

Summary Record of Discussions of the Twentieth Meeting of Scientific Advisory Committee to the Cabinet (SAC-C) held on 7th September, 2010, at New Delhi.

The twentieth meeting of the Scientific Advisory Committee to the Cabinet (SAC-C) was held on 7th September, 2010, under the Chairmanship of Dr. R. Chidambaram, Principal Scientific Adviser to the Government of India (PSA to GOI) and Chairman, SAC-C.

The agenda of the meeting and the list of participants are at **Annexure-I** and **Annexure-II** respectively.

M20A1 Opening remarks by Chairman, SAC-C.

The Chairman welcomed all members. At the outset, he expressed deepest condolences on his behalf and on behalf of the members of the committee to the bereaved family of Dr. Homi N. Sethna, former Chairman of the Atomic Energy Commission. He said that he was one of the nuclear pioneers, particularly in the field of reprocessing. He was one of the colleagues of Dr. Homi Bhabha when the atomic energy programme was initiated in the country.

Chairman stated that this meeting would focus on enhancing Academia-Industry interaction and for the purpose of general discussion, the term 'Academia' would include both university and national labs. He also brought out the following aspects:

- The development of products, systems and processes in Mission oriented agencies are largely driven by the agencies themselves and not by industry: on the other hand for commercial products, the drive for academia-industry interaction has to come from industry. Academia-industry interaction is already strong here.
- Universities are good in research and companies are good in delivery and both are poor in development.
- Pre-competitive applied research deals with generic problems and is the responsibility of the government sector. Pre-competitive applied research

was initiated by the Office of the Principal Scientific Adviser to the Government of India (O/o PSA to GoI) in the fields of Automotives, Machine tools and most recently in Electronic hardware. Since development of electronic hardware is a big weakness in India, the core group on Electronic Hardware (CAREL) was recently constituted and projects are being formulated. Similar core groups had been created earlier in the automotive sector (CAR) and the machine tool sector (C-MAT).

- In developed countries, the knowledge gap between industry and academic system is small and they are at equilibrium with one another. Pre-competitive applied research has to be backed by 'directed basic research'.
- PSA requested all concerned to give a comprehensive document on 'industry-academia interaction' for each sector or department so that O/o PSA to GoI could compile them together.

M20A2 Core Advisory Group for R&D in specific sectors:

M20A2P1 *Automotive Sector*

Chairman said that there has been already a discussion on CAR in SAC-C.

M20A2P2 *Machine Tools - Presentation by Prof. P. Radhakrishnan, Director, PSG Institute of Advanced Studies, Coimbatore.*

- *In his presentation, Prof. P. Radhakrishnan stated at the outset that in manufacture of Machine Tools, China stands first in the world with about 15,000 million \$ worth production whereas India stands at 19th position with about 400 million \$ worth production. He added that from 2008 to 2009, Indian production has decreased while that of China increased. He felt that the Machine tool industry needs to be considered as a mother industry for other manufacturing industries. He had also brought out the following facts:-*
- *China is also first in the world in machine tool consumption and procures most of its machine tools from local sources whereas India is eighth in machine tool consumption but imports most of its requirements.*

- *There is a lack of R&D support for machine tools industry. Know-how is needed not only for high end machine tool industry but also for strategic sector.*
- *Machine tools produced in the country are not competitive in the world market since the aggregates for these machine tools are mostly imported which leads to higher costs.*
- *A technology roadmap with prioritization of goals has been made and the same is under the consideration of Department of Heavy Industries.*
- *Development of smart machines is an area where we can do better than other countries by leveraging our IT infrastructure.*
- *Multitasking machines, high-speed machines, hard turning machines, machine tools for strategic sector, machine tools for automotive and aerospace applications are the identified areas for development. Micro-machines are being developed in the world market and India also can catch up with that growth. In future, significant R&D will be needed for nano machines.*
- *Good quality human resource is lacking and for this purpose, centres of excellence for machine tools need to be nurtured in select educational institutions.*
- *CNC controllers with open source concept, A/c servo motors, high speed spindle, high speed chucks, special bearings, tool changers, etc., need to be developed indigenously. Necessary know-how and policy support are needed for the manufacture of the ancillaries.*
- *He stated that the following projects are under development:*
 - *Creation of State of Art Testing facilities for testing new designs of machine tools.*
 - *Study on quantification and compensation of thermal deformations in machine tools including machining centres.*
 - *Study on improving reliability of grinding machines, particularly the reliability of bearings.*
 - *Study on improving precision levels of grinding machines.*
- *He further added that the projects under discussion are:*
 - *Turn Mill Centre – by HMT*
 - *Five axes machine – by TAL*
 - *Flow Turning Machines – by Electronic Limited*

