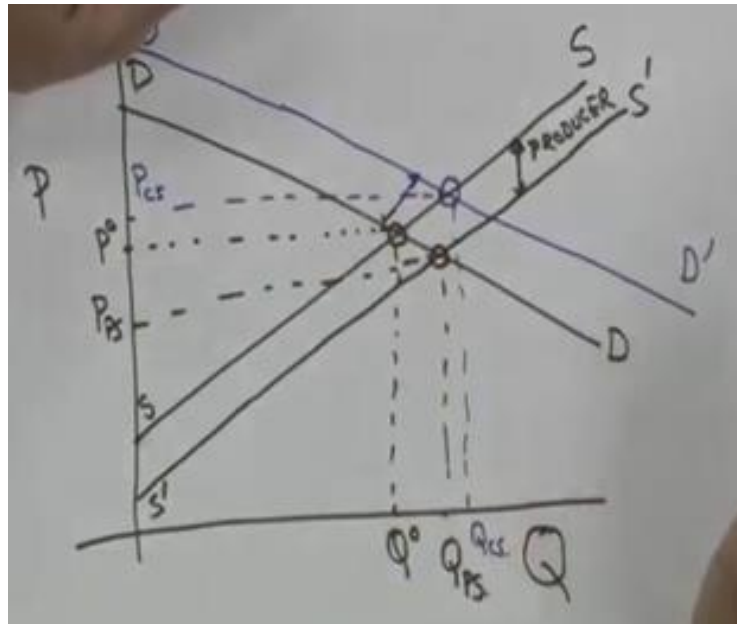
So, for instance, we can say that every power-plant will be fitted with some pollution control equipment and we specify that this is the kind of technology that is mandated or we can say that different units will have a certain amount of emission quotas. And people can stick within that quota if they exceed the quota they will be penalized, if they are less than the quota they get an incentive.

We can also provide performance standards and benchmarks. So, that means if you are emission or your efficiency is better than a particular thing then that means you have a, and there is a minimum performance standard that you have to meet and this is often there for instance in the case of vehicle emissions, we have standards which we have to adhere to which is based on the different years and which the models have.

We could also have, this is in terms of regulating instruments. We can have implied deregulation in terms of a emission permit trading and this has been done in European Union. There could be green certificates, we can have voluntary agreements and then there are this whole set of

incentives, fiscal and financial instruments, taxes, subsidies or grants. And so there is this possibility we can either ration or we can provide subsidies or taxes.

(Refer Slide Time 13:03)



Classification of policy Instruments

- Regulating instruments
 - Rationing – emission quotas, mandatory technology
 - Performance standards, benchmarks
- Implied Deregulation-
 - Emission Permit Trading, Green Certificates
 - Voluntary Agreements
- Fiscal and Financial Instruments- Taxes, subsidies or grants
- Supportive Actions
 - Improvement knowledge, market transparency
 - Dissemination
 - Reduce Transaction costs

Perrels, IPCC, 2001

To give you an example if we just take a fuel where you have price and quantity and if we see, if you have the demand at going like this and you have a supply curve. So, in the normal case this point is Q and this is the equilibrium price Q_0, P_0 . Now suppose so this is let say for a fuel. Suppose the fuel is subsidize and in the sense, that we are giving a subsidy to the, we are providing a subsidy to the consumer so if you are providing a subsidy to the consumer there is a product to the producer.

We have a subsidy so that means we have a fixed amount per product which would mean that now S dash, S dash and you can see what happens here this then now with the subsidy, this is Q with a producer subsidy, right. The demands remain the same. The point increases and if this is a fuel where this is a fossil fuel, in the case of the subsidy the emission will of course increase. Because of this now the price also decreases the effective price decreases and this is why are we providing this subsidy?

We are maybe providing this subsidy from a development goal or from an equity goal and with the idea that we would like that fuel to be affordable. So, for instance we have a subsidy for kerosene, we have subsidy for LPG, for cooking gas so that people can afford it. And with the result that this will result in this kind of a thing. This is where this subsidy is, if this subsidy is given essentially to the producer.

