

## *The Quaid-i-Azam Lecture*

### **Energy, Environment and Sustainable Development in South Asia**

RAJENDRA K. PACHAURI

Honourable Federal Minister for Planning, Development and Reform, his excellency Mr Ahsan Iqbal, the President, Pakistan Society of Development Economists, discussants, Dr Ashfaq Hasan Khan and Dr Rehana Siddiqui, Dr Durr-e-Nayab, distinguished ladies and gentlemen, let me say at the outset that it is a great privilege for me to be here and to be given this opportunity to deliver the Quaid-i-Azam Lecture. I regard this as a signal honour and I feel particularly privileged coming from India being able to speak in honour of the Quaid-i-Azam, the founder of this country. I want to express my gratitude for this particular privilege which I have been given. I also want to acknowledge the very warm sentiments expressed by his Excellency the Minister. I certainly believe that in this day and age we have to look forward, we have to look at the future and I think we have to erase some of the problems, demolish some of the barriers and the hindrances that have prevented South Asian cooperation in the past. So Sir, your words in that context are certainly appreciated and I would say that we have to put them into effect by ushering in a new future for this region. I want to mention that when I had the privilege of accepting the Nobel peace prize on behalf of Inter-governmental Panel on Climate Change (IPCC) in 2007 along with Mr Al Gore, in my acceptance speech I used a Sanskrit phrase which is Vasudhaiva Kutumbakam and that means the universe is one family. Now if the universe is one family, may I submit that, we particularly in Pakistan and India are really the core of that family. I believe the future lies in our ability to develop a model of economic growth and development that serves as an example for the rest of the world.

Let me at the very outset say that we have been somewhat negligent and perhaps short sighted in emulating what has been established as a form of development in other parts of the world and I will say a little more about this as I move on. Let me start by referring to the definition of sustainable development which essentially comes out of the work of the Brundtland Commission that was completed in 1987 and it's a very simple definition. It defines sustainable development as that form of development which allows the current generation to meet their own needs without compromising on the ability of future generations to meet their own needs. So, therefore, it essentially takes into account the issue of intergenerational equity. Whatever we do today should not be selfishly oriented by which we might meet more than our needs today but we certainly make it

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difficult for future generations to be able to meet their own needs. May I also submit that the emphasis here is on needs, which of course is a very difficult concept to really come down to grips with. A billionaire's needs or what he calls needs might be very different from the needs of a poor person who has to look for his next meal. However, I think both in terms of humanitarian as well as purely biological considerations we can define certain needs which include adequate nutrition, shelter and livelihood.

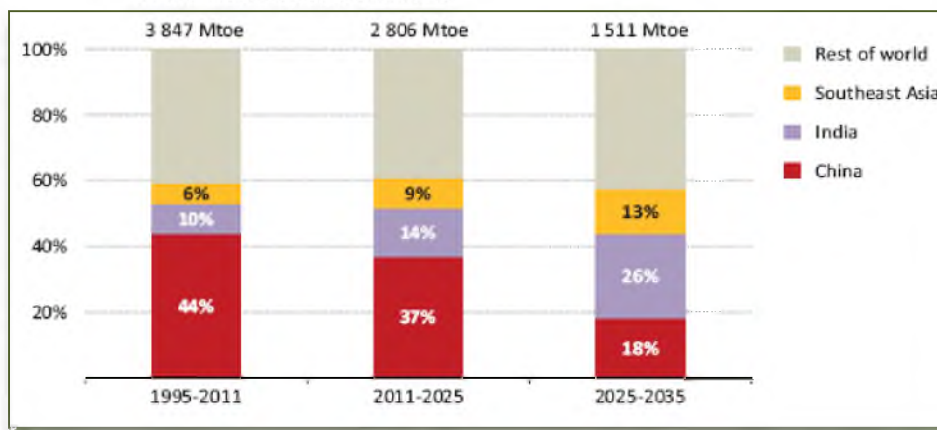
I believe that in coming up with directions for the future we would necessarily have to keep in mind the concept of sustainability. Now this was also something that was clearly articulated in the very first conference on the human environment which was held in Stockholm in 1972, and to a large extent it was also given attention in the Rio plus Twenty (Rio+20) conference which took place last year. But may I say the world has moved on in several respects but it has not moved on in several other aspects. Now this is why I would like to refer to what is known as the *tragedy of the commons*, a tragedy which you see around you everywhere. This was a concept that was perpetrated by a biologist of all people and to my mind it represents a very powerful new way of looking at economics. The *tragedy of the commons* was defined by Garrett Hardin who as I said was a biologist and I quote from what he wrote. He said, "The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is the day when the long desired goal of social stability becomes a reality. At this point the inherent logic of the commons remorselessly generates tragedy". Because essentially what he is trying to say is that global commons, whether it is the air that we breathe, the forest and the pastures which are open to the use of various societies and communities or for that matter the water that flows through our rivers and oceans from which we derive a lot of benefits are commons. They are resources that everybody benefits from but nobody has responsibility for looking after. If we exploit them to a level where they get damaged and degraded, then that clearly represents a tragedy and that also defines the conditions that go against the very concept of sustainable development. If you degrade and damage these common resources then clearly future generations are going to find it very difficult to be able to meet their own needs.