And the projects under evaluation are:

- *Slideway Lubrication*
- *Motors and Controllers*
- *Smart machines and intelligent manufacturing systems.*

After the above presentation, discussions were held, Dr. Jamshed J. Irani mentioned that customers for the machine tool know-how need to be identified and he felt that Machine Tool Industry as a whole cannot be considered as the customer – individual companies are. He gave the example of fertilizers being produced by chemical industry but know-how for the farmers, who are the customers in this case, has been developed by Indian institute of Science, through a project funded by Tata Chemicals by developing a model to predict rainfall and the appropriate time for use of fertilizers.

PSA mentioned that such an approach could be used by specific company for proprietary process or product development whereas for pre-competitive applied research, a consortium of companies is involved.

Dr. V. Sumantran stated that science of metal cutting in the country needs to be improved by proper simulation studies. This will lead to improvement in productivity.

Dr. Jamshed J. Irani added that in addition to improving metal cutting science, producers of machine tools must be part of production technology development and should support the development process. Policy inducements for buying machine tools made in the country should also be planned by Government of India.

In reply to these remarks, Prof. P. Radhakrishnan stated that six major machine tool industry customers have been invited for a meeting to be held in the near future at CMTI and that simulation studies have been started at IITM on the initiative of TIFAC. He mentioned that considerable data inputs are needed for such a simulation study. He stated that capacity for machine tool production may be increased by policy initiatives. However, he felt that enhancement of technology levels particularly those related to reliability of machine tools being produced presently is also important.

Dr. V.K. Saraswat commented that know-how for aggregates or basic building blocks should be made available before producing generic and special purpose machine tools. He added that development approaches for development of generic tools would be different from that needed for special purpose machines. He gave the example of development of SPM for turbine rotors at HAL and how the non-availability of basic building blocks hampered its development.

He felt that CMTI and HMT design centres should work together to create the building blocks for machine tools. He also elaborated on the denial of machine tools to strategic sector by foreign countries in the areas of micro machines and high speed machines like spinner, flow forming machines, etc. He added that propellant mixer was denied but CMTI, ISRO and DRDO could jointly develop an indigenous mixing machine.

At this stage, PSA suggested that IMTMA members had visited BARC to discuss about the requirements of special machines and a similar team could visit important DRDO labs. in Hyderabad. He also recommended joint working of DAE and DRDO in the area of denied machines. This was agreed to by Dr. V.K. Saraswat.

Shri Subodh Bhargava emphasized that focus should be in creating capability to offer engineering solutions rather than machine tools alone. He also brought out that the consumption of machine tools is less than that of China. He added that auto components manufacture was the key to success of Indian auto industry and similarly focus should be on aggregates for the machine tools.

Dr. Radhakrishnan said that the issue of the aggregates is very important and was discussed during the second meeting of the reconstituted PAC.

