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I am privileged to be given this opportunity to deliver the keynote address for the "Energy Research, Engineering, Development and Commercialisation Forum". I would like to congratulate the Working Committee for Energy of the National Council for Scientific Research and Development, the Ministry of Science and Technology and Environment and the Petronas Research and Scientific Services, for organising this forum.

Being an input to other economic activities, energy has played an important role in the development of this country.

The development of energy resources has contributed significantly to the expansion of our economy not only in enhancing export earnings and increasing public sector revenue but also in widening and strengthening the industrial base of the economy. The Government will continue to further expedite the diversification efforts, especially in the light of the expected increases in energy demand by end users resulting from the projected strong growth of the Malaysian economy. With greater industrialization and urbanization, the efficient supply of energy at economically acceptable cost and in sufficient quantity will be the paramount consideration in our development efforts in the energy sector.

R&D is going to play an increasingly important role in our efforts to achieve the goals of Vision 2020. The advancement into higher value added activities implies that increasing efforts are required in upgrading our indigenous R&D capability. At present, Malaysia's R&D efforts, as measured by R&D expenditure as a proportion to GNP, of 0.8 per cent, is very small. Thus, the Government is committed to giving more importance to R&D by setting the following major objectives and targets for 90's and beyond for national R&D: Firstly, to double R&D expenditure by year 2000, Secondly, to increase scientific R&D manpower to population ratio from 400 per 1 million to 1,000 per 1 million in the year 2000, Thirdly, to refocus R&D in the public sector with the view to undertaking relevant market oriented research and commercialising potential research findings, and Fourthly to accelerate the acquisition, development and use of new technologies, particularly in the following areas:

- (i) Automated Manufacturing Technology;
- (ii) Advanced Materials;
- (iii) Biotechnology;
- (iv) Electronics and Information Technology; and
- (v) Energy and Environment.

The achievement of these objectives will entail Government intervention to varying degrees. While the broad policies, plans and programmes are already in place, the task now is to accelerate implementation. Emphasis should be given not only to current and future energy R&D and technological development needs but also prospects on commercialisation of R&D findings. Full support will continue to be given to R&D. Over the years a number of R&D institutions have been established. The Malaysian R&D system, particularly that of the public sector excels in making technical discoveries and inventing new products. However, related downstream activities such as product design and manufacturing process have not received adequate attention. The situation gives rise to the issue of how best and how fast can the commercialization of technology from laboratory to the market take place.

Attempts are under way to further enhance collaboration between public sector research organizations and universities with industry in order to market and commercialise potential research findings. These

organizations are in the process of restructuring and reorienting their research programmes to ensure that the R&D undertaken are relevant to market needs. The Government has established the Malaysian Technology Development Corporation in 1992 to assist companies venturing into new technologies.

At the same time, the Government is considering the creation of a scheme that provides matching grants to local corporations that undertake R&D in collaboration with public sector research institutions or universities, especially in new and emerging technologies.

Our Energy Policy encompasses the supply, utilization and environmental objectives. The supply objective involves providing the nation with adequate and secure energy supplies by reducing our dependence on oil and by developing and utilizing alternative sources of energy. The utilization objective is aimed at promoting and encouraging the efficient utilization of energy and discouraging wasteful and non-productive patterns of energy consumption within the given socio-cultural and economic parameters. Lastly, the environmental objective seeks to ensure that factors pertaining to the environment are not neglected in pursuing the supply and utilization objectives. R&D in the energy sector will have to be geared to meet the above objectives.

Under the supply objective, Malaysia has adopted the four fuel diversification strategy comprising gas, oil, hydro and coal. In respect of oil and gas, while the country is endowed with these resources, exploitation of these resources is becoming increasingly costly due to the fact that remaining recoverable resources are located in deeper waters. Therefore, for the upstream oil and gas sector, R&D will have to be intensified to realise the full development of the production fields. This would involve technological improvements on enhanced recovery of these resources and on deep water extraction. R&D on gas should not only concentrate on extraction technologies but also on the downstream end, that is, in the utilization of the resources, such as gas to energy conversion technologies and usage of gas as feedstock to industries and as fuel in the transportation sector (natural gas for vehicles), gas for air conditioning, gas for combined heat and power and gas for burners.

Another indigenous energy resource which can be exploited is coal. We have large deposits of coal in Sabah and Sarawak which may be used as fuel for energy production. R&D in this area should target at making available economically clean coal technologies. Apart from these hydrocarbons, this country is also blessed with other resources of energy, which are renewable such as solar, industrial and agricultural wastes, wind and others. These resources which are environment friendly are hardly exploited due to the high cost in harnessing energy from them and therefore are having low level of viability. In this regard, R&D should focus on developing technologies to harness these resources with the objective of making them economically competitive vis-a-vis other conventional resources. Research into solar energy can focus on solar photovoltaic and solar thermal for use in the rural areas. As for biomass, research can focus on waste heat recovery, wood briquette manufacture, pyrolysis of wood and wood gasification.

With respect to hydro resources which is also a renewable energy, Malaysia has an estimated usable potential of about 29,000 MW or energy output of 123,000 Gwh per year. This substantial energy resource represents not only an important long term development alternative for electricity generation and a significant opportunity for diversification but more importantly, a considerable cheaper source of energy option.

To tap the energy source from hydropower, which is abundant in Sarawak, the Bakun hydroelectric project has a potential capacity of around 2,400 MW. R & D in the generation of electricity from hydropower can focus on making the technically usable potential of 29,000 MW as much as possible into economically feasible projects.

Since the bulk of energy resources currently used are depletable, it is imperative that they are efficiently used to ensure that their life can be stretched for as long as possible to benefit also the future generations. In addition, the efficient utilization of energy resources is also important to ensure that the nation's output is competitive in the world markets. Therefore, R&D in efficient use of the energy resources should be seriously looked into. The Government is undertaking energy audit of several selected industries with a view to formulating strategies to achieve the objectives of efficient utilization of

energy. Experience in other countries has shown that investments in energy saving is cheaper compared to investments in establishing new capacities for energy production. R&D should therefore focus on developing products which are energy saving and production systems which are energy efficient.

It is admitted that energy production affects the environment in one way or another. With the world's concern over this issue currently, it should be given an appropriate place in R&D efforts in the energy sector. The immediate focus should be on the reduction in the emission of green houses gas and suspended particulate during the process of energy production. In addition, R&D should also be intensified to explore alternative energy sources which are non polluting.

The national development programme now focuses on a vision whereby the national economic growth is sustained by a dynamic manufacturing sector. The future is dependent on development of technology to sustain the dynamism of economy. In this regard the focus on development of new technology to develop additional manufacturing industry capability is necessary. Therefore the forum should review the following issues: namely (i) sustainable economic growth;

(ii) development of new industry base; and

(iii) development of technology to harness energy to propel us to the 21st century. Current development of hydroelectric power, for instance, have seen IPPs importing various equipment. We should be looking at the prospect to locally develop this equipment and export them in the future.

The management of Energy R&D Strategy calls for a stronger rapport between the government, the public and the scientific community, in planning and co-ordination of cost-effective national R&D programmes in the energy sector.

I believe that this forum would arrive at implementable strategies that would address issues on Research, Engineering, Development and Commercialisation in the energy sector in line with the national development objectives of balanced and sustainable growth. As Chairman of the National Council for Scientific Research and Development, I look forward to receiving the results of your deliberation and recommendations. With this note, I now have the great pleasure to declare open the Energy Research, Engineering, Development and Commercialisation (REDC) forum.