This is something that Amartya Sen and Sudhir Anand have talked about. As they say, and I quote, "It would be a gross violation of the universalist principle if we were to be obsessed about intergenerational equity without at the same time seizing the problem of intergenerational equity". There is a terrible problem of poverty in our part of the world and clearly that is also something that goes totally against the concept of sustainable development. Our society has stark disparities and large number of people are living in abject poverty. In India this is a reality that you see despite the fact that we have had fairly healthy growth over the last fifteen odd years. The fact, however, is that we still have a very large number of people in India who are living in abject poverty. Now that clearly goes against the very concept of sustainable development because the society which has these disparities cannot possibly be a sustainable society. It will have tensions. It will have conflict and it will certainly have inherent in it the problems that often spill over borders as well, and I think we need to be concerned about the multifarious impacts of poverty that make it one of the worst problems that we have and therefore, the most important challenges for us to meet.

Sustainable development can reduce vulnerability to climate change, and here let me introduce the concept of climate change. In my view, climate change is one of the biggest threats we face across the globe that imperils and endangers the possibility and potential of sustainable development. For making development more sustainable we need to enhance mitigative and adaptive capacities, reduce emissions and also reduce vulnerabilities, but there may be barriers to implementation. The point I would like to get across is that if we were to integrate the challenge of meeting the problem of climate change and facing that challenge effectively through adaptation as well as mitigation efforts then clearly that would also define a sustainable path of development.

Let me now move to the concept of planning for energy within the context of sustainable development. Energy is something which is essential to development and in our part of the world we have some serious challenges in that regard. I would like to focus now on some of the serious challenges that the world as a whole and certainly we in South Asia face in respect of meeting the energy problem. If you look at Figure 1, you see the share of the growth in world primary energy demand by region in the new policy scenario. This new policy scenario is a progressive scenario developed by the international energy agency and published in the *World Energy Outlook*. What this shows clearly is, as you would notice, that how energy is going to change over a period of time. If you look at the period from 1995 to 2011 you have a 44 percent of the total energy being consumed by China. By 2011 to 2025 it goes down to 37 percent of the total and is projected that by 2025 to 2035, China's share would go down to 18 percent. On the other hand India's share is going up quite sharply and I would say that it will also apply to the rest of South Asia. It is unfortunate that we do not have projections for South Asia as a whole and that to my mind is symptomatic of the lack of cooperation that we have. Certainly in respect of defining our challenges and the problems that we should meet in the future, this kind of joint exercise would be extremely helpful. If you look at Southeast Asia their share also goes up significantly and the rest of the world by and large stays more or less constant. The South Asian region, I believe, is certainly going to be the driver that is going to account for changes in the energy market of the world.

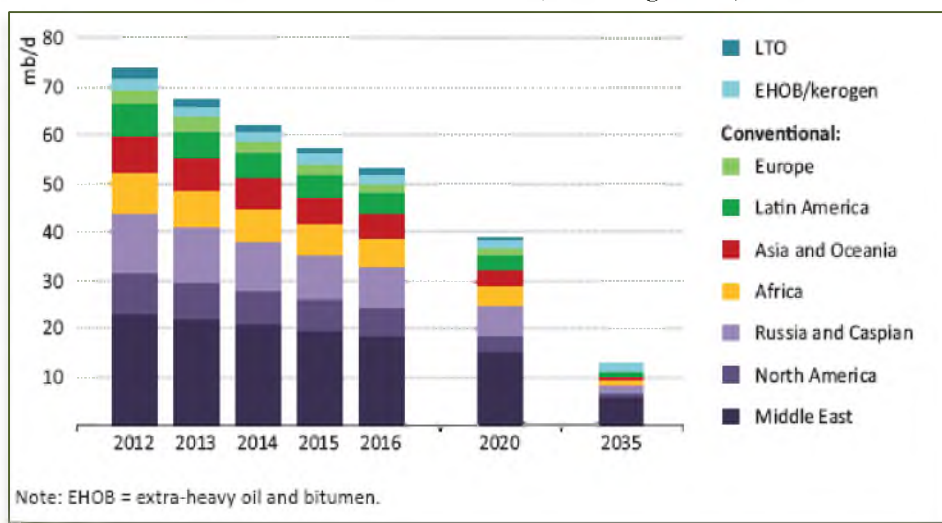
**Fig. 1. Share of the Growth in World Primary Energy Demand by Region in the New Policies Scenario**



Source: WEO (2013).

Figure 2 shows something that clearly is of common interest to all of us and certainly to us in South Asia. It shows the production that would be observed from all currently producing fields in the absence of any further investment. Now this is not to say that there would not be further investment. I want to point out to you that in North America for instance you have got a major revolution which has taken place with the exploitation of shale gas. Deep sea drilling for exploration of oil is becoming quite common but may I submit that it carries a number of environmental and other risks. You would be aware of what happened at the deep water horizon well in the Gulf of Mexico about 3 years ago, when as a matter of fact the amount of damage that took place as a result of the oil spill that occurred has still not been mitigated effectively and BP which was the company responsible for that well is still facing a lot of litigation and paying out large sums of money to be able to meet the legal demands of its responsibility. So the point I would like to make is that the new areas where oil is to be explored for and drilled are going to be increasingly difficult and perhaps fraught with technical as well as economic risks that we have to keep in mind. The arctic ice is melting as a result of climate change. That region is being looked on as a very attractive area for exploration and drilling but may I submit that it will carry several environmental hazards. The reality is that whether it is 10 years, 20 years or 30 years, the depletion of oil is certainly going to raise the price of oil over a period of time.

**Fig. 2. Production that would be Observed from All Currently Producing Fields in the Absence of Further Investment (Excluding NGLs)**



Source: WEO (2013).