M20A2P3 *Electronics Hardware (CAREL) – Presentation by the Co-Chairman Shri G.P. Srivastava, Director, Electronics and Instrumentation Group, BARC, Mumbai/ Shri Ajai Chowdhry, Chairman and Chief Executive Officer, HCL Infosystems Limited, Noida.*

At the outset, Shri Ajai Chowdhry mentioned that since CAREL was formed only recently and significant work was yet to be done, his presentation would be more in the nature of statement of desire and the direction in which the committee would work in the future. He stated that

perhaps due to large demand for electronic hardware in the country, it was met by imports and as a consequence indigenous R&D and manufacture were neglected. He brought out that for the manufacture, a separate committee under his chairmanship was formed by DIT and the committee's report is available in the website of DIT. CAREL has been formed by office of PSA for the R&D part of electronic hardware. He also stated that the size of the electronics industry is about 4.4 times of oil, petrol and mineral, 2.75 times of chemical and plastics, 2.45 times of food, beverage and tobacco and about 2.44 times of transportation and about 2.2 times of electricity, gas and water sectors and hence this large industry needs more attention for the overall growth of economy. Other aspects brought out during his presentation were:-

- India has emerged as a major R&D hub in electronic components and ICT sectors and its offshore firms are working for a broad range of global companies. This may put it in a strong position to develop its own industries. This will happen only if design and development are done within the country.
- The gap areas of electronics for R&D needs to be identified carefully. These should be chosen using decision support database. CAREL should produce such a database.
- Standards for Indian requirements to be formulated for the products imported.
- Products and processes developed by our firms are claimed by MNCs as their own and awareness of patents among our stakeholders is quite low.

He reiterated that biggest challenge in the area of electronics hardware would be selection of focus areas. Automotive electronic and machine tools electronics may be considered as possible areas. Also initiative has been taken by Government of India in the field of solar energy and this will create R&D capability. In telecommunication, R&D capacity was set up earlier but not sustained. Now imports of telecommunication equipments are more. There is good scope for electronics hardware/ embedded system initiative in this area. He suggested that frugal engineering in electronics with low cost may meet the requirements of e-governance, MGNREGA, etc., for rural India. Standards for hand held devices for these rural programmes need to be evolved.

He stated that four sub-committees of CAREL have been formed for the purposes of planning technology roadmap, components, incubation centres and IPR.

During the discussion that followed,

- *Shri Shyam Saran mentioned that R&D centers of MNCs in India, while sub-contracting to local firms, impose constraints on sharing of knowledge generated within India. He stated that huge market exists within the country but not properly leveraged.*
- *Shri Arun Maira felt that in respect of creation of demand for local electronic hardware by Government of India, imports need not be restricted at the cost of overall economic growth. He explained it by quoting the example of distributors in Malaysia protesting against restriction on imports. So an effective balance between imports and local devices needs to be worked out. He suggested collective deliberations would lead to effective initiatives and policies.*
- *Shri Anil Razdan mentioned that standards and specifications for the products of usage in our country should be developed and published; only then our electronics industry would be in a position to do as per them. Otherwise, this would be met by imports.*
- *Dr. M.J. Zarabi suggested that support to engineers should be given in creating IPR and licenses and also by providing grants and soft loans to start-ups.*
- *Dr. V.K. Saraswat stated that like in the case of machine tools, component manufacturing base is not available within the country. However the design capability exists. Because of denials, commercial sector should invest in machines for semiconductor foundries. This would assist the strategic sector also. Attention needs to be paid for development and manufacture of functional materials. He added that DRDO would assist in these areas.*
- *Dr. B.K. Gairola stated that Indian IT industry was too small as compared to global industry and hence large investments will be needed for creation of hardware eco-system and also the market to be catered to should include strategic sector. This would facilitate growth of the hardware sector.*
- *Dr. V. Sumantran mentioned that the topics of manufacture that were being discussed in this meeting were essentially scale dependent and we should consider global markets in auto, machine tools, electronic hardware, etc. This could be*

boosted by balanced support for imports and local products by way of graded tariff structure.

- *Shri Ajai Chowdhry responded to the discussions, by telling that*
 - o *Support by Government of India is needed for electronics hardware industry as was provided for auto industry. The opportunity provided by Government of India in 2005 was lost and this initiative needs to be revived.*
 - o *China had given huge R&D support particularly in telecommunication area and a global scale was created. Similar initiatives need to be taken up for local entrepreneurship and for development of materials. Government of India should itself become a big buyer of local products. The cost of design in our country is very low, as compared to that of other countries and hence the products would become globally competitive.*

M20A3 *Impact of R&D on Indian Chemical Industry by Dr. K.V. Raghavan, Principal Scientific Investigator, Reaction Engineering Laboratory, Indian Institute of Chemical Technology, Hyderabad.*

Dr. K.V. Raghavan, in his presentation, covered various aspects of R&D sector in chemical industry. Specifically, he brought out the details related to the following aspects.

