THE CHANGING CLIMATE FOR INDIA'S ENERGY POLICY

Text of Public Address delivered by Jairam Ramesh, MP at the National Institute of Advanced Studies, Bengaluru, November 10th, 2014

I

This is the second in a series of public lectures that I am delivering in different parts of the country on climate change under the aegis of the Hindu Centre for Politics and Public Policy. The first was in Chennai two weeks back and in that talk I focussed on why India must take bold and proactive intellectual and political leadership on global climate change negotiations and on why our traditional defensive stance has simply not been in the enlightened national interest.

My main arguments were three: *one*, that there is no other country like India which faces multiple vulnerabilities—both current and future—to the vagaries of climate change; *two*, that the sheer demographics of India which will add another 400 million to its present population of 1.24 billion and become the world's most populous country by the middle of this century calls makes sustainable development an over-riding imperative; and *three*, that environmental issues in India have already begun to have critical public health impacts. These three arguments necessitate a change in our mindsets towards doing something constructive, both domestically and internationally, on what is surely the epochal issue of our times, namely global warming and its local impacts.

II

This evening I will focus on the energy sector and look at what our options are. Climate change has added a whole new context to our energy policy. When I carried out one of the early analysis of India's future energy demand and supply in the early 1980s in the Advisory Board on Energy, the word "environment" or "climate" did not figure even once in about a 300-page report. I now plead *mea culpa*. The situation has changed dramatically since then. Over half of India's greenhouse gas emissions expressed in carbon dioxide equivalent terms is from the electricity generation sector alone. And as coal-based generating capacity increases rapidly as it is expected to, this share will only go up.

More coal-based power generating capacity is what might be called a "double whammy". Coal-based power plants emit carbon dioxide which is the most preponderant greenhouse gas. In the Indian context because of high ash content, the combustion of 1 tonne of coal will result in an emission of around 1.5 tonnes of carbon dioxide. More than this, much of the new coal reserves and mines are in rich forest areas in states like Jharkhand, Odisha and Chhattisgarh. An analysis of nine major coalfields in the country that had been carried out in 2010 revealed that anywhere between 30% to 45% of the coal-blocks fall in what are called "no go" areas, that is areas with high forest cover. Their extraction will lead to considerable deforestation and thereby to a loss of a valuable carbon sink. It is well known that forests absorb carbon dioxide and deforestation leads to global warming. And compensatory forestation through plantations can never compensate for loss of natural forests with their rich biodiversity. I have started with coal and it is but natural to do so since almost two-third of our electricity generation comes from coal-based power plants, a proportion that, according to current conventional wisdom, is most unlikely to change over the next two decades at least. We use something like 500 million tonnes of coal to generate electricity and current plans are to double this to around a billion tonnes by the end of this decade. India incidentally has the world's third largest reserves of coal, although as I have mentioned earlier these reserves have high ash content which bring down the heat that can be generated from the combustion of one tonne of coal.

I was a Minister of State for Power between April 2008 and February 2009. One of the far-reaching decisions taken then was for India to invest heavily in supercritical technology which leads to a reduction of emissions of at least 5% over conventional power plants. Supercritical plants operate at much higher temperatures and pressures. After 2017, that is the end of the Twelfth Five Year Plan, my recommendation to the Government was that all new coal-based power plants should be based on super-critical technology, a recommendation that was accepted and that I am sure will continue under the present ruling dispensation as well.

What else can be done? Carbon capture and sequestration or CCS as it is usually called has been talked about and Norway has commissioned the world's first such facility with the carbon dioxide being injected into oil reservoirs to enhance recovery. Recently, Canada announced the launch of the world's first commercial scale CCS power plant with a generating capacity of 110 megawatts. Theoretically, carbon dioxide from the flue gases can be captured and used in this manner or combined with ammonia to manufacture urea. But what appears attractive on paper

may not be feasible in practice and truth be told CCS is still a far, far way off. IGCC is another technology that might hold promise. IGCC stands for integrated gasification of coal in combined cycle where the efficiency can go up to 45% and more. Since coal is converted into gas, carbon dioxide emissions from the power plant are also eliminated. Dr. R. Chidambaram then Principal Scientific Advisor to the Union Cabinet and I had launched India's first IGCC facility in Vijaywada six years ago to be put up by BHEL but sadly, that facility has made no progress whatsoever, yet another example of how India doesn't lag in knowledge but fails in translating that knowledge into commercial technologies. I still believe that this is an area where India can build a strategic advantage.