For energy security, while we do need to move ahead with some large projects which are essential for our countries, there are ample opportunities to bring about improvements in energy efficiency and also to be able to exploit renewable sources of energy particularly on a decentralised basis but not confined only to decentralised sources. Here if I could deviate just for a minute and introduce my institute, The Energy and Resources Institute (TERI). It is a fairly large non-profit organisation,

now having a staff of over twelve hundred people with a presence in several parts of the world. We have launched a programme called Lighting a Billion Lives, which essentially addresses the stark reality of 1.3 billion people in the world who have no access to electricity. This to my mind is in some sense worse than the tragedy of the commons because well over a hundred years ago Thomas Edison discovered the filament incandescent lamp but you still have 1.3 billion people who have never seen a lamp light up or do not have a lamp in their homes in the twenty first century. So what we are doing is to implement solutions at the grassroot level in a number of villages in India as well as in Africa, and I would submit that even though Pakistan has a large number of villages that are electrified there might still be opportunities for implementing some of these renewable energy solutions. I will just take a minute to describe one such solution. We train women in a village to install a solar panel on the roof. She charges about fifty odd lanterns during the daytime and rents them out to the whole village at night, and they come back to her in the morning to get the lamps recharged again. The benefits are that people in villages can work longer hours, and children can do their homework over clean, pollution-free and totally reliable lighting. They also have health benefits because otherwise people are sitting around a kerosene lamp and inhaling all those toxic fuels. That is just one example of what can be done, and what I wanted to point out over here is the imperative of energy independence. We really need to set out on a direction by which we reduce and minimise our consumption of fossil fuels, and this of course will require changes on the demand side as well, for instance in the transport sector. We know that the proliferation of personalized motor vehicle is something we all aspire but in essence if we were to provide good public transport options people would not drive to work in their own cars.

The total energy consumed by the SAARC countries shows large disparities, as can be seen in Figure 3. Some of those differences are inherent in the size of the countries of this region but the growth in energy use is somewhat even, as we can see from the graphs on the right hand side of Figure 3. There is in my view a very strong and compelling logic for us to work together in finding energy solutions. One of the things that we are doing in India, and my institute has been involved in carrying out its feasibility study, is to set up solar parks which would be about three thousand megawatts each and these would use concentrated solar power. The benefit of this is that most of the equipment can be fabricated within the country itself and, therefore, the cost would be substantially lower than if we were to import all the equipment that is needed. I was very happy to see the honourable Chief Minister of Punjab show lots of interest in the Cholistan Region in Punjab. I believe it is a perfect region for the purpose as it has plenty of land, very high levels of insulation and, therefore, solar energy could be an option but before that there are also options for photovoltaic. The benefit of a country of the size of India is that we can exploit economies of scale. If there is trade between the two countries, including that of energy, it would be possible to ensure that if you set up a plant in Cholistan, using large scale power generation on the solar source, then you need not consume all that electricity yourself, part of it could be exported to India due to growing demand there over time. So I think some of these renewable energy solutions clearly would benefit from cooperation across all of South Asia.

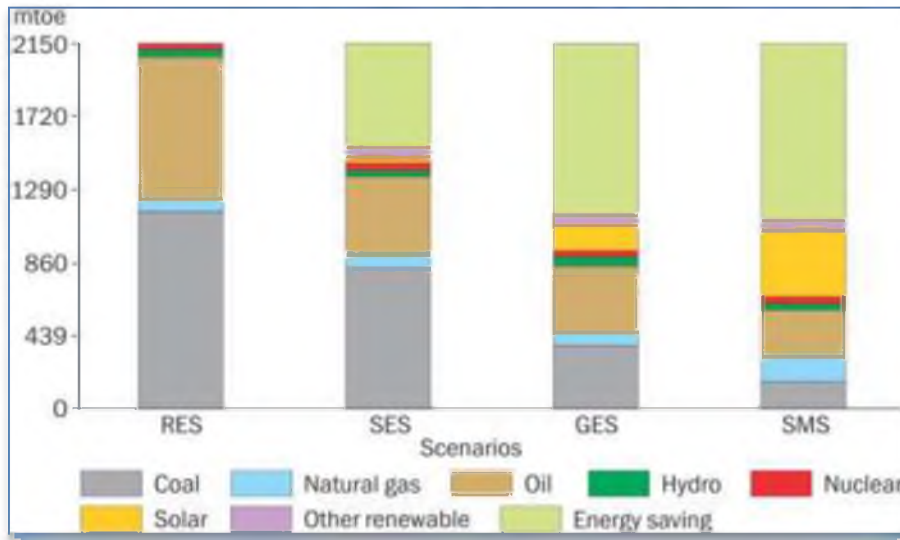
**Fig. 3. Energy Consumed by SAARC Countries**

Country	Energy Consumption in Quadrillion Btu	Previous Trends (History)
Pakistan 	2.561	 1980-2011
India 	23.611	 1980-2011
Afghanistan 	0.104	 1980-2010
Nepal 	0.084	 1980-2010
Bangladesh 	1.013	 1980-2011
Maldives 	0.015	 1980-2011
Sri Lanka 	0.228	 1980-2010
Bhutan 	0.057	 1980-2010