- *R&D intensity (R&DI)*
- *IP management*
- *Government funded R&D utilization*
- *University-Industry linkage*
- *HR Management*
- *R&D for SMEs in clusters*
- *Launching new start-ups*

Important details presented were:

- *The R&DI, intensity which is defined as R&D expenditure expressed as share of industry output, has on the overall remained same from 1998-2008. However the R&DI of knowledge intensive pharma sector, had increased from 2.8 to 4.5%.*
- *Though the general R&DI for India is lowest at 0.75% the public sector contribution is the highest at 80%. However, in pharma industry, R&DI is 4.5% in India as against 16.7% in USA.*

- *Significant differences in turnover thresholds for R&D spending in chemical sector exist among the sub-sectors. For example R&D spending happens after a threshold turnover of about Rs. 50 crores in fertilizer sector as against Rs. 1 crore in agriculture sector.*
- *In export/import performance of chemical sector, basic chemicals have not import whereas speciality chemicals and knowledge incentives have net exports.*
- *Indian chemical sector contribution to global research publication is 4.4% (9th position) and in patents a very meager share of less than 0.6%.*
- *Among the S&T disciplines within the country, the chemical sector's share in publications is about 35% and in patents about 37%. However, contribution to patents is decreasing every year.*
- *Patenting and publications in organic chemistry are more as compared to other sectors in chemical industry.*
- *Product patents are less as compared to process patents.*
- *Major efforts are needed to attract industry participation in the research projects of academia.*
- *In SMEs, food, pharma and speciality chemical industries form the major segment of chemical sector. R&D intensity is very low in general except in pharma sector.*

Dr. R. Chidambaram appreciated the efforts made by the project team to collect and analyse enormous data on Indian Chemical industry.

During the discussions subsequent to this presentation, Dr. T. Ramasami commented that the size of the Indian chemical sector is big and heterogeneous. The size of knowledge intensive sectors like pharmaceuticals, biotechnology etc., is small and their overall impact will be marginal. The impact of current and future environmental regulations on Indian Chemical Sector need to be considered. The R&D in SMEs and corporate sector in Indian chemical industry operate on economies of scope and scale respectively and their R&D structure is accordingly very different. The corporate sector requires globally competitive generic technologies of high public consumption. It operates on global compulsions of investment. The Petroleum/ Petrochemical sector is generally low on R&D intensity. While evolving final recommendations on R&D impact on Indian chemical sector, there is need to select appropriate subsectors depending on their size

and level of impact and particularly look at their natural advantage in India. The strategy for choice of sectors for R&D intensity growth should be on a disaggregated approach and the ratio of cost of material to product value could be one of the guiding factors. There is need to examine the value proposition of R&D in Indian chemical sector. There is better scope for R&D in sectors where raw material cost is less than 50% of operating cost.

Dr. S. Sivaram expressed the opinion that for several sectors of Indian chemical industry, their survival is not R&D dependent. A deeper analysis made by him on certain sectors had shown that the factors like better supply chain have much higher impact on the new investments as compared to R&D. As far as pharmaceutical sector is concerned, the R&D is both process and product oriented. This sector operates on growing global market and long term sustenance depends on it. He could foresee huge opportunities and space for speciality chemical sector to grow in India. The main problem is its highly scattered nature. Reengineering of products should be the main focus area for its growth in India. He suggested that there is a need to identify suitable resource bases for Indian chemical sector which are sustainable. As an example, he cited the availability of cellulose in abundance.

Prof. P. Balaram stated that as far research in India is concerned it should be based on maximization of originality and utility. The main roadblock in the case of former is lack of clarity on what to maximize.