This is like a producer subsidy and often instead of that we could give this subsidy to the consumer and if we look at a consumer subsidy which means that the consumer is given a certain amount and then in the original case this now becomes, this is your D dash and this becomes P consumer subsidy. So, in both these cases what will happens is that we are producing more than the earlier case, the equilibrium point shifts and you can see what happen is because we are providing this. We now have this is the consumer (sub), this is this amount which is subsidize.

So effectively, this is the effective price but we are this much is given as a subsidy. So, the consumers are paying less than in the earlier case. And in so this is one set of things, if we think in terms of putting a tax we move in the other direction and we are reducing the amount of the quantity and then the price also effectively increases. Instead of doing this we could also do this by rationing and providing the quantity.

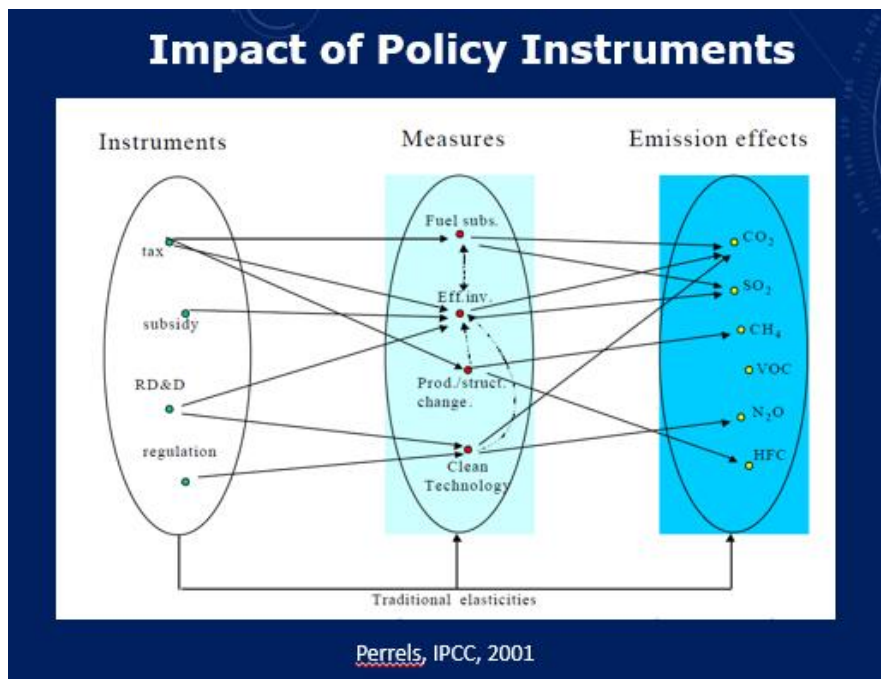
The difference in both these cases is that if we ration and provide and fixed the quantity. We do not know how much that quantity should be and where the market will operate but in effect either of these are the choices. Either we put it in terms of a target and ration or we put it in terms of a tax, the subsidy or the tax. In the case of new technologies that we want to get through and where we want them to initially have a bigger volumes.

We can also provide them in terms of a grant and an initial capital subsidy for instance this has happened in the case of solar for many of these has happened in for wind and happen for the many of the renewables. So these are in terms of the fiscal and financial instruments.

Another instrument that we had which we talked about earlier when we looked at the economic, the module on energy economics is that we can have accelerated depreciation and so if you have an accelerated depreciation it means that we are reducing the tax impact and because of that effectively it will act like an initial subsidy.

There are many other supportive actions that we may provide in terms of policy instruments often one of the barriers is because of lack of information, so we can provide dissemination, we can reduce the transaction cost, we can improve knowledge and market transparency. So, these are some of the possible policy instruments, there are of course many other policy instruments.