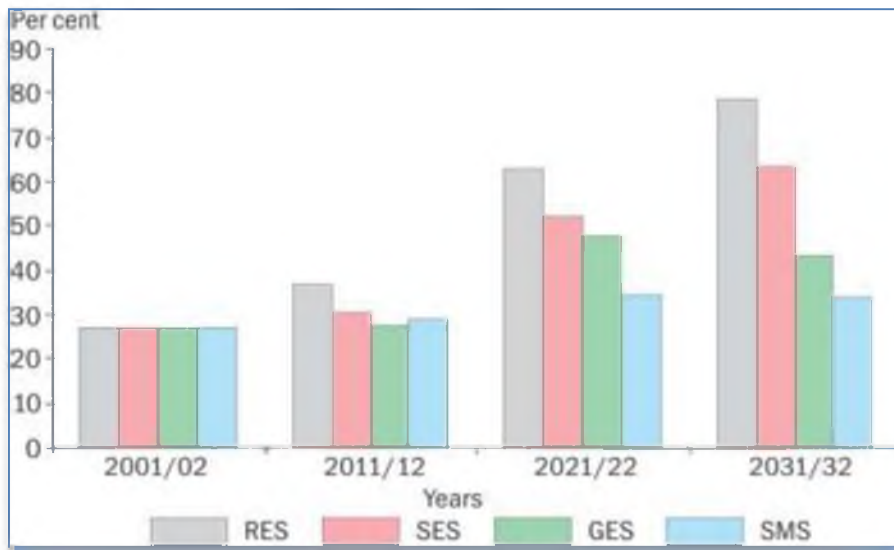
Source: US Energy Information Administration website.

At TERI we have carried out very extensive energy economic modelling for India and we have got a number of very detailed models for the country as a whole and we have come up with different scenarios as presented in Figure 4 for the year 2031. The bar on the extreme right hand side of Figure 4 is particularly important because it comes up with solutions that would be low cost, assuming technological developments in the renewable energy field. This is going to happen because cost reduction in renewable energy is around the corner which would lower the production costs. So my submission is that each of us, perhaps on an integrated basis, should carry out a detailed exercise on the choices that we have in the energy sector by which we can minimise the total cost of energy supply and also ensure a much higher level of energy security by exploiting those particular sources of energy that are in abundance. With this the benefit that you would see is the substantial reduction in fossil fuel dependency across scenarios (see Figure 5). It should be one of the objectives of any energy policy that we must reduce such imports simply because we have an abundance of solar energy, in some cases wind and certainly biomass. Agriculture residual is also a significant source of energy supply and I think with the technologies that research and development is now trying to develop it would be possible to produce even liquid fuels from agriculture residual.

**Fig. 4. Distribution of Primary Commercial Energy Supply—2031 India**

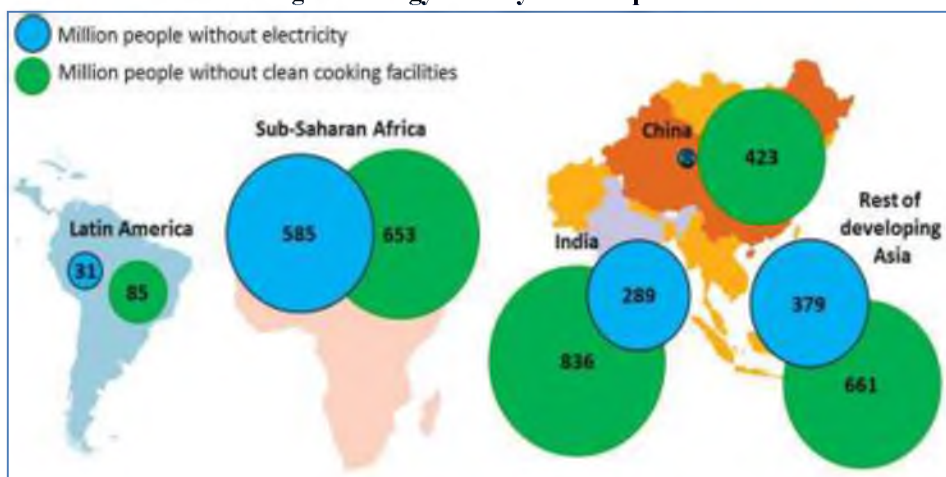


**Fig. 5. Fossil Import Dependency Across Scenarios—India**



The stark reality is that energy poverty is very wide spread. A large number of people, around 1.3 billion as I have told you about, have no access to electricity and more than twice the number who are totally dependent on biomass for cooking and other domestic applications. That to my mind is again a massive tragedy as those burning biomass in the house are often living in little huts where you have very poor ventilation. Women and children in particular inhale large quantities of these forms of pollutions and they have very serious health problems as a result. So there are enormous benefits in moving to clean renewable forms of energy.