Dr. Jamshed J. Irani mentioned that there is scope for consolidation in case of Indian SMEs. If not done, their life span can be curtailed. It will be interesting to study the rate of extinction of SMEs in Indian chemical sector.

The Chairman, SAC-C invited Dr. K.V. Raghavan to respond to the observations made by the members. While thanking the Chairman and members of SAC-C for their valuable suggestions, Dr. K.V. Raghavan stated the following:

- The final analysis will be on sectoral basis and high impacting R&D areas with natural advantage to India will be prioritized. The heterogeneity of Indian chemical sector has received due attention.*
- The impact on environmental regulations will receive attention.*

- *The Indian speciality chemical sector which has a flat R&D intensity profile during last 20 years definitely needs higher growth rate.*
- *Enhancing R&D intensity in petrochemical sector will be one of the major focus areas while formulating the final recommendations.*
- *Biotechnology sector with areas relevant to Indian chemical sector alone are being considered in the project study. Basic life science areas are outside the scope of the current studies.*
- *All efforts will be made to collect data on survival rate of SMEs in Indian chemical sector.*
- *The growth dynamics and market compulsions of each subsector of Indian chemical industry will also receive attention.*

M20A4 *Academia-Industry interaction in low carbon sector – potential mission for National Action Plan on Climate Change – Presentation on Ultra Supercritical Technology by Dr. Baldev Raj, Director, IGCAR, Kalpakkam.*

Before the presentation started, PSA to GoI requested Shri Shyam Saran to give his views on the subject of Advanced Ultra Super Critical Technology.

Shri Shyam Saran stated that after formulation of National Action Plan on Climate Change, it was realized that clean coal technologies would also have to be considered due to expected dependence on coal based energy generation at least for the next few decades. He also added that pre-combustion technologies such as Ultra Super Critical Technology will be useful and this technology is already available with DAE and needs to be adapted.

PSA to GoI had also mentioned that an MoU has recently been signed between IGCAR, NTPC and BHEL for development of an advanced ultra super critical technology demonstration unit.

Thereafter Dr. Baldev Raj gave his presentation and brought out the following details:

- *Advanced ultra super critical (Adv-USC) technology will create savings in the coal consumption to the extent that life of coal reserves will get extended and also will reduce CO₂ emission.*

- *Adv-USC will involve a paradigm shift with respect to state of art high temperature, high pressure and intermediate pressure turbines.*
- *Corrosion of materials at high temperatures and pressures in a challenging environment of coal combustion is an important problem to be solved.*
- *Capacity and expertise used in building prototype fast breeder reactor and ITER-components have created the basic building blocks and science needed for Adv-USC.*
- *National Knowledge Network will be the backbone for Mission partners and allied collaborators to enable knowledge dissemination and sharing of resources to realize the objectives, expeditiously.*

During the discussions which followed, Shri Anil Razdan commented that the project is timely though the target year 2017 is optimistic. He added that milestones could be reviewed by Planning Commission and the Government of India should give necessary funds at the earliest.

Dr. Baldev Raj stated that compared to collaboration with foreign industrial companies, it would be preferred to have collaborations with academic and research institutes in joint development mode.

PSA to GoI added that Fast Breeder Reactor is an important development. IGCAR is strong in design and material technologies, BHEL with its strength in manufacturing technology and NTPC with experience in supercritical technologies, plant construction and management are a good example of coherent synergy to realize the important mission for the nation.

As a general comment on the discussions of the meeting, Prof. M. Vijayan expressed the opinion that as part of 'directed basic research' concept, it may have to be nurtured to strengthen the hardware and instrumentation capabilities in academia. He also added that Academia-Industry interaction should be more flexible and resilient. He was of the opinion that though liberalization had worked for industry, it had not helped the growth of academia. He also suggested that pre-competitive applied research should be done in all sectors and not limited to few sectors as at present.