I want to raise two other pressing environmental issues arising from the large-scale use of coal. New emission concerns are emerging. India is already the world's second largest emitter of sulphur dioxide. The main reason for this has been the phenomenal expansion in coal-fired electricity generating capacity, an expansion that will continue for quite some time. Given the fact that sulphur dioxide stays long in the atmosphere and can be transported long distances, it is urgent that concentration standards, from a health perspective at least, be developed and enforced. True, progressive ambient air quality standards were promulgated four years back and steps have been taken to clean up cities by, for instance, reducing the sulphur content of diesel and by the use of natural gas in public transportation. But the hotspots are clearly elsewhere and these are not being captured in ground-based monitoring systems that are in place. In a recent publication of the American Chemical Society, scientists at the Argonne National Laboratory and NASA have used data collected from satellite-based remote sensing instruments to assess the situation. The conclusion is the sulphur dioxide emissions increased by 71% between 2005 and 2012 and the increment was highest in Chattisgarh, Gujarat and Odisha. The researchers also use satellite-based measurement data to establish that overall nitrogen oxide chemistry over Indian power plants has changed significantly in recent years. Here again, unfortunately as in the case of sulphur dioxide, there are no concentration standards for coal-fired power plants.

A second "new" concern relates to mercury. Singrauli in Sonbhadra district of Uttar Pradesh is a huge private and public sector industrial and power-generating cluster. Some estimates are that around 17 percent of India's power plant mercury emissions are from this cluster alone. Both official and non-official studies of the local population have revealed higher mean mercury blood levels and mercury levels in hair

that have resulted in highly adverse health conditions for them, particularly in terms of respiratory disorders. India has just joined the Minamata Convention on Mercury named after the Japanese city that, since the 1950s, has become synonymous with deadly mercury contamination and poisoning. Given their tremendous expansion inevitable over the next decade at least, it is imperative that like the USA and China, India now establish and enforce mercury emission standards for coal-fired power plants (and for coal mining as well). The Minamata Convention gives India five years to control and, where feasible, to reduce emissions from new power plants and ten years to do so for existing power plants. But we need not wait that long.

III

I now want to turn to nuclear power which from the point of view of climate policy is ideal since atomic power plants emit no carbon dioxide that is responsible for global warming or sulphur dioxide that aggravates human health. Our performance on the nuclear power front has been disappointing, to say the least. No doubt, sanctions imposed after the first Pokhran explosion of May 1974 severely handicapped the expansion of our nuclear power programme. Even so, the fact remains that forty-five years after the first nuclear power plant at Tarapur became operational, nuclear power still accounts for just about 3.5 percent of electricity supply.

As of now, the total installed capacity is just about 4780 megawatts and another 4800 megawatts of capacity (that includes the two 1000 megawatt plants at Koodankulam that are in an advanced stage of commissioning) is under various stages of construction. Other than this, everything else is still really only on paper. For instance, the Jaitapur nuclear power park that would host 9600 megawatts of capacity with French technology got environmental clearance four years back but is nowhere in sight. The landmark 2005 Indo-US nuclear agreement has not much to show for itself till now except that India has been able to get natural uranium from other countries to increase the capacity factor of existing nuclear power plants. Five years ago, the capacity factor was an abysmal 50 percent but is now up to around 82-83 percent.

But there is one extraordinary development amidst this somewhat depressing scenario on nuclear power. And this has to do with India becoming the second country in the world to have a commercial scale fast breeder reactor running on a mix of plutonium and uranium oxides. India's 500 megawatt prototype fast breeder reactor (PFBR) started eleven years ago at Kalpakkam near Chennai is almost 97 percent complete and is likely to become fully operational by this time next year.

Russia is the only other country to have operating fast breeder reactors (it has two reactors with a total capacity of around 1200 megawatts). France used to have a 250 megawatt fast breeder which it operated smoothly for almost thirty-five years and then decommissioned it. A second 1200 megawatt fast breeder reactor was commissioned in 1985 but was shut down following an accident involving leakage of molten sodium that is used as a coolant in the reactor. The UK and Japan both shut down their commercial scale fast breeders in the 1990s.