**Fig. 6. Energy Poverty is Widespread**

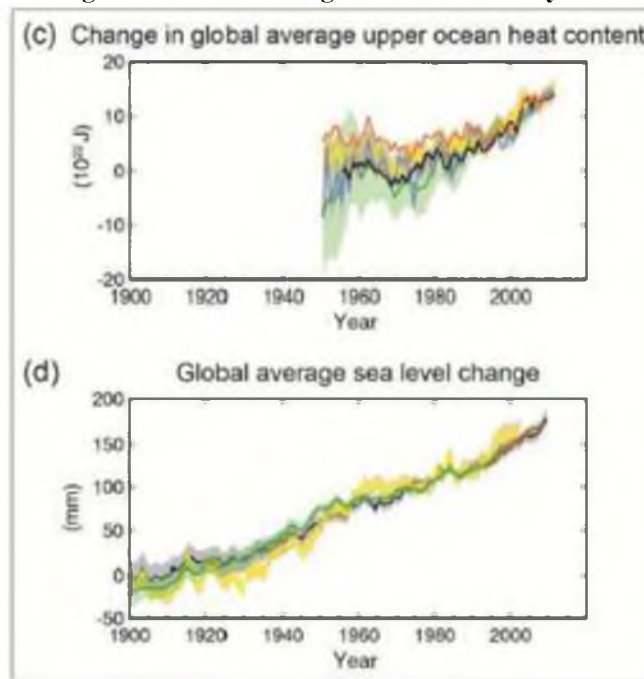
There are also other environmental problems that we need to address. These include: increasing air pollution that largely comes from transport and biomass; indoor air pollution; rivers, wetlands and ground water reserves being polluted; depletion of ground water; deforestation and loss of biodiversity; and degradation of soil. Soil is something we get from nature literally as a free gift. If we are going to deplete that then clearly we have to substitute that with chemical fertilisers which in themselves have serious problems. We carried out a very detailed exercise in 1997, on the eve of the fifty years of independence of India, and this created a major stir because we found that India was losing over 10 percent of its GDP on account of pollution and environmental cost. The loss of agricultural output due to soil degradation was between 11 to 20 percent. Decline in water availability was very serious and in fact in 1997 it had gone down to about one third its value since the time of independence, and we projected that it will go down even further to about two thirds of the value it had in 1997 over time in 2047. May I submit here that we really need to come up with the path of development which is resource efficient, which ensures that we maintain our natural resources and that we minimise environmental degradation and damage. Here I would like to invoke a little anecdote of Gandhi which is one of my favourite anecdotes. Gandhi-ji was once asked would if he like India to become as prosperous as Britain and his answer was, "It took Britain half the resources of this planet to achieve this level of prosperity. How many planets will a country like India require?". We have to accept the fact that even though technology and human ingenuity makes possible for us to exploit resources almost on an unlimited basis, there is finiteness in resources. There is a certain quality that we have to maintain whether it is the air that we breathe, the water that we drink or the soil on which we grow our crops. My submission, therefore, is that South Asia has to evolve a pattern of development that is highly resource efficient and can serve as a model for the rest of the world.

This brings us to the problem of climate change and why is it that we need to take that into account very seriously in our development planning strategies. I had occasion to fly over Pakistan in the year 2010 and it was a very clear day. What I saw below me was



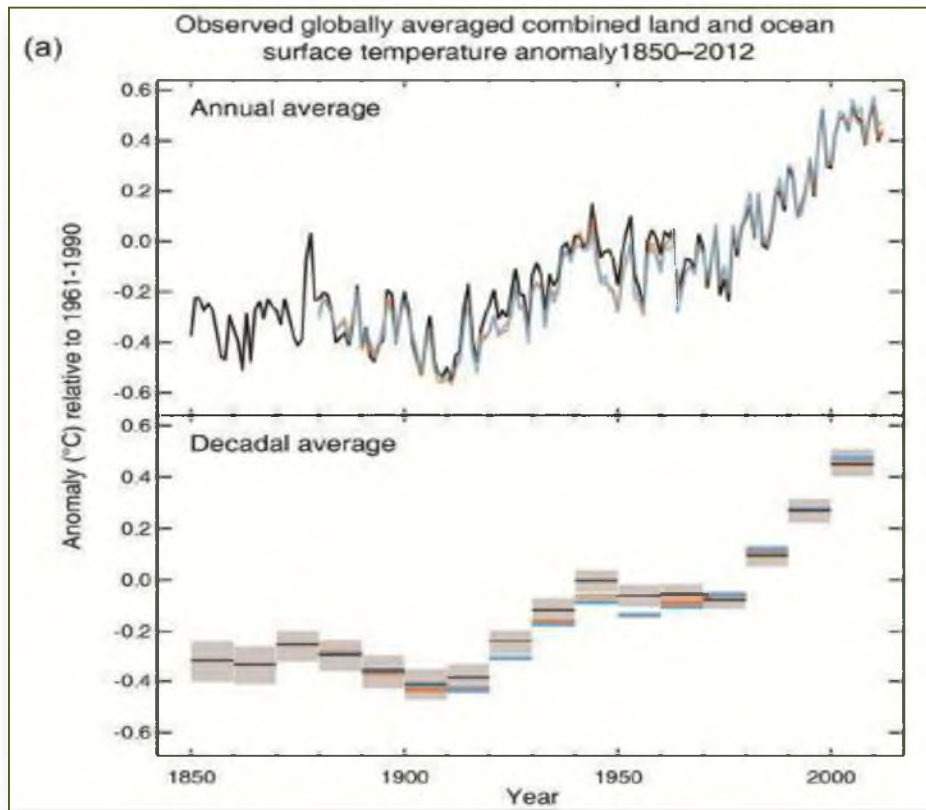
something that I just could not believe. A huge area of land was under water, muddy water, so not only were you losing water but also losing very rich top soil. That is a major loss quite apart from the fact that this was a major threat to life and property. I want to submit to you that we at the Inter-governmental Panel on Climate Change (IPCC) have projected that extreme events are going to increase in the future. It is virtually certain that the upper ocean, that is 0 to 700 meters, has warmed from 1971 to 2010 and the rate of sea level rise since the mid nineteenth century has been larger than the mean rate during the previous two millennia (see Figure 7). Why is sea level rise taking place? It is because of thermal expansion of the ocean with warming and also the melting of the bodies of ice across the globe—over the period 1901 to 2010 global mean sea level rose by 19 cm. That is close to a foot and definitely something to worry about.