Dr. S. Sivaram suggested about creating wealth in general by cleverly using our design and in sourcing the materials and sub-systems from the world market. He added that for the country to go up in knowledge chain, more and more open source would be needed and every developmental activity need not be carried out within the country. He illustrated this with the example of design and manufacture of i-phone. However he agreed that this approach may not work in all sectors of development.

The agenda item no. M20A5 – General Discussion on “Enhancing Academia-Industry Interactions” and agenda item no. M20A6 – Comments of Industry Associations were deferred to be taken-up in the next meeting of SAC-C.

The meeting ended with a vote of thanks to the Chair.

**Twentieth Meeting of the Scientific Advisory Committee
to the Cabinet (SAC-C)**

Date : 7th September, 2010.
Time : 1030 hrs.
Venue : Committee Room 'A', Vigyan Bhawan Annexe, New Delhi.

Agenda

M20A1 Opening remarks by Chairman, SAC-C.

M20A2 *Core Advisory Group for R&D in specific sectors:*

M20A2P1 *Automotive Sector*

M20A2P2 *Machine Tools – Presentation by Prof. P. Radhakrishnan, Director, PSG Institute of Advanced Studies, Coimbatore.*

M20A2P3 *Electronics Hardware (CAREL) – Presentation by the Co-Chairman Shri G.P. Srivastava, Director, Electronics and Instrumentation Group, BARC, Mumbai/ Shri Ajai Chowdhry, Chairman and Chief Executive Officer, HCL Infosystems Limited, Noida.*

M20A3 *Impact of R&D on Indian Chemical Industry by Dr. K.V. Raghavan, Principal Scientific Investigator, Reaction Engineering Laboratory, Indian Institute of Chemical Technology, Hyderabad.*

M20A4 *Academia-Industry interaction in low carbon sector – potential mission for National Action Plan on Climate Change – Presentation on Ultra Supercritical Technology by Dr. Baldev Raj, Director, IGCAR, Kalpakkam.*

M20A5 *General Discussion on “Enhancing Academia-Industry Interactions”*

M20A5P1 *Presentation by Dr. K. Radhakrishnan, Secretary, Department of Space, Bangalore.*

M20A5P2 *Presentation by Dr. V.K. Saraswat, SA to RM, DRDO, New Delhi.*

M20A5P3 *Presentation by Dr. S. Banerjee, Secretary, Department of Atomic Energy, Mumbai.*

M20A5P4 *Presentation by Dr. Samir K. Brahmachari, Secretary, DSIR & DG, CSIR, New Delhi.*

M20A5P5 *Presentation by Dr. T. Ramasami, Secretary, Department of Science and Technology, New Delhi.*

M20A5P6 *Presentation by Dr. M.K. Bhan, Secretary, Department of Biotechnology, New Delhi.*

M20A6 Comments of Industry Associations.

M20A7 Any other item with the permission of the Chair.

M20A8 Concluding remarks by the Chair.

List of participants of the twentieth meeting of the Scientific Advisory Committee to the Cabinet (SAC-C)