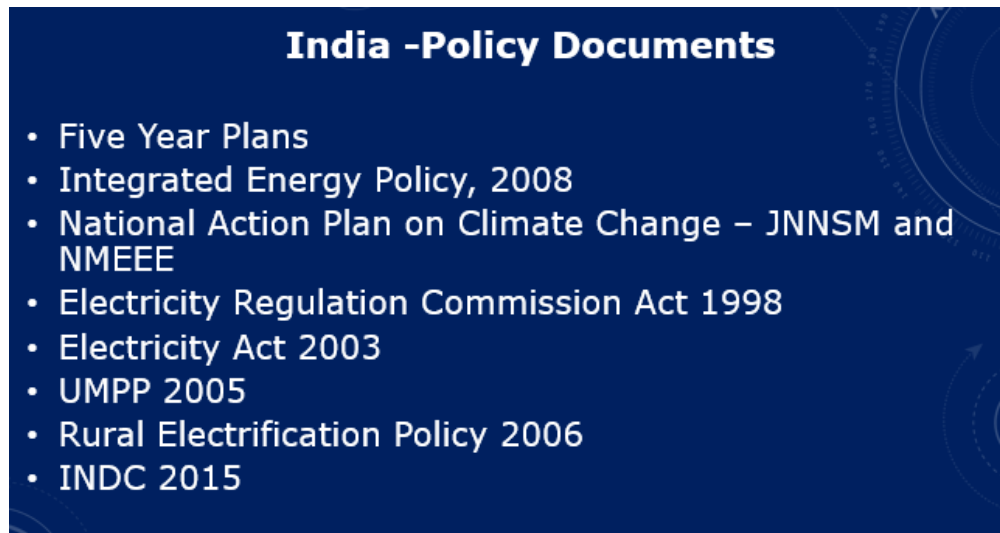
(Refer Slide Time: 19:32)



So, this is from the IPCC report by Perrels. You can see that when we look at the taxes and we can see what kind of the instruments which are there whether it is a tax subsidy or we fund, research, development and design we can have regulation in all of this we can substitute the fuels we can look at energy efficiency, we can change the structure of the production, we can look at new clean technologies coming in.

And then based on that, based on all of this there will be an impact, based on the kind of elasticities that we have and will result in a change in the kind of emissions which we are looking at. So, if we can create a model of our system either through an input-output or through computable general equilibrium or any other model of the economy that is there and we can see when we impact, when we implement a policy instrument what happens overall.

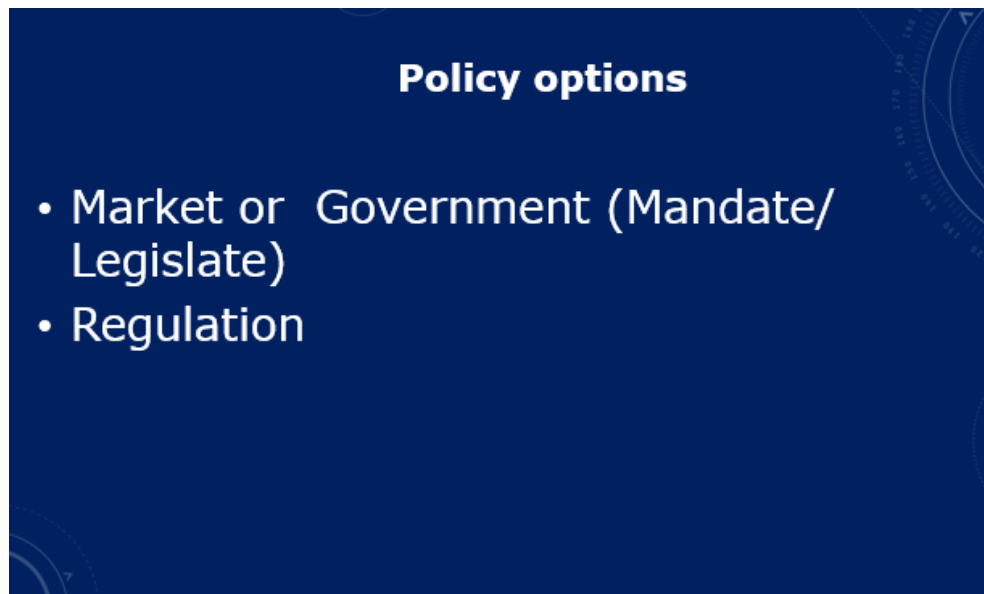
(Refer Slide Time 20:40)



So this is the way in which there are a large number of different policy documents. In the earlier years we used to have, in the days of the planning commission we used to have 5 year plans. And you can take at some of these which will give you an idea of how the planning and implementation was being done. There was an integrated energy policy report and that is was an attempt in 2008 from the planning commission where the different sectoral approaches were planned to be put together.