India's logic for the fast breeder programme is fundamental and impeccable. Without such a programme that uses the spent fuel from natural uranium reactors, India will not be able to use its vast reserves of thorium. Thorium, unlike uranium, is not a fissile material. It cannot produce electricity by itself. It is a fertile material that can get converted into a fissile material like uranium-233. Estimates vary quite widely but it is generally accepted that India could well have some 25 percent of the world's thorium reserves. The fast breeder route is the only way our abundant reserves of thorium can be used to produce electricity. The other benefit of a fast breeder is that by recycling the spent fuel, most of the long-lived radioactive waste is eliminated. Current plans are to install another two 500 megawatt fast breeder reactors at Kalpakkam itself that will come on stream sometime towards the later part of the next decade and another two such reactors elsewhere in the country. India clearly is a world-leader in this area.

The atomic energy establishment's projections envisage a nuclear power generation capacity of some 63,000 megawatts by 2030. It is important to think big and act bold especially when we confront the challenge to move on to a low carbon growth path at the earliest. But in light of past performance and current realities, this target does appear very ambitious and unrealistic. The Planning Commission's low carbon strategy expert group had scaled it down to 40,000 megawatts which itself is a formidable goal. At this level of capacity in 2030, nuclear will account for around 8 percent of electricity supply roughly on par with solar and wind contributions. To achieve even this lower figure will call for urgent steps to address the concerns of global companies on the unlimited liability imposed on them by the nuclear liability legislation passed by Parliament and that came into force in November 2011. Having said this, it is perhaps time to revisit assumptions related to the acquisition of imported reactors and have a much bolder strategy for the expansion of indigenous heavy water reactors themselves.

India also needs to put in place a truly independent regulator along the lines proposed in the legislation introduced in Parliament three years back. Such a regulator has to necessarily address public concerns on safety and other risks associated with nuclear technology. Earlier this year, India had agreed to have a peer review of its nuclear regulatory system under the auspices of the International Atomic Energy Agency (IAEA) and hopefully this review will commence in the next few months. This would be the first time such a formal review would be taking place and should help in generating greater public confidence in the plans of the atomic energy establishment.

IV

The Germans gave the word *kindergarten* to the world of education. To development economics they gave the term *wirtschaftwunder* that is used to describe their country's remarkable economic transformation immediately following World War II. Now in the area of sustainable growth another typically compound German word is inviting global attention and that is *energiewende.* This refers to the profound energy transition Germany is going through. For a country dubbed as the sick man of Europe" at the beginning of this century, the achievement is stupendous.

Today, already something like 30 per cent of its electricity *supply* comes from solar and wind energy and it is actually exporting power. The goal is to increase this contribution to 50 per cent by 2030 and a staggering 80 per cent by 2050. Smaller countries in Scandinavia have similar achievements and ambitions but Germany is completely different because it is the world's pre-eminent industrial economy and has a population of slightly over 80 million. The scale of what Germany has accomplished over the past decade and a half is what gives it wider relevance, especially to large countries like India.

Presently, Germany has around 37,000 megawatts of installed solar energy capacity. In addition, it has another 29,000 megawatts of installed wind energy capacity. What has given renewables new momentum is the decision of Chancellor Angela Merkel to completely phase out Germany's present nuclear power generating capacity of about 12,000 megawatts by the year 2022. It was a bold decision given that when Fukushima happened Germany was getting between a fifth and a quarter of electricity supply from its nuclear power plants. It is the complete decommissioning of all such plants in eight years time coupled with an over-riding emphasis on energy efficiency that gives *energiewende* a unique dimension.

Meeting domestic and international environmental objectives has undoubtedly been the primary motivation for this remarkable change. Legislation for promoting renewable energy was first enacted fourteen years ago. It has undergone many changes subsequently but the anchor remains the concept of a "feed-in tariff" that depends on the technology being used. Anybody can invest in solar or wind power, sell surplus power to the grid and get a generous income that covers both the investment and running costs and that is guaranteed regardless of demand for twenty years. The grid operator has a legal obligation to connect the installation and an obligation to accept any electricity whenever it is produced. As a result there are now close to 5 million small producers--individuals and cooperatives--accounting for around half of the installed renewable energy capacity. This means that some 6% of Germans are energy producers. This is the nearest equivalent to the mobile phone revolution. The structure of electricity generation has been thoroughly shaken up and the four big private utilities have been consistently losing market share.