**Fig. 7. Observed Changes in the Climate System**



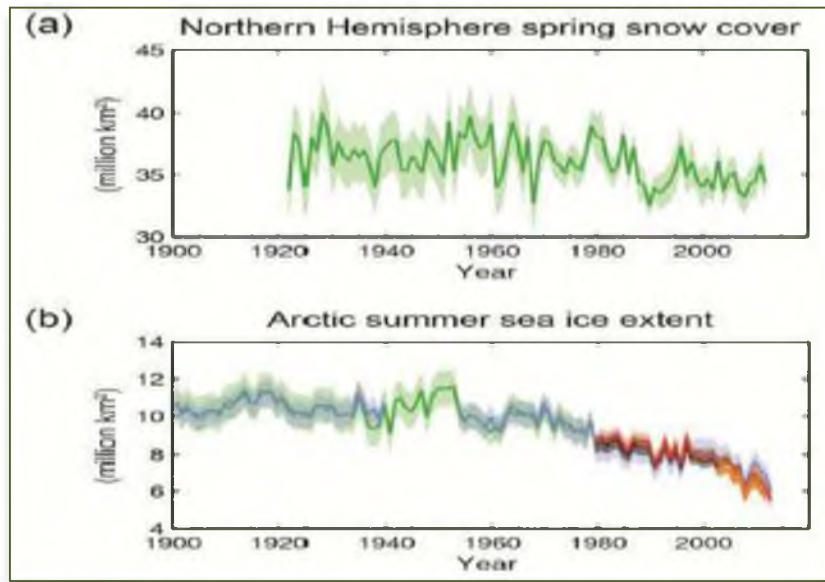
Source: IPCC AR5.

If you look at the Maldives islands, most of the island, in over a thousand plus islands, are just about a meter high, or may be a little more, and if the sea level rises by one foot that clearly represents a major threat to that nation as also to low line coastal areas everywhere else in the world. I also want to draw your attention to the fact that since the 1950s many of the observed changes have been unprecedented over the last millennia (see Figure 8). The atmosphere in the oceans are warm, the amounts of snow and ice have diminished, sea level has risen, the concentration of greenhouse gases has increased and each of the last three decades has been successively warmer at the earth surface than any preceding decade since 1850. So we are affecting the climate of this planet in a very serious way.

**Fig. 8. Warming of the Climate is Unequivocal**

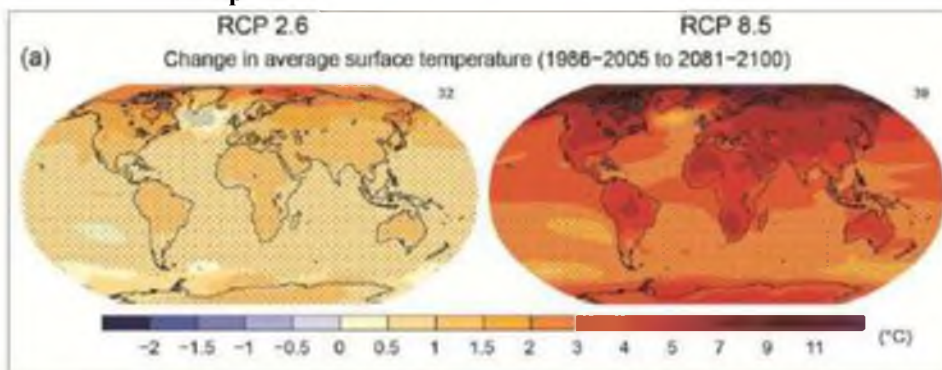
Source: IPCC AR5.

Over the last two decades, I want to highlight the fact that, the Greenland and the Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease rapidly. The arctic region was covered entirely with ice not so long ago but not any longer. Since the early 1970s, glacial mass loss and the ocean thermal expansion as a result of warming explain about 75 percent of the observed global mean sea level rise, as can be seen in Figure 9. The increase in carbon-dioxide concentration from two hundred parts per million at the beginning of industrialisation has gone up to over four hundred part per million now. We in a short period of time, in the age of industrialisation, have affected the atmosphere of this planet to an extent where it is really leading to the very serious problem of climate change. The ocean has absorbed about 30 percent of the entire anthropogenic carbon dioxide causing ocean acidification. The overall human influence on the climate system is, therefore, very clear and it could be said with confidence that changes in total solar irradiance have not contributed to the increase in global mean surface temperature over the period 1986 to 2008. And of course, if we continue with increasing our emissions of greenhouse gases, climate change will become far more serious.

**Fig. 9. Observed Changes in the Climate System**

Source: IPCC AR5.

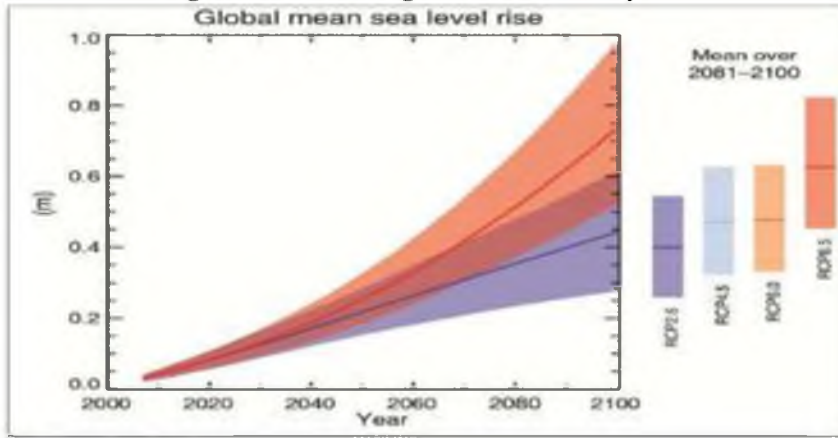
We have developed four different scenarios of economic growth and development for the future and Figure 10 presents two of these scenarios—the RCP 2.6 and RCP 2.8. The darker the shade in Figure 10, the higher the temperature. The lower emission scenario on the left hand side, which involves some very stringent mitigation of emission of greenhouse gases, gives you a much lower temperature increase but the one on the right hand side which involves low mitigation of emissions leads to very high temperature increase. In fact at the upper end of that range, by the year 2100 you would end up with the temperature increase of 4.8 degree Celsius and that can really play havoc with our ecosystem and all forms of life on the planet.