There is also national action plan on climate change, and the national solar mission earlier this is we call a Jawaharlal Nehru National Solar Mission, the national mission for enhanced energy efficiency. There are different kind of there was the energy electricity act and the electricity regulation commission act, ultra-mega power projects, rural electrification policy and then are intended domestic commitments which we committed to in Paris which is now which we have signed off and we will discuss some of these in detail. There are this is only a subset of the different kinds of policies there are many different policy options.

(Refer Slide Time 21:54)



So, as we saw we have actually a number of different possibilities we can look at market or government and in typically we can look at policies implementing through the market or we can look at a government intervention where we mandate or legislate or we can look at an independent regulator looking at this. So, there is, these are the option that we have in many of these systems what will happen is that the market usually has imperfection, so it needs regulation.

And several, at several times the government also intervenes, so it is always a hybrid of all of these and this is what makes policy analysis and interpretation much more complicated. The problem in all of this is when we look at a physical system, if I am looking at a heating water and I have an electric heater, I can measure the temperatures, I can estimate the time I will get exactly, I can create a model which will exactly replicate and I can decide what kind of, how much heating for what temperature.

When I look at system which is a physical system, we have energy you have energy supply we have energy use but there is a behavioral component in terms of individuals and their response is companies and their responses and the experimentation at that kind of scale whether it is at the local city, state or country is quite expensive. So, one can creates some mental models, one can create some mathematical models like we saw the input output models and then we can see what will be the impacts and this is often done then you try and you compare the policies and then you try and see, adopt and enact it and then see what happens.

And sometimes one makes mistakes in doing the policy because there are unintended impacts of these policies. For instance, in the Indian context in the initial years when we started on renewables we started providing an incentive for a capital subsidy for wind machines, we also had a tax benefit and in some states, we also had sales tax benefit. So, in many cases there was an incentive web, people installed wind farms in areas where there was not enough sufficient wind.

They relatively low capacity factor and even though there was not much generation, the company still benefited in terms of all the other benefits which were there. So, this was ofcourse corrected later on, so that was why at one point we had a overall capacity factor of wind generation in our country of less than 14 %.

Now that has, that is increasing with the change in the policy. So, what are the criteria to analyze policy again this is from global energy assessment chapter 22.

(Refer Slide Time 25:18)

Criteria to Analyse Policy

- Effectiveness
- Economic efficiency
- Administrative feasibility
- Equity
- Political acceptability
- Policy robustness
- Policy consistency

Source: GEA Chapter 22

We can look at the effectiveness of the policy. Effectiveness will be judged in terms of its ability to meet the goal that was set. We can look at the economic efficiency, what happens, what is the in terms of overall economics what is the overall is there is surplus or is there a loss and the consumer and the producer surplus does it get decreased and overall impact on the GDP or on the income of the different stakeholders.

We can look at the administrative feasibility how easy and cost effective is it to implement, is there a possibility that this will be there will be distortion which will be there. We also want to see what is the equity impact, equity impact means that how does it affect the poorest of the poor and is it, is the impact equal across different income classes?

And then of course the equity impact can affect the policy, political acceptability and ofcourse political acceptability is not is a tricky thing and it depend on the whole host of different things including perceptions and so that is a tricky point when you are looking at large scale policies which affect a whole set of population, we need to look at this.

Policy robustness, if there are any changes that we have not anticipated, if anything different environmental factors change, does the policy results, do the policy results remain the same. Policy consistency overall when we think in investments and in terms of decisions making, it is important that over the years we do not keep changing policies.

So that it is difficult to then take decisions, so overall we should try to see that policies are consistent over different governments, over different kinds of different time periods. So, these are typically the kind of criteria.