What about the energy transition in India? Presently, wind energy capacity is close t0 22,000 megawatts and solar amounts to another 2650 megawatts or so (nuclear is about 4800 megawatts). Capacity-wise, wind and solar account for about 13 per cent of total electricity generating capacity although contribution to actual energy supply is perhaps no more than 6 per cent. In April 2014, the Planning Commission's expert group on low carbon strategies for inclusive growth had released its final report that suggested that by 2030 the share of solar, wind and biomass in electricity supply be tripled to around 18 per cent. Unfortunately this report has yet to get the full public attention it warrants.

The main difference with Germany of course is that in 2030 India's energy supply basket is projected to have an 8 per cent contribution from nuclear energy as well. In terms of capacity, wind energy is recommended to increase to 120,000 megawatts and solar to 100,000 megawatts by 2030. These may look daunting goals at the moment but they are eminently feasible especially given the fact that India is more favourably endowed especially in relation to solar energy and in some parts even in wind energy.

The energy transition which will have to be driven by innovations in technology, regulation and financing will bring multiple benefits. It will, of course, increase energy security and also reduce emissions of carbon dioxide. It will also have significant positive impacts on public health and also stimulate development in regions that have remained backward so

far. The possibility of India acquiring strategic leadership in the green technology industry globally in about a decade's time also is very real provided it is linked with a strong indigenous research and development and engineering capability. New avenues for employment will accelerate. A very recent study by the Council on Energy, Environment and Water and the National Resources Defense Council has estimated that around 24,000 jobs have been created in the last three years alone when solar capacity has increased from around 1800 to 2650 megawatts. In Germany, the renewables sector employs close to 400,000 people and therefore as capacity and supply contribution expands, green employment in India too will grow substantially.

V

Brazil derives almost 80% of its electricity from hydel sources and that is one reason why it accounts for just around 2% of world greenhouse gas emissions, as compared to China's share of 29% and India's share of 6%. Incidentally, the share of China has almost trebled over the past two decades while that of India's has doubled. China's share might well stabilise but India's will increase to at least around 10% by 2025. Clearly a large hydel share is very climate-friendly. Presently, some 17-20% of India's electricity supply come from hydel sources and we have exploited just about 35% or so of our ultimate hydel potential, of which about a third is in the state of Arunachal Pradesh alone. Can this increase significantly and relieve some of the pressure on us as far as the use of coal is concerned?

Hydel projects are certainly non-polluting and non-CO2 emitting. But they pose formidable ecological challenges of their own, especially when they involve the construction of storage dams. Large-scale displacement of people becomes inevitable. There have been concerns of reservoir-induced seismicity perhaps triggered by our experience in Koyna in Maharashtra. But experts have opined that these fears are exaggerated. In the context of a series of hydel projects in the same river basin, issues related to cumulative impact assessments and minimum ecological flows arise to which we have not paid adequate attention and hence the opposition to hydel projects in places like Uttarakhand and the northeast. An excessively engineering approach to hydel resource planning has cost us dearly and it is time we adopt a whole new perspective if we are to build public confidence and stem the tide of public protests.

VI

So what does all this add up to?

It is clear that we are in a tight situation. We cannot escape dependence on coal for the foreseeable future and the best we can do is to minimise its environmental costs. Clean coal is an oxymoron, a contradiction in terms. All we can plan for and certainly make a reality is cleaner, much cleaner coal. Our nuclear programme requires some new adrenalin. Hydel can certainly expand but this must be done in a most sensitive manner, a manner which sadly we have not demonstrated as yet for the most part. We need radical new thinking, German-style, on renewables, especially on solar energy. There are other aspects of our energy policy that also demand our attention like the dissemination of improved cook-stoves to deal with the black carbon issue which will have profound public health implications as well and the widespread use of biogas for generated both from cattle dung as well as human waste. These aspects, however, are more social than technological in nature and the barriers are more organisational than scientific, more to do with the 3 Ds of development, dissemination and diffusion.

The electricity sector is also some sort of safety valve for us to argue in global forums against taking on any mitigation responsibilities. The fact that over 50 million homes still don't have access to basic electricity facilities (almost one in four homes) gives us a strong wicket to bat on free from any worries to reduce emissions. That window is closing slowly but surely and India will be called upon soon to announce some mitigation commitments for 2025 and 2030 to begin with. India must play a pivotal role in designing a new architecture for a global climate change agreement at Paris in December 2015. This would be in keeping with a civilisation which proclaims " *Vasudhaiva Kutumbakam*".