**Fig. 10. Warming will Continue Beyond 2100 under All RCP Scenarios Except RCP 2.6**

Source : IPCC AR5.

Figure 11 shows the global mean sea level rise under different scenarios and we see that the highest increase projected can get the sea level rise close to a meter, 0.98 m to be precise. Clearly if that were to happen large parts of the globe would be submerged, and we would practically have a changed geography of the planet.

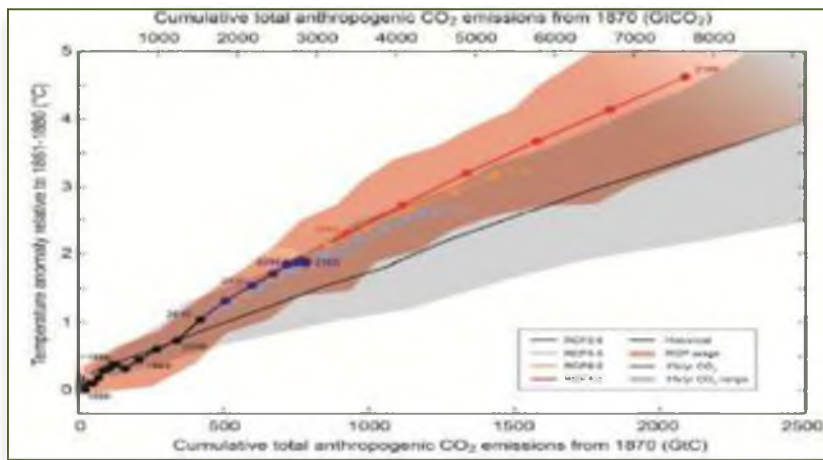
**Fig. 11. Future Changes in the Climate System**



Source: IPCC AR5.

Figure 12 gives changes in temperature that would take place and the global mean surface temperature increase that is shown here as the function of the cumulative total global CO<sub>2</sub> emissions from various lines of evidence. It is evident that there is a range because you cannot predict the future with perfect certainty but indeed what you find over here are temperature increases that would cause some very serious problems. As I mentioned earlier, at the upper end you could get a temperature increase of up to 4.8 degree celsius.

**Fig. 12. Changes in the Climate System**



Source: IPCC AR5.

A far more serious problem and consequences of climate change is the increase in extreme events during and by the end of twenty first century and here I want to highlight two types of extreme events. It is very likely that the length, frequency, and/or intensity of warm spells or heat waves will increase over most land areas. So much so that under some scenarios, a one in twenty year hottest day is likely to become a one in two year event in most regions. In other words, heat waves will increase to the extent that those heat waves which currently take place once in twenty years can occur in the future once in two years. What is even more serious, and I think this is something that in our part of the world we have to be concerned about, is the fact that it is likely that the frequency of heavy precipitation or the proportion of total rainfall from heavy falls will increase over many areas of the globe. You could, thus, get very heavy rainfall as a result of which flooding is likely to become more frequent and more intense.

Countries like Bangladesh, China and India are susceptible to increasing salinity of their ground water and surface water resources due to increases in sea level. In India, gross per capita water availability will decline from 1820 cubic meter per year in 2001 to about 1140 cubic meters per year in the year 2050. There would also be serious impacts on human health. These include: malnutrition with implications for child growth and development; death, disease and injury due to heat waves; floods; storms; fires; droughts; diarrheal disease; and frequency of cardiorespiratory diseases. The projected climate change exposures are likely to affect the health status of millions of people particularly those with low adaptive capacity. Please do remember that there are a large number of people in the world who are living in the state of malnutrition. Partial loss of ice sheets on polar land could imply meters of sea level rise, major changes in coastlines and inundation of low lying areas. We also found that 20 to 30 percent of the species that we assessed were likely to be at risk of the extinction if increases in warming exceed 1.5 to 2.5 degree Celsius.

The interactions among climate change mitigation and adaptation and disaster risks reduction may have a major influence on resilient and sustainable pathways. We, therefore, have to create communities, we have to create cities that are sustainable and resilient and are able to meet the threats of climate change. I want to give you an example here. Little over a month ago we had a terrible cyclone which hit the eastern part of India in the state of Orissa. Ten years ago a cyclone of similar intensity hitting that region would have led to a loss of lives of hundreds of thousands of people but today with early warning system and government taking preventive steps they were able to protect life and property by giving people shelter and moving them to safer locations. This is a form of adaptation that I wanted to bring to your attention. All of us have to assess the impact of climate change in the future and start adapting to them and taking steps by which we can save life and property.

Some key findings of the special report we brought out highlight heavy precipitation events, warm/cold daily temperature extremes, heat waves and sea level rise. As I have already mentioned the fact that some scenarios show a one in twenty year heat wave becoming one in two years, and the trend in disaster losses unfortunately are very unfavourable for developing countries. Now total economic losses from natural disasters are higher in developed countries no doubt. Economic losses as a proportion of GDP are higher in developing and middle income countries, which have borne the

highest burden. I also want to mention that the economic losses from weather and climate related disasters vary from year to year and place to place but overall have increased. In the year 2005 we had hurricane Katrina which hit part of the US, a city in New Orleans, and in that year total losses worldwide were about two hundred billion dollars. That is only the economic aspect but there is the loss of heritage, the loss of culture, the loss of lives and those things on which you cannot possibly put a dollar value. As it happens the fatalities are higher in developing countries and over the period of time from 1970 to 2008 these have been 95 percent in developing countries as opposed to five percent in developed countries.