S. No.	Name, Designation and Address
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2.	Dr. Padmanabhan Balaram, Director, Indian Institute of Science, Bangalore - 560 012
3.	Dr. Mustansir Barma, Director, Tata Institute of Fundamental Research (TIFR), Homi Bhabha Road, Navy Nagar, Colaba, Mumbai - 400005
4.	Shri Subodh Bhargava, Industrialist, A-15/1, DLF City, Phase I, Gurgaon - 122001
5.	Dr. B. K. Gairola, Director-General, National Informatics Centre, Department of Information Technology, Ministry of Communications and Information Technology, A-Block, CGO Complex, Lodhi Road, New Delhi - 110003
6.	Dr. Jamshed J. Irani, Director, Tata Sons Limited Bombay House, 24 Homi Modi Street Fort, Mumbai-400001
7.	Prof. S.K. Joshi, Vikram Sarabhai Professor & Honorary Emeritus Scientist, 252, National Physical Laboratory, Dr. K.S. Krishnan Marg, New Delhi - 110 012
8.	Dr. Baldev Raj, Distinguished Scientist & Director, Indira Gandhi Centre for Atomic Research, Kalpakkam - 603102, Tamil Nadu
9.	Dr. Seyed Ehtesham Hasnain, Vice-Chancellor, University of Hyderabad, Central University P.O., Gachibowli, Hyderabad - 500046 (A.P.)
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12.	Dr. S. Sivaram, Director, National Chemical Laboratory (NCL), Dr. Homi Bhabha Road, Pune - 411008
13.	Dr. Milan K. Sanyal, Director, Saha Institute of Nuclear Physics, Department of Atomic Energy, 1/AF, BidhanNagar, Calcutta - 700064
14.	Dr. M.K. Bhan, Secretary, Department of Biotechnology, CGO Complex, Block No. 2, Lodhi Road, New Delhi - 110 003
15.	Dr. V.K. Saraswat, SA to RM, Defence Research & Development Organization, DRDO Bhawan, New Delhi - 110 011
16.	Dr. V. M. Katoch, Secretary (Department of Health Research) & Director-General Indian Council of Medical Research, Post Box No. 4911, Ansari Nagar, New Delhi
17.	Dr. T. Ramasami, Secretary, Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi - 110 016
18.	Prof. M. Vijayan, President, Indian National Science Academy, 2, Bahadur Shah Zafar Marg, New Delhi - 110 002
19.	Dr. A.K. Sood, President, Indian Academy of Sciences, Department of Physics, Indian Institute of Science, Bangalore - 12

20	Prof. Asis Datta, President, The National Academy of Sciences, India, 5, Lajpatrai Road, New Katra, Allahabad - 211 002
21.	Shri. Arup Roy Choudhury, Chairman, Standing Conference of Public Enterprises, 1st Floor, Core - 8, SCOPE Complex, 7 Lodi Road, New Delhi - 110 003
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23	Shri Vijai Sharma, Secretary, Ministry of Environment and Forests, Paryavaran Bhavan, CGO Complex, Lodhi Road, New Delhi - 110003
24	Dr. K.V. Raghavan, Principal Scientific Investigator, Reaction Engineering Laboratory, Indian Institute of Chemical Technology, Uppal Road Tarnaka, Hyderabad - 500007
25	Prof. P. Radhakrishnan, Director, PSG Institute of Advance Studies, PO No. 1609 Avinashi Road, Coimbatore - 641004
26	Shri Ajai Chowdhry, Chairman and CEO, HCL Infosystems Limited, E 4,5,6 Sector 11 Noida - 201301
27	Shri Arun Maira, Member, Planning Commission, Yojana Bhavan, Sansad Marg, New Delhi -110001
28	Shri Shyam Saran, C-I/1 Lodi Garden, Amrita Shergill Marg, New Delhi - 110 003
29	Prof. Shankar Narasimhan, Professor, Indian Institute of Technology Madras, I.I.T. Post Office, Chennai - 600036
30	Dr. Surdeep Kumar, Head, Planning and Performance Division, Council of Scientific & Industrial Research, Anusandhan Bhawan, 2, Rafi Marg, New Delhi - 110001
31	Dr. M.J. Zarabi, Vice-President (Finance & Establishment), Indian National Academy of Engineering, 6th Floor, Vishwakarma Bhawan, Shaheed Jeet Singh Marg, New Delhi - 110 016
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33	Prof. S.C. Chetal, Director, Reactor Engineering Group, Indira Gandhi Centre for Atomic Research, Kalpakkam - 603102, Tamil Nadu
34	Shri Anil Razdan, Scientific Consultant (Energy Technology), Former Secretary, Power, C1/34 Pandara Park, New Delhi - 110003
35	Shri Rajan Rahi, Vice President, Head Corporate Strategy, HCL Infosystems Limited, E 4,5,6 Sector 11 Noida - 201301
36	Dr. Prahlada, Chief Controler (R&D), Defence Research & Development Organization, Room No. 401, DRDO Bhawan, New Delhi - 110 011
37	Shri B. Rajendiran, Adviser, Office of the Principal Scientific Adviser to the Government of India, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi - 110011