Our development strategies have to focus on adaptation as well as mitigation because neither one nor the other alone is going to be able to help us meet the challenge of climate change and the cost of doing so is really very low. We have assessed the cost of mitigation that means reducing emissions of greenhouse gases. As it happens in 2030, the total cost of very stringent mitigation would be less than the three percent of the GDP which basically means that the level of prosperity or GDP growth that you would attain will be postponed by a few months or years at the most and that clearly is not a very high price to pay for saving lives and be able to take care of some of the worst impacts of climate change. In Table 1 below I want to focus on the top most line which shows that if we want to limit temperature increase globally by 2 to 2.4 degree Celsius, the CO<sub>2</sub> emissions will have to peak no later than 2015. Delayed emissions reduction significantly constrain the opportunities to achieve lower stabilisation levels and increase the risk of more severe climate change impacts. So that is the challenge before the global society, and here I come to the importance of exploiting renewable sources of energy.

Table 1

*Characteristics of Stabilisation Scenarios*

Stabilisation Level (ppm CO <sub>2</sub> -eq)	Global Mean Temp. Increase (°C)	Year CO <sub>2</sub> Needs to Peak	Global Sea Level Rise above Pre-industrial from Thermal Expansion (m)
445–490	2.0–2.4	2000–2015	0.4–1.4
490–535	2.4–2.8	2000–2020	0.5–1.7
535–590	2.8–3.2	2010–2030	0.6–1.9
590–710	3.2–4.0	2020–2060	0.6–2.4

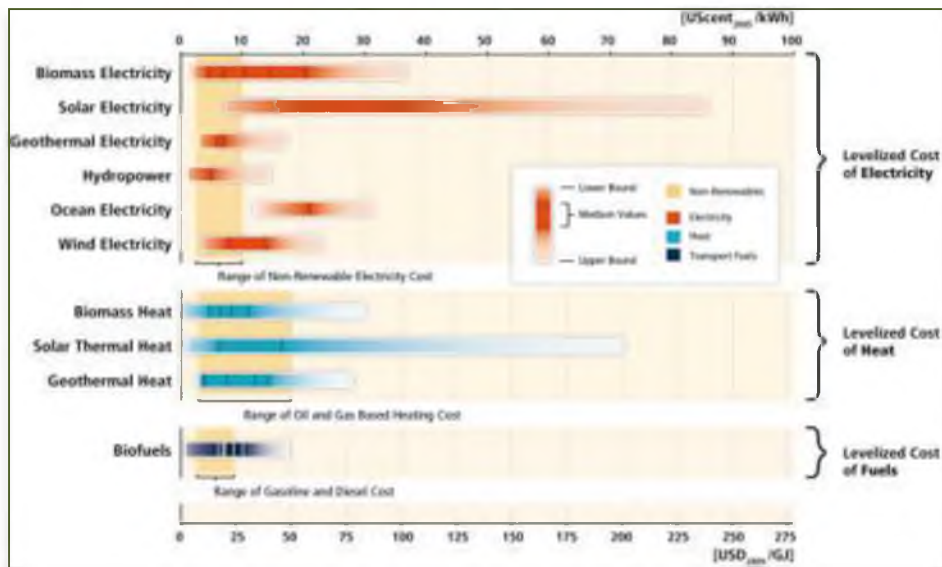
Source: IPCC AR4.

We carried out a detail study at the IPCC and brought out the report on renewable energy resources and climate change mitigation and found that in several applications, renewable resources of energy are already economically viable. If we look at the left hand side of Figure 13 we see a band which represents the cost of conventional forms of energy. In those applications you could find that the renewable energy overlaps with that band, which in other words mean that the costs are identical and very favourable and, therefore, I think the time has come for us to look at these opportunities and achieve economies of scale and cost reduction through technological up-gradation. The future really belongs to renewable sources of energy and the sooner we move on that path the better. We actually carried out an assessment of how renewable energy can contribute to



total energy supply. We assessed 164 different scenarios which have been produced by scholars and researchers and found that the range varies. According to this assessment, at the upper end by 2050, the world could get almost 80 percent of its energy needs from renewable resources. By implication this means that we have to put in place policies today which promote research, development, commercialisation and large scale installation of renewable energy devices. We have to basically overcome a number of barriers if we want to bring about a transition to a high share of renewable energy. We would need investments in technologies and infrastructure and policies, of course play a crucial role and these policies include regulations for instance. What I would propose is, let us say a city like Islamabad or Lahore can go in for a large scale roof top solar programme with buyback arrangements. You would, of course, have to make some improvements in the grid to be able to buyback power when people are not consuming it on their own. We have reached the point today with photovoltaic prices where this could be a very attractive option. So I think if we can come up with some of these solutions it would help alleviate the problem to a large extent. What we really need is a set of enabling policies.

**Fig. 13. Costs of Renewable Energy and Existing Energy Prices**



Source: IPCC SRREN.

Mahatma Gandhi rightly said, “We may utilise the gifts of nature just as we choose but in her books the debits are always equal to the credits”. So my submission is that when we devise development policy we have to keep in mind that at present stock of natural resources does not enter the GDP system. We have to put in place accounting systems through which we see how our policies are really affecting the stock of natural resources and the quality of natural resources because neglecting them clearly go against the very concept of sustainable development and have an unfavourable impact on the generations to come. This is a responsibility that we have to shoulder. We have to ensure



that the future generations do not justifiably have a basis to blame us for leaving a planet to them that is degraded, that is denuded and that has destruction of the ecosystem on which all forms of life depend. There is no religion in the world that does not highlight the importance of taking care of nature, '*qudrat*' and what we have inherited from